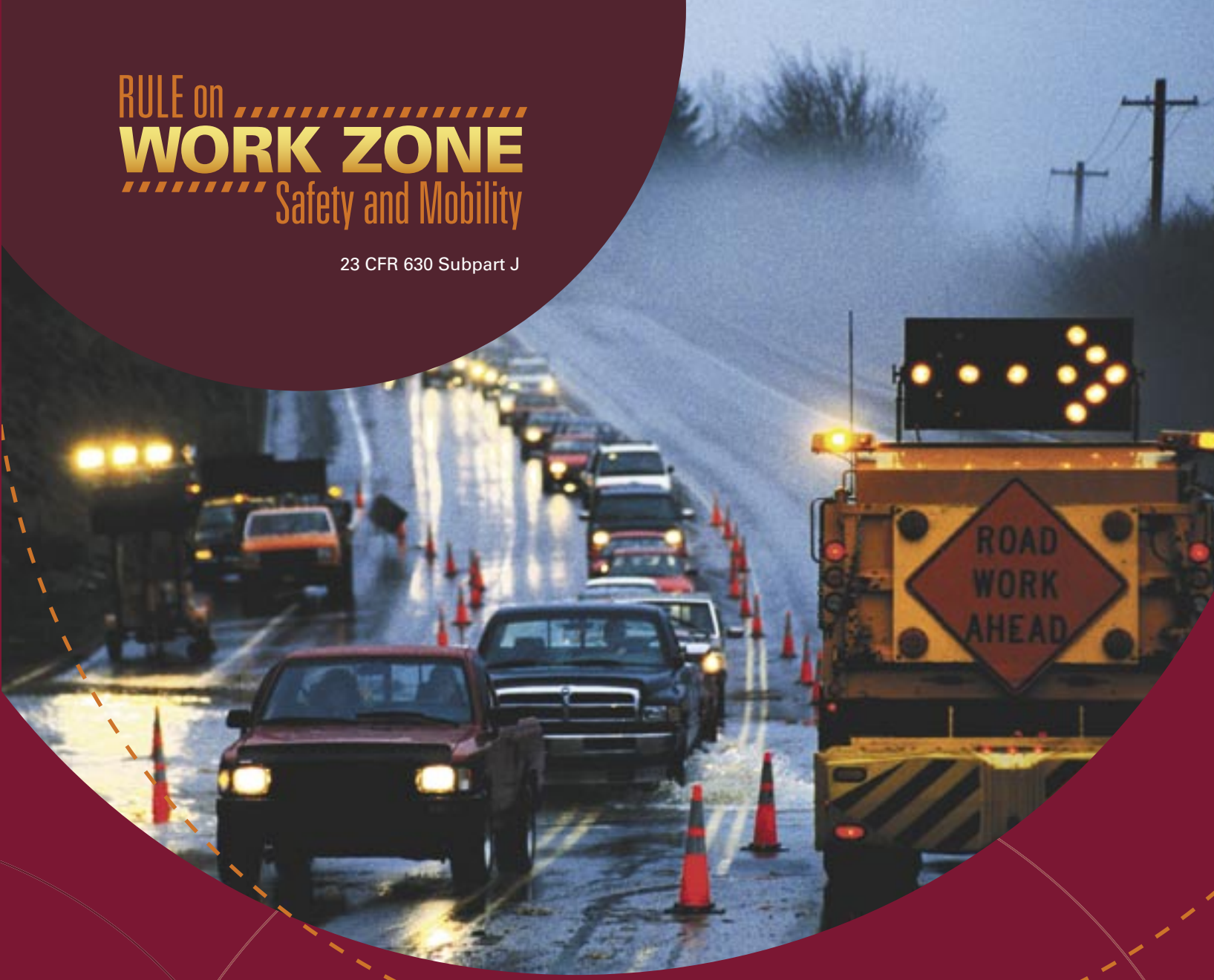
RULE on
WORK ZONE
Safety and Mobility

23 CFR 630 Subpart J



Developing and Implementing Transportation Management Plans for Work Zones

U.S. Department of Transportation
Federal Highway Administration

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Developing and Implementing Transportation Management Plans for Work Zones

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U.S. Department of Transportation
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List of Acronyms

AASHTO – American Association of State Highway and Transportation Officials
AWIS – Automated Work Zone Information System
CBD – Commercial Business District
CCTV – Closed-Circuit Television
CFR – Code of Federal Regulations
CMS – Changeable Message Sign
COZEEP – Construction Zone Enforcement Enhancement Program
DOT – Department of Transportation
DTM – District Traffic Manager
FHWA – Federal Highway Administration
FR – Federal Register
HAR – Highway Advisory Radio
HCM – Highway Capacity Manual
HOV – High Occupancy Vehicle
ITS – Intelligent Transportation System(s)
MOT – Maintenance of Traffic
MUTCD – Manual on Uniform Traffic Control Devices
NEPA – National Environmental Policy Act
PI – Public Information
PLC – Permitted Lane Closure
PS&Es – Plans, Specifications, and Estimates
RE – Resident Engineer
TCP – Traffic Control Plan
TMA – Transportation Management Area
TMC – Transportation Management Center
TMP – Transportation Management Plan
TO – Transportation Operations
TTC – Temporary Traffic Control

Executive Summary

In September 2004, the Federal Highway Administration (FHWA) published updates to the work zone regulations at 23 CFR 630 Subpart J. The updated Rule is referred to as the Work Zone Safety and Mobility Rule (Rule) and applies to all State and local governments that receive Federal-aid highway funding. Transportation agencies are required to comply with the provisions of the Rule by October 12, 2007. The changes made to the regulations broaden the former Rule to better address the work zone issues of today and the future.

Growing congestion on many roads, and an increasing need to perform rehabilitation and reconstruction work on existing roads already carrying traffic, are some of the issues that have lead to additional, more complex challenges to maintaining work zone safety and mobility. To help address these issues, the Rule provides a decision-making framework that facilitates comprehensive consideration of the broader safety and mobility impacts of work zones across project development stages, and the adoption of additional strategies that help manage these impacts during project implementation. At the heart of the Rule is a requirement for agencies to develop an agency-level work zone safety and mobility policy. The policy is intended to support systematic consideration and management of work zone impacts across all stages of project development. Based on the policy, agencies will develop standard processes and procedures to support implementation of the policy. These processes and procedures shall include the use of work zone safety and operational data, work zone training, and work zone process reviews. Agencies are also encouraged to develop procedures for work zone impacts assessment. The third primary element of the Rule calls for the development of project-level procedures to address the work zone impacts of individual projects. These project-level procedures include identifying projects that an agency expects will cause a relatively high level of disruption (referred to in the Rule as significant projects) and developing and implementing transportation management plans (TMPs) for all projects.

To help transportation agencies understand and implement the provisions of the Rule, FHWA has been developing four guidance documents. This Guide is designed to help transportation agencies develop and implement TMPs. An overall Rule Implementation Guide provides a general overview of the Rule and overarching guidance for implementing the provisions of the Rule. Two additional technical guidance documents cover specific aspects of the Rule: work zone public information and outreach strategies, and work zone impacts assessment. All four of the guides include guidelines and sample approaches, examples from transportation agencies using practices that relate to the Rule, and sources for more information. The examples help illustrate that many transportation agencies already use some policies and practices that the Rule either encourages or requires, and that there is more than one way to achieve compliance with the Rule. While what these agencies are doing may not yet be fully compliant with the Rule, their current practices still serve as good examples of how to work toward Rule implementation. While the guides cover aspects of the Rule, they also contain information that can be useful to agencies in all of their efforts to improve safety and mobility in and around work zones and thereby support effective operations and management of our transportation system.

State and local transportation agencies and FHWA are partners in trying to bring about improved work zone safety and mobility. Consistent with that partnership, the Rule advocates a partnership between agencies and FHWA in Rule implementation and compliance. Staff from the respective FHWA Division Offices, Resource Center, and Headquarters will work with their agency counterparts to support implementation and compliance efforts. This guidance document is one key element of that support.

Contents of this Guide

A TMP lays out a set of coordinated transportation management strategies and describes how they will be used to manage the work zone impacts of a road project. The scope, content, and level of detail of a TMP may vary based on agency's work zone policy and the anticipated work zone impacts of the project. *The intended audience for this Guide is the persons responsible for developing TMPs. Depending on the agency's processes and procedures, this may be agency personnel and/or contractors. Persons responsible for TMP-related policy/procedure development and revision, implementation, review, approval, and assessment will also benefit from this Guide.*

Section 1 of this Guide goes into more detail about the definition of a TMP; provides an overview of why developing, implementing, and assessing TMPs is important; describes the purpose of the Guide; and expands on the intended audience for the Guide. Section 1 also describes how TMPs fit into the updated Rule.

Section 2 describes how and where a TMP fits into project-level processes and procedures. It provides guidance and tips to support the development and use of TMPs and offers examples of related practices currently in use by various transportation agencies. This section includes a general TMP development process diagram that may be used as a starting point for agencies to consider in developing TMP procedures and TMPs for specific projects.

Section 3 contains a list of the components that could be considered for inclusion in TMPs. The components discussed include elements of the TMP document itself, as well as elements for implementation and evaluation of the TMP. For each component, the Guide includes a definition and a description of some of the key items and issues to consider. This section is supported by Appendix A, which contains a TMP component checklist.

Section 4 describes various work zone management strategies. The strategies are grouped into categories representing the three main TMP areas: temporary traffic control, public information, and transportation operations. This section provides brief definitions for the strategies and is supported by Appendix B, which contains information to help agencies determine when to consider the strategies, pros/cons, and whether the strategies are likely to improve mobility and/or safety.

The Guide closes with Section 5, which provides a number of examples and practices describing how agencies are currently using TMPs. This section contains a table listing resource information and web links to some examples of TMPs, TMP-related policies and procedures, and other TMP practices.

Table of Contents

List of Acronyms ..... **i**
Executive Summary ..... **ii**

1.0 Introduction **1-1**
1.1 What is a TMP? 1-1
1.2 Why Develop and Implement TMPs? 1-1
1.3 Purpose of this Document 1-3
1.4 Target Audience 1-3
1.5 TMPs and the Work Zone Rule 1-3
1.6 Overview of Guidance Material for the Rule 1-5
1.7 Key Terminology 1-6

2.0 Process for TMP Development, Implementation, and Assessment **2-1**
2.1 How and When Should TMPs be Developed, Implemented, and Assessed? 2-1
2.2 TMP Development, Implementation, and Assessment Process 2-1
2.2.1 TMP Development During Planning, Preliminary Engineering, and Design 2-3
2.2.2 TMP Implementation, Monitoring, and Revisions During Construction 2-10
2.2.3 TMP Performance Assessment 2-11
2.3 Tips for an Effective TMP 2-12

3.0 Potential TMP Components **3-1**
3.1 Introductory Material 3-3
3.2 Executive Summary 3-3
3.3 TMP Roles and Responsibilities 3-3
3.4 Project Description 3-4
3.5 Existing and Future Conditions 3-5
3.6 Work Zone Impacts Assessment Report 3-5
3.7 Selected Work Zone Impacts Management Strategies 3-8
3.8 TMP Monitoring 3-9
3.8.1 Monitoring Requirements 3-9
3.8.2 Evaluation Report for the TMP 3-9
3.9 Contingency Plans 3-10
3.10 TMP Implementation Costs 3-10
3.11 Special Considerations (As Needed) 3-11
3.12 Attachments (As Needed) 3-11

4.0 Work Zone Impacts Management Strategies 4-1

4.1 Temporary Traffic Control (TTC) 4-4
4.1.1 Control Strategies 4-4
4.1.2 Traffic Control Devices 4-6
4.1.3 Project Coordination, Contracting, and Innovative Construction Strategies 4-8

4.2 Public Information (PI) 4-9
4.2.1 Public Awareness Strategies 4-10
4.2.2 Motorist Information Strategies 4-12

4.3 Transportation Operations (TO) 4-14
4.3.1 Demand Management Strategies 4-14
4.3.2 Corridor/Network Management Strategies 4-15
4.3.3 Work Zone Safety Management Strategies 4-17
4.3.4 Traffic/Incident Management and Enforcement Strategies 4-20

5.0 Current TMP Use, Examples, and Practices 5-1

5.1 Current TMP Use 5-1
5.1.1 Current TMP Policies and Processes 5-1
5.1.2 Work Zone Impact Mitigation Strategies 5-5
5.1.3 TMP Development and Implementation Costs 5-7
5.1.4 Conclusions and Lessons-Learned 5-8
5.1.5 Contact Information 5-9

5.2 Examples and Practices 5-9

Appendix A – Transportation Management Plan Potential Components Checklist ..... Appendix A-1

Appendix B – Work Zone Management Strategies Matrix ..... Appendix B-1

List of Tables

Table 3.1 Potential TMP Components 3-2
Table 4.1 Work Zone Management Strategies by Category 4-2
Table 5.1 Resources for Examples and Best Practices 5-10
Table B.1 TMP Strategy Matrix – Mobility/Safety Improvement and Considerations for Implementation ..... Appendix B-1

List of Figures

Figure 2.1 A Process for TMP Development 2-2

1.0 Introduction

1.1 What is a TMP?

A transportation management plan (TMP) lays out a set of coordinated transportation management strategies and describes how they will be used to manage the work zone impacts of a road project. Transportation management strategies for a work zone include temporary traffic control measures and devices, public information and outreach, and operational strategies such as travel demand management, signal retiming, and traffic incident management. The scope, content, and level of detail of a TMP may vary based on the State or local transportation agency's[1] work zone policy and the anticipated work zone impacts of the project.

1.2 Why Develop and Implement TMPs?

Our highways are at an age where they require more reconstruction and repair, resulting in more work zones. At the same time, highway traffic volumes and congestion are increasing, with very little growth in road miles. As a result, more work is being done on roadways with pre-existing high traffic demand, adding pressure on agencies and contractors to compress schedules and sometimes perform work at night. Work zone safety continues to be a concern, with more than 41,000 injuries and 1,028 fatalities in work zones in 2003.[2] Further, travelers are frustrated with the delays, unexpected road conditions, and inconsistencies caused by work zones.

The above trends indicate a strong need for better management of the impacts of road construction and maintenance projects. In September 2004, the Federal Highway Administration (FHWA) published updates to the work zone regulations at 23 CFR 630 Subpart J. The updated Rule is referred to as the Work Zone Safety and Mobility Rule (the Rule). One of the goals of the updated Rule is to expand work zone impacts management beyond traffic safety and control by using transportation management strategies, as applicable to the project. Inclusion of these strategies helps to reduce traffic and mobility impacts, improve safety, and promote coordination within and around the work zone. This will be accomplished through the development of TMPs. TMPs are required by the Rule for all Federal-aid highway projects. Section 1.5 contains a discussion on the Rule and how it addresses TMPs.

Work zone impacts and issues vary, so agencies need to develop and implement TMPs that best serve the mobility and safety needs of their road users, highway workers, businesses, and community. Projects anticipated to have greater work zone impacts may warrant additional attention during the project delivery process and/or additional funding for transportation management strategies to manage the impacts. Therefore, it is important to have different types of TMPs for different projects based on the expected levels of work zone impacts.

[1] Hereinafter referred to as agency.

[2] U.S. Department of Transportation, National Highway Traffic Safety Administration, Fatality Analysis Reporting System and General Estimates System. Washington D.C., 2003.

"TMP – The use of a multi-faceted and multi-jurisdictional program of operational, communications, and demand management strategies to maintain acceptable levels of traffic flow during periods of construction activities. Typically, TMPs consist of elements from each of the following areas: Public Information, Motorist Information, Incident Management, Construction Strategies, Demand Management Strategies, and Alternative Route Strategies. A TMP can be used for either single projects or for coordination of multiple projects within a given area."

Source: Ohio Department of Transportation (ODOT) policy on Traffic Management in Work Zones Interstate and Other Freeways, Policy No. : 516-003(P), July 18, 2000. Available online in the Policy section of ODOT's web site. URL: **http://www.dot.state.oh.us/Policy/516-003p.pdf** (Accessed 09/08/05)

Some of the key benefits of a TMP are to help:

- Address the broader safety and mobility impacts of work zones at the corridor and network levels.
- Promote more efficient and effective construction phasing and staging, minimize contract duration, and control costs.
- Improve work zone safety for construction workers and the traveling public.
- Minimize the traffic and mobility impacts of a work zone.
- Improve public awareness.
- Minimize complaints from the traveling public and local businesses and communities.
- Minimize circulation, access, and mobility impacts to local communities and businesses.
- Improve intra- and inter-agency coordination.
- Identify responsibilities and actions.

"TMPs would streamline the process through which road user impacts due to work zones can be properly analyzed and addressed."

Source: Quote from Jawad Paracha, Maryland State Highway Administration, used in Transportation Management Plans for Work Zones Fact Sheet (FHWA-HOP-05-022), URL: **http://www.ops.fhwa.dot.gov/wz/resources/tmp_factsheet.pdf** (Accessed 11/18/05)

1.3 Purpose of this Document

This document is a compendium of guidance material, available resources, and suggested practices to help agencies develop, implement, and assess TMPs. Work zone objectives, needs, and issues vary from project to project. Therefore, it is ultimately up to agencies to establish procedures and implement TMPs that best serve the safety and mobility needs of the traveling public, highway workers, businesses, and community. This Guide is not intended to present the only possible approach to develop and implement TMPs. Rather, this Guide sets forth some basic guiding principles and describes a general approach for developing, implementing, and assessing TMPs in order to assist agencies with developing their own procedures. This document also provides support to agencies in their efforts to implement the recently updated work zone regulations in 23 CFR 630 Subpart J. Other guidance documents related to the Rule are presented in Section 1.6.

1.4 Target Audience

The target audience for this document primarily includes the persons responsible for developing TMPs. Depending on the agency's processes and procedures, this may be agency personnel and/or contractors. Persons responsible for TMP-related policy/procedure development and revision, implementation, review, approval, and assessment will benefit from this Guide. Agencies are encouraged to develop and implement the TMP in consultation with the Federal Highway Administration (FHWA) and appropriate stakeholders, such as other transportation agencies, law enforcement, railroad agencies/operators, transit providers, freight movers, utility suppliers, emergency responders, schools, and business communities.

1.5 TMPs and the Work Zone Rule

The FHWA published the Work Zone Safety and Mobility Rule (the Rule) on September 9, 2004 in the Federal Register (69 FR 54562). The Rule updates and renames the former regulation on "Traffic Safety in Highway and Street Work Zones" in 23 CFR 630 Subpart J. All State and local governments that receive Federal-aid highway funding are affected by this updated Rule, and are required to comply with its provisions no later than October 12, 2007. While the Rule applies specifically to Federal-aid highway projects, agencies are encouraged to apply the good practices that it fosters to other road projects as well.

The Rule updates and broadens the former regulation to address more of the current issues affecting work zone safety and mobility by:

- Fostering systematic assessment of the work zone impacts of road projects and development and implementation of transportation management strategies that help manage these impacts.
- Expanding thinking beyond the project work zone itself to address corridor, network, and regional issues while planning and designing road projects.
- Expanding work zone impacts management beyond traffic safety and control, to address mobility in addition to safety, and to address the broader concepts of transportation operations and public information.
- Advocating innovative thinking in work zone planning, design, and management, so as to consider alternative/innovative design, construction, contracting, and transportation management strategies.

An important provision of the Rule is the requirement to develop TMPs for all projects. The former Rule required the development of traffic control plans (TCPs) for all road projects. A TCP is a plan for handling traffic through a specific highway or street work zone or project. The updated Rule expands the former TCP requirement to now require the development and implementation of TMPs for all projects. TMPs must include traffic control strategies, and may also include additional work zone management strategies based upon the expected work zone impacts of a project. The specific requirements associated with TMPs are in § 630.1012 of the Rule and are summarized as follows:

- The possible components that constitute a TMP are: the temporary traffic control (TTC) plan[3], the transportation operations (TO) component, and the public information (PI) component. A TMP shall always contain a TTC plan, while the requirement for the TO and PI components varies based on the project.
- The distinguishing factor in the TMP requirements for different projects is whether a project is a significant project or not. Simply stated, a significant project is a project that the agency expects will cause a relatively high level of disruption. The Rule provides a more detailed definition of significant project, and specifically includes certain projects on the Interstate system. Identifying significant projects is intended to help agencies effectively develop appropriate TMPs.

What is a Significant Project?

Section 630.1010 of 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. 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 shall be considered as significant projects.

- For significant projects, the TMP shall consist of a TTC plan as well as transportation operations and public information components. A TTC plan addresses traffic safety and control through the work zone. The TO component addresses sustained operations and management of the work zone impact area, and the PI component addresses communication with the public and concerned stakeholders.
- For projects that are not classified as significant projects, the TMP may consist only of a TTC plan. However, agencies are encouraged to consider TO and PI issues for these projects as well.
- A TTC plan shall be consistent with the provisions under Part 6 of the Manual on Uniform Traffic Control Devices (MUTCD) and with the work zone hardware recommendations in Chapter 9 of the American Association of State Highway and Transportation Officials (AASHTO) Roadside Design Guide.[4] The TTC plan may be incorporated in the TMP by reference, such as reference to elements in the MUTCD or approved standard agency plans or manuals. TTC plans may also be specifically designed for individual projects. In developing and implementing the TTC plan, the Rule requires that pre-existing roadside safety hardware be maintained at an equivalent or better level than existed prior to project implementation.

[3] A TTC plan is the term currently used by the Manual on Uniform Traffic Control Devices (MUTCD) for what is commonly referred to as a TCP. The MUTCD is available at http://mutcd.fhwa.dot.gov.

[4] MUTCD URL: http://mutcd.fhwa.dot.gov. Roadside Design Guide, Chapter 9 - Traffic Barriers, Traffic Control Devices, and Other Safety Features for Work Zones, AASHTO, 2002, URL: https://bookstore.transportation.org/

- Agencies should coordinate with appropriate stakeholders in developing a TMP.
- The provisions for a TMP shall be included in the project's plans, specifications, and estimates (PS&Es). The PS&Es shall either contain all the applicable elements of an agency-developed TMP, or include provisions for a contractor to develop a TMP at the most appropriate project phase, as applicable to the agency's chosen contracting methodology for the project. In the case of contractor-developed TMPs, it is expected that the contractor would incorporate the minimum TMP requirements already developed by the agency during the planning process. For example, the PS&Es for a design-build project may include the skeleton for a TMP, as developed by the agency in its planning process, and the provisions for completing TMP development under the contract. The agency must approve contractor developed TMPs and they cannot be implemented until approved.
- Pay item provisions for implementing the TMP shall be included in PS&Es, either through method-based (pay items, lump sum, or combination) or performance-based specifications (performance criteria and standards). Examples of potential performance criteria include number of crashes in the work zone, incident response or clearance time, travel time through the work zone, delay, queue length, and/or traffic volume.
- The agency and the contractor shall each designate a trained person at the project-level who has the primary responsibility and sufficient authority for implementing the TMP. The designated personnel have to be appropriately trained (per § 630.1008(d) of the Rule).

1.6 Overview of Guidance Material for the Rule

To help transportation agencies implement the provisions of the Rule, the FHWA has developed a suite of guidance documents that address the following topics:

- **Overall Rule Implementation.** Provides an overview of the Rule and general guidance for implementing the Rule, lays out fundamental principles, and presents agencies with ideas for implementing the Rule's provisions.
- **Work Zone Impacts Assessment.** Provides guidance on developing procedures to assess work zone impacts of road projects.
- **Work Zone Transportation Management Plans (TMPs).** The guidance material provided in this document addresses this topic.
- **Work Zone Public Information and Outreach Strategies.** Provides guidance on developing communications strategies to inform affected audiences about construction projects, their expected work zone impacts, and the changing conditions on projects.

All Rule resources will be available on the FHWA work zone web site at the following URL: **http://www.ops.fhwa.dot.gov/wz/resources/final_rule.htm**

1.7 Key Terminology

The following list defines some of the key terminology used in this document:

- **Mobility.** For work zones, mobility pertains to moving road users efficiently through or around a work zone area with a minimum delay compared to baseline travel when no work zone is present, while not compromising the safety of highway workers or road users. The commonly used performance measures for the assessment of mobility include delay, speed, travel time and queue lengths.
- **Safety.** For work zones, safety refers to minimizing potential hazards to travelers and highway workers in the vicinity of a work zone.
- **Significant project.** A significant project is 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 agency policy and engineering judgment. All Interstate system projects within the boundaries of a designated Transportation Management Area (TMA)[5] that occupy a location for more than three days with either intermittent or continuous lane closures shall be considered as significant projects.
- **Work zone.** The area of a roadway with construction, maintenance, or utility work activities. A work zone is typically marked by signs, channelizing devices, barriers, pavement markings, and/or work vehicles. It extends from the first warning sign or high-intensity rotating, flashing, oscillating, or strobe lights on a vehicle to the END ROAD WORK sign or the last TTC device.
- **Work zone impacts.** Deviation from normal range of transportation system mobility and safety as a result of the presence of a work zone. The extent of the impacts may vary based on factors such as road classification, area type, travel characteristics, type of work, temporal factors, and project complexity.

[5] 23 U.S.C. 134 (i)(1)(A) & (B) requires the Secretary of Transportation to designate as a TMA each urbanized area with a population of over 200,000 individuals. In addition, at the request of the Governor and metropolitan planning organization (MPO) (or affected local officials), other areas may be officially designated as TMAs by the Administrators of the FHWA and the FTA. The list of TMAs is contained in the July 8, 2002 Federal Register on pages 45173 to 45178 (http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=2002_register&docid=02-16998-filed).

2.0 Process for TMP Development, Implementation, and Assessment

This section provides guidance on how and where a transportation management plan (TMP) fits into the processes and procedures that are part of a typical project delivery process for road projects. It provides guidance on policies and processes that support the development and use of TMPs and also offers examples of related practices currently in use by various State and local transportation agencies.[1] This section concludes with tips for effective TMPs.

2.1 How and When Should TMPs be Developed, Implemented, and Assessed?

TMP development begins during systems planning and progresses through the design phase of a project. Existing project development processes can provide valuable information to guide TMP development. For example, the National Environmental Policy Act (NEPA) process during project planning may be a key source of inputs or constraints for the project. Developing the TMP will involve the identification of applicable transportation management strategies to manage the impacts of the project. The costs for the management strategies needs to be incorporated in early project estimates and the budgeting process to ensure that funding is available for TMP implementation. This is especially applicable to projects likely to have greater work zone impacts. The TMP development process is iterative and evolves through project design. As the TMP evolves, it is important to reassess the management strategies to confirm that the work zone impacts are addressed and the necessary funding is available. The TMP may be re-evaluated and revised prior to and during implementation and monitoring. Finally, both project level and program level assessments of the TMP are recommended to evaluate the effectiveness of the management strategies and improve TMP policies, processes, and procedures.

2.2 TMP Development, Implementation, and Assessment Process

According to the updated Rule (the Rule), TMPs are required for all Federal-aid highway projects and consist of strategies to manage the work zone impacts of a project. Figure 2.1 presents a general TMP development process diagram that may be used as a starting point for agencies to consider when developing TMP procedures and TMPs for specific projects. The example process in Figure 2.1 shows three types of TMPs (Basic, Intermediate, and Major). Agencies may elect to develop a different number of categories of TMPs than what is described here.

[1] Hereinafter referred to as agencies.

Each of the eleven steps in the diagram is explained in the remainder of this section. References to the expected work zone impacts of a project are made throughout the steps. Additional information pertaining to the specifics of how work zone impacts may be progressively assessed through each stage of project delivery/development can be found in **Work Zone Impacts Assessment: An Approach to Assess and Manage Work Zone Safety and Mobility Impacts of Road Projects.**[2]

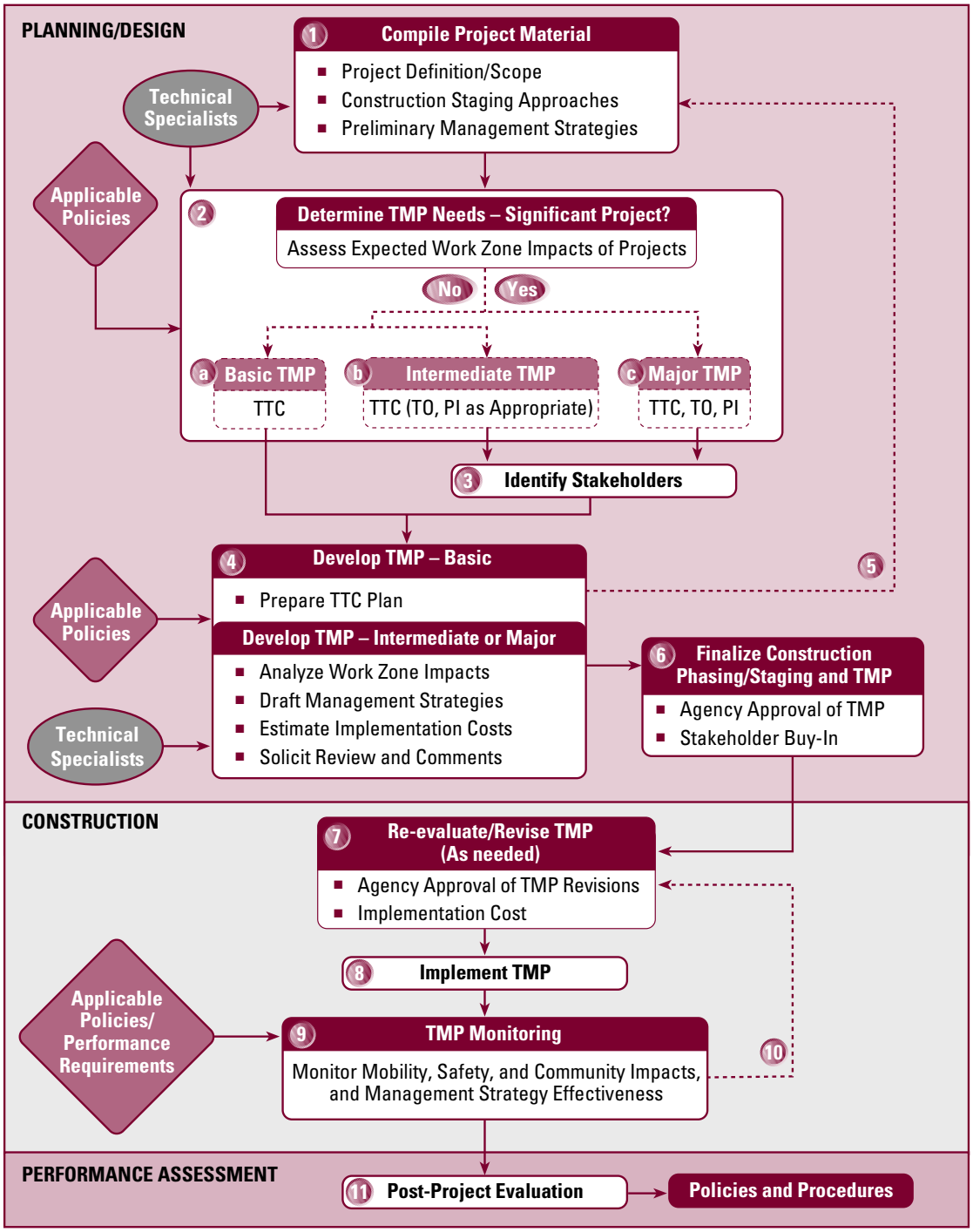

Figure 2.1 A Process for TMP Development

[2] Available at http://www.ops.fhwa.dot.gov/wz/resources/final_rule.htm

2.2.1 TMP Development During Planning, Preliminary Engineering, and Design

Two of the keys to a successful TMP are:

- Developing it as early as possible.
- Using a multidisciplinary approach.

Although a full TMP document is not developed until design, conducting some TMP analyses during systems planning[3] and preliminary engineering will help ensure that the TMP development and implementation costs are included in the project budget. At this early stage, more alternatives for addressing work zone impacts are available, so a broader range of strategies can be chosen. Early TMP development will also help with scheduling and coordinating projects to minimize the cumulative work zone impacts of multiple projects along a corridor or in a region. This includes examining the adequacy of detour or alternate routes and coordinating with the agencies responsible for those routes. Another strategy available in the earlier stages of project development is to consider work zone impacts in the evaluation and selection of design alternatives. For some projects it may be possible to choose a design alternative that alleviates many work zone impacts. These broader strategies cross various disciplines and highlight the need for a multidisciplinary approach.

Steps towards TMP development that might occur during planning, preliminary engineering, and design are described below. The steps to TMP development are intended to work in an iterative manner where the level of detail progressively increases from planning through preliminary engineering through design, as more project specific information becomes available.

Step 1 – Compile Project Material

Staff responsible for each stage of the project (planning, preliminary engineering, design, construction) begin by compiling available project materials such as:

- Project definition (project scope, roadway and traffic characteristics, other factors such as public outreach, community information, etc.).
- Construction phasing/staging approaches and plans.
- Preliminary work zone management strategies.
- Preliminary cost estimates for strategy implementation (when available).
- Information from other projects in the corridor to evaluate the combined or cumulative impact of the projects.

The planning or design team should work with traffic engineering/operations personnel and other relevant technical specialists (such as right-of-way experts, pavement engineers, environmental specialists, etc.) to obtain the project information and help identify potential issues or concerns. This collaboration can help in developing the best combination of design, construction phasing/staging, and work zone management strategies. As more information and data become available, the management strategies and their costs should be refined.

[3] Systems planning is the stage of project delivery when short- and long-term transportation needs and deficiencies are identified, and appropriate projects are recommended and programmed.

Step 2 – Determine TMP Needs

The components of a TMP for a project are based on the expected work zone impacts of a project and whether the project is determined to be significant. Section 1.7 provides a definition of significant projects.

Identification of significant projects should be:

- Based upon the agency's work zone policies and procedures, and the project's characteristics and anticipated work zone impacts.
- Conducted as early as possible in the project delivery and development process.
- Done in cooperation with FHWA.

Agencies may already have policies that lay out criteria and requirements for significant projects. If no policies exist, agencies are encouraged to develop policies for determining when a project is significant. The Rule is specific for one case: "Interstate system projects within the boundaries of a designated Transportation Management Area (TMA)[4] that occupy a location for more than three days with either intermittent or continuous lane closures shall be considered as significant projects." Exceptions may be requested from the FHWA if the agency can demonstrate that the project, or category of projects, does not have sustained work zone impacts.

According to the California Department of Transportation's (Caltrans) policy guidance, "Significant traffic impact is 30 minutes above normal recurring traffic delay on the existing facility or the delay threshold set by the District Traffic Manager (DTM), whichever is less."

Source: California Department of Transportation (Caltrans), Transportation Management Plan Guidelines, July 1, 2001. Also available in the Caltrans Deputy Directive DD-60, Transportation Management Plans, June 2000, URL: **http//www.valleyair.org/Workshops/postings/3-25-2002/caltrans/dd-60.pdf** (Accessed 08/16/05)

Some of the key project characteristics that agencies may want to consider in their policies and procedures for significant projects include:

- Type of project (new construction, major reconstruction, major rehabilitation, or bridge/pavement replacement).
- Degree of roadway congestion at and near the project location.
- Capacity reductions (lane, ramp, or facility closures).
- Impacts on mobility through and within the project area.
- Impacts on safety through and within the project/work zone impact area.
- Impacts on local businesses and community.
- Impacts from or on special events or due to seasonal variations (e.g., weather related, tourist traffic related).
- Whether considerable detour and alternate routing will be necessary.
- Whether feasible alternate routes are available.

[4] 23 U.S.C. 134 (i)(1)(A) & (B) requires the Secretary of Transportation to designate as a TMA each urbanized area with a population of over 200,000 individuals. In addition, at the request of the Governor and metropolitan planning organization (MPO) (or affected local officials), other areas may be officially designated as TMAs by the Administrators of the FHWA and the FTA. The list of TMAs is contained in the July 8, 2002 Federal Register on pages 45173 to 45178 (http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=2002_register&docid=02-16998-filed).

More detailed guidance on assessing work zone impacts and identifying significant projects can be found in **Work Zone Impacts Assessment: An Approach to Assess and Manage Work Zone Safety and Mobility Impacts of Road Projects,** and **Implementing the Rule on Work Zone Safety and Mobility**,[5] respectively.

If a project is expected to be significant, the TMP will consist of a temporary traffic control (TTC) plan, as well as a transportation operations (TO) component and a public information (PI) component (Step 2c – Major TMP). A TTC plan addresses traffic safety and control through the work zone. The TO component addresses sustained operations and management of the work zone impact area, and the PI component addresses communication with the public and other affected parties. If the project is not classified as a significant project, the TMP will contain a TTC in all cases (Step 2a – Basic TMP). Agencies are encouraged to consider TO and PI components for non-significant projects also, particularly those with moderate mobility or safety impacts (Step 2b – Intermediate TMP).

Agencies may elect to develop multiple levels or categories of TMPs, different from what is described here. The use of Basic, Intermediate, and Major TMP categories described below is just one example of how an agency may implement this.

The California Department of Transportation (Caltrans) uses three levels of TMPs: blanket TMP; minor TMP; and major TMP. See Section 5.1.1 for more information.

Source: Transportation Management Plans Effectiveness Study, Robert Copp, Caltrans, TRB 2004 Annual Meeting, Session 526: Work Zone Impacts – A New Frontier

Step 2a – Basic TMP (TTC)

Basic TMPs are typically applied on construction or maintenance projects with minimal disruption to the traveling public and adjacent businesses and community. These projects typically only involve the development of a TTC plan, often known as a Traffic Control Plan (TCP) or Maintenance of Traffic (MOT) plan. TTC plans need to be consistent with Part 6 (Temporary Traffic Control) of the Manual on Uniform Traffic Control Devices (MUTCD), and with the work zone hardware recommendations in Chapter 9 (Traffic Barriers, Traffic Control Devices, and Other Safety Features for Work Zones) of the American Association of State Highway and Transportation Officials (AASHTO) Roadside Design Guide. The Rule specifies that the TTC plan be:

- A reference to:
  - Specific TTC elements in the MUTCD, or
  - Approved standard TTC plans, or
  - Agency TTC manual, or
- Be designed specifically for the project.

Agencies may decide to implement basic TMPs (TTCs) through the use of one- or two-page forms. These forms would provide information on the location and schedule of the construction or maintenance project, plus what is traditionally done by agencies for a TCP or MOT. For Basic TMPs, the next relevant step of the process is Step 4 – Develop TMP.

[5] Both documents are available at http://www.ops.fhwa.dot.gov/wz/resources/final_rule.htm

Step 2b – Intermediate TMP (TTC, and some optional TO and/or PI)

Intermediate TMPs can be used for construction or maintenance projects that are anticipated to have more than minimal disruption, but have not been identified as significant projects. For example, these projects may be expected to impact a moderate number of travelers and have moderate public interest, such as single lane closures in urban areas or commercial business districts (CBDs). Intermediate TMPs could include more detailed work zone impacts analysis and management strategy information than Basic TMPs, including some element of PI and/or TO strategies, as well as cost estimates.

Step 2c – Major TMP (TTC/TO/PI)

Major TMPs are intended for significant projects. These projects, such as multiple lane-closures or total closure of an important corridor in an urban area or CBD, typically have moderate to high impacts on traffic and the local area and generate public interest. The Rule requires that TMPs for significant projects consist of a TTC plan, and also address PI and TO components. In addition to the TMP components required by the Rule, TMPs may also contain cost estimates, coordination strategies between stakeholders, secondary mitigation strategy(s), analysis of potential impacts on detour routes, and analysis of the potential effects of the management strategies. The consideration and incorporation of these additional items may help an agency develop and implement a TMP that effectively manages the work zone impacts of the project, and serves the needs of the agency, the traveling public, workers, and other parties affected by the project.

The California Department of Transportation (Caltrans) requires contingency plans for all TMPs to "address specific actions that will be taken to restore or minimize effects on traffic when congestion or delays exceed original estimates due to unforeseen events such as work zone accidents, higher than predicted traffic demand, or delayed lane closures."

Source: Caltrans Deputy Directive DD-60, Transportation Management Plans, June 2000,
URL: **http://www.valleyair.org/Workshops/postings/3-25-2002/caltrans/dd-60.pdf** (Accessed 08/16/05)

Guidance for TMP components can be found in Section 3.0 of this document.

Step 3 – Identify Stakeholders

This step involves the identification of stakeholders (internal and external) that can provide valuable input to the agency on what strategies to include in the TMP to help manage the work zone impacts of a project. This is generally intended for the development of intermediate and major TMPs. Stakeholders should represent different perspectives and will vary depending on the location and nature of the project. These varying perspectives can help the agency identify and consider a broader range of concerns in deciding what to include in a major TMP.

Stakeholders may include internal agency staff from planning, design, safety, construction, operations, maintenance, public affairs, public transportation, pavement, bridge, as well as other technical specialists. External stakeholders may include local government (county, city, regional), FHWA, public transportation providers, contractors, regional transportation management centers (TMCs), railroad agencies/operators, freight operators, enforcement agencies, utility providers, emergency services, freeway service patrol, businesses, community groups, and schools.

During summer 2002, Michigan DOT (MDOT) performed full surface reconstruction, and repair, removal, or replacement of five bridges, on a 1.3-mile stretch of a busy downtown freeway in Detroit (M-10). MDOT engineers planned to close the road to expedite construction and improve safety for travelers and workers. During planning for the full closure of M-10, MDOT worked with numerous stakeholders. For example, MDOT project personnel met with local businesses, including representatives from a large casino located near M-10. Based on stakeholder input, MDOT decided to reduce the impact of traffic diversion by installing temporary signs to guide traffic to the casino. Other casinos in the area expressed concern that more signing would be available to the casino near the closed facility, so MDOT decided to erect additional signing for the other casinos to maintain equity.

Source: Full Road Closure for Work Zone Operations: A Case Study. Accelerating Construction and Reducing Crashes During the Rehabilitation of a Major Downtown Route: M-10 Lodge Freeway in Detroit, Michigan (FHWA-HOP-05-013) 2004, URL: **http://www.ops.fhwa.dot.gov/wz/construction/full_rd_closures.htm** (Accessed 07/20/05)

It is recommended that a TMP team made up of the key stakeholders be developed for major TMP efforts to see the project through from design to final assessment. The TMP team should vary depending on the project characteristics.

> "[TMPs] bring all stakeholders into the discussions in advance, so we can work out the best detour routes, signal retiming, and other geometric improvements."
>
> Source: Quote from Thomas Notbohm, Wisconsin Department of Transportation, used in Transportation Management Plans for Work Zones Fact Sheet (FHWA-HOP-05-022), URL: **http://www.ops.fhwa.dot.gov/wz/resources/tmp_factsheet.pdf** (Accessed 11/18/05)

Step 4 – Develop TMP

The level of detail of the TMP during early planning is largely dependent upon the type of planning activity, the expected impacts of the project, and the availability of data. At a minimum, early planning should entail a qualitative exercise to list the potential impacts of a project, along with a list of potential management strategies, and the expected costs of those management strategies. Once this information is included in transportation plans and programs, the appropriate funding may be allocated for work zone impacts management, and the thinking and rationale that went into identification of the management strategies can be carried over to the subsequent phases of the project. The same is true for the preliminary engineering phase of a project, where the project design team should work with other technical specialists, including construction, traffic engineering, and public outreach/relations personnel to jointly identify the work zone impacts issues that need to be accounted for.

Since construction phasing and staging greatly affect the safety and mobility of work zones, it is important that designers/construction engineers who develop the construction phasing and staging plans consult and appropriately involve safety experts, traffic engineers, and other technical specialists in their processes. Some agencies have

expanded the scope of work to address infrastructure needs to accommodate construction traffic or future projects (e.g., shoulder widening to accommodate realigned lanes serves as a buffer after construction and may assist in later corridor reconstruction/staging).

Often times, engineers develop the construction phasing/staging plans followed by an appropriate TTC plan for the project. However, it would be beneficial if the construction phasing/staging plans and TTC plans were developed hand-in-hand. Transportation operations and management issues are often included in the plans, specifications, and estimates (PS&E)[6] late in the project development cycle, resulting in project delays and increased costs. However, if TO and PI issues are considered at the same time that construction phasing/staging and TTC issues are considered, it may result in the development of a TMP that has synergy across its different components. For example, on a particular corridor, it may be the case that a shoulder closure is desired to construct a project; it may also be the case that the corridor has a high crash history. The high crash history may prohibit the shoulder closure option. However, if someone knowledgeable in traffic operations and management is involved in the discussion of construction options, he/she could have mentioned that an incident management plan with a tow-truck based incident response program could be implemented as a TO management strategy to allow the shoulder to be closed for construction.

The essence of the TMP development process lies in developing and evaluating the best alternative combination of construction phasing/staging, project design options, TTC plan, TO strategies, and PI strategies hand-in-hand with each other.

Work zone management strategies should be identified based on the project constraints, construction phasing/staging plan, type of work zone, and anticipated work zone impacts. Some agencies may use strict lane closure policies/strategies or permissible lane closure times that must be followed. Other agencies may use analysis tools to predict delays, queues, and impacts of detours on the city arterials of various strategies. While many agencies would like to use more complex simulation tools to analyze work zone impacts and management strategies in greater detail, many end up using less sophisticated and less intensive tools such as QUEWZ and QuickZone. Cost is often a constraint in the development of a TMP, particularly for major construction projects affecting large portions of the transportation network, business districts, and community.

Some agencies, such as New Jersey and Texas, are considering road user costs in the overall costs for construction activities to capture the traveler delay costs and potentially reduce construction time by using road user costs as an incentive or disincentive in contracts.

Sources: New Jersey Department of Transportation, Road User Cost Manual, June 2001, URL: **http://www.state.nj.us/transportation/eng/documents/RUCM/#Introduction** (Accessed 07/20/05)

Texas Transportation Institute, Texas Transportation Researcher, Volume 36, Number 2, 2000, URL: **http://tti.tamu.edu/researcher/v36n2/36_2.pdf** (Accessed 07/20/05)

[6] PS&E package typically includes a project's plan sheets, standard and special specifications, general notes, special provisions, cost estimate, and project agreements.

QUEWZ and QuickZone are software programs designed for evaluating work zones. Additional information on work zone analysis tools can be found in:

- The Work Zone & Traffic Analysis/Management section of the FHWA work zone web site, available at **http://ops.fhwa.dot.gov/wz/traffic_analysis.htm** (Accessed 08/19/05)
- Work Zone Impacts Assessment: An Approach to Assess and Manage Work Zone Safety and Mobility Impacts of Road Projects, available at **http://www.ops.fhwa.dot.gov/wz/resources/final_rule.htm** (Accessed 08/19/05)

For basic TMPs, the TMP development process will largely consist of developing a TTC or MOT plan. The TTC or MOT plan shall be either a reference to specific TTC elements in the MUTCD, approved standard TTC plans, agency transportation department TTC manual, or can be designed specifically for the project.

Finally, the TMP needs to include appropriate pay item provisions for implementation, either through method- or performance-based specifications.

Step 5 – Update/Revise TMP

This step represents the iterative aspect of TMP development, wherein the TMP is updated or revised as the project progresses through its various developmental stages, and as more project-specific information becomes available. The TMP may be envisioned as a 'dynamic document' that is maintained and revised by the TMP team, as necessary. This step also represents possible reclassification of a project as significant or not significant.

Step 6 – Finalize Construction Phasing/Staging and TMP

The PS&Es shall include either all the applicable elements of a TMP, or the provisions for a contractor to develop a TMP.[7] FHWA encourages agencies to begin TMP development early in the project development process, so in many cases agencies will have begun TMP development prior to project letting, even for design-build projects. FHWA envisions that in cases where contractors will develop TMPs, the PS&Es are likely to contain the skeleton/outline of a TMP developed by the agency during its planning process, and the provisions for completing TMP development under the contract. For example, if an agency uses performance-based specifications for a project, the performance requirements are laid out in the contract documents with the contractor being responsible for developing a TMP (working from any agency-provided skeleton) that best meets the performance specifications. TMPs are subject to agency approval, with input from stakeholders, as appropriate. Once approved, the TMP and the phasing/staging plans are finalized.

[7] Depending upon the contracting and PS&E approach for a given project, agencies may choose to have contractors develop the TMP prior to the start of work.

2.2.2 TMP Implementation, Monitoring, and Revisions During Construction

Step 7 – Re-evaluate/Revise TMP

If alternative construction phasing/staging plans or other management strategies have been suggested, technical specialists from the contractor or agency need to review the TMP to see if changes are needed. TMPs developed or revised during contracting or construction are approved by the agency prior to implementation.

Step 8 – Implement TMP

The TMP is implemented. In some cases, components of the TMP may need to be implemented prior to construction (e.g., public relations campaign, improvements to detour routes, etc.).

Step 9 – TMP Monitoring

Monitoring the performance of the work zone and that of the TMP during the construction phase is important to see if the predicted impacts closely resemble the actual conditions in the field and if the strategies in the TMP are effective in managing the impacts. Examples of possible performance measures for TMP monitoring include volume, travel time, queue length, delay, number of incidents, incident response and clearance times, contractor incidents, community complaints, user costs, and cumulative impacts from adjacent construction activities. Performance monitoring requirements and performance measures should be based on agency policies, standards, and procedures, and should be included in the project contract documents when appropriate. TMP monitoring and assessment are best written into the TMP during TMP development, rather than devised after the fact. **Work Zone Impacts Assessment: An Approach to Assess and Manage Work Zone Safety and Mobility Impacts of Road Projects**[8] contains examples and more information on monitoring work zone impacts and management strategies during construction.

Step 10 – Update/Revise TMP Based on Monitoring

If performance requirements are not met, the agency and/or contractor should revisit the TMP and consider alternate management strategies and/or phasing/staging approach(es) that meet the approval of the agency.

[8] Available at http://www.ops.fhwa.dot.gov/wz/resources/final_rule.htm

2.2.3 TMP Performance Assessment

Step 11 – Post-Project TMP Evaluation

Evaluations of work zone TMP policies, processes, and procedures aid in addressing and managing the safety and mobility impacts of work zones, particularly for significant projects and when performance-based contracting is used.

TMP performance assessment can aid in addressing the following concerns:

- Which management strategies have proven to be either more or less effective in improving the safety and mobility of work zones?
- Are there combinations of strategies that seem to work well?
- Should TMP policies, processes, procedures, standards, and/or costs be adjusted based on what has been observed or measured?
- Are the best decisions in planning, designing, implementing, monitoring, and assessing work zones being made?

This performance assessment may involve two tracks: 1) the overall TMP process and 2) actual field performance of the work zone and TMP.

Following construction completion, it is a good idea, particularly for significant projects, to prepare a short report that contains an evaluation of the TMP. The post-project evaluation may include successes and failures, changes made to the TMP and results of those changes, any feedback received from the public, actual measurements of conditions versus what was predicted, cost for implementation of the strategies, and suggested improvements. Section 630.1008(e) of the Rule requires agencies to perform a process review at least every two years. This review may include the evaluation of work zone data statewide and/or for randomly selected projects. The results of TMP evaluations can be useful in the process reviews, and vice versa. Collecting, analyzing, and synthesizing the findings from multiple projects can help in the development and implementation of future TMPs.

Work Zone Impacts Assessment: An Approach to Assess and Manage Work Zone Safety and Mobility Impacts of Road Projects[9] provides guidance and information for conducting a post-construction work zone performance assessment. It also contains several examples of post-construction performance assessments.

Indiana DOT's Design Manual Section 81-1.03(01) recommends that upon completion of a project, the TMP team prepare a report identifying the successes and failures of the TMP.

Source: Indiana Department of Transportation, Chapter 81 of the Indiana Design Manual, Transportation Management Plans, URL: **http://www.in.gov/dot/div/contracts/standards/dm/Part%208/Ch%2081/Ch81.pdf** (Accessed 8/16/05)

[9] Available at http://www.ops.fhwa.dot.gov/wz/resources/final_rule.htm

2.3 Tips for an Effective TMP

The following highlights some of the key tips for developing an effective TMP. These tips can be used in coordination with the TMP development steps previously described in this section.

- Involve all of the relevant stakeholders early in the process (e.g., operations, construction, planning, design, safety, maintenance, public affairs, technical specialists, FHWA, local transportation agencies, enforcement agencies, utility providers, emergency services, local businesses, community groups, etc.).
- Consider potential transportation management strategies and their costs early in planning and programming.
- Consider and develop management strategies for impacts beyond the physical location of the work zone itself, for example, on adjacent roadways and on local communities and businesses.
- Avoid limiting the number and/or type of transportation management strategies that may be considered.
- Balance constructability and construction staging requirements with the work zone management strategies.
- Estimate and budget for the development and implementation of the TMP early in the project development process, and update as appropriate throughout the project. Cost is often a constraint for the development of a TMP, particularly for major TMPs.
- Update the TMP, as needed, throughout project development and implementation. The TMP is a 'dynamic document' that must be maintained and revised with changes made by the project team.
- Monitor field conditions and use project logs during construction to identify potential safety and mobility concerns within the work zone and on adjacent roadways, and revise the TMP as necessary.
- Evaluate the effectiveness of TMPs after a project is constructed, and use lessons learned to improve TMPs for future projects.

> "Effective TMPs are ones that are developed early, and address both the traffic control design and traffic operational components of the work zone."
>
> Source: Quote from Steve Kite, North Carolina Department of Transportation, used in Transportation Management Plans for Work Zones fact sheet (FHWA-HOP-05-022), URL: **http://www.ops.fhwa.dot.gov/wz/resources/tmp_factsheet.pdf** (Accessed 11/18/05)

3.0 Potential TMP Components

This section contains a comprehensive list of the components that could be considered for inclusion in transportation management plans (TMPs). This list is intended to serve as guidance. The order, terminology, and inclusion of the components may vary by agency and/or type of project. The level of detail of the TMP depends on whether a project is classified as significant; agency policies, procedures, and guidelines; and the potential work zone impacts of the project. While a State and local transportation agency[1] may include many of these components in a major TMP, it is not expected that agencies would include many of them in a basic TMP. Most agencies have temporary traffic control (TTC) plan policies and report procedures in place for basic TMPs, in the form of traffic control plans (TCPs) or maintenance of traffic (MOT) plans.

TMP components may be described in other existing reports the agency has for the project. For example, an agency may have a detailed project design report with sections for geotechnical, bridge, drainage, and pavement. Many of the suggested items outlined in Sections 3.1 through 3.5 are included in preliminary design reports. In such cases, an agency may decide to include a summary of these items or a reference to such items in the TMP for coordination purposes.

The components discussed in this section include elements of the TMP document itself, as well as elements for implementation and evaluation of the TMP. A definition and a description of some of the key items and issues to consider for each component are provided. Most of the information is based on policies, procedures, guidance, manuals, and practices from agencies currently implementing TMPs.

Table 3.1 summarizes some recommended components for agencies to consider for their TMPs. The individual TMP components are described in more detail in the subsections that follow the table. In addition, a TMP Component Checklist is provided in Appendix A. This checklist may be used by agencies as a starting point to develop their own checklists to assist preparers and reviewers of TMPs.

Minnesota DOT's Traffic Engineering Manual contains a TMP checklist, which focuses on traffic control considerations.

Source: Minnesota Department of Transportation, Traffic Engineering Manual (Chapter 8: Work Zone Traffic Control), June 2000, URL: **http://www.dot.state.mn.us/trafficeng/otepubl/tem/Chap-8-2000.pdf** (Accessed 07/21/05)

[1] Hereinafter referred to as agencies.

TMP Component	Brief Description
1 Introductory Material	Cover page, Licensed Engineer stamp page (if required by the agency), table of contents, list of figures, list of tables, list of abbreviations and symbols, and terminology
2 Executive Summary	Overview of each of the TMP components
3 TMP Roles and Responsibilities	TMP manager, stakeholders/review committee, approval contact(s), TMP implementation task leaders (e.g., public information liaison, incident management coordinator, etc.), TMP monitoring, and emergency contacts
4 Project Description	Information such as project type, project background, project area/corridor, project goals and constraints, proposed construction staging, general schedule and timeline, and related projects
5 Existing and Future Conditions	For the project area, including data collection and modeling approach, existing roadway characteristics (history, roadway classification, number of lanes, geometrics, urban/suburban/rural), existing and historical traffic data (volumes, speed, capacity, volume/capacity, percent trucks, queue length, peak traffic hours), existing traffic operations (signal timing, traffic controls), incident and crash data, local community and business concerns/issues, traffic growth rates (for future construction dates), and traffic predictions during construction (volume, delay, queue)
6 Work Zone Impacts Assessment	Depending on the type of TMP, could just be a qualitative assessment of the potential work zone impacts and the effect of the chosen management strategies; or a detailed analysis of the same, or both
7 Work Zone Impacts Management Strategies	For the mainline and detour routes by construction staging, including TTC strategies, PI strategies, and TO strategies. Findings and recommendations
8 TMP Monitoring Requirements	TMP monitoring requirements and what the evaluation report of the TMP successes and failures should include
9 Contingency Plans	Potential problems and corrective actions to be taken, standby equipment or personnel
10 TMP Implementation Costs	Itemized costs, cost responsibilities/sharing opportunities, and funding source(s)
11 Special Considerations	As needed
12 Attachments	As needed

Table 3.1 Potential TMP Components

3.1 Introductory Material

This section contains introductory material for the report. Components may include:

- **Cover page.** The cover page should contain the title/project name, date, and the name of the agency and/or person responsible for the report with contact information.
- **Licensed Engineer stamp page (if necessary).** This page would include the name of the project, a statement that the TMP was developed under the direction of a licensed engineer, and the signature, printed name, and license stamp of the engineer responsible for the TMP development.
- **Table of contents.** The table of contents lists the sections and subsections of the report with their page numbers.
- **List of figures.** This component lists the figures and page numbers in the report.
- **List of tables.** This lists the tables in the report.
- **List of abbreviations and symbols.** This lists repeated abbreviations and mathematical symbols found in the report, in alphabetical order.
- **Terminology.** The terminology component describes the key technical terms found in the report.

3.2 Executive Summary

The executive summary should contain a brief overview and summary of the project, general approach, selected construction phasing and staging approach(es), anticipated work zone impacts of the project, the chosen TMP strategies, cost estimate for the TMP, links to locations of specific TMP components, and conclusions/recommendations for the project.

3.3 TMP Roles and Responsibilities

The roles and responsibilities for the development, implementation, monitoring, and evaluation of the TMP should be documented. This may include, but is not limited to:

- **TMP manager.** The person responsible for the overall development and implementation of the TMP. The updated Rule (Rule) requires that both the agency and the contractor designate a trained person at the project level who has the primary responsibility and sufficient authority for implementation of the TMP (see Section 1.5 for more information on the Rule).
- **Stakeholders/review committee.** This committee provides input and information to the TMP manager, and assists in the decision-making process. Depending on the type and complexity of the project, the stakeholders committee may include the highway patrol, police, city traffic engineers, business representatives, transit and school representatives, as well as emergency and towing services.
- **Approval contact(s).** The person or persons, if any, who need to give final approval to the TMP.
- **TMP implementation task leaders.** These are project engineers responsible for implementing specific tasks recommended by the TMP (e.g., public information liaison, incident management coordinator, etc.).

- **TMP monitors.** TMP monitors conduct windshield surveys (observations based on driving through the work zone) and site visits to assess firsthand the effectiveness of the phasing and staging plans and TMP strategies. They inform the TMP manager when strategies are not working according to plan.
- **Emergency contacts.** This lists the contact person(s) with each emergency service agency, including police, fire, and ambulance.

The Indiana Department of Transportation's Design Manual states that the anticipated traffic impacts of a project will dictate the extent and nature of the TMP team's responsibilities.

Source: Indiana Department of Transportation, Chapter 81 of the Indiana Design Manual, Transportation Management Plans, URL: **http://www.in.gov/dot/div/contracts/standards/dm/Part%208/Ch%2081/Ch81.pdf** (Accessed 8/16/05)

3.4 Project Description

This component of the TMP presents the scope and definition of the project. It may include:

- **Project background.** This includes a brief description of the project, its purpose, and its developmental history. It may also include additional information related to the project, roadway, or study area.
- **Project type.** The nature of the project, which may range from capital projects, new construction, rehabilitation, major maintenance, to routine maintenance, is identified here.
- **Project area/corridor.** This component describes physical extents of the construction or maintenance work, as well as the estimated region(s) and corridor(s) that may be affected by the proposed project. Using a map to show this information is recommended.
- **Project goals and constraints.** A brief listing of the goals, benefits, and challenges that are expected by this project.
- **Proposed construction phasing/staging.** This includes the project phasing, lane and/or facility closure strategies, whether or not high-occupancy vehicle (HOV)/temporary lanes/shoulders will be utilized for general traffic, ramps/interchanges closures, construction strategy, closure hours, and duration. TTC plans should be provided in separate diagrams.
- **General schedule and timeline.** The start and finish dates for the project and phasing schedule (if appropriate), including all major milestones.
- **Related projects.** Other ongoing/planned projects in the vicinity of the project area that may cause cumulative impacts to the region(s) and corridor(s).

3.5 Existing and Future Conditions

This TMP component provides information on existing and anticipated future conditions in the study area including traffic, safety, and business and community access. While the level of detail will vary based on the project, it should consider:

- **Data collection and modeling approach.** A brief discussion on how existing traffic data and information was obtained, and what approach was used to estimate future conditions.
- **Existing roadway characteristics.** This includes a history of roadways in the study area, roadway classification(s), number of lanes, geometrics, and urban/suburban/rural.
- **Existing and historical traffic data.** This includes measures such as volumes, speed, capacity, volume to capacity ratio, percent trucks, queue length, peak traffic hours, and through versus local traffic. If possible, historical traffic data should be within the last two to three years.
- **Existing traffic operations.** This includes signal timing, delay, and traffic control types.
- **Incident data.** Where feasible, historical incident data including number and type of crashes should be documented. The historical incident information should be current and the number of prior years of data may vary according to the agency's crash data recording system. Usually crash data for the last three years are appropriate.
- **Local community and business concerns/issues.** Input from the community and business representatives should be included and prioritized to address local concerns.
- **Traffic growth rates (for future construction dates).** A brief discussion on the growth rates used for analysis, including the source and any assumption.
- **Traffic predictions during construction (volume, delay, queue).** Based on the existing and historical data, traffic growth rates, and the modeling/estimating approach used, estimates of traffic and safety during construction should be developed and documented. Future estimates should be compared to the existing data.

3.6 Work Zone Impacts Assessment Report

Depending upon the type of TMP, the work zone impacts assessment component may include:

- A qualitative assessment of the potential impacts of the work zone and those of the chosen management strategies; or
- A quantitative analysis of the impacts of the work zone and those of the chosen management strategies; or
- Both qualitative and quantitative assessments.

Detailed information regarding the work zone impacts assessment process is contained in **Work Zone Impacts Assessment: An Approach to Assess and Manage Work Zone Safety and Mobility Impacts of Road Projects.**[2]

[2] Available at http://www.ops.fhwa.dot.gov/wz/resources/final_rule.htm

A work zone impacts assessment report may include:

- **Qualitative summary of anticipated work zone impacts.** This involves a brief discussion on how the project is expected to impact its vicinity, including major corridors, local streets, how traffic patterns are expected to change, and an estimate on how traffic demand might change due to the project.

During the I-5 Interstate Bridge Trunnion Repair project in Washington State, it was estimated that without a Traffic Management Plan (TMP) during the bridge closure and if there was no diversion or cancellation of interstate trips, traffic backups at the I-5 Interstate Bridge could have potentially extended 50 miles to the north and 40 miles to the south. As a result, a multi-jurisdiction, bi-State Traffic Management Team worked cooperatively to develop a TMP to lessen the traffic impacts of the northbound structure closure.

Source: Southwest Washington Regional Transportation Council, I-5 Interstate Bridge Trunnion Repair Project Traffic Management Plan Report, Executive Summary, Final Draft, URL: **http://www.rtc.wa.gov/Studies/Archive/trunnion/tmpexec.htm#Mission** (Accessed 07/21/05)

- **Impacts assessment of alternative project design and management strategies (in conjunction with each other).** This is a discussion on how the project design and mitigation efforts would impact the project area, how they would affect each other, and how they might adversely impact specific areas, if any.
  - **Construction approach/phasing/staging strategies.** This lists the benefits and costs of the construction strategies, the expected duration, and expected delays resulting from this strategy.
  - **Work zone impacts management strategies.** Management strategies to be implemented for the project, including temporary traffic control, public information, and traffic operations strategies, may be listed here or in a subsequent section. Section 3.7 of this document provides more detail on work zone management strategies.
- **Traffic analysis results (if applicable).** This includes:
  - **Traffic analysis strategies.** A brief description on how the expected future traffic conditions were determined. Any traffic reduction factors or other parameters assumed for the calculations should be documented.
  - **Identify measures of effectiveness.** This lists the measures of effectiveness used for the analysis, such as capacity, volume, queue, speed, travel time, diversion, safety, noise, environmental, adequacy of detour routes, cost effectiveness, etc.
  - **Analysis tool selection methodology and justification.** When applicable, list the traffic analysis tools used. Include a brief methodology on how the tool was selected, and criteria used to select the most appropriate tool. Various traffic analysis tools are available for conducting this analysis including QuickZone, QUEWZ, CORSIM, Highway Capacity Manual (HCM), other deterministic methods and/or tools, travel demand models, and/or simulation models.

More information on available software tools that support work zone impacts analysis can be found at the following locations:

- The Work Zone & Traffic Analysis/Management section of the FHWA work zone web site, available at **http://ops.fhwa.dot.gov/wz/traffic_analysis.htm** (Accessed 08/19/05)
- Work Zone Impacts Assessment: An Approach to Assess and Manage Work Zone Safety and Mobility Impacts of Road Projects, available at **http://www.ops.fhwa.dot.gov/wz/resources/final_rule.htm** (Accessed 08/19/05)

– **Analysis results.** This involves a comparison between existing and future traffic conditions and operations, with and without the TMP management strategies. The need for traffic analysis within the TMP should be determined on a case-by-case basis. For significant projects, it is preferable to conduct a detailed analysis. A qualitative and/or quantitative assessment of business and community impacts should be included under the analysis results (e.g., access to residences and businesses; access for pedestrians, bicyclists, and persons with disabilities; emergency service impacts (fire, ambulance, police, hospitals); and school bus operations, bus stops, or other transit services). In some cases, a qualitative assessment, while valuable, may underestimate the potential severity of traffic impacts to the community. A quantitative examination of traffic impacts to the local community may be necessary for some projects. The potential community impacts may be a significant driving factor in the project, resulting in changes to construction phasing or staging and/or the use of several transportation management strategies for mitigation. Seasonal impacts should also be considered.

  For cost effectiveness, constructability needs to be balanced with the work zone transportation management strategies in order to best serve the public, construction workers, and agency. There may be more than one option for addressing safety and mobility during construction. In order to decide which option is appropriate, the benefits and costs of the transportation management strategies could be estimated and compared. The cost evaluation may consider on-site costs (e.g., strategy, right-of-way, environmental, delay, safety, accessibility to businesses and community, user costs) and detour costs, both capital and operating.

Designers should consider road user costs when determining the most appropriate construction staging and final design. This should be done early in the design process while there is still flexibility in the design. The optimal design will mitigate or avoid disruptions before they can be created.

Source: New Jersey Department of Transportation, Road User Cost Manual, June 2001,
URL: **http://www.state.nj.us/transportation/eng/documents/RUCM/#Introduction** (Accessed 07/21/05)

- **Selected alternative.** Depending on the type of TMP required, the information required for the selected alternative may range from a list referring to the MUTCD or agency standards, to comprehensive plan sheets and special provisions. The level of detail should be determined on a project-by-project basis. Where appropriate, the construction approach/phasing/staging strategy should be provided on detailed plan sheets with plans for accommodating traffic at each stage. The work zone transportation management strategies should be documented on the plan sheets where possible (e.g., geometric improvements, control devices, etc.). If not, the strategies should be listed with text describing any restrictions, usage (duration, stage/phase, etc.), or other considerations. The type, number, location, and timing for traffic control devices should be listed for directing traffic through the work zone. Any work schedule restrictions should be documented for each stage (e.g., night work, peak hour restrictions, etc.).

3.7 Selected Work Zone Impacts Management Strategies

Work zone impacts management strategies are intended to minimize traffic delays, maintain or improve motorist and worker safety, and maintain access for businesses and residents. For the TMP, work zone impact management strategies should be identified for both the mainline and detour routes for the selected construction phasing/staging approach(es). Where appropriate, the management strategies should be documented on plan sheets. Agencies may elect to develop separate sections or plans specific to the PI and/or TO strategies to distinguish them from the TTC strategies.

TTC, PI, and TO work zone management strategies that could be considered for the TMP are defined in Section 4.0 of this document. Appendix B provides information helpful for determining when the strategies should be considered, pros/cons, and whether the strategies are likely to improve mobility and/or safety.

The work zone impacts management strategies component of the TMP also highlights some of the key findings for the selected alternative, discusses feasibility, anticipated traffic or safety concerns (e.g., specific roadways with long estimated queues, accessibility issues, ability of the detour routes to handle diverted traffic), and any special provisions or issues related to the work zone management.

3.8 TMP Monitoring

3.8.1 Monitoring Requirements

Monitoring requirements for the TMP should be included in the TMP and be made part of the construction contract. This should include or refer to any agency policies, standards, requirements, and procedures for TMP implementation and monitoring. The evaluation should consider both the performance of individual TMP strategies as well as overall performance of the work zone and work zone impact area. This may include but is not limited to:

- Verification of work zone setup.
- Identification and process for monitoring TMP performance (e.g., volume counts, queue length, crashes, complaints and feedback, surveys, etc.).
- Tracking TMP implementation costs and comparing them to the budgeted costs.
- Approach for corrective action when TMP performance requirements are not met.
- Submission of alternative TMPs and the approval process.
- Who is responsible for each component of the TMP monitoring.

3.8.2 Evaluation Report for the TMP

The TMP should include reference to the development of an evaluation report upon completion of construction to document lessons learned and provide recommendations on how to improve the TMP process and/or modify guidelines.

Indiana DOT's Design Manual recommends that the evaluation report include the following:

- An overall statement reflecting the usefulness of the TMP.
- Where changes were necessary to correct oversights in the TMP.
- What changes were made to the original plan and if they were successful.
- Public reaction to the TMP.
- The average delay time encountered (e.g., average queues, slowdowns).
- Identification of the peak loading times.
- Frequency of legitimate complaints and the nature of the complaints.
- Types of crashes that occurred during construction.
- Suggested improvements or changes for similar future projects.
- What areas of the TMP were successfully implemented.

Source: Indiana Department of Transportation, Chapter 81 of the Indiana Design Manual, Transportation Management Plans, URL: **http://www.in.gov/dot/div/contracts/standards/dm/Part%208/Ch%2081/Ch81.pdf** (Accessed 8/16/05)

3.9 Contingency Plans

The contingency plan component should specify activities that should be undertaken to minimize traffic impacts when unexpected events occur in the work zone (e.g., crashes, unforeseen traffic demand, inclement weather, etc.). The contractor's contingency plan should address activities under the contractor's control within the work zone. Contingency plans should be included in all TMPs.

The California Department of Transportation's (Caltrans) Transportation Management Plan Guidelines recommend that a TMP contingency plan should include but not be limited to the following:

- Information that clearly defines trigger points which require lane closure termination (i.e., inclement weather, length of traffic queue exceeds threshold).
- Decision tree with clearly defined lines of communication and authority.
- Specific duties of all participants during lane closure operations, such as, coordination with law enforcement or local police, etc.
- Names, phone numbers and pager numbers for the TMP manager or their designee, the resident engineer (RE), the maintenance superintendent, the permit inspector, the on-site traffic advisor, law enforcement area commander(s), appropriate local agency representatives, and other applicable personnel.
- Coordination strategy (and special agreements if applicable) between the TMP manager, RE, on-site traffic advisor, maintenance, law enforcement, and local agencies.
- Contractor's contingency plan.
- Standby equipment, agency personnel, and availability of local agency personnel for callout (typically requires a cooperative agreement).
- Development of contingencies based on maintaining minimum level of service or performance standards.

Source: California Department of Transportation (Caltrans), Transportation Management Plan Guidelines, July 1, 2001. Also available in the Caltrans Deputy Directive DD-60, Transportation Management Plans, June 2000, URL: **http://www.valleyair.org/Workshops/postings/3-25-2002/caltrans/dd-60.pdf** (Accessed 08/16/05)

3.10 TMP Implementation Costs

Estimating the work zone management strategy implementation costs of the TMP and including these costs within the overall project cost is critical, as it may be difficult to obtain additional funding at a later time. It potentially avoids under-allocation of funds. Where feasible, the cost estimates for the various management strategies should be itemized and documented in the TMP, with cost responsibilities, opportunities for sharing or coordinating with other projects, and funding sources specified. TMP components can be funded as part of the construction contract and/or in separate agreements.

3.11 Special Considerations (As Needed)

Any special considerations related to the TMP could be identified under this component. This could reiterate special provisions, highlight considerations that may need to be included in contracting documents, identify work zone management strategies that require implementation prior to construction (public information meetings, brochures, web sites, rideshare programs, coordination with local agencies for detour routes, etc.), etc.

3.12 Attachments (As Needed)

Appendices may be included in the TMP to include information that may be relevant or of interest to the TMP implementer, TMP manager, the agency, or other stakeholders. This could include, but is not limited to observed, historical, and/or estimated traffic volumes, speeds, travel times, level-of-service, delay, crashes; maps; staging/phasing plans; lane closure charts; detailed analysis methodology, assumptions, parameters used; etc.

4.0 Work Zone Impacts Management Strategies

Many work zone impacts management strategies can be used to minimize traffic delays, improve mobility, maintain or improve motorist and worker safety, complete roadwork in a timely manner, and maintain access for businesses and residents. This section briefly describes various work zone management strategies, grouped according to the following categories:

- **Temporary traffic control (TTC):**
  - Control strategies.
  - Traffic control devices.
  - Project coordination, contracting and innovative construction strategies.
- **Public information (PI):**
  - Public awareness strategies.
  - Motorist information strategies.
- **Transportation operations (TO):**
  - Demand management strategies.
  - Corridor/network management (traffic operations) strategies.
  - Work zone safety management strategies.
  - Traffic/incident management and enforcement strategies.

Table 4.1 presents various work zone management strategies by category. This set of strategies is not meant to be all-inclusive, but offers a large number to consider, as appropriate, in developing transportation management plans (TMPs). Individual strategies may fit into multiple categories. For example, changeable message signs (CMS) are a traffic control device defined in the Manual on Uniform Traffic Control Devices (MUTCD), and thus are included in this category. However, they are also frequently used for motorist information and are included in that category as well.

This section is intended to be a reference for selecting work zone management strategies as described in Section 2.2.1, Step 4 and Section 3.7 of this document. Agencies can look through Table 4.1 to get ideas for potential strategies, and then refer to the rest of the chapter for more information as needed. This section provides definitions for the strategies and is supported by Appendix B, which provides information helpful for determining when the strategies should be considered, pros/cons, and whether the strategies are likely to improve mobility and/or safety.

Several best practices associated with work zone management strategies can be found on the FHWA Work Zone web site at **http://www.fhwa.dot.gov/workzones** (Accessed 07/15/05). Benefits information for real-world applications and studies for some of the transportation operations and public information strategies is located in the Intelligent Transportation Systems (ITS) Joint Program Office Benefits Database at **http://www.benefitcost.its.dot.gov/its/benecost.nsf/ByLink/BenefitsHome** (Accessed 07/15/05).

I. Temporary Traffic Control (TTC)			II. Public Information (PI)	
A. Control Strategies	**B. Traffic Control Devices[2]**	**C. Project Coordination, Contracting and Innovative Construction Strategies**	**A. Public Awareness Strategies**	**B. Motorist Information Strategies**
IA1 Construction phasing/staging IA2 Full roadway closures IA3 Lane shifts or closures - Reduced lane widths to maintain number of lanes (constriction) - Lane closures to provide worker safety - Reduced shoulder width to maintain number of lanes - Shoulder closures to provide worker safety - Lane shift to shoulder/median to maintain number of lanes IA4 One-lane, two-way operation IA5 Two-way traffic on one side of divided facility (crossover) IA6 Reversible lanes IA7 Ramp closures/ relocation IA8 Freeway-to-freeway interchange closures IA9 Night work IA10 Weekend work IA11 Work hour restrictions for peak travel IA12 Pedestrian/bicycle access improvements IA13 Business access improvements IA14 Off-site detours/use of alternate routes	IB1 Temporary signs - Warning - Regulatory - Guide/ information IB2 Changeable message signs (CMS) IB3 Arrow panels IB4 Channelizing devices IB5 Temporary pavement markings IB6 Flaggers and uniformed traffic control officers IB7 Temporary traffic signals IB8 Lighting devices	IC1 Project coordination - Coordination with other projects - Utilities coordination - Right-of-way coordination - Coordination with other transportation infrastructure IC2 Contracting strategies - Design-build - A+B bidding - Incentive/disincentive clauses - Lane rental IC3 Innovative construction techniques (precast members, rapid cure materials)	IIA1 Brochures and mailers IIA2 Press releases/ media alerts IIA3 Paid advertisements IIA4 Public information center IIA5 Telephone hotline IIA6 Planned lane closure web site IIA7 Project web site IIA8 Public meetings/ hearings IIA9 Community task forces IIA10 Coordination with media/schools/ businesses/ emergency services IIA11 Work zone education and safety campaigns IIA12 Work zone safety highway signs IIA13 Rideshare promotions IIA14 Visual information (videos, slides, presentations) for meetings and web	IIB1 Traffic radio IIB2 Changeable message signs (CMS) IIB3 Temporary motorist information signs IIB4 Dynamic speed message sign IIB5 Highway advisory radio (HAR) IIB6 Extinguishable signs IIB7 Highway information network (web-based) IIB8 511 traveler information systems (wireless, handhelds) IIB9 Freight travel information IIB10 Transportation management center (TMC)

Table 4.1 Work Zone Management Strategies by Category[1]

[1] See Appendix B for information helpful in determining when these strategies should be considered, pros and cons, and whether the strategy tends to improve mobility, motorist safety, and/or worker safety.

[2] A range of other safety devices are described in Part 6 of the Manual on Uniform Traffic Control Devices (MUTCD) and are widely used to enhance safety and mobility in highway work zones. These devices, such as temporary traffic barriers and crash cushions, are included in the Work Zone Safety Management Strategies category.

III. Transportation Operations (TO)			
A. Demand Management Strategies	**B. Corridor/Network Management Strategies**	**C. Work Zone Safety Management Strategies**	**D. Traffic/Incident Management and Enforcement Strategies**
IIIA1 Transit service improvements	IIIB1 Signal timing/ coordination improvements	IIIC1 Speed limit reduction/variable speed limits	IIID1 ITS for traffic monitoring/ management
IIIA2 Transit incentives	IIIB2 Temporary traffic signals	IIIC2 Temporary traffic signals	IIID2 Transportation management center (TMC)
IIIA3 Shuttle services	IIIB3 Street/intersection improvements	IIIC3 Temporary traffic barrier	IIID3 Surveillance (Closed-Circuit Television [CCTV], loop detectors, lasers, probe vehicles)
IIIA4 Ridesharing/carpooling incentives	IIIB4 Bus turnouts	IIIC4 Movable traffic barrier systems	IIID4 Helicopter for aerial surveillance
IIIA5 Park-and-ride promotion	IIIB5 Turn restrictions	IIIC5 Crash-cushions	IIID5 Traffic screens
IIIA6 High-occupancy vehicle (HOV) lanes	IIIB6 Parking restrictions	IIIC6 Temporary rumble strips	IIID6 Call boxes
IIIA7 Toll/congestion pricing	IIIB7 Truck/heavy vehicle restrictions	IIIC7 Intrusion alarms	IIID7 Mile-post markers
IIIA8 Ramp metering	IIIB8 Separate truck lanes	IIIC8 Warning lights	IIID8 Tow/freeway service patrol
IIIA9 Parking supply management	IIIB9 Reversible lanes	IIIC9 Automated Flagger Assistance Devices (AFADs)	IIID9 Total station units
IIIA10 Variable work hours	IIIB10 Dynamic lane closure system	IIIC10 Project task force/ committee	IIID10 Photogrammetry
IIIA11 Telecommuting	IIIB11 Ramp metering	IIIC11 Construction safety supervisors/inspectors	IIID11 Coordination with media
	IIIB12 Temporary suspension of ramp metering	IIIC12 Road safety audits	IIID12 Local detour routes
	IIIB13 Ramp closures	IIIC13 TMP monitor/inspection team	IIID13 Contract support for incident management
	IIIB14 Railroad crossings controls	IIIC14 Team meetings	IIID14 Incident/emergency management coordinator
	IIIB15 Coordination with adjacent construction site(s)	IIIC15 Project on-site safety training	IIID15 Incident/emergency response plan
		IIIC16 Safety awards/incentives	IIID16 Dedicated (paid) police enforcement
		IIIC17 Windshield surveys	IIID17 Cooperative police enforcement
			IIID18 Automated enforcement
			IIID19 Increased penalties for work zone violations

4.1 Temporary Traffic Control (TTC)

Temporary traffic control strategies, devices, and contracting/construction techniques and coordination are used to facilitate traffic flow and safety through and around work zones. Standards, guidance, and other information defining the proper use of the traffic control strategies and devices are provided in Part 6 (Temporary Traffic Control) of the MUTCD and Chapter 9 (Traffic Barriers, Traffic Control Devices, and Other Safety Features for Work Zones) of the American Association of State Highway and Transportation Officials (AASHTO) Roadside Design Guide. Information on contracting and construction techniques is available from various references listed throughout this report.

4.1.1 Control Strategies

This category includes various traffic control approaches used to accommodate road users within the work zone or the adjoining corridor in an efficient and safe manner, while providing adequate access to the roadway for the required construction, maintenance, or utility work to be performed.

IA1. **Construction phasing/staging.** Staging typically refers to how the contractor will position the equipment and materials. Phasing refers to the sequencing of the aspects of a project, completing portions of the project one part at a time. The impacts of a work zone on traffic may be minimized by using operationally-sensitive phasing and staging throughout the life of the project.

In Maine, the Department of Transportation has an agreement (constructability review agreement) with Associated Contractors of Maine to assist the State with developing construction-phasing options on selected high-risk projects. This is done prior to letting the project.

Source: Maine Department of Transportation

The Oklahoma DOT (ODOT) provides for contractor participation in constructability reviews for projects over $5 million by allowing all contractors to review plans in advance of advertisement. This allows ODOT to incorporate good design and construction ideas, prior to advertisement, which will result in more economical and quicker projects. Such early review by contractors also provides a way to detect errors overlooked in the design phase and allows contractors additional time to become more familiar with the project, enabling them to submit more accurate bids.

Source: FHWA Work Zone Best Practices Guidebook, April 2000, **http://ops.fhwa.dot.gov/wz/practices/best/Default.htm** (Accessed 08/18/05)

IA2. **Full roadway closures.** This strategy involves complete closure of the roadway for various time periods to minimize the duration of the project and improve worker safety by reducing traffic conflicts. Full closures may be brief (e.g., intermittent, off-peak), short-term (e.g., night, weekend), or long-term (e.g., continuous for the duration of the project).

Information on the application and benefits of full road closure during rehabilitation and construction for DOTs in Oregon, Kentucky, Michigan, Ohio, Washington, and Delaware are available in a report and case studies at **http://ops.fhwa.dot.gov/wz/construction/full_rd_closures.htm** (Accessed 07/15/05)

IA3. Lane shifts or closures. Lane shifts or closures last for varying durations of time. They may be intermittent, off-peak, night, weekend, for a single project phase, or continuous for the duration of the project. This strategy involves multiple approaches including:

- **Reduced lane widths to maintain number of lanes (constriction).** This involves reducing the width of one or more lanes in order to maintain the existing number of lanes on the facility while permitting work access to part of the facility.
- **Lane closures to provide worker safety.** This strategy closes one or more existing traffic lanes to accommodate work activities.
- **Reduced shoulder width to maintain number of lanes.** This involves reducing the width of the inside and/or outside shoulder to maintain the existing number of lanes on the facility while allowing access for the work activities to take place.
- **Shoulder closures to provide worker safety.** This strategy closes the shoulder for use by the public, making it available to accommodate the work activities.
- **Lane shift to shoulder/median to maintain number of lanes.** This strategy involves diverting traffic onto the shoulder, or a portion of the shoulder, for use as a traffic lane.

IA4. One-lane, two-way operation. One lane, two-way traffic control involves using one lane for both directions of traffic, allowing work activities to occur in the other lane that is now closed.

IA5. Two-way traffic on one side of divided facility (crossover). This strategy involves closing one side of a divided facility to permit the work to proceed without traffic interference while both directions of traffic are accommodated on the opposing side of the roadway.

IA6. Reversible lanes. This strategy, also known as variable lanes or contra-flow lanes, involves sharing lane(s) of travel to accommodate peak-period traffic flow. The direction of travel in the shared lane varies by time of day or day of the week.

IA7. Ramp closures/relocation. Ramp closure involves closing one or more ramps in or near the work zone for specific time periods or construction phases to allow work access or improve traffic flow on the mainline.

IA8. Freeway-to-freeway interchange closures. This strategy involves closing one or more freeway-to-freeway interchange connectors over a period of time.

IA9. Night work. Work is performed at night (end of evening peak period to beginning or morning peak period) to minimize work zone impacts on traffic and adjacent businesses.

NCHRP Report 475 provides a process to help agencies determine whether to perform nighttime construction or maintenance.

Source: National Cooperative Highway Research Program, Report 475, A Procedure for Assessing and Planning Nighttime Highway Construction and Maintenance, 2002, URL: **http://trb.org/publications/nchrp/nchrp_rpt_475.pdf** (Accessed 07/27/05)

IA10. **Weekend work.** Construction work (all or individual phases) is restricted to weekend periods from the end of the Friday afternoon peak period to the beginning of the Monday morning peak period.

IA11. **Work hour restrictions for peak travel.** This involves restricting work hours such that work that impacts traffic does not occur during periods of peak travel demand and congestion (e.g., peak hours, holidays, special events).

IA12. **Pedestrian/bicycle access improvements.** This strategy involves providing alternate facilities for bicyclists and pedestrians (including those with disabilities in accordance with the Americans with Disabilities Act of 1990) in places where the work zone impacts their accessibility.

IA13. **Business access improvements.** Some projects will have a direct impact on businesses, particularly to accessibility. Accessibility improvements for businesses may include signage or information to direct motorists to the business(es) and/or relocation of access locations.

IA14. **Off-site detours/use of alternate routes.** This strategy involves re-routing some or all traffic off of the roadway under construction and to other existing roadways.

4.1.2 Traffic Control Devices[3]

The MUTCD provides standards, guidelines, and other information pertaining to installing, maintaining, and operating traffic control devices on streets and highways. Part 6 of the MUTCD, "Temporary Traffic Control," addresses safety, mobility, and constructability issues in work zones, and is applicable to all types of highway work from major construction on high-volume freeways to minor maintenance on residential streets, and everything in-between. Traffic control devices and other safety devices used for work zones include:

IB1. **Temporary signs.** Several types of temporary signs can be used to provide information to road users to enable safe and efficient travel through the work zone or a detour. Temporary signs are an essential and integral part of temporary traffic control, and are used in nearly all work zones. Accepted practices for work zone signing are provided in the MUTCD, including Part 6 and various other references. Temporary signs typically include the following types:

- **Warning.** These signs give notice to road users of a situation that may not be readily apparent (e.g., speed reductions, road or lane narrows, etc.).
- **Regulatory.** Regulatory signs provide notice to road users of traffic laws or regulations through the work zone (e.g., speed limits, fine notices, parking restrictions, road closed, etc.).

[3] A range of other safety devices are described in Part 6 of the Manual on Uniform Traffic Control Devices (MUTCD) and are widely used to enhance safety and mobility in highway work zones. These devices, such as temporary traffic barriers and crash cushions, are included in the Work Zone Safety Management Strategies category (Section 4.3.3).

- **Guide/information.** Advance signing and signing in and around the work zone area are used to notify the motoring public of the work zone and/or offer options for alternative routes. Signs may include dates and/or locations of construction and/or closures. Detour signs direct motorists onto detour routes, through the detour, and back to the route from which they were detoured. Advance notice is required so that motorists have time to choose an alternate route.

IB2. **Changeable message signs (CMS).** Both fixed and portable changeable message signs are highly effective in conveying work zone information to drivers, especially when that information is subject to frequent change or it addresses a short term or current situation or condition within the work zone. These signs provide real time information to drivers concerning specific work operations, traffic patterns, and other conditions in the work zone. These devices assist drivers in avoiding conflicts and potential crashes as they travel through the work zone.

IB3. **Arrow panels.** Also referred to as arrow boards, arrow panels operating in flashing or sequential mode are intended to aid motorists in navigating and merging through and around the work zone.

IB4. **Channelizing devices.** This strategy involves the use of channelizing devices such as traffic cones, drums, barricades, or tubular markers for traffic control through the work zone. The purpose is to define the intended travel path through the work zone and delineate potential work zone hazards.

IB5. **Temporary pavement markings.** Various types of temporary markings on the pavement are available to define travel lanes and provide guidance and information for the road user through the work zone.

IB6. **Flaggers and uniformed traffic control officers.** Flaggers, and to a lesser extent police or traffic control officers, are used to direct and control road user and pedestrian traffic in work zones.

IB7. **Temporary traffic signals.** This strategy involves the use of fixed or portable temporary traffic signals to improve traffic flow through and near the work zone and/or address safety concerns.

IB8. **Lighting devices.** A wide range of lighting devices, listed in Part 6 of the MUTCD, is available for use in work zones. Lighting strategies offer enhancement to other work zone strategies by attracting attention to the devices and improving delineation, particularly for adverse conditions. They can also be used for improved worker safety and for guiding road users through a work zone, particularly for night work.

General guidance for worker safety and visibility is provided in the FHWA Office of Safety Worker Safety and Visibility Brochure, available at **http://safety.fhwa.dot.gov/wz/wzw5.htm** (Accessed 07/15/05)

4.1.3 Project Coordination, Contracting, and Innovative Construction Strategies

IC1. Project coordination. Project coordination strategies having the potential to reduce mobility and safety impacts of work zone activities include:

- **Coordination with other projects.** This involves coordinating, sequencing, and scheduling projects to minimize motorist delay and impacts to potentially affected businesses and communities.
- **Utilities coordination.** This involves coordinating and scheduling utility work both within the impacted work zone area and near the project to minimize potential work disruptions or interruptions due to utility work, and reduce overall construction duration. Coordination can also reduce the recurrence of work zones by doing two jobs together. For example, the installation of a communications conduit (for traffic management, ITS, etc.) along a highway corridor may coincide with a pavement reconstruction project on that highway.

In Phoenix, Arizona, design and construction of city water and sewer lines within the street right of way is done by the Street Transportation Department. Prior to the implementation of this policy, each entity designed and constructed their facilities in a separate project. This in effect resulted in the neighborhoods being torn up on three separate occasions to construct the project. By bringing all work under the Street Transportation Department, the work could all be accomplished in one contract thereby saving time, money, increasing safety, and having less impact and disruption to the community.

Source: FHWA Work Zone Best Practices Guidebook, April 2000, **http://ops.fhwa.dot.gov/wz/practices/best/Default.htm** (Accessed 08/19/05)

- **Right-of-way coordination.** Increased consideration of potential right-of-way needs and issues may help reduce project delays and duration.
- **Coordination with other transportation infrastructure.** Coordination with non-highway transportation facilities such as transit junctions, railroad crossings, and intermodal facilities can help minimize traffic disruptions.

IC2. Contracting strategies. These strategies typically involve contractual agreements to reduce the project duration or traffic impacts including:

- **Design-build.** This strategy involves the use of one contract to design and build the project thus reducing project duration by allowing construction to begin prior to design completion.
- **A+B bidding.** A+B bidding encourages contractors to minimize construction impacts by reducing construction time. Part A refers to the contractor's bid for the actual items of work, and Part B is the total of the number of days bid to complete the project multiplied by the daily road user cost stipulated in the contract. The combined values of the A and B portions determine the winning bid. The contractor's payment is based on both Part A and the actual number of days used under Part B.

- **Incentive/disincentive clauses.** This strategy involves the use of incentives and/or disincentives in the construction contract to minimize construction duration.
- **Lane rental.** Lane rental involves a charge assessed to the contractor when a portion of the roadway is obstructed and unavailable to traffic. The lane rental charge can vary according to time of day, day of week, number of lanes impacted, and duration. The contractor's bid includes an estimate of the number of hours that closures will be in place, with the actual payment to the contractor based on the actual use of closures.

IC3. Innovative construction techniques (precast members, rapid cure materials). These strategies involve the use of special materials such as quick curing concrete or precast items (e.g., culverts, bridge deck slabs, and pavement slabs) to minimize the duration of construction or maintenance activities where traffic restrictions need to be minimized (e.g., roadways with high volumes), and when work activities need to be completed during night or weekend periods to allow reopening travel lanes for normal weekday travel.

4.2 Public Information (PI)

The inclusion of a public information component in the TMP has the potential to reduce work zone impacts by providing specific information concerning road projects to road users and the community to alert them to potential impacts and available means to avoid them, as well as more general information concerning appropriate driving and travel behavior and travel options associated with the work zone. Early public involvement, particularly by the impacted communities and businesses, in the development of the TMP and keeping them informed throughout the project, is essential both to identify potential impacts and to ensure that effective mitigation strategies are developed and implemented. Coordination with the agency's public information office will help to ensure success, particularly for significant projects. These strategies include both public awareness strategies and motorist information strategies.

> "Based on our experience, public information is the TMP mitigation strategy that gives us the 'biggest bang for the buck' – its effectiveness is greater in urban areas, but still holds true in rural areas."
>
> Source: Quote from Robert Copp, California Department of Transportation, used in Transportation Management Plans for Work Zones fact sheet (FHWA-HOP-05-022), URL: **http://www.ops.fhwa.dot.gov/wz/resources/tmp_factsheet.pdf** (Accessed 11/18/05)

4.2.1 Public Awareness Strategies

Public awareness strategies include various methods to educate and reach out to the public, businesses, and the community concerning the road project and work zone:

IIA1. **Brochures and mailers.** Brochures and mailers are printed material containing project-related information such as advanced notice of the project's start date, schedules, pictures/graphics of the project, a description of the need for the project, alternative routes, etc. These may be passed out to motorists at key locations (e.g., large employers in the project area, rest stops, travel information centers), via automobile associations, or mailed to affected businesses or communities.

IIA2. **Press releases/media alerts.** This strategy provides project-related information to the news media, affected businesses, and other affected or interested parties using print and/or electronic media.

At the project level, Arizona uses a Construction Project Public Information/Public Relations Program where weekly newsletters are sent to the media, business, local residents, and others who request to be included. The newsletters typically provide information on project status, lane restrictions, ramp closures, recommended detour routes, access to area businesses, and other work zone traffic restrictions in effect for the next few weeks. This program is generally used for very large projects in urban areas; however, it has also been used for some rural projects.

Source: FHWA Work Zone Best Practices Guidebook, April 2000, **http://ops.fhwa.dot.gov/wz/practices/best/Default.htm** (Accessed 07/15/05)

IIA3. **Paid advertisements.** Paid announcements of an upcoming major project may use newspaper, radio, and television ads, as well as billboards. Paid advertisements can also be used for progress updates or to provide information regarding major changes to the work zone configuration and management approach.

IIA4. **Public information center.** This is a facility typically located on or near the project site that contains such materials as scale model displays, maps, brochures, videos, etc. describing the project, its potential impacts, and available alternatives to minimize the impacts.

IIA5. **Telephone hotline.** This traveler information system provides traffic or travel information for the work zone using a toll-free telephone number. It can include prerecorded messages and/or real-time interactive request and response information.

IIA6. **Planned lane closure web site.** This strategy is typically not for one specific project, but is usually implemented for an entire State, district, or geographic region. The web page summarizes planned lane closures for public information, listing the routes involved as well as the closure start and end dates, both in text and graphical form.

IIA7. **Project web site.** This traveler information system provides traffic or travel information for the work zone via the web/Internet. It can include both long term static information and/or real-time interactive information.

IIA8. **Public meetings/hearings.** This strategy involves the presentation of project information to the public, community, and/or businesses by public relations staff, and solicitation of input concerning potential concerns, impacts, and management strategies.

IIA9. **Community task forces.** This strategy involves the development of community task force(s), which includes various stakeholders from the community likely to be impacted by the work zone (businesses, neighborhood groups, interested individuals, public officials, or other representatives). Task forces can be a means of both providing information and receiving input related to a road project.

IIA10. **Coordination with media/schools/businesses/emergency services.** This strategy involves coordinating with various community, business, and media groups that are likely to be impacted by the work zone, or that can disseminate needed information. Examples of these groups include local/cable TV newsrooms, schools and school districts, local major employers/businesses, and local emergency services (fire, police, and ambulance). Various mechanisms such as fax, e-mail, phone message, mailings, etc. can be established to communicate project-related information including start dates, project schedules, significant traffic pattern changes, and traffic crashes and incidents within the work zone.

IIA11. **Work zone education and safety campaigns.** This strategy involves improving the awareness of motorists and/or increasing worker training in order to reduce the number of fatalities and injuries in work zones. This can be accomplished through brochures, web sites, media campaigns (radio, television), and videos.

IIA12. **Work zone safety highway signs.** This strategy involves the use of signs placed strategically at work zone approaches to increase driver awareness to work zone safety concerns.

IIA13. **Rideshare promotions.** This strategy involves the marketing of an existing rideshare program or creation of a new program through signage, advertisements, brochures, and events.

IIA14. **Visual information (videos, slides, presentations) for meetings or for web-based dissemination.** This involves the use of videos, slides, and presentations to supplement public meetings, public information center displays, or press releases.

The Tennessee Department of Transportation (TDOT) implemented a highway work zone program designed to improve traffic flow and safety in construction areas. The plan is called Merge Left.

Source: **http://www.tdot.state.tn.us/news/2005/040405.htm** (Accessed 07/15/05)

4.2.2 Motorist Information Strategies

These strategies provide current and/or real-time information to road users regarding the project work zone. Motorist information strategies include:

IIB1. **Traffic radio.** Project-related information is disseminated via the regularly scheduled traffic reports on commercial radio stations.

IIB2. **Changeable message signs (CMS).** These are fixed or portable message boards placed along roadways to notify road users of lane and road closures, work activities, incidents, potential work zone hazards, queues and slowed or stopped traffic ahead, and travel time or delay information, as well as alternate routes in or around the work zone. CMS can be placed at key locations before potential diversion points to give motorists an opportunity to divert to an alternate route or take other appropriate measures based on the information provided. As an enforcement tool, these signs can be used to inform drivers of speed limit reductions and enforcement activities in a work zone.

IIB3. **Temporary motorist information signs.** Temporary conventional signs mounted in the ground, overhead, or on vehicles to provide traveler information to guide motorists through the work zone and warn of potential hazards.

IIB4. **Dynamic speed message sign.** This portable system can be mounted as a fixed sign or located on a portable trailer. Radar measures the speed of approaching vehicles, which is displayed on the sign along with or near the work zone speed limit. The objective of this system is to enhance safety by reducing speeding and speed variations.

IIB5. **Highway advisory radio (HAR).** Longer, more detailed messages than can be provided using signage may be necessary for some work zone situations. HAR involves the dissemination of information to motorists while en route over wide-area wireless communications directly to in-vehicle radios. Signs are used to inform motorists of the radio frequency where the information is available.

Arkansas used an Automated Work Zone Information System (AWIS) in a rural work zone involving a central system controller, two HAR, five traffic sensors, five CMS, and two supplemental speed stations per lane closure. This system was designed to manage speed variability approaching the work zone, and to provide work zone information and delay times to travelers via CMS and HAR. The objective was to reduce the number of rear-end and fatal crashes at the site. An interview with the engineer responsible for overseeing the work zone construction indicated that the AWIS appeared to prevent/reduce rear-end collisions as long as traffic was not backed up past the CMSs.

Source: U.S. Department of Transportation, ITS Joint Program Office, Benefits Database, URL: **http://www.benefitcost.its.dot.gov/its/benecost.nsf/ByLink/BenefitsHome** (Accessed 07/15/05)

IIB6. **Extinguishable signs.** Extinguishable signs are typically associated with highway advisory radio (HAR) systems where the sign indicates how to obtain information on roadway conditions (e.g., tune in to 1610 AM). These signs turn on and off depending on when the HAR has a message available.

IIB7. Highway information network (web-based). A highway information network is a web site where multiple stakeholder groups can place information related to the roadway. The web site is shared among the various stakeholder groups, each with their own data storage areas (including control of functionality, security, data quality, etc.).

IIB8. 511 traveler information systems (wireless, handhelds). This strategy provides motorists with work zone-related information, static (e.g., project dates) and/or real time (e.g., potential delays), using such technology as cell phones, pagers, in-vehicle systems, and e-mail notifications.

IIB9. Freight travel information. This strategy may be appropriate when there is a moderate to high percentage of freight movement through the work zone. It involves coordination with the freight community (trucking companies, truck drivers, etc.) to identify work zone information considered useful (e.g., truck restrictions, occurrences of incidents, planned closures, etc.) and development of a mechanism to disseminate that information to freight stakeholders. The information can be disseminated to central locations (e.g., via a fax or email distribution list to trucking companies) or to truckers as they approach the work zone (e.g., via CB communications tools such as the CB Wizard Alert System.)

The Wizard CB Alert System is a device that continuously broadcasts, over CB radio, a message that warns approaching drivers of the work zone ahead. The information can be broadcast over any selected CB channel, but since most truckers listen to channel 19, broadcasting over that channel means truckers generally have to take no action to receive the message.

The Smart Work Zone Deployment Initiative, a pooled-fund study in which researchers investigate better ways of controlling traffic through work zones and improving the safety and efficiency of traffic operations and highway work, has completed several evaluations of the Wizard CB Alert System. The findings have shown that truckers tend to find the system effective at alerting them to a work zone ahead so they can be prepared for altered conditions, such as lane closures, that may require them to change lanes or reduce speed.

Source: Smart Work Zone Deployment Initiative Pooled Fund Study, URL: **http://www.ctre.iastate.edu/smartwz/index.cfm** (Accessed 10/3/05)

The Oregon Department of Transportation's (ODOT) QuickFax service provides commercial truckers with up-to-the-minute information on closures and traffic delays on Oregon State highways. With this service, bulletins are faxed to approximately 154 trucking companies and 30 truck stops to inform them of immediate traffic delays related to incidents or weather. The service's subscriber base reaches truck stops as far away as Virginia, Nebraska, Wyoming, and California, so truckers heading into Oregon from those locations can have advance warning of any long-term road closures.

Source: U.S. Department of Transportation, Federal Highway Administration, "Fact Sheet 1 – Oregon's QuickFax Service", URL: **http://www.ops.fhwa.dot.gov/wz/practices/factsheets/factsheet1.htm** (Accessed 10/3/05)

IIB10. Transportation management center (TMC). This strategy involves the use of a TMC for coordinating and managing road user information dissemination activities. Often an existing TMC for the region is utilized and may be staffed by either contract staff and/or agency personnel. If the project is large and of long duration, a project specific TMC may be established and operated to help manage incidents and maintain traffic flow.

4.3 Transportation Operations (TO)

Transportation operations strategies are used to mitigate work zone impacts through the use of improved transportation operations and management of the transportation system. TO strategies typically include demand management, corridor/network management, work zone safety management strategies, and traffic/incident management and enforcement strategies.

4.3.1 Demand Management Strategies

Demand management strategies include a wide range of techniques intended to reduce the volume of traffic traveling through the work zone by such means as diverting travelers to alternate modes, shifting trips to off-peak hours, or shifting vehicles to alternate routes. These strategies include:

IIIA1. Transit service improvements. Where appropriate, transit service improvements may include the modification of transit schedules and/or routes, increases in frequency, or the establishment of transit service in the corridor.

IIIA2. Transit incentives. Transit incentives include employer and/or traveler transit subsidies and guaranteed ride home programs.

IIIA3. Shuttle services. Shuttles and charter buses can reduce traffic volumes through a work zone if a sufficient number of users along the corridor are anticipated to use the service.

IIIA4. Ridesharing/carpooling incentives. This strategy involves the use of rideshare/carpool incentives to reduce the number of vehicles traveling through a work zone. Incentives may include preferential parking for carpools, the addition of mainline HOV lanes or bypass lanes on ramps, provision of vanpool vehicles, etc.

The Woodrow Wilson Bridge project in Virginia and Maryland developed a program called "Bridge Bucks" which provides a $50 a month incentive to use transportation alternatives for commuters affected by the construction. Bridge Bucks can be applied to rail, bus, and organized vanpools.

Source: **http://www.wilsonbridge.com/cms/cms-commuter-bb.htm** (Accessed 07/15/05)

IIIA5. Park-and-ride promotion. This involves the creation, expansion, and/or promotion (advertising) of park-and-ride lots to encourage ridesharing or transit use, thus reducing the number of vehicles traveling through the work zone.

IIIA6. High-occupancy vehicle (HOV) lanes. HOV lanes, also known as carpool lanes, require two or more persons per vehicle for use (exceptions may include motorcycles and/or low emission vehicles). HOV lanes are intended to provide an incentive for carpooling.

IIIA7. Toll/congestion pricing. Tolls involve fees paid by motorists to drive on a particular roadway. Congestion pricing, or value pricing, is intended to reduce peak-period vehicle trips through the use of higher tolls during congested conditions.

IIIA8. Ramp metering. Ramp meters are traffic signals located on on-ramps or freeway connectors to maintain safe and smooth freeway operations by controlling the entry of vehicles onto the roadway. This strategy serves both to decrease demand on a facility by controlling the entrance of vehicles, and to improve flow by matching entering vehicles to gaps in the traffic stream.

IIIA9. Parking supply management. This strategy involves reducing traffic demand by managing the parking supply typically through cost strategies.

IIIA10. Variable work hours. This strategy involves encouraging motorists who typically travel through the work zone during periods of high demand to work variable hours (off-peak) in order to reduce travel demand during peak periods.

IIIA11. Telecommuting. Telecommuting means working at home, or at a telecommuting center near home, either full or part time. Motorists who normally travel through the work zone would be encouraged to telecommute for the duration of the project to reduce the demand.

4.3.2 Corridor/Network Management Strategies

This category includes strategies to optimize traffic flow through the work zone corridor and adjacent roadways using various traffic operations techniques and technologies, including:

IIIB1. Signal timing/coordination improvements. This involves retiming traffic signals to increase throughput of the roadway(s), improve traffic flow, and optimize intersection capacity in and around the work zone.

IIIB2. Temporary traffic signals. The installation of temporary traffic signals can be used to improve traffic flow through and near the work zone. At a corridor or network level, using temporary traffic signals is more effective than stop signs or flaggers for providing mobility through the work zone area. These temporary traffic signals may also be coordinated with existing signals (see strategy IIIB1).

IIIB3. Street/intersection improvements. Improvements on streets and intersections for the roadway and/or alternate routes may be necessary to provide increased capacity to handle the traffic through the work zone or within the adjacent corridor. This may include improvements to the mainline and intersections, including roadway and/or shoulder widening and additional through and/or turn lanes.

IIIB4. Bus turnouts. This involves the construction of bus stop areas that are recessed from the travel lanes. This strategy may be helpful in work zones or on detour routes with a high occurrence of bus traffic and stops.

IIIB5. Turn restrictions. This involves restricting turn movements for driveways and/or intersections to increase roadway capacity, reduce potential congestion and delays, and improve safety. Restrictions may be applied during peak periods or all day.

IIIB6. Parking restrictions. This strategy involves the elimination of parking in all or part of the work zone and/or alternate routes, or parking restrictions during work hours or peak traffic periods. Parking restrictions can be used to increase capacity by converting the parking lane to an additional travel lane, reduce traffic conflicts, or provide improved access to the work area.

IIIB7. Truck/heavy vehicle restrictions. This strategy, which imposes restrictions on truck travel through the work zone either during specific periods or at all times, can increase passenger vehicle capacity of the roadway when a facility normally has a high truck volume. When using this strategy, the requirements of 23 CFR Part 658.11 (d) (1) and (g) must be followed.

IIIB8. Separate truck lanes. This strategy involves the provision of a separate truck lane through the restricted use of an existing lane, use of the shoulder or median, or construction of a new lane.

IIIB9. Reversible lanes. This strategy, also known as variable lanes or contra-flow lanes, involves sharing lane(s) of travel to accommodate peak period traffic flow. The direction of travel in the shared lane varies by time of day or day of the week.

IIIB10. Dynamic lane closure system. Also called dynamic lane merge system. This system uses dynamic electronic signs and other special devices to control vehicle merging at the approach to lane closures.

Intelligent Transportation Systems in Work Zones: A Case Study. Dynamic Lane Merge System – Reducing Aggressive Driving and Optimizing Throughput at Work Zone Merges in Michigan (FHWA-HOP-04-033) (2004) evaluates the use of a dynamic lane merge (DLM) system.

Source: **http://ops.fhwa.dot.gov/wz/technologies/michigan/index.htm** (Accessed 07/15/05)

IIIB11. Ramp metering. Ramp meters are traffic signals located on on-ramps or freeway connectors to maintain safe and smooth freeway operations by controlling the entry of vehicles onto the roadway. This strategy serves both to decrease demand on a facility by controlling the entrance of vehicles, and to improve flow by matching entering vehicles to gaps in the traffic stream. Various strategies for ramp metering include pre-set timing, traffic actuated (metering changes based on mainline traffic), or centrally controlled. Ramp metering may be used during peak periods or all day.

IIIB12. Temporary suspension of ramp metering. This strategy involves turning existing ramp meters off during specific time periods or for the duration of the project.

IIIB13. Ramp closures. Ramp closure involves closing one or more ramps in or around the work zone. The ramp closure may be necessary to provide work access within the work space or can be used to improve traffic flow on the mainline.

[4] 23 CFR Part 658, Truck Size and Weight, Route Designations – Length, Width and Weight Limitations, URL: http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr&sid=d29ba0f1f467909a35cf9e35171e60d2&rgn=div5&view=text&node=23:1.0.1.7.32&idno=23

IIIB14. Railroad crossings controls. When a rail crossing is located within a work zone and/or on a detour or diversion route, traffic control improvements at the crossing may become necessary for safety purposes, especially if work zone delays and congestion have the potential to force vehicles to stop on the tracks or between the crossing gates. Improvements may include advanced warning signs, railroad crossing signs, pavement markings, flashing lights, gate arms, flaggers or police officers, and possibly closure of the crossing to traffic during work periods.

IIIB15. Coordination with adjacent construction site(s). This involves combining or coordinating projects within a specific corridor to minimize the combined impacts on the motoring public and community. Coordination typically involves scheduling projects within a corridor to ensure that adequate capacity remains available to accommodate the anticipated travel demand within the corridor by not implementing work zones on adjacent or parallel highways at the same time. This may entail communicating about the timing of lane closures and occurrence of incidents, and coordinating diversion routes. It may also involve the completion of needed capacity and safety improvements on a highway prior to its use to carry traffic diverted or detoured from another project.

Oklahoma found that many adjacent and alternate routes were being rehabilitated at the same time causing motorist delays. They are now making efforts to coordinate State DOT, local government, utility construction, and maintenance work.

Source: FHWA Work Zone Best Practices Guidebook, April 2000, **http://ops.fhwa.dot.gov/wz/practices/best/Default.htm** (Accessed 07/15/05)

4.3.3 Work Zone Safety Management Strategies

This category includes devices, features, and management procedures used to address traffic safety concerns in work zones. Work zone safety management strategies include:

IIIC1. Speed limit reduction/variable speed limits. A reduced speed limit may improve traffic safety in a work zone and help protect workers. Speed limit reductions may be implemented through an entire work zone, or only in active work areas or adjacent to workers. Reduced speed limits may also be appropriate on detours where traffic volumes and conflicts are increased.

Information on variable speed limit applications and safe speeds in work zones is provided on the FHWA Office of Safety Speed Management web site, available at **http://safety.fhwa.dot.gov/speed_manage/index.htm** (Accessed 08/19/05)

IIIC2. Temporary traffic signals. This involves the installation of temporary traffic signals to address safety concerns. In some work zones, temporary traffic signals can be used in place of traffic control officers or flaggers, which can increase safety by removing these personnel from the roadway.

IIIC3. Temporary traffic barrier. Temporary traffic barriers provide positive physical separation between travel lanes and the adjacent work space, or between opposing travel lanes. Screens may be mounted on the top of temporary traffic barriers to discourage gawking and reduce headlight glare.

IIIC4. Movable traffic barrier systems. This system consists of a mechanical transfer machine, which quickly shifts temporary barrier laterally up to the full width of a travel lane while both the transfer operation and traffic in the work zone are protected. This system permits the rapid and safe reconfiguration of the traffic barrier system, allowing daily opening and closing of lanes for reversible lane operations and to provide additional space for the contractor to work during off-peak conditions.

IIIC5. Crash-cushions. Also known as an impact attenuator, a crash cushion is a fixed or mobile barrier used to protect a temporary hazard or prevent vehicle intrusion into the workspace or other hazardous area. It works by gradually decelerating the vehicle to a stop or by redirecting the vehicle away from the hazard.

IIIC6. Temporary rumble strips. Rumble strips are grooves or raised strips placed across or adjacent to a travel lane to alert motorists to a change in roadway conditions, or that they have strayed out of the travel lane.

The Ohio Department of Transportation uses rumble strips placed across the travel lane(s) approaching a long-term work zone to alert motorists of the construction zone.

Source: FHWA Work Zone Best Practices Guidebook, April 2000, **http://ops.fhwa.dot.gov/wz/practices/best/Default.htm** (Accessed 07/15/05)

IIIC7. Intrusion alarms. This strategy involves the use of various types of sensors to detect vehicles that stray out of the travel lane approaching or adjacent to the workspace and into the work area. When an intrusion is detected, a loud siren and/or flashing lights provide a warning to workers.

IIIC8. Warning lights. Various types of warning lights, as described in the MUTCD, are available to alert drivers and pedestrians and draw attention to critical signs, channelizing devices, and other work zone features.

IIIC9. Automated Flagger Assistance Devices (AFADs). AFADs are portable traffic control systems that assist a flagger operation for short-term lane closures, on two-lane highways. For a typical flagging operation with AFADs, one or both flaggers can be positioned a short distance away from the roadway and moving traffic. A flagger(s) can operate an AFAD(s) by using a radio control unit or an attached cable.

IIIC10. Project task force/committee. This strategy creates a project task force/committee to address safety and/or traffic control within the work zone and adjacent corridor.

IIIC11. Construction safety supervisor/inspectors. Daily inspection and supervision of safety and/or traffic control operations is an integral part of project management, and can be provided by various contractor and/or agency personnel, as appropriate to their specific project responsibilities.

IIIC12. Road safety audits. Road safety audits involve analysis of the future or existing roadway by an independent expert on safety issues. It is a proactive way to reduce crashes and identify potential safety hazards. Audits may be performed during any stage of a road project, including planning, preliminary design, detailed design, traffic control planning, construction, pre-opening, and on existing roads.[5]

IIIC13. TMP monitor/inspection team. This strategy involves the establishment of a team (or person) to monitor and inspect implementation and monitoring of the work zone transportation management strategies.

IIIC14. Team meetings. This involves conducting project team meetings on a regular basis to discuss TMP strategies, implementation, and monitoring, particularly related to safety concerns.

IIIC15. Project on-site safety training. This strategy provides on-going safety training to ensure that workers are familiar with safety procedures and specific risks associated with the project, and to maintain a high level of safety awareness.

IIIC16. Safety awards/incentives. This strategy involves the use of awards or incentives for innovations that reduce the safety impacts associated with the work zone.

Minnesota DOT has a Work Zone Safety Award Program for contractors and DOT employees that recognizes contractors and public agency personnel who have put forward outstanding work zone safety efforts on construction projects. This program has resulted in a positive impact toward improving work zone worker safety consciousness.

Source: FHWA Work Zone Best Practices Guidebook, April 2000, **http://ops.fhwa.dot.gov/wz/practices/best/Default.htm** (Accessed 07/15/05)

IIIC17. Windshield surveys. This strategy involves a designated DOT employee and/or contractor driving through the work zone area to conduct a firsthand assessment of safety and/or traffic flow. This strategy provides periodic assessments of the effectiveness of project safety features.

[5] Road Safety Audits and Road Safety Audits Review: Executive Summary. http://www.roadwaysafetyaudits.org/executivesummary.pdf (Accessed 10/11/05).

4.3.4 Traffic/Incident Management and Enforcement Strategies

This category includes various strategies to manage work zone traffic operations. Work zone traffic management strategies involve monitoring traffic conditions and making adjustments to traffic operations based on changing conditions. Some of those changing conditions involve traffic incidents, so this category also looks at management strategies that have specific applicability to traffic incidents. These strategies involve improved detection, verification, response, and clearance of crashes, mechanical failures, and other incidents in work zones and on detour routes. This category also includes strategies to provide adequate enforcement of traffic regulations in work zones. Strategies in this area include:

IIID1. ITS for traffic monitoring/management. ITS can be used in work zones to identify areas where traffic flow is impeded so that traveler information can be provided and/or adjustments to the work zone can be made. A work zone ITS deployment uses sensors to detect traffic conditions and can automatically feed this information to motorist information outlets such as CMS and websites, or to a TMC. Monitoring traffic cameras can help detect places where drivers are having difficulty negotiating a work zone and then the layout can be adjusted.

IIID2. Transportation management center (TMC). This strategy involves the use of a TMC for coordinating and managing traffic and incident management activities in and around the work zone. Often an existing TMC for the region is used and may be staffed by either contract staff and/or agency personnel. If the project is large and of long duration, a project specific TMC may be established and operated to help manage incidents and maintain traffic flow.

IIID3. Surveillance [Closed-Circuit Television (CCTV), loop detectors, lasers, probe vehicles]. This strategy involves the use of surveillance equipment, such as detector stations or cameras, to help identify traffic problems and to detect, verify, and respond to incidents in the work zone.

IIID4. Helicopter for aerial surveillance. This involves the use of aerial surveillance to identify and verify traffic problems and incidents.

IIID5. Traffic screens. Traffic screens help prevent driver distractions in work zones, which can help to keep traffic moving and enhance safety. Screens may be mounted on the top of temporary traffic barriers to discourage gawking and reduce headlight glare.

IIID6. Call boxes. Temporary or permanent call boxes may be installed through the work zone to provide motorists with a means to contact incident response personnel, thus expediting the response and clearance times for crashes and breakdowns.

IIID7. Mile-post markers. Mile-post markers consist of a sign located in the median or shoulder, which lists location information (direction, route, mile, and tenths of a mile). Some areas may refer to these as location reference markers, since they can be used to mark direction; route, bridge or overpass names; intersection names; etc. in addition to mileage information.

IIID8. Tow/freeway service patrol. This strategy involves the use of dedicated or on-site (or near site) towing services to reduce the time required to remove vehicles involved in an incident (breakdown or crash). Towing service is almost always contracted, while freeway service patrols might be contracted but are more likely to be publicly operated.

IIID9. Total station units. This involves the use of survey equipment for documenting/mapping major incidents (e.g., fatal crashes, HAZMAT conditions, etc.) in order to reduce the clearance time. In some locations, total station units are being replaced by laser measuring units.

IIID10. Photogrammetry. Photogrammetry involves the use of photos taken in the field and computer software for documenting and measuring incident-related data (e.g., skid marks, vehicle location, etc.) which may reduce incident clearance times.

The Utah Highway Patrol has reduced their average clearance time from an average of 60 to 90 minutes when total stations are used to 35 minutes with photogrammetry.

Source: Texas Department of Transportation, Use of Photogrammetry for Investigation of Traffic Incident Scenes, October 2000, URL: **http://tti.tamu.edu/documents/4907-2.pdf** (Accessed 08/18/05)

IIID11. Coordination with media. This strategy involves working with local news media to publicize traffic delays, incidents, and incident management. Working with media contacts in advance to establish procedures to be followed in the event of a major delay or incident can facilitate the dissemination of specific information upon the occurrence of a major delay or incident.

IIID12. Local detour routes. Advance identification and approval/authorization of local detour routes is an especially useful strategy to address major traffic delays and incidents, particularly for high volume and incident prone work zones.

IIID13. Contract support for incident management. This strategy provides additional contract support for incident management and response beyond that available from the construction contractor or within the agency. Contracts may include entities such as police agencies, towing/recovery providers, engineering consultants, or others, depending on the support needed for a project.

IIID14. Incident/emergency management coordinator. This strategy provides a designated individual with overall responsibility for incident and emergency management on a project. Responsibilities may include developing incident and/or emergency response plans, overseeing implementation and monitoring of the work zone management strategies, and overall management of incidents or emergencies.

IIID15. Incident/emergency response plan. This involves the development of a plan with information needed to respond to an incident. This information typically includes roles and responsibilities, response agencies, processes/procedures, actions to take for various incident types and levels, contact information, alternate routes, personnel and equipment information, staging area locations, and other information as appropriate to the individual project.

IIID16. Dedicated (paid) police enforcement. This strategy provides police patrols in the work zone under a contractual arrangement with the agency or contractor.

IIID17. Cooperative police enforcement. Cooperative enforcement is similar to dedicated enforcement, except it is implemented through a cooperative agreement between the police and agency.

IIID18. Automated enforcement. Automated enforcement involves the use of various technologies such as radar, cameras, video, and sensors to detect and record vehicle speed or traffic signal violations. When a vehicle speed exceeds a specified threshold or a red signal violation occurs, the vehicle's license plate and/or driver are photographed. The citation with the photo(s) is then mailed to the registered owner of the vehicle.

IIID19. Increased penalties for work zone violations. This strategy involves the imposition of increased penalties for speeding or other violations in work zones. Such penalties include increased fines, increased points, license suspension, and even mandatory prison terms for serious violations.

5.0 Current TMP Use, Examples, and Practices

5.1 Current TMP Use

This section presents an overview of findings from an investigation of the current use and formats of transportation management plans (TMPs) based on interviews of four State departments of transportation (DOTs) conducted in September and October 2004. The four States interviewed were California, North Carolina, Ohio, and Wisconsin. In addition, background literature reviews on current practices in other States were conducted. Indiana, Maryland, and Washington were states identified through this literature review as having some noteworthy policies, practices, or procedures related to TMP development and implementation.

5.1.1 Current TMP Policies and Processes

In general, TMP policies, processes, and requirements are informal and rely mostly on engineering judgment. Each State has some policy provisions for work zone planning and management, but they differ in name, nature, and goal. In **Maryland**, work zone mitigation efforts are detailed in the Maintenance of Traffic (MOT) reports, which are largely comprised of the work zone temporary traffic control (TTC) plan. The objective of the MOT report is to outline how to maintain traffic for the duration of construction. **Indiana** Department of Transportation's (INDOT) work zone impact management goal is for an "effective corridor," while **California** Department of Transportation (Caltrans) Deputy Directive Number 60 (DD-60) concerning work zone impacts strives to "manage delay and safety." **Ohio** DOT's work zone mitigation policy calls for "Exception Reports" and TMPs whenever lane closure restrictions may be violated by the project, with the priority being "minimizing crashes." Meanwhile, in **Wisconsin** the main priority is to "reduce construction duration."

Despite these differences in specific goals, each agency is trying to manage work zone impacts and some level of agency pre-construction planning effort exists. For simplicity reasons, mitigation strategy reports developed by the different agencies will be referred to as TMPs, although they might differ from the definition of TMP in the updated work zone Rule (Rule).

TMP Policies and Methodology

Based upon the literature review, most States (other than those interviewed) do not have TMP policies covering major work zone issues typically found during construction, nor do they have guidelines to develop TMPs. Some of the interviewed States do mandate that all construction or maintenance projects must be accompanied by a TMP, which may range from a single-page datasheet to comprehensive reports. The following discussion summarizes some of the processes.

California is one of the few States that has a specific policy on TMPs, and has spent years improving it. In 1993, Caltrans developed their first version of a TMP guidelines document, entitled the TMP Effectiveness Study.[1] Since then, the Office of Operations within Caltrans Headquarters continues to improve upon the guidelines, mainly using past experience. Caltrans focused on improving guidelines on the most effective mitigation strategies in the State of California. The most recent version of California's TMP guidelines was published in June 2001, with addendums on bicycle and pedestrian mitigation strategies added in May 2004.

California policy states, "TMPs, including contingency plans, are required for all construction, maintenance, encroachment permit, planned emergency restoration, locally or specially-funded, or other activities on the State highway system. Where several consecutive or linking projects or activities within a region or corridor create cumulative needs for a TMP, the Department coordinates individual TMPs or develops a single interregional TMP." TMPs are considered early, during the project initiation or planning stage. The project team includes a District Traffic Manager (DTM) or a TMP manager to investigate the level of TMP needed for a project at hand. Caltrans has defined a significant traffic impact as "30 minutes above normal recurring traffic delay on the existing facility or the delay threshold set by the DTM, whichever is less." In California, the level of TMP may fall into three distinct categories:

- **TTC Plan only/Blanket TMP.** This is typically a one-page datasheet containing information on the proposed construction project, including project description, limits, dates, and duration. Permissible work hours are defined in lane requirement charts.
- **Minor TMP.** Projects that are considered for minor TMPs typically include those that require additional work zone mitigation measures beyond a TTC plan, such as portable or fixed changeable message signs (CMS) or the California Highway Patrol's (CHP) construction zone enforcement enhancement program (COZEEP).
- **Major TMP.** For major improvement projects, an extensive TMP that evaluates multiple mitigation strategies, public outreach, and extended closure methods is needed. Major TMPs typically require several months to prepare, and are developed for less than five percent of all construction or maintenance projects at Caltrans.

Ohio Department of Transportation (ODOT) has developed a decision support methodology in determining whether an "Exception Report" (a precursor to TMPs) is required, based on past experience and in-house research efforts. First, the project manager checks the ODOT Permitted Lane Closure (PLC)[2] web application to determine when and how many lanes can be closed on a segment of the freeway. (Every link of the interstate and interstate look-alikes has defined closure times.) If the suggested closure does not violate the PLC, the project may proceed. If the proposal violates the PLC, then a QUEWZ[3]/ODOT spreadsheet analysis of queues is conducted. If for whatever reason the proposal does not meet the PLC and the expected queues exceed the ODOT policy maximums[4], an exception request is made. The exception request provides numerous alternatives that include discussions on queue impacts, construction costs, and construction schedule. If this report is approved by the Traffic Operations Division at the central office, the full TMP detailing public information strategies, traffic control adjustments, and signing will follow during the detailed engineering phase.

INDOT currently has a TMP development guideline that may be "generally observed" by its practitioners. In Indiana, a TMP is an overall strategy, beyond just a TTC, to accommodate traffic during construction. It is intended to address all project impacts throughout the corridor and region, not just the work zone.

[1] California Department of Transportation, Traffic Management Plan Effectiveness Study, prepared by Wilbur Smith Associates, May 1993. URL: http://www.its.dot.gov/JPODOCS/REPTS_TE/89V01!.PDF (Accessed 07/17/05).

[2] URL: https://dotaw100.dot.state.oh.us/plcm/plcm_web.jsp (Accessed 07/17/05).

[3] QUEWZ is a program designed for evaluation of freeway work zones but can be used for other highway types. Traffic management approaches for work zones, such as single direction closures and crossovers, can be analyzed.

[4] The Ohio Department of Transportation (ODOT) Maintenance of Traffic Policy sets allowable queue thresholds. These thresholds are discussed in the Criteria and Thresholds section of this document on page 5-4.

At the start of the preliminary engineering phase, the design team, with input from the district traffic engineers, must decide whether or not a TMP is needed. Once determined, a TMP development team consisting of designers, construction managers, traffic engineers, and stakeholders are formed. The team prepares the TMP in parallel with the development of the preliminary engineering designs. Construction staging and traffic impact issues are considered as one, and in the end, the TMP is incorporated as part of the preliminary engineering report.

During the construction phase, if a significant deviation from the TMP is desired by the construction management team or the contractor, it must be reviewed and approved by the TMP team. For larger projects, a TMP manager is typically appointed to coordinate communications between the TMP and construction teams.

Maryland, North Carolina, and **Wisconsin** rely on past practice and various design manuals for traffic-related mitigation strategies for work zones. The mitigation documentation must at least include a TTC plan, which is required for all State- and Federally-funded projects.

Development and Implementation Timeline

Indiana, North Carolina, and **Wisconsin** DOTs believe that in order to develop sound mitigation strategies, the traffic engineers should be an integral part of the design team and consulted during the development of the construction phasing plan. Depending on the complexity of the project, additional issues such as public information, alternate routes, and incident management should also be discussed with the appropriate personnel and stakeholders, as needed. **Caltrans** also emphasizes this, stressing that the TMP is a dynamic document that is reviewed and modified throughout as necessary. Caltrans considers the DTM and TMP Manager an integral part of the Project Development Team for capital projects.

In other States, the designers often begin the project scoping on their own, developing the construction staging and phasing before sharing the construction plans with the traffic division. In general, the TMP development process starts one or two years in advance of the start of construction, typically during design or preliminary engineering. However, the bulk of the effort is performed on different timelines at different agencies. **North Carolina,** for example, prefers a simple preliminary analysis far in advance, but does not go into the detailed analysis until three to six months prior to "letting," or the beginning of construction. In **California,** the districts are encouraged to plan and execute the TMP early for public awareness (one to two years prior to start of construction). **Ohio** DOT develops MOT scenarios early in project development and uses MOT viability as one of the decision criteria in selecting the project design. The project is designed with the MOT criteria becoming more detailed as the project progresses.

Analysis Tools

Many agencies, including Caltrans, are making an effort to use more advanced analysis tools such as simulation for work zone impacts assessment. However, simulation costs and time are barriers, since for the types of projects it has been used on it typically costs at least $150,000 and takes several months to collect traffic data and build and calibrate the simulation network. Most agencies rely on conventional analysis, although some **California** and **Wisconsin** districts may use QuickZone.[5] **Indiana** uses QUEWZ to "determine queues and users costs that are associated with work zone lane closures." **Ohio** incorporated QUEWZ with their own thresholds and default values to determine whether or not an "Exception Report" and TMP are necessary. Additional information on work zone analysis tools can be found in **Work Zone Impacts Assessment: An Approach to Assess and Manage Work Zone Safety and Mobility Impacts of Road Projects.**[6]

[5] QuickZone compares the traffic impacts for work zone mitigation strategies and estimates the costs, traffic delays, and potential backups associated with these impacts.

[6] Available at http://www.ops.fhwa.dot.gov/wz/resources/final_rule.htm

Organizational Structures and Stakeholders

The interviews and the literature review found that in most cases TMPs are developed by the district traffic agencies, under the supervision of a DTM or a TMP manager. Other agencies and/or stakeholders are involved during the TMP development process only if necessary, often serving as sounding boards. While most agencies rely on the DTM (or its equivalent) for engineering judgment, they can also contact their headquarters' office of operations (or its equivalent) for further review and counsel. Smaller districts have few personnel responsible for traffic management, and often they perform dual roles in addition to work zone planning and management.

In **California, Washington,** and **North Carolina**, TMPs are typically reviewed only by the DTM or TMP manager, including those developed by consultants. Occasionally, the DTM or TMP manager forwards complex TMPs to the agency headquarters for assistance – this is done on a case-by-case basis. In **Ohio**, all "Exception Reports" must be submitted to the central office for review – otherwise, no reporting is needed. In **Wisconsin**, the designers oversee the work of the traffic team on the development of the TMP.

Criteria and Thresholds

Establishing reasonable performance criteria or thresholds for determining TMP requirements is a policy decision each State has considered. As an example, some agencies have set a maximum additional delay over and above normal operating conditions and use engineering judgment. For example, **Caltrans** and **Wisconsin** DOT require that construction or maintenance projects should not increase delay by more than 30 minutes above the normal recurring traffic delay. Interviews with Caltrans traffic operations officials revealed that in practice, this threshold is much stricter, typically set at 15-20 minutes. Any proposed closures that fail to satisfy this threshold require approval from the District Lane Closure Review Committee (DLCRC). The DLCRC decides when to submit lane closure requests that are of an interregional, statewide, environmental, or otherwise sensitive nature to the Headquarters Lane Closure Review Committee for their approval.

Ohio DOT's decision support methodology employs a criterion that a queue length less than 0.75 mile is acceptable. Queues greater than 0.75 mile but less than 1.5 miles are acceptable if the queue exceeds 0.75 mile for less than two hours. Queues longer than 0.75 mile for more than two hours, or longer than 1.5 miles for any period of time, are unacceptable and alternate strategies must be considered.

Engineering judgment is often used in selecting diversion or trip reduction rates. Major construction or maintenance projects, with a reasonable public information campaign, experience some level of trip reduction due to trip cancellations, rescheduling, or significant detours. Many agencies prefer basing their TMPs on the worst-case scenario, where no diversion takes place. In **California,** if the proposed project results in significant additional delays and queues, the first option is to revisit the construction strategy. If queues and delays continue to exceed the allowable threshold regardless of the staging option, the DTM or TMP manager may take into account the effects of diversion, along with a stronger emphasis on the public information campaign.

Post-Project Evaluations

The States interviewed tend to rely on prepared templates, past TMPs, and anecdotal information from past projects for the development of TMPs. In **Indiana,** detailed post-project evaluations are developed as TMP Final Reports, and they contain discussions on the following:

- Overall statement on the usefulness of the TMP.
- Changes to the TMP during construction or implementation.
- Discussion on whether the changes were successful.
- Public reaction to the TMP.
- Average delay, queue length, and number of slowdowns encountered.
- Identification of the peak loading times.
- Frequency of legitimate complaints and their nature.
- Types of crashes that occurred during construction.
- Lessons-learned for future projects.
- Which mitigation strategies were most successful.

California and **Ohio** also have detailed post-project reviews of the overall project. Included in this are the bid TMP implementation costs, which are archived and can be used for future TMP developments. In addition, California has conducted research focusing on public information strategies, since Caltrans officials believe these are most effective for the cost.

5.1.2 Work Zone Impact Mitigation Strategies

This section describes some of the work zone impact management strategies currently used by the interviewed agencies. The classifications and groupings of the TMP components are those that are typically done by the States. The applicable classifications of TMP components from the updated work zone Rule (i.e., TTC, PI, and TO) have been identified within brackets for informational purposes.

Traffic Management Strategies

Some common methods used by agencies to reduce traffic in work zone areas are listed below:

- **Ramp closures (TTC, TO – Corridor/Network Management).** **Ohio, North Carolina,** and **California** DOTs have closed on-ramps in the corridor in urban work zones to reduce traffic. Use of this strategy is selective and requires adequate alternate routes and public information.
- **Truck restrictions (TO – Corridor/Network Management).** **Ohio** and **California** DOTs have banned trucks in work zones in cases where there was a need to reduce truck demand and when viable alternate routes exist. This depends on the predicted delay and queue length, and input from the stakeholders.

- **Public information (PI).** According to **Maryland, California,** and **Wisconsin,** public information is the best mitigation strategy that may lead to significant traffic reductions. In rural work zones, Maryland and Wisconsin believe that public information via portable CMS is the best work zone mitigation strategy. Washington DOT has a comprehensive public information program for work zones called "Give 'Em A Brake," with goals of raising public awareness and improving workers' safety.[7]
- **Rerouting traffic (TTC – Off-Site Detours, TO).** Work zone impact mitigation measures on arterial streets in the affected corridor have been implemented as part of several reconstruction projects, including traffic signal retiming, and intersection and roadway improvements. These measures can facilitate traffic flow even when specific detour routes are not established.
- **Transit use and ridesharing (TO – Demand Management).** Promoting public transit alternatives is another common work zone mitigation technique for highly urbanized areas with a good transit network. In some cases, services may be expanded temporarily to reduce traffic in the affected corridor.

Lane Closure Strategies

Lane closure strategies (TTC) vary based on several factors (e.g., functional class, geographic characteristics, scope/type of work, construction techniques, traffic demand, etc.). Lane closures can range from the closure of a single lane up to full closure of the road. In the case of full closures, all the lanes are closed in one or both directions, and the traffic is detoured. Lane closure durations generally can be divided into four categories:

1. Daytime off-peak only.
2. Nighttime only (10-hour closures).
3. Weekend closures (55 to 72 hours).
4. Continuous lane closure for the duration of one or more phases or the entire project.

Each State must balance the safety and operational criteria for the specific project when selecting the most effective lane closure strategy. In **North Carolina** most construction or maintenance work is performed at night, while trying to keep the maximum number of ramps and lanes open. **Washington** DOT's experience with full closures has been very successful. The approach requires good coordination between the design and traffic operations teams, as well as with local agencies and the public, but can be very effective and efficient.

Wisconsin and **California** DOTs have flexible lane closure strategies. They use nighttime, off-peak only, weekend, and continuous closure. With the continuous closure, the objective is to reduce the project duration, as well as schedule the project at a time of the year when the traffic volume is typically lower. **California** is encouraging the use of continuous closures where adequate lead time for public notification is available and the duration is compatible with the proposed construction or maintenance practices.

[7] URL: http://www.wsdot.wa.gov/brake/, (Accessed 07/17/05).

Monitoring Strategies

Most of the interviewed States do not have set procedures to monitor the work zone impacts of projects and the effectiveness of their work zone mitigation strategies. In most cases, work zone and TMP monitoring is the responsibility of the construction manager. However, on projects with greater impacts, there may be a concerted effort to share the responsibility between the DTM and the construction manager, at least during the early stages of construction. Many States rely on the following techniques for monitoring purposes:

- Designated inspectors [TO – Work Zone Safety Management Strategies].
- Windshield surveys [TO – Work Zone Safety Management Strategies].
- Electronic surveillance [TO – Traffic/Incident Management and Enforcement].
- Incident management [TO – Traffic/Incident Management and Enforcement].

Most construction or maintenance projects in **California** with potentially significant traffic impacts (as defined by Caltrans) have a monitoring program in place, at least during the initial stages of the project. Some districts in California have designated construction traffic managers that can assist in this effort. The **Ohio** DOT policy requires the project personnel to monitor the queues and compare them against the expected queues generated by the computer model. If the project-generated queues exceed the expected queue lengths, the district must recommend corrective action and the Central Office staff will review the data to determine the cause. The ODOT Central Office and the FHWA conduct field reviews twice a year and watch for safety problems. The Ohio DOT also obtains work zone crash reports (generally within two weeks) and compares them to historical crash trends before the work zone in an effort to identify unexpected problems caused by the work zone and make field changes, as necessary and appropriate.

5.1.3 TMP Development and Implementation Costs

Most of the States interviewed estimate the costs of TTC/TMP development and implementation as a percentage of the construction project costs. Based on **Wisconsin** DOT's experience, for example, the development and implementation of a TMP could range approximately from three to five percent of the total construction costs of the project.

TTC development costs of most projects in **North Carolina** range from approximately a quarter to one-half-percent of the construction costs. North Carolina spends approximately three to five percent of the construction costs to implement the TTC. Approximately $15,000 to $40,000 is spent on typical traffic control designs for about 85 percent of the reconstruction projects in North Carolina. A compilation of projects in the **Caltrans'** TMP Effectiveness Study[8] indicated that the cost of a TMP ranges from four percent of the construction cost to 30 percent, which amounted to TMP implementation costs ranging from $250,000 to $30 million for these projects. More recent results reported in 2003 show that TMP costs have ranged between one and 15 percent of the total project cost (from $25,000 to $3.35 million).

While still in the process of developing TMP guidelines, **Wisconsin** DOT has recognized the need for estimating the costs of TMP development and implementation based on road user cost as opposed to a percentage of construction costs. In **Maryland,** road user costs are not directly used, but the State applies certain strategies to balance between the cost of construction and road user costs, such as contractor bonus/penalty for project timeliness, contractor incentive/disincentive for performance efficiencies, readiness to prepare contract addendums to counter significant problems, or combining several projects into one.

[8] California Department of Transportation, Traffic Management Plan Effectiveness Study, prepared by Wilbur Smith Associates, May 1993. URL: http://www.its.dot.gov/JPODOCS/REPTS_TE/89V01!.PDF (Accessed 07/17/05).

5.1.4 Conclusions and Lessons-Learned

Few States have formal TMP guidelines or policies in place. In most States currently using TMPs, queue or delay threshold criteria and engineering judgment are applied to determine whether a full TMP is required or not. Determining the extent of TMP required, assigning TMP team responsibilities, and estimating TMP development and implementation costs should be done during preliminary engineering or early design. In practice, however the TMP development process often begins only six months prior to the start of construction.

Some lessons learned and comments from the interviews include:

- **TMP guidelines should not be restrictive.** Project challenges vary greatly from one to another, and these must be identified first before solutions are developed. TMP guidelines should serve as a checklist to consider by practicing agencies.
- **Early start.** The design team, traffic operations division, and other relevant stakeholders should meet as early as possible, to discuss the project design, staging, and work zone mitigation strategies.
- **Determining TMP level.** Currently, most agencies rely on engineering judgment, but a "quick-and-dirty" decision support tool similar to the one used in Ohio or another approach may be used to assess TMP needs.
- **Clear project scope.** Concerning TMP development, implementation, and monitoring, it is imperative to define roles and expectations clearly.
- **Road user cost estimation.** While most TMPs used today are budgeted as a percentage or a portion of the overall project funding, perhaps actual costs and road user costs should be considered. This is particularly useful for smaller projects with large impacts.
- **Mitigation strategy.** Public information is considered to be one of the most effective mitigation strategies. It works best in highly urbanized work zones, but still yields effective results in rural areas.
- **Balanced focus.** Although the main purpose of TMPs is to support road construction projects, work zone transportation management should be considered along with construction issues, not after. Poorly planned construction or maintenance projects may lead to crashes, motorists/worker injuries and fatalities, and/or excessive delays.
- **Use of software.** Simulation is often used for major projects with significant regional impacts, but simpler queue and delay analysis software to determine the impacts of the project are generally adequate for small to medium range projects.
- **Urban areas more tolerant.** Urban areas tend to be more tolerant of work zone impacts, since urban commuters are more accustomed to congestion on a daily basis.
- **Data may change over time.** On many projects, particularly those that have been shelved for some time, project design or traffic volumes may change after the preparation of the plans, specifications, and estimates (PS&E) package. For this reason, Caltrans requires its Project Manager to obtain DTM/TMP Manager signoff right before the project is ready to list, or released for bid, rather than earlier in the process. This helps make sure that traffic volumes are current and that the strategies are compatible with the project design.

5.1.5 Contact Information

The following contains contact information for the individuals interviewed for this section of the document.

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5.2 Examples and Practices

Table 5.1 provides resource information and web links to some examples of TMPs, TMP-related policies and procedures, and other TMP practices. It also lists references used and literature reviewed related to TMPs.

Resource	URL	Work Zone Safety and Mobility Rule and Guidance
British Columbia Ministry of Transportation, **Traffic Management Guidelines for Work on Roadways,** September 2001	http://www.th.gov.bc.ca/publications/eng_publications/geomet/traffic_mgmt_guidelines.pdf (Accessed (07/17/05)	
California Department of Transportation, **Transportation Management Plan Guidelines,** July 1, 2001	http://www.ntoctalks.com/icdn/caltrans_tmp/final_guidelines_may_04.doc (Accessed 11/22/05)	
California Department of Transportation, **Deputy Directive DD-60, Transportation Management Plans,** June 2000	http://www.valleyair.org/Workshops/postings/3-25-2002/caltrans/dd-60.pdf (Accessed 07/17/05)	
California Department of Transportation, **Traffic Management Plan Effectiveness Study,** prepared by Wilbur Smith Associates, May 1993	http://www.its.dot.gov/JPODOCS/REPTS_TE/89V01!.PDF (Accessed 07/17/05)	
Caltrans, **Traffic Management Plan for the West Approach Project**	http://www.dot.ca.gov/dist4/safer/docs/tmp3.pdf (Accessed 07/17/05)	
Caltrans Presentation, **Transportation Management Plans: Effectiveness Study Handouts, Rough Costs for TMP Strategies**	http://www.ops.fhwa.dot.gov/wz/workshops/accessible/Copp_Handouts.htm (Accessed 07/17/05)	
California State Department of Transportation and California Highway Patrol (CHP) **Construction Zone Enhanced Enforcement Program (COZEEP)**	http://www.agc-ca.org/services/safety/SB98-4.htm (Accessed 07/17/05)	
Colorado Department of Transportation, **Guidelines for Developing Traffic Incident Management Plans for Work Zones,** September 2003	http://www.dot.state.co.us/Traffic_Manuals_Guidelines/Incident_management_guidelines/Incident_management_guidelines_20030919.pdf (Accessed 08/18/05)	
Connecticut Department of Transportation, **I-95 New Haven Harbor Crossing Corridor Improvement Program, Construction Traffic Management Plan**	http://www.i95newhaven.com/making_commute/construction.asp (Accessed 07/26/05)	
Federal Register, **23 CFR 630 Subpart J,** September 9, 2004	http://www.ops.fhwa.dot.gov/wz/resources/final_rule.htm (Accessed 07/17/05)	✓
Illinois Department of Transportation, Chapter 13 of the Bureau of Design and Environmental Manual, **Work Zone Traffic Management Studies, Traffic Management Analysis (TMA) Report,** December 2002	http://www.dot.state.il.us/desenv/BDE%20Manual/BDE/pdf/chap13.pdf (Accessed 07/17/05)	
Indiana Department of Transportation, Chapter 81 of the Indiana Design Manual, **Transportation Management Plans**	http://www.in.gov/dot/div/contracts/standards/dm/Part%208/Ch%2081/Ch81.pdf (Accessed 07/17/05)	
Indiana Department of Transportation, Chapter 82 of the Indiana Design Manual, **Traffic Control Plans/Design**	http://www.in.gov/dot/div/contracts/standards/dm/Part%208/Ch%2082/ch82.htm (Accessed 07/17/05)	

Table 5.1 Resources for Examples and Best Practices

TMP Policies/ Guidelines/ Content	TMP Team, Roles and Responsibilities	TMP Checklist	Work Zone Transportation Management Strategies	Work Zone Safety Programs	Work Zone Cost Effectiveness/ Evaluation	Example TMPs	Other Resources
✓		✓	✓		✓		
✓		✓	✓				
✓	✓						
✓			✓		✓		
						✓	
			✓				
			✓	✓			
			✓				
						✓	
✓	✓		✓		✓		
✓	✓		✓		✓		
✓	✓		✓		✓		

Resource	URL	Work Zone Safety and Mobility Rule and Guidance
Indiana Department of Transportation, **Interstate Highways Lane-Closure Policy,** July 2003	http://www.state.in.us/dot/div/contracts/standards/memos/0308-pc.pdf (Accessed 07/17/05)	
Indiana Department of Transportation, **Traffic Control Plans Checklist**	http://www.in.gov/dot/div/contracts/standards/dm/Part%208/Ch%2082/figures/Fig%2082-7A.pdf (Accessed 07/17/05)	
Minnesota Department of Transportation, Chapter 8 of the Traffic Engineering Manual, **Work Zone Traffic Control,** June 2000	http://www.dot.state.mn.us/trafficeng/otepubl/tem/Chap-8-2000.pdf (Accessed 07/17/05)	
National Cooperative Highway Research Program, Report 475, **A Procedure for Assessing and Planning Nighttime Highway Construction and Maintenance,** 2002	http://gulliver.trb.org/publications/nchrp/nchrp_rpt_475.pdf (Accessed 07/17/05)	
National Cooperative Highway Research Program, Report 476, **Guidelines for Design and Operation of Nighttime Traffic Control for Highway Maintenance and Construction,** 2002	http://trb.org/publications/nchrp/nchrp_rpt_476.pdf (Accessed 07/17/05)	
New Jersey Department of Transportation, **Road User Cost Manual,** June 2001	http://www.state.nj.us/transportation/eng/documents/RUCM/#Introduction (Accessed 07/17/05)	
New York State Department of Transportation, New York State Police, and New York Thruway Work Zone Safety Program, **Operation Hard Hat**	http://www.dot.state.ny.us/traffic/ohh/index.html (Accessed 07/17/05)	
Ohio Department of Transportation, **Traffic Management in Work Zones Interstate and Other Freeways, Policy No.: 516-003(P),** July 18, 2000	http://www.dot.state.oh.us/Policy/516-003p.pdf (Accessed 07/17/05)	
Oregon Department of Transportation, **Traffic Control Plans Design Manual,** 2005	http://www.oregon.gov/ODOT/HWY/TRAFFIC/Temp_Traffic_Control_Plans/PDF/TCP_Manual.pdf (Accessed 07/17/05)	
Southwest Washington Regional Transportation Council, **I-5 Interstate Bridge Trunnion Repair Project Traffic Management Plan Report, Executive Summary,** Final Draft	http://www.rtc.wa.gov/Studies/Archive/trunnion/tmpexec.htm#Mission, http://www.rtc.wa.gov/Studies/Archive/trunnion/tmpmap.htm (Accessed 07/17/05)	
U.S. Department of Transportation, Federal Highway Administration, **Full Road Closure for Work Zone Operations: A Cross-Cutting Study,** August 2003	http://ops.fhwa.dot.gov/wz/resources/publications/FullClosure/CrossCutting/its.htm/ (Accessed 07/17/05)	
U.S. Department of Transportation, Federal Highway Administration, **Intelligent Transportation Systems in Work Zones: A Cross-Cutting Study,** November 2002	http://www.itsdocs.fhwa.dot.gov/JPODOCS/REPTS_TE/13600.html (Accessed 07/17/05)	

Table 5.1 Resources for Examples and Best Practices (continued)

TMP Policies/ Guidelines/ Content	TMP Team, Roles and Responsibilities	TMP Checklist	Work Zone Transportation Management Strategies	Work Zone Safety Programs	Work Zone Cost Effectiveness/ Evaluation	Example TMPs	Other Resources
			✓				
		✓					
✓	✓	✓	✓				
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✓			✓		✓		
			✓				
			✓				

Resource	URL	Work Zone Safety and Mobility Rule and Guidance
U.S. Department of Transportation, Federal Highway Administration, **Meeting the Customer's Needs for Mobility and Safety During Construction and Maintenance Operations,** September 1998	http://www.fhwa.dot.gov/reports/bestprac.pdf (Accessed 07/17/05)	
U.S. Department of Transportation, Federal Highway Administration, International Technology Exchange Program, **Methods and Procedures to Reduce Motorist Delays in European Work Zones,** October 2000	http://safety.fhwa.dot.gov/wzipd_methods.htm (Accessed 07/17/05)	
U.S. Department of Transportation, Federal Highway Administration, **Implementing the Rule on Work Zone Safety and Mobility,** 2005	http://www.ops.fhwa.dot.gov/wz/resources/final_rule.htm (Accessed 07/17/05)	✓
U.S. Department of Transportation, Federal Highway Administration, **Work Zone Impacts Assessment: An Approach to Assess and Manage Work Zone Safety and Mobility Impacts of Road Projects,** 2005	http://www.ops.fhwa.dot.gov/wz/resources/final_rule.htm (Accessed 07/17/05)	✓
U.S. Department of Transportation, Federal Highway Administration, **Work Zone Public Information and Outreach Strategies**, 2005	http://www.ops.fhwa.dot.gov/wz/resources/final_rule.htm (Accessed 07/17/05)	✓
U.S. Department of Transportation, Federal Highway Administration, **Work Zone Operations Best Practices Guidebook,** April 2000	http://www.ops.fhwa.dot.gov/wz/practices/best/Default.htm (Accessed 07/17/05)	
Washington State Department of Transportation, Traffic Manual, Chapter 5, Work Zone Traffic Control, **Traffic Control Planning and Strategy Checklist,** August 1994	http://www.wsdot.wa.gov/fasc/EngineeringPublications/Manuals/Traffic.pdf (Accessed 07/17/05)	
Washington State Department of Transportation, **Give 'em a Brake Campaign**	http://www.wsdot.wa.gov/brake/ (Accessed 07/17/05)	
Wisconsin Department of Transportation, **Facilities Development Manual,** February 2003	https://trust.dot.state.wi.us/extntgtwy/fdm/11/11-50-22.pdf (Note: Requires registration) (Accessed 07/17/05)	

Table 5.1 Resources for Examples and Best Practices (continued)

TMP Policies/ Guidelines/ Content	TMP Team, Roles and Responsibilities	TMP Checklist	Work Zone Transportation Management Strategies	Work Zone Safety Programs	Work Zone Cost Effectiveness/ Evaluation	Example TMPs	Other Resources
							✓
			✓				
✓	✓	✓	✓				✓
✓	✓		✓		✓		
			✓				✓
			✓				✓
✓		✓	✓				
				✓			
✓			✓				

Appendix A – Transportation Management Plan Potential Components Checklist

The following checklist represents the possible transportation management plan (TMP) components described in Section 3.0 of this document. Agencies may want to consider developing something like this to assist preparers and reviewers of TMPs.

TMP Component	✓
1 Introductory Material	
■ Cover page	☐
■ Licensed Engineer stamp page (if necessary)	☐
■ Table of contents	☐
■ List of figures	☐
■ List of tables	☐
■ List of abbreviations and symbols	☐
■ Terminology	☐
2 Executive Summary	☐
3 TMP Roles and Responsibilities	
■ TMP manager	☐
■ Stakeholders/review committee	☐
■ Approval contact(s)	☐
■ TMP implementation task leaders (e.g., public information liaison, incident management coordinator, etc.)	☐
■ TMP monitors	☐
■ Emergency contacts	☐
4 Project Description	
■ Project background	☐
■ Project type	☐
■ Project area/corridor	☐
■ Project goals and constraints	☐
■ Proposed construction phasing/staging	☐
■ General schedule and timeline	☐
■ Related projects	☐
5 Existing and Future Conditions	
■ Data collection and modeling approach	☐
■ Existing roadway characteristics (history, roadway classification, number of lanes, geometrics, urban/suburban/rural)	☐
■ Existing and historical traffic data (volumes, speed, capacity, volume to capacity ratio, percent trucks, queue length, peak traffic hours)	☐
■ Existing traffic operations (signal timing, traffic controls)	☐
■ Incident and crash data	☐
■ Local community and business concerns/issues	☐
■ Traffic growth rates (for future construction dates)	☐
■ Traffic predictions during construction (volume, delay, queue)	☐

TMP Component	✓
6 Work Zone Impacts Assessment Report	
■ Qualitative summary of anticipated work zone impacts	☐
■ Impacts assessment of alternative project design and management strategies (in conjunction with each other)	☐
– Construction approach/phasing/staging strategies	☐
– Work zone impacts management strategies	☐
■ Traffic analysis results (if applicable)	☐
– Traffic analysis strategies	☐
– Measures of effectiveness	☐
– Analysis tool selection methodology and justification	☐
– Analysis results	☐
-- Traffic (volume, capacity, delay, queue, noise)	☐
-- Safety	☐
-- Adequacy of detour routes	☐
-- Business/community impact	☐
-- Seasonal impacts	☐
-- Cost effectiveness/evaluation of alternatives	☐
■ Selected alternative	☐
– Construction approach/phasing/staging strategy	☐
– Work zone impacts management strategies	☐
7 Selected Work Zone Impacts Management Strategies	
■ Temporary Traffic Control (TTC) strategies	☐
– Control strategies	☐
– Traffic control devices	☐
– Project coordination, contracting, and innovation construction strategies	☐
■ Public Information (PI)	☐
– Public awareness strategies	☐
– Motorist information strategies	☐
■ Transportation Operations (TO)	☐
– Demand management strategies	☐
– Corridor/network management strategies	☐
– Work zone safety management strategies	☐
– Traffic/incident management and enforcement strategies	☐
8 TMP Monitoring	
■ Monitoring requirements	☐
■ Evaluation report of successes and failures of TMP	☐
9 Contingency Plans	
■ Trigger points	☐
■ Decision tree	☐
■ Contractor's contingency plan	☐
■ Standby equipment or personnel	☐
10 TMP Implementation Costs	
■ Itemized costs	☐
■ Cost responsibilities/sharing opportunities	☐
■ Funding source(s)	☐
11 Special Considerations (As Needed)	☐
12 Attachments (As Needed)	☐

Appendix B – Work Zone Management Strategies Matrix

The information contained in this appendix is intended to support transportation agencies in the selection of work zone management strategies described in Section 2.2.1, Step 4 and Section 3.7 of this document. For the various work zone impact management strategies described in Section 4.0 of this document, Table B.1 presents some guidance for which strategies are anticipated to lead to an improvement in mobility or safety (motorist and worker), what project characteristics may trigger a strategy for consideration, pros and cons associated with the strategy, and other considerations. There may be exceptions; this is intended as guidance. The organization of the matrix is based on a compendium of options table contained in Ohio DOT's Policy No.: 516-003(P) –Traffic Management in Work Zones Interstate and Other Freeways[1] document.

Some of the typical project characteristics that should be considered when selecting work zone impact management strategies for a project include:

- Facility type (freeway, highway).
- Area type (urban, rural).
- Project length.
- Project duration.
- Multiple construction stages/phasing.
- Traffic volume.
- Capacity reductions.
- Expected delay.
- Crash rate.
- Percentage of trucks.
- Available detour route(s).
- Available alternative travel modes.
- Community factors (public exposure, business impacts, and residential impacts).

[1] Ohio Department of Transportation (ODOT) policy on Traffic Management in Work Zones Interstate and Other Freeways, Policy No.: 516-003(P), July 18, 2000. Available online in the Policy section of ODOT's web site. URL: http://www.dot.state.oh.us/Policy/516-003p.pdf (Accessed 09/08/05).

	Management Strategy	Mobility Improvement	Motorist Safety Improvement	Worker Safety Improvement	Triggers for Consideration
I. Temporary Traffic Control (TTC) Strategies					
A. Control Strategies					
IA1	Construction phasing/staging	✓			■ Long project duration
IA2	Full roadway closures Continuous (for a project phase or the entire project)			✓	■ Detour routes available ■ Project needs to be completed in a compressed timeframe ■ Traffic volume through the project can be accommodated on detour route(s) ■ Highway facilities ■ Short project length
	Off-peak/night/weekend	✓		✓	■ Detour routes available ■ High traffic volumes ■ Low traffic volumes during work time period
	Intermittent		✓	✓	■ Short project length ■ Short project duration ■ When work can be accomplished in short periods of time ■ Low traffic volumes ■ Rural areas
IA3	Lane shifts or closures Reduced lane widths to maintain number of lanes (constriction)	✓			■ Long project duration ■ High traffic volumes
	Lane closures to provide worker safety			✓	■ When the remaining lanes provide adequate capacity to handle the traffic demand ■ Minor work with short duration

Table B.1 TMP Strategy Matrix—Mobility/Safety Improvement and Considerations for Implementation

Potential Pros	Potential Challenges	Other Considerations
■ Less traffic impacts at each construction phase	■ Longer project duration	■ Adequate work areas ■ Extended periods of lane/ramp closures expected ■ When schedule allows
■ Faster construction ■ Easier, more efficient construction – larger workspace with more flexibility ■ No traffic distractions ■ Safer for workers ■ Better construction (e.g., smoother ride) ■ Public feedback often positive ■ Reduces need to set up and take down traffic control	■ May increase cost to motorists (time and fuel) ■ Accessibility to businesses and residences ■ Motorists may get lost ■ May significantly impact local roadways used for detours	■ Public information necessary ■ Signage and/or capacity improvements to detour route(s) may be necessary ■ Need enough labor and materials available for accelerated work
■ Faster construction ■ Less traffic impacts ■ Safer for workers	■ Motorists may get lost	■ Public information necessary ■ Signage and/or capacity improvements to detour route(s) may be necessary ■ Need to schedule around special events
■ Can close as necessary for construction purposes	■ Can result in large delays	■ Public information necessary ■ Detour route(s), with signage, may be needed
■ Can maintain existing number of lanes ■ Easier design ■ Detour route may not be necessary ■ Ramps can remain open	■ Can reduce traffic capacity ■ May interfere with contractor access ■ Narrow lanes (may affect motorist safety) ■ May take longer to construct ■ Barrier could still be required for some drop-offs	■ Less width reductions may be needed if the shoulder has adequate width and structural adequacy ■ May not be feasible where traffic volumes already approach or exceed the capacity of the roadway ■ Sometimes difficult to obtain minimum lane widths ■ Potential conflicts between width of roadway and width needed for work
■ Safer for workers ■ Can provide more work space	■ May interfere with contractor access ■ May sacrifice project quality ■ May cause delays	■ In conjunction with lane shift to shoulder or median

Management Strategy		Mobility Improvement	Motorist Safety Improvement	Worker Safety Improvement	Triggers for Consideration
I. Temporary Traffic Control (TTC) Strategies (Continued)					
A. Control Strategies (Continued)					
IA3	Reduced shoulder width to maintain number of lanes	✓			■ Enough shoulder space available ■ Minor work with short duration
	Shoulder closure to provide worker safety			✓	■ Enough shoulder space available ■ Minor work with short duration
	Lane shift to shoulder/median to maintain number of lanes	✓			■ High traffic volume ■ Enough shoulder space available ■ Where bridges can accommodate use
IA4	One-lane, two-way operation[2]				■ Highway type facilities ■ Rural areas ■ Short-term project covering a short distance ■ Traffic volume through the project is not high
IA5	Two-way traffic on one side of divided facility (crossover)			✓	■ Long project duration ■ Projects with multiple construction stages/phasing ■ Concerns for worker safety ■ When detour routes and/or median or shoulder is not available
IA6	Reversible lanes	✓			■ Where there are capacity limitations and no alternate routes ■ Significant directional peaking of traffic ■ Long project duration
IA7	Ramp closures/relocation	✓	✓		■ Alternative ramps/routes available ■ Shorter construction period required ■ High traffic volumes
IA8	Freeway-to-freeway interchange closures		✓		■ Alternative routes available
IA9	Night work	✓			■ Urban area ■ High traffic volume

Table B.1 TMP Strategy Matrix—Mobility/Safety Improvement and Considerations for Implementation (Continued)

[2] This strategy is most often used when access must be maintained, there are no feasible diversion routes available, or to avoid diverting traffic a long distance. Agencies are more likely to use this strategy out of necessity rather than to bring about mobility and safety improvements.

Potential Pros	Potential Challenges	Other Considerations
■ Traffic remains on routes	■ May interfere with contractor access ■ May compromise safety	■ In conjunction with lane shift to shoulder or median
■ Traffic remains on routes	■ May interfere with contractor access ■ May affect motorist safety ■ No room for breakdowns	■ Avoid in high incident areas
■ Traffic remains on routes ■ Low cost ■ Allows wider work area or maintains capacity	■ May interfere with contractor access ■ May compromise safety ■ No room for breakdowns ■ May damage the shoulder/median	■ May need to upgrade shoulder/median ■ Adequate structural capacity to carry traffic mix (including heavy trucks) is necessary
■ Easy to set-up	■ May result in long delays	■ Flaggers or temporary/portable traffic signals are typically used to control traffic ■ May be necessary to perform the work
■ Provides a more efficient work space ■ Can reduce construction period ■ Safer for workers	■ Additional cost to construct crossovers and separations between opposing traffic ■ Difficulty handling ramps	■ Shoulders and/or lane width reductions may be used to maintain an adequate number of lanes ■ Positive separations are required ■ Where roadway geometry makes the construction of crossovers practical
■ Accommodates peak traffic flow	■ May be labor intensive ■ Confusing to motorists ■ Cost of positive separation	■ Best serves commuter traffic ■ For high speed roadways, a movable barrier system or other form of positive separation is typically used to separate and direct traffic
■ Faster construction ■ Reduces mainline and cross road traffic congestion ■ May simplify the work zone	■ Diverts congestion elsewhere ■ Increases cost to motorists (time and fuel) ■ Motorists may get lost	■ Public information necessary
■ Construction duration can be reduced ■ May simplify the work zone	■ May significantly affect facility capacity ■ Additional signage to route motorists	■ In conjunction with accelerated construction/contracting techniques ■ Public information necessary
■ Maintains normal capacity during the day ■ Fewer delays	■ May be less safe due to lighting distractions, higher speeds, and increased driver impairment ■ Costly for labor ■ Possible reduced quality of work ■ May extend project duration	■ Where feasible to carry out work in nightly increments ■ Where traffic controls can be reconfigured on a nightly basis ■ Urban noise ordinances ■ Need enough resources and laborers available for night work

	Management Strategy	Mobility Improvement	Motorist Safety Improvement	Worker Safety Improvement	Triggers for Consideration
I. Temporary Traffic Control (TTC) Strategies (Continued)					
A. Control Strategies (Continued)					
IA10	Weekend work	✓			■ High traffic volume ■ Commuter traffic is significant
IA11	Work hour restrictions for peak travel	✓			■ Urban areas ■ High traffic volume ■ Significant peaking of traffic ■ Where significant capacity reductions are necessary
IA12	Pedestrian/bicycle access improvements	✓	✓		■ Long project duration ■ Significant pedestrian/bicyclist activities ■ Existing sidewalks traverse the work zone ■ A school route traverses the work zone
IA13	Business access improvements	✓			■ Long project duration ■ Where access to businesses may be reduced ■ Anticipated impacts to businesses
IA14	Off-site detours/Use of alternate routes	✓	✓		■ Where significant reduction in capacity is necessary in one or both directions ■ When a full road closure is being used to perform the roadwork ■ Long project duration ■ High traffic volume ■ Detour routes with capacity available
B. Traffic Control Devices[3]					
IB1	Temporary signs Warning	✓	✓	✓	■ In a situation that may not be readily apparent (e.g., speed reductions, road or lane narrows, etc.)
	Regulatory	✓	✓	✓	■ When necessary to inform road users of traffic laws or regulations
	Guide/information	✓	✓		■ When off-site detours are being used ■ When advanced notice is necessary for road users to choose an alternate route

Table B.1 TMP Strategy Matrix—Mobility/Safety Improvement and Considerations for Implementation (Continued)

[3] A wide range of other safety devices are described in Part 6 of the Manual on Uniform Traffic Control Devices (MUTCD) and are widely used to enhance safety and mobility in highway work zones. These devices, such as temporary traffic barriers and crash cushions, are included in the Work Zone Safety Management Strategies category.

Potential Pros	Potential Challenges	Other Considerations
■ Maintains normal capacity during weekdays ■ Fewer delays	■ May extend project duration	■ Need to consider special events when scheduling ■ Need enough resources and laborers available for weekend work
■ Maintains normal capacity during traffic peak times ■ Fewer delays	■ May extend project duration	■ Duration of work restrictions will vary by location
■ Safer for pedestrians and bicyclists	■ Additional cost to build alternate paths for pedestrians/bicyclists	■ Need local jurisdiction support ■ Improvements to the detour route may be needed to accommodate the diverted traffic including capacity and geometric improvements, signal retiming and coordination, signing and pavement markings, parking restrictions, and CMS to provide detour information
■ Accessibility to businesses ■ Positive community relations	■ Additional cost	
■ More efficient utilization of existing transportation facilities ■ May reduce motorist delays	■ May require additional cost ■ May significantly impact roadways used for detours ■ Motorists may get lost	
■ Reduces potential for incidents	■ May be ignored or missed by motorists when much signage is present	
■ Encourages reduced speeds ■ Reduces incident potential	■ May be ignored or missed by motorists when much signage is present	
■ Provides alternate route and work zone information to road users	■ May be ignored or missed by motorists when much signage is present	

	Management Strategy	Mobility Improvement	Motorist Safety Improvement	Worker Safety Improvement	Triggers for Consideration
I. Temporary Traffic Control (TTC) Strategies (Continued)					
B. Traffic Control Devices (Continued)					
IB2	Changeable message signs (CMS)	✓	✓		■ When work zone information is subject to frequent changes ■ Projects with multiple construction stages/phasing ■ Detour routes with capacity available
IB3	Arrow panels	✓	✓	✓	■ Lane closures, particularly on high-speed roadways
IB4	Channelizing devices	✓	✓	✓	■ All work zone types ■ When changes to the road configuration or potential hazards necessitate their use
IB5	Temporary pavement markings	✓	✓	✓	■ Long project duration ■ When additional markings are necessary to guide road users through the work zone
IB6	Flaggers and uniformed traffic control officers		✓		■ Low traffic volume projects ■ Rural areas ■ One-lane, two-way operations
IB7	Temporary traffic signals	✓	✓	✓	■ Where the work zone operations disrupt normal traffic patterns ■ One-lane, two-way operations ■ For longer-term projects ■ When additional capacity is needed
IB8	Lighting devices		✓	✓	■ When night work is being conducted ■ Long project duration ■ High traffic volume

Table B.1 TMP Strategy Matrix—Mobility/Safety Improvement and Considerations for Implementation (Continued)

Potential Pros	Potential Challenges	Other Considerations
■ Effective way to communicate real-time information to road users ■ Allows road users to adjust travel plans based on information ■ Draws special attention to key information	■ May be ignored or missed by motorists when much signage is present ■ Additional cost	■ Used to supplement normal static work zone signs ■ Needs a means of controlling/updating signs, such as a TMC
■ Assists motorists in navigating and merging through and around the work zone ■ Effective method to alert motorists of lane closures ■ Highly visible ■ Encourages smooth merging behavior	■ Additional cost	■ Used to supplement conventional traffic control devices
■ Helps to direct road users through the work zone ■ Delineates potential work zone hazards ■ Easy to set-up	■ Errant vehicles are not prevented from intruding beyond these devices	
■ Provides guidance and information for road users through the work zone	■ Visibility of the markings may be limited by weather conditions and debris	■ Need to obliterate obsolete markings to minimize possibility of misleading road users
■ Helps to alert road users to the presence of work operations	■ Reduces safety for road workers	■ In conjunction with intermittent closure
■ Helps improve ramp and/or detour capacity ■ Improves traffic flow through and near the work zone ■ Improves safety	■ Changes traffic patterns on the cross road ■ Cost	■ Signal installation should be warranted
■ Enhances visibility of devices and delineations in the work zone ■ Improves worker safety ■ Guides road users through the work zone particularly during night and under adverse conditions	■ May be distracting to motorists	

	Management Strategy	Mobility Improvement	Motorist Safety Improvement	Worker Safety Improvement	Triggers for Consideration
I. Temporary Traffic Control (TTC) Strategies (Continued)					
C. Project Coordination, Contracting and Innovative Construction Strategies					
IC1	Project coordination Coordination with other projects	✓			■ May be beneficial to any project
	Utilities coordination	✓			■ May be beneficial to any project
	Right-of-way coordination	✓			■ May be beneficial to any project
	Right-of-way coordination	✓			■ May be beneficial to any project
IC2	Contracting Strategies Design-build	✓			■ High traffic volume ■ When project acceleration is desirable
	A+B bidding	✓			■ High traffic volume ■ Where significant reduction in capacity is anticipated ■ Projects with significant impacts to traffic flow, businesses, and/or the community
	Incentive/disincentive clauses	✓			■ High traffic volume ■ Where significant reduction in capacity is anticipated ■ Projects with significant impacts to traffic flow, businesses, and/or the community ■ When an out-of-service facility needs to be replaced ■ No good alternate routes available

Table B.1 TMP Strategy Matrix—Mobility/Safety Improvement and Considerations for Implementation (Continued)

Potential Pros	Potential Challenges	Other Considerations
■ Reduces motorist delay ■ Minimizes impacts to potentially affected businesses and communities ■ Reduces exposure time to road work ■ May increase efficiencies	■ May be difficult to identify potential projects to coordinate with	■ Routine agency meetings may address coordination at the project level, corridor level, district region level, and at the State level
■ Reduces construction duration and delay ■ May reduce number of work zones and exposure to road work	■ May be difficult to identify potential projects to coordinate with	■ Development of training, education, and auditing standards for utility work can further minimize traffic impacts
■ Reduces construction duration and delay	■ May be difficult to identify coordination opportunities	■ Considering right-of-way issues early in project development can minimize traffic impacts
■ Minimizes potential impacts on other transportation facilities	■ May be difficult to identify coordination opportunities	
■ Shorter project duration ■ Less traffic impacts ■ May reduce administrative costs ■ Provides a single point of contact for design and construction issues ■ Allows for flexibility for innovative designs, materials, and construction techniques	■ May pay more for the actual construction	
■ Reduces construction time ■ Less traffic impacts	■ May pay more for the work ■ Potential for disagreement ■ Issues must be resolved quickly	■ If a project has significant issues with utilities, time-based bidding may be difficult; it may be possible to separate that portion of the project
■ Reduces construction time ■ Less traffic impacts ■ Early project completion may result in significant cost savings	■ Potential arguments for time extensions ■ Issues must be resolved quickly	■ If a project has significant issues with utilities, time-based bidding may be difficult; it may be possible to separate that portion of the project

	Management Strategy	Mobility Improvement	Motorist Safety Improvement	Worker Safety Improvement	Triggers for Consideration
I. Temporary Traffic Control (TTC) Strategies (Continued)					
C. Project Coordination, Contracting and Innovative Construction Strategies (Continued)					
IC2	Lane rental	✓			■ Urban area ■ High traffic volume ■ For paving freeways ■ No good alternate routes available
IC3	Innovative construction techniques (precast members, rapid cure materials)	✓			■ High traffic volume ■ Where traffic restrictions need to be minimized ■ When work activities need to be completed during night or weekend periods
II. Public Information (PI) Strategies					
A. Public Awareness Strategies					
IIA1	Brochures and mailers	✓	✓	✓	■ Urban area ■ Long project duration ■ Alternate travel modes available ■ High public exposure ■ Significant business impacts ■ Significant residential impacts
IIA2	Press releases/media alerts	✓	✓	✓	■ Large projects ■ Projects with multiple phases/construction stages ■ High public exposure ■ Significant business impacts ■ Significant residential impacts
IIA3	Paid advertisements	✓	✓	✓	■ Alternate routes available ■ High public exposure ■ Significant business impacts ■ Significant residential impacts

Table B.1 TMP Strategy Matrix—Mobility/Safety Improvement and Considerations for Implementation (Continued)

Potential Pros	Potential Challenges	Other Considerations
■ Less traffic impacts ■ Lanes only closed for short periods, when truly needed	■ Requires careful timekeeping ■ Potential for disagreements	
■ Reduces construction time ■ Less traffic impacts		
■ Condensed format of brochures lends itself to brief, high-impact messages ■ Brochures have a relatively long shelf life, which is useful for projects of long duration ■ Low cost ■ Easy to distribute	■ Information (e.g., dates of road closures) may change and not be reflected in the printed materials ■ Often targets local motorists only	■ Used in conjunction with other elements in the TMP ■ Most useful if it gives people an alternative to driving alone through the work zone – transit, ridesharing, alternate route
■ Cost effective if it uses free publicity to inform	■ Often targets local motorists only	■ For larger projects, announcements may include project start ups, periodic progress reports, and major traffic pattern changes
■ Gives travelers advanced warning to plan for delays or alternate routes ■ Covers a large or multi-jurisdictional area ■ Reinforces public awareness of the project ■ Can reach many people at one time	■ Requires advanced planning ■ Additional cost ■ May only target local motorists ■ Newspaper readers may skip over ads	■ Advance planning prior to the start of construction is essential to develop and schedule the needed advertisements

Management Strategy		Mobility Improvement	Motorist Safety Improvement	Worker Safety Improvement	Triggers for Consideration
II. Public Information (PI) Strategies (Continued)					
A. Public Awareness Strategies (Continued)					
IIA4	Public information center	✓	✓	✓	■ Urban area ■ Long project duration ■ Projects with multiple phases/construction stages ■ High public exposure ■ Significant business impacts ■ Significant residential impacts
IIA5	Telephone hotline	✓	✓	✓	■ Urban area ■ Long project duration ■ Projects with multiple phases/construction stages ■ Detour routes available ■ High public exposure ■ If frequent land and/or ramp closures are expected
IIA6	Planned lane closure web site	✓	✓	✓	■ Long project duration ■ Projects with multiple phases/construction stages ■ Detour routes available ■ High public exposure ■ Project includes lane closures
IIA7	Project web site	✓	✓	✓	■ Urban area ■ Long project duration ■ High public exposure ■ Project and traffic information changes frequently
IIA8	Public meetings/hearings	✓	✓	✓	■ Long project duration ■ High public exposure ■ Significant business impacts ■ Significant residential impacts
IIA9	Community task forces	✓	✓	✓	■ Long project duration ■ High public exposure ■ Significant business impacts ■ Significant residential impacts

Table B.1 TMP Strategy Matrix—Mobility/Safety Improvement and Considerations for Implementation (Continued)

Potential Pros	Potential Challenges	Other Considerations
■ Single, centralized access point to information about project ■ Provides direct access to information and people to talk to about the project	■ Additional cost of staffing and leasing office space and equipment	■ Project is localized ■ Construction zone is near major activity centers ■ Plan to have an information hotline ■ Center located near construction
■ Provides commuters with up-to-date traffic/construction information and demand management information ■ Information can be accessed whenever it is needed ■ May be easy to update	■ Pre-recorded messages may not contain all the information that travelers need ■ Needs to be accurate information, otherwise the information is not credible	■ Part of incident management ■ Can include prerecorded messages and/or real time interactive response information
■ Information can be posted for the construction season	■ The web site would need to be publicized for people to use	■ This web site is usually done for the entire region or State
■ Single access point to find out all the information for a particular project ■ May be easy to update	■ Web site would need to be maintained for effectiveness	■ Includes both static and/or real-time interactive information ■ Audience needs to be made aware of the web site ■ Cost will vary based on the complexity of the site
■ Community and stakeholders can feel informed and involved in the project ■ Opportunity to find out the information that stakeholders need	■ Stakeholders may feel frustrated if they feel that their inputs were not considered	■ Need to be wary of making "empty promises"
■ Gets buy-in from different stakeholders	■ Requires coordination beforehand ■ May not be cost effective	■ Best if developed early in planning for the project and continue meeting through design, construction, and project assessment

	Management Strategy	Mobility Improvement	Motorist Safety Improvement	Worker Safety Improvement	Triggers for Consideration
II. Public Information (PI) Strategies (Continued)					
A. Public Awareness Strategies (Continued)					
IIA10	Coordination with media/schools/ businesses/emergency services	✓	✓	✓	■ Long project duration ■ High crash rate ■ High public exposure ■ Significant business impacts ■ Significant residential impacts
IIA11	Work zone education and safety campaigns	✓	✓	✓	■ High traffic volume ■ Long project duration ■ Projects with multiple phases/construction stages ■ High crash rate
IIA12	Work zone safety highway signs		✓	✓	■ High traffic volume ■ Long project duration ■ Projects with multiple phases/construction stages ■ High crash rate
IIA13	Rideshare promotions	✓			■ Urban area ■ Long project duration ■ High expectation of delay ■ Where advantages to carpools exist (parking cost reductions, HOV lanes, HOV bypass lanes)
IIA14	Visual information (videos, slides, presentations) for meetings and web	✓	✓	✓	■ Projects with multiple phases/construction stages ■ High public exposure ■ Significant impact on businesses ■ Significant residential impacts

Table B.1 TMP Strategy Matrix—Mobility/Safety Improvement and Considerations for Implementation (Continued)

Potential Pros	Potential Challenges	Other Considerations
■ Travelers at major activity centers can plan in advance to take alternate routes		■ Requires advanced planning and coordination with these activity centers ■ Proximity to schools
■ May reduce the number of fatalities and injuries in work zones ■ Encourages general safety when driving around work zones ■ Help travelers know what signs mean and what resources there are for advanced planning	■ Results are harder to quantify	
■ Increases driver awareness to work zone safety concerns ■ May encourage speed reduction	■ Highway signs should be maintained – if there is no work zone, signs should be taken down	
■ May reduce the number of vehicles traveling through the work zone ■ Access to HOV lanes (if that exists) ■ May reduce delays	■ Cost of promotion and initial coordination effort ■ Need enough participation in order to make a difference	■ Works with large employment centers
■ Increases community awareness and understanding of the project	■ Publicity needed for travelers to visit the web site and view the visual information ■ May be expensive to produce	■ Supports public meetings, information center, or press releases ■ In conjunction with project or agency web site ■ Requires preparation, up front planning

	Management Strategy	Mobility Improvement	Motorist Safety Improvement	Worker Safety Improvement	Triggers for Consideration
II. Public Information (PI) Strategies (Continued)					
B. Motorist Information Strategies					
IIB1	Traffic radio	✓	✓	✓	■ Long project duration ■ Projects with multiple phases/construction stages ■ Detour routes available ■ Alternate travel modes available ■ High public exposure
IIB2	Changeable message signs (CMS)	✓	✓	✓	■ Projects with multiple phases/construction stages ■ Alternate routes available ■ When work zone conditions are subject to frequent or on-going changes (e.g., lane and/or ramp closures expected)
IIB3	Temporary motorist information signs	✓	✓	✓	■ All situations – Advanced warning/public information and signage is generally always beneficial
IIB4	Dynamic speed message sign		✓	✓	■ High crash rate
IIB5	Highway advisory radio (HAR)	✓	✓		■ When longer, more detailed messages than can be provided using signage are necessary ■ Alternate routes available ■ Long project duration ■ Projects with multiple phases/construction stages ■ Frequent lane and/or ramp closures expected

Table B.1 TMP Strategy Matrix—Mobility/Safety Improvement and Considerations for Implementation (Continued)

Potential Pros	Potential Challenges	Other Considerations
■ Can reach many commuters over a wide area ■ Little to no cost ■ Targets people who are likely to use the information	■ "Old" information is no longer useful	■ Coverage more likely for major projects
■ Provides real time information to motorists ■ Gives public advance warning to make decisions ■ Provides information to motorists directly affected by the project	■ Needs to be accurate information, otherwise the information is not credible	■ Needs means of controlling/updating messages, such as a TMC ■ Supports incident management ■ Need to keep information up to date and useful
■ Provides information to motorists ■ Warns motorists of potential hazards	■ If project is delayed, sign is wrong	■ Need to keep information up to date
■ Enhances safety by reducing speeding and speed variability		■ May not be effective without enforcement ■ May not be effective over a long work zone length and duration
■ Provides current information directly to motorists ■ Allows for longer, more detailed messages regarding a work zone incident ■ Promotes diversion of traffic to alternate routes when appropriate ■ Traffic patterns may resume to normal patterns more quickly ■ Easy to access	■ Limited range ■ Typically low utilization rates	■ Signs are used to inform road users of the HAR radio ■ Information needs to be current/ real-time ■ Newer technologies based on in-vehicle navigation systems and cell phones are replacing HAR usage ■ Motorists may not be aware of the HAR

	Management Strategy	Mobility Improvement	Motorist Safety Improvement	Worker Safety Improvement	Triggers for Consideration
II. Public Information (PI) Strategies (Continued)					
B. Motorist Information Strategies (Continued)					
IIB6	Extinguishable signs	✓	✓		■ When HAR is available or proposed ■ Long project duration ■ Projects with multiple phases/construction stages ■ Alternate routes available
IIB7	Highway information network (web-based)	✓		✓	■ Urban area ■ Long project duration
IIB8	511 traveler information systems (wireless, handhelds)	✓	✓	✓	■ Urban area ■ Long project duration ■ Detour routes available ■ Alternate travel modes available
IIB9	Freight travel information	✓	✓	✓	■ Urban area ■ Long project duration ■ Moderate to high percentage of trucks traveling through the work zone
IIB10	Transportation management center (TMC)	✓	✓	✓	■ Project located on a freeway in an urban area ■ Long project duration ■ Projects with multiple phases/construction stages ■ Delay highly expected for the project ■ High public exposure

Table B.1 TMP Strategy Matrix—Mobility/Safety Improvement and Considerations for Implementation (Continued)

Potential Pros	Potential Challenges	Other Considerations
■ Makes motorists aware that current information is available	■ Additional cost of maintenance and operation	■ Used in conjunction with HAR
■ Provides helpful information to motorists in one place ■ Convenient way to share information among stakeholders	■ Requires advanced planning	■ Information should be up-to-date
■ Provides motorists with current information ■ Information can be accessed whenever it is needed ■ May be easy to update	■ Can be distracting to the driver if used on the road ■ Road users must have these personal devices	■ General public awareness of 511 is needed
■ Provides useful information to freight stakeholders ■ May improve safety (e.g., reduce rear end collisions) by raising awareness before a work zone	■ Additional cost of coordination and disseminating information to select group	■ Work with the freight community to find out what information would be helpful ■ Can be provided to a central location (e.g., trucking company) or to truckers approaching work zone via CB radio
■ Have access to real-time information on traffic and incidents and relay that to the traveling public through different media outlets	■ Costly to build and operate ■ Detectors may be difficult to maintain while the work zone is taking place	

	Management Strategy	Mobility Improvement	Motorist Safety Improvement	Worker Safety Improvement	Triggers for Consideration
III. Transportation Operations (TO) Strategies					
A. Demand Management Strategies					
IIIA1	Transit service improvements	✓			■ Transit exists with capacity and frequency ■ Where transit use is likely to be adequate to make the improvements worthwhile
IIIA2	Transit incentives	✓			■ Where adequate transit routes and frequencies exist that serve major origins and destinations for motorists that would normally drive through the work zone if transit options were not available
IIIA3	Shuttle services	✓			■ Long project duration ■ High expectation for delay ■ Large amounts of similar origins and destinations
IIIA4	Ridesharing/carpooling incentives	✓			■ Long project duration ■ High expectation for delay ■ Few or no alternate routes ■ Where ridesharing has the potential to reduce travel volumes ■ Commuter traffic is significant
IIIA5	Park-and-ride promotion	✓			■ Long project duration ■ High expectation for delay ■ Alternative travel modes are available ■ Good parking sites are available ■ Commuter traffic is significant
IIIA6	High-occupancy vehicle (HOV) lanes	✓			■ Urban area ■ Long project duration ■ High traffic volume ■ High expectation for delay ■ Alternative travel modes are available

Table B.1 TMP Strategy Matrix—Mobility/Safety Improvement and Considerations for Implementation (Continued)

Potential Pros	Potential Challenges	Other Considerations
■ Shifts some demand from highway while it is under construction	■ Requires advance planning and coordination	■ In conjunction with transit incentives
■ Shifts some demand from highway while it is under construction	■ Requires advance planning and coordination	■ In conjunction with transit service improvements
■ Reduces vehicle trips and traffic in the work zone	■ Can be costly	■ Service would need to provide a benefit in terms of reduced travel time, travel and parking costs, etc. to attract users ■ Providing express shuttles from a few key locations may increase use
■ May reduce vehicle trips and traffic	■ Need many people participating in order for it to be cost effective	■ In conjunction with HOV lanes and/or parking management ■ Major activity and employment centers exist and can be targeted
■ Can be very cost-effective to commuters ■ May reduce the number of vehicles traveling through the work zone		■ In conjunction with rideshare programs, transit service available at lot, HOV lanes, and/or parking management ■ Good promotion of program is needed
■ Better roadway efficiency (move more people per lane)	■ Needs a high amount of similar origins and destinations and/or incentives ■ Taking a lane for HOV is likely to be controversial	■ In conjunction with HOV bypass and ramp metering, express transit, park and ride, and other demand management strategies ■ Enforcement needed

Management Strategy		Mobility Improvement	Motorist Safety Improvement	Worker Safety Improvement	Triggers for Consideration
III. Transportation Operations (TO) Strategies (Continued)					
A. Demand Management Strategies (Continued)					
IIIA7	Toll/congestion pricing	✓			■ Project is on a freeway ■ High traffic volume ■ Long project duration ■ Significant reductions in capacity are anticipated
IIIA8	Ramp metering	✓	✓		■ Long project duration ■ Project is on a freeway ■ There are a number of entrance ramps near the work zone
IIIA9	Parking supply management	✓			■ Urban area ■ Long project duration ■ Alternate travel modes are available ■ Limited supply of on-site and off-site parking lots
IIIA10	Variable work hours	✓			■ Long project duration ■ High traffic volume ■ Employment and activity center along corridor and alternate routes ■ Commuter traffic is significant ■ Significant traffic increases during peak hours
IIIA11	Telecommuting	✓			■ Urban area ■ High traffic volume ■ Long project duration ■ High expectation for delay ■ When significant reduction in capacity anticipated

Table B.1 TMP Strategy Matrix—Mobility/Safety Improvement and Considerations for Implementation (Continued)

Potential Pros	Potential Challenges	Other Considerations
■ Reduces peak-period vehicle trips	■ Lane(s) will need to be temporarily set aside	■ Enforcement needed
■ Maintains safe and smooth freeway operations ■ Controls entrance of vehicles to the roadway	■ May cause vehicles to idle too long ■ May result in ramp queues on local streets ■ Cost	■ Queues onto local streets may cause a problem depending on their extent ■ Can be used during peak periods or continuously ■ Secondary effect of diverting traffic to alternate routes
■ Cost-effective ■ Decreases single occupancy vehicle use when implemented in conjunction with other elements and incentives	■ Difficult to implement unless the responsible agency owns the lot and/or parking supply is limited	■ In conjunction with other demand management strategies
■ Distributes peak hour commuting over longer time period, thereby reducing travel demand during the peak periods	■ Effort to convince employers of the benefits	■ Needs to be supported by businesses and community
■ Reduces vehicle trips	■ Effort to convince employers of the benefits ■ May affect businesses, such as restaurants that are near employment centers	■ Needs to be supported by businesses and community

Management Strategy		Mobility Improvement	Motorist Safety Improvement	Worker Safety Improvement	Triggers for Consideration
III. Transportation Operations (TO) Strategies (Continued)					
B. Corridor/Network Management Strategies					
IIIB1	Signal timing/coordination improvements	✓	✓		■ Long project duration ■ High traffic volume ■ When additional capacity is needed through the intersection in the work zone or on nearby roadways during construction
IIIB2	Temporary traffic signals	✓	✓	✓	■ Long project duration ■ High traffic volume ■ High expectation for delay ■ When safety needs to be improved for new (temporary) turning movements through the work zone ■ When additional capacity is needed
IIIB3	Street/intersection improvements	✓	✓		■ Long project duration ■ High expectation for delay ■ When work zone results in major congestion that can be alleviated by street/intersection improvements
IIIB4	Bus turnouts	✓	✓		■ Long project duration ■ High occurrence of bus traffic and stops
IIIB5	Turn restrictions	✓	✓		■ Long project duration ■ High expectation for delay ■ When turning vehicles are causing unreasonable delays or crash potential in the work zone ■ When the geometric design or the available sight distance at the intersection does not adequately provide for a safe turning movement
IIIB6	Parking restrictions	✓			■ Long project duration ■ When significant reduction in capacity anticipated ■ When traffic demand at the location can be reduced by parking restrictions ■ When parking spots can be converted to an additional travel lane ■ When restricting parking spots can improve work zone access and quicken work zone activity

Table B.1 TMP Strategy Matrix—Mobility/Safety Improvement and Considerations for Implementation (Continued)

Potential Pros	Potential Challenges	Other Considerations
■ Increases throughput of the roadway ■ Improves traffic flow ■ Optimizes intersection capacity ■ Reduces frequent stops ■ Improves driver safety by smoothing the flow through work zone bottlenecks	■ Cost of estimating new saturation flow rates and demand	■ Estimating both potential demand and capacity constrained volumes for obtaining the optimal coordination
■ Improves traffic flow through and near the work zone ■ Helps achieve re-routing of traffic from project location ■ Improves driver safety by separating conflicting movements ■ Improves worker safety	■ Cost of signal design, placement, and operation ■ Changes traffic patterns on cross-roads	■ Signals should be warranted as per the agency's signal warrant requirements
■ Provides increased capacity ■ Improves motorist safety	■ Cost ■ Time to design and construct	■ Need to plan ahead to complete these before the main roadwork
■ Improves traffic flow and safety by minimizing traffic conflicts	■ Cost ■ Time to design and construct	■ Provision of gaps and sight distance for the buses to re-enter the traffic stream
■ Simple, cost-effective ■ Increases roadway capacity ■ Reduces potential congestion and delays ■ Improves safety	■ Additional delays for turning vehicles ■ Turning vehicles need to re-route	
■ Simple, cost-effective solution ■ Increases roadway capacity ■ Reduces traffic conflicts ■ Quickens work zone activity by improving access ■ Reduces duration of the work zone	■ Affects local parking ■ Will need flaggers if parking is converted to travel lane ■ Will need barricades if parking is closed, requiring additional setup time and cost	■ Impact to local businesses must be considered ■ May need to improve intersection geometrics to accommodate additional or relocated lanes ■ Can limit use to peak travel periods

Management Strategy		Mobility Improvement	Motorist Safety Improvement	Worker Safety Improvement	Triggers for Consideration
III. Transportation Operations (TO) Strategies (Continued)					
B. Corridor/Network Management Strategies (Continued)					
IIIB7	Truck/heavy vehicle restrictions	✓	✓		■ Projects with high truck volume ■ When significant reduction in capacity anticipated ■ When the location has heavy truck traffic but also has potential alternate truck routes ■ When capacity/safety concerns exist for truck movements through work zone ■ Passenger cars are expected to be significantly delayed due to truck traffic
IIIB8	Separate truck lanes	✓	✓		■ Long-duration projects with high truck volume ■ High expectation for delay ■ When significant reduction in capacity anticipated ■ When capacity/safety concerns exist for truck movements through work zone ■ Passenger cars are expected to be significantly delayed due to the trucks (e.g., areas with major inclines)
IIIB9	Reversible lanes	✓			■ Where there are capacity limitations in the direction of travel and no alternate routes ■ Long project duration ■ Significant peaking of traffic ■ Commuter traffic is significant
IIIB10	Dynamic lane closure system	✓	✓	✓	■ Long project duration ■ Projects with multiple construction stages/phasing ■ Moderate traffic volume and congestion ■ When needed capacity can be gained ■ When frequent lane closures are anticipated
IIIB11	Ramp metering	✓	✓		■ Long project duration ■ During mainline paving of basic freeway lanes where freeway demand needs to be metered to control congestion ■ Project is on a freeway ■ There are a number of entrance ramps near the work zone

Table B.1 TMP Strategy Matrix—Mobility/Safety Improvement and Considerations for Implementation (Continued)

Potential Pros	Potential Challenges	Other Considerations
■ Improves passenger car flow through the work zone by removing trucks from the traffic stream	■ Provision of an alternate truck route may adversely affect other traffic or roads ■ Requires additional signage/ personnel to enforce truck restrictions	■ Availability and sustainability of alternate routes for the trucks must be considered ■ Federal, State, and/or local ordinances that govern truck traffic access must be considered ■ Appropriate design and geometric concerns related to trucks would need to be addressed ■ Noise and business impacts from use of detour route may need to be considered
■ Can increase capacity of the roadway	■ Requires additional signage/personnel to enforce separate truck lane	■ Design of the dedicated truck route ■ State and/or local ordinances that govern truck traffic need to be considered ■ If shoulder is used, may need to improve it first
■ Accommodates peak traffic flow	■ Safety concerns ■ Cost of positive separation and/or additional pavement markings and signs ■ Confusing to infrequent road user	■ Works well with commuter traffic ■ For high speed roadways, a movable barrier system or other form of positive separation is typically used to separate and direct traffic
■ Enhances mobility and safety ■ Controls vehicle merging at the approach ■ Reduces vehicle conflicts ■ Construction time can be reduced with additional contractor area	■ Cost of dynamic message signs or other messaging devices is not available in-house	■ Can be used in conjunction with reversible lane
■ Maintains safe and smooth freeway operations ■ Controls entry of vehicles to the roadway ■ Improves safety by matching gaps between freeway and on-ramp vehicles ■ May help spread traffic to other roads	■ May result in ramp queues backing onto local streets ■ Cost	■ Potential impacts on local streets need to considered before introducing ramp metering ■ Various ramp metering strategies should be considered ■ Can be used during peak periods or continuously

Management Strategy		Mobility Improvement	Motorist Safety Improvement	Worker Safety Improvement	Triggers for Consideration
III. Transportation Operations (TO) Strategies (Continued)					
B. Corridor/Network Management Strategies (Continued)					
IIIB12	Temporary suspension of ramp metering	✓			■ At the end of a detour where it is advantageous to get traffic onto the freeway quickly
IIIB13	Ramp closures	✓	✓	✓	■ High traffic volume ■ If accelerated construction at the ramps is required ■ Where work zone activity requires work space associated with the ramps ■ Where freeway volumes at the ramp location have to be controlled ■ When alternate ramps/routes are available close by
IIIB14	Railroad crossings controls		✓		■ Long project duration ■ When work zone stops and delays have potential of forcing vehicles to stop on railroad tracks
IIIB15	Coordination with adjacent construction site(s)	✓			■ Whenever multiple work zone projects are in close proximity of each other or impact the same region

Table B.1 TMP Strategy Matrix—Mobility/Safety Improvement and Considerations for Implementation (Continued)

Potential Pros	Potential Challenges	Other Considerations
■ Simple, cost-effective solution for improving traffic flow through the detour	■ Can lead to a potential downstream freeway bottleneck	■ Downstream freeway volumes must be evaluated before suspending ramp metering
■ Cost-effective ■ Can pave/repair the full width of the ramp ■ Better, faster construction ■ Can provide work access within the work zone ■ May improve traffic flow on the mainline ■ Reduces crossroad congestion ■ Easy to sign in rural areas	■ Potential impact to business and community access ■ Blocks traffic pattern and forces new traffic pattern ■ Moves congestion elsewhere ■ May have negative impact on local streets in high density locations	■ It might affect motorist mobility adversely ■ Impact to local businesses should be considered ■ The strategy is inexpensive if only signs are used but will cost more if alternate route modifications are required ■ Adequate driver information signs and clearly marked detour routes need to be provided
■ Enhances motorist safety ■ Enhances rail safety	■ Cost	■ Requires understanding on the traffic dynamics of the specific location ■ State and/or local ordinances that govern railroad traffic control
■ Minimizes the combined impacts on road users ■ Potential for cost savings to road users, community, and agency ■ Addresses the need to maintain adequate capacity in the system ■ Evaluates the complete city-wide street network for capacity needs rather than individual work zones ■ Maintains system-wide mobility	■ Complexity of coordinating adjacent work zones ■ Cost	■ Accommodate anticipated travel demand by not implementing work zones on parallel highways or complementary or alternate routes ■ Requires good communication within and across various agencies ■ Some work, such as utility work, may be done by other agencies

Management Strategy		Mobility Improvement	Motorist Safety Improvement	Worker Safety Improvement	Triggers for Consideration
III. Transportation Operations (TO) Strategies (Continued)					
C. Work Zone Safety Management Strategies					
IIIC1	Speed limit reduction/variable speed limits		✓	✓	■ Where significant reduction in capacity is anticipated ■ When turning/merging conflicts exist that cannot be otherwise resolved ■ When there are lane or shoulder closures, traffic shifts, or other changes in geometry ■ On detours where traffic volumes and conflicts are increased ■ When work is adjacent to the traffic lane
IIIC2	Temporary traffic signals	✓	✓	✓	■ Long project duration ■ High traffic volume ■ When safety needs to be improved (e.g., for temporary turning movements) ■ When additional capacity is needed on a temporary basis during construction ■ When high delays are expected on ramps/detour routes ■ One-lane, two-way operations
IIIC3	Temporary traffic barrier		✓	✓	■ Long project duration ■ When long-term work zone activity is next to the travel lanes ■ When high-speed opposing travel lanes are present
IIIC4	Movable traffic barrier systems	✓	✓	✓	■ Long project duration ■ Projects with multiple construction stages/phasing ■ High traffic volume ■ When roadway capacity can be gained ■ Roadways with capacity limitations in the direction of travel and no alternate routes ■ When repeated barrier shifts are needed ■ When frequent lane closures are anticipated ■ When reversible lanes are used

Table B.1 TMP Strategy Matrix—Mobility/Safety Improvement and Considerations for Implementation (Continued)

Potential Pros	Potential Challenges	Other Considerations
■ Enhances motorist and worker safety	■ Traffic mobility ■ Compliance with speed limit reductions is often poor	■ Additional enforcement and/or increased penalties might be needed for motorist compliance with the reduced speed limits ■ Can be continuous, or intermittent (e.g., only when workers are present)
■ Improves worker safety by replacing flaggers with temporary signals ■ Improves driver safety by separating conflicting movements ■ May increase capacity	■ Cost of signal design, placement, and operation ■ Changes traffic patterns on cross-roads	■ Signals should be warranted as per the agency's signal warrant requirements ■ May lead to re-routing of traffic from project location
■ Enhances safety to workers by the physical separation of the motorists from work zone ■ Enhances motorist safety by physically separating traffic traveling in opposite directions	■ Barrier system reduces saturation flow rates of travel lanes	■ Temporary barrier usage should be based on length of the work zone project, volume and speeds in the location, and agency practices ■ Screens may be mounted on the top of temporary traffic barriers to discourage gawking and reduce headlight glare
■ Rapid and safe reconfiguration of the traffic barrier system ■ Can provide additional space for the contractor to work ■ Enhances motorist safety by clearly delineating direction of travel	■ Cost ■ Labor for movement of barrier	■ More effective when there is a majority commuter traffic and/or fluctuating demand on the roadway ■ Shift distance must be constant

Management Strategy		Mobility Improvement	Motorist Safety Improvement	Worker Safety Improvement	Triggers for Consideration
III. Transportation Operations (TO) Strategies (Continued)					
C. Work Zone Safety Management Strategies (Continued)					
IIIC5	Crash-cushions		✓	✓	■ Long project duration ■ High traffic volume ■ High crash rate ■ When temporary hazards (e.g., work zone vehicles and other work zone-related barriers) are in close proximity to motorists
IIIC6	Temporary rumble strips		✓	✓	■ Long project duration ■ High crash rate ■ When the work zone occurs on an open stretch of highway where drivers may tend to lose alertness ■ Where the traffic pattern has been changed ■ Where there is alternating one-way traffic with a temporary traffic signal
IIIC7	Intrusion alarms		✓	✓	■ Long project duration ■ High crash rate ■ In locations where worker safety is of particular concern ■ Areas where sight distance is limited (e.g., after curves)
IIIC8	Warning lights		✓	✓	■ Long project duration ■ High crash rate ■ Where attention needs to be drawn to critical information that can lead to potentially severe consequences if missed
IIIC9	Automated Flagger Assistance Devices (AFADs)			✓	■ High crash rate ■ Where flaggers are needed ■ Short-term lane closures
IIIC10	Project task force/committee		✓	✓	■ Long project duration ■ High public exposure/traffic volume ■ High business impacts ■ High residential impacts ■ In locations where worker and motorist safety are of particular concern

Table B.1 TMP Strategy Matrix—Mobility/Safety Improvement and Considerations for Implementation (Continued)

Potential Pros	Potential Challenges	Other Considerations
■ Protects a temporary hazard ■ Prevents vehicle intrusion into the work space ■ Significantly enhances safety of both motorist and worker	■ Cost ■ Space and labor for placement	■ If cushion is struck frequently, replacement and repair costs may be significant
■ Alerts motorists about the presence of work zone ■ Alerts motorists to change in traffic pattern	■ Cost ■ Rumble strips are not as effective in urban settings and are not appropriate for residential areas because of the noise	■ Pavement needs to be prepared for laying rumble strips ■ Implementation of rumble strips must be evaluated on a project-to-project basis
■ Wakens dozing or unalert drivers, who are a cause of roadway and work zone crashes ■ Provides workers with critical reaction time needed to move out of harms way	■ Cost ■ Can startle the errant motorist and also other adjacent vehicles	■ Unreliable and/or frequent false alarms may cause workers to ignore the warning sounds
■ Alerts motorists to critical information that can increase both motorist and worker safety	■ Cost ■ Space and labor for placement	■ Must be used smartly so that motorists will not ignore the lights ■ State and/or local ordinances that govern signage must be considered
■ Improves worker safety by removing worker from the roadway	■ Cost	
■ Develops solutions to safety and traffic flow issues ■ Improves worker and motorist safety due to trained and responsible persons in-charge	■ Cost of training ■ Team dynamics where no one takes responsibility for a particular job	■ Team members must be assigned specific tasks with specific objectives to achieve overall safety during the project

Management Strategy		Mobility Improvement	Motorist Safety Improvement	Worker Safety Improvement	Triggers for Consideration
III. Transportation Operations (TO) Strategies (Continued)					
C. Work Zone Safety Management Strategies (Continued)					
IIIC11	Construction safety supervisors/inspectors		✓	✓	■ Long project duration ■ In locations where worker and motorist safety are of particular concern ■ May be applicable to any work zone
IIIC12	Road safety audits		✓	✓	■ May be performed during any or all stages of a project and on existing roads
IIIC13	TMP monitor/inspection team	✓	✓	✓	■ Long project duration ■ Projects with multiple construction stages/phasing ■ When congestion is a concern ■ In locations where worker and motorist safety are of particular concern
IIIC14	Team meetings		✓	✓	■ Long project duration ■ Where large projects with complex traffic conditions are present
IIIC15	Project on-site safety training			✓	■ Long project duration ■ In locations where worker and motorist safety are of particular concern
IIIC16	Safety awards/incentives		✓	✓	■ Long project duration ■ In locations where worker and motorist safety are of particular concern
IIIC17	Windshield surveys	✓	✓	✓	■ Long project duration ■ In locations where worker and motorist safety are of particular concern

Table B.1 TMP Strategy Matrix—Mobility/Safety Improvement and Considerations for Implementation (Continued)

Potential Pros	Potential Challenges	Other Considerations
■ Improves worker and motorist safety due to trained and responsible person in-charge	■ Cost of training	■ In larger projects more than one person might be needed, while in smaller projects the safety supervisor may have other responsibilities
■ Improves worker and motorist safety due to upfront identification of potential safety hazards for remediation	■ Cost and time to perform audit	
■ Improves worker and motorist safety due to trained and responsible person in-charge ■ Aids in identifying whether the TMP is effective and if changes are needed to improve safety and mobility ■ Provides useful data for improving future TMPs	■ Cost of training	
■ Improves worker and motorist safety	■ Cost and time involved	■ Team dynamics may be challenging ■ Meetings should be regularly held to be effective
■ Improves worker safety due to the clear understanding on safety procedures and specific risks associated with the project by all workers	■ Cost of safety training for all personnel	■ Such trainings must be conducted periodically during the project life
■ Provides an alert work force that is proactively weeding out safety problems	■ Dissension among workers due to not receiving awards	■ Incentives and awards must be judged in an acceptable, non-partial way
■ Identifies and addresses potential safety deficiencies ■ Improves worker and motorist safety due to the proactive approach of identifying potential safety concerns ■ May lead to improved traffic flow	■ Cost and time to perform surveys	■ Such inspections are typically conducted by designated agency staff in cooperation with project staff

Management Strategy		Mobility Improvement	Motorist Safety Improvement	Worker Safety Improvement	Triggers for Consideration
III. Transportation Operations (TO) Strategies (Continued)					
D. Traffic/Incident Management and Enforcement Strategies					
IIID1	ITS for traffic monitoring/management	✓	✓	✓	■ Can be applicable to all situations–to convey messages that communicate accurate, timely, and pertinent information to motorists about prevailing and anticipated traffic conditions ■ Long project duration ■ Presence of permanent ITS deployment and/or TMC ■ High expected delay ■ Projects with multiple construction stages/phasing ■ Available detour routes exist ■ Frequent lane and/or ramp closures expected ■ Existing and potential high incident locations
IIID2	Transportation management center (TMC)	✓	✓		■ Urban area ■ Long project duration ■ Projects with multiple construction stages/phasing ■ High expected delay ■ High public exposure/traffic volume
IIID3	Surveillance [Closed-Circuit Televisions (CCTV), loop detectors, lasers, probe vehicles]	✓	✓		■ Long project duration ■ All situations–advanced warning/public information and signage is generally always beneficial

Table B.1 TMP Strategy Matrix—Mobility/Safety Improvement and Considerations for Implementation (Continued)

Potential Pros	Potential Challenges	Other Considerations
■ Provides real-time information to motorists ■ Enables agency to manage the transportation system in and around the work zone in real-time ■ Provides road users with information to divert or take other appropriate measures in response to an incident ■ Informs drivers of speed limit reductions and enforcement activities ■ Allows motorists to avoid hazards and delays, and respond properly to changing roadway conditions ■ Improves driver guidance and creates safer operations	■ Cost ■ Needs accurate and reliable information that is dependable	■ Needs means of communication to transmit data; communication options may be limited by geography or existing infrastructure ■ Needs an existing or planned TMC or the establishment of one—TMC can be virtual/remote ■ Supports incident management ■ May reduce the impact on businesses created by construction activities and detours
■ Provides centralized coordination and management of incidents ■ Enhances safety and mobility by the use of centralized approach to manage traffic	■ Cost	■ Existing TMC is usually used and is staffed by either contract staff and/or agency personnel
■ Verifies the presence of traffic problems and incidents ■ Helps to determine appropriate response to address an incident ■ Contributes to saving both motorist and worker lives by aiding quick, appropriate response from local incident response agencies	■ If project is delayed, sign is wrong	■ Supports incident management ■ Needs existing, planned, or virtual TMC ■ Requires reliable and timely data ■ Used to provide road user information

Management Strategy		Mobility Improvement	Motorist Safety Improvement	Worker Safety Improvement	Triggers for Consideration
III. Transportation Operations (TO) Strategies (Continued)					
D. Traffic/Incident Management and Enforcement Strategies (Continued)					
IIID4	Helicopter for aerial surveillance	✓	✓		■ Long project duration ■ Projects with multiple construction stages/phasing ■ Large, complex work zone project
IIID5	Traffic Screens	✓	✓	✓	■ High traffic volumes ■ When crash rate is high ■ When headlight glare needs to be reduced ■ When construction is immediately adjacent to traffic
IIID6	Call boxes	✓	✓		■ Rural/low-density highways where help is not readily available ■ Where cell phone coverage is poor
IIID7	Mile-post markers		✓		■ Long project duration ■ May be applicable to any work zone
IIID8	Tow/freeway service patrol	✓	✓		■ Long project duration ■ High public exposure/traffic volume ■ Where incidents can create significant delays ■ Where shoulder width reductions or closures are expected ■ Existing and potential high incident locations

Table B.1 TMP Strategy Matrix—Mobility/Safety Improvement and Considerations for Implementation (Continued)

Potential Pros	Potential Challenges	Other Considerations
■ Aids in quick identification of traffic problems and incidents and quick response ■ Enables excellent coverage of a wide area	■ Cost ■ More often the helicopter is media controlled rather than controlled by the project or incident agency	■ Supports incident management ■ Mostly achieved by cooperation and cost sharing with local media
■ Reduced driver distraction ■ Reduced rubbernecking, which can prevent congestion ■ Reduces headlight glare	■ Additional cost to set up and maintain screens	
■ Provides motorists the means to reach help quickly ■ Expedites response and clearance times for crashes and breakdowns	■ Cost	■ Call boxes must be accessible within walking distance from the incident ■ With increasing use of cell phones and cell phone coverage, call boxes are becoming less common
■ Provides the motorist with the location information critical for getting quick help ■ Aids in responding to incidents or breakdowns ■ Helpful in managing traffic records and subsequent analysis		■ With the E911 mandate and increasing use of cell phones this might not be necessary in the future for pin-pointing incident locations for 911 dispatchers ■ May also be called location reference markers ■ The spacing of the markers is important. Placing markers a tenth of a mile apart rather than a mile apart enables motorists to more easily reference their location ■ Location markers can be helpful in areas where people may become easily confused, such as at a complicated intersection
■ Reduces the time required to remove the incident from the roadway	■ Cost of maintaining dedicated towing equipment and crew	■ Parking areas and turnaround locations are needed for the tow trucks to ensure quick response times ■ Towing services are generally contracted, while freeway service patrols are more likely to be publicly operated

Management Strategy		Mobility Improvement	Motorist Safety Improvement	Worker Safety Improvement	Triggers for Consideration
III. Transportation Operations (TO) Strategies (Continued)					
D. Traffic/Incident Management and Enforcement Strategies (Continued)					
IIID9	Total station units	✓			■ Long project duration ■ High crash rate ■ Where incidents can create significant delays
IIID10	Photogrammetry	✓			■ Long project duration ■ High crash rate ■ Where incidents can create significant delays
IIID11	Coordination with media	✓	✓		■ Long project duration ■ High public exposure/traffic volumes
IIID12	Local detour routes	✓			■ Long project duration ■ High traffic volume ■ High crash rate ■ Where detour routes are available
IIID13	Contract support for incident management	✓	✓		■ Long project duration ■ High crash rate ■ In large urban areas with large and frequent work zone projects

Table B.1 TMP Strategy Matrix—Mobility/Safety Improvement and Considerations for Implementation (Continued)

Potential Pros	Potential Challenges	Other Considerations
■ Reduces incident clearance times	■ Cost ■ Time consuming	■ Photogrammetry or laser measuring units might replace total station units as a cost-effective and time-efficient alternative ■ In order to be most effective, a trained crew should set up and manage these units
■ May reduce incident clearance times	■ Cost ■ Not widely validated for effectiveness in crash investigations	■ Photogrammetry is cost-effective when compared to total station units
■ Procedures to be followed in the event of an incident or major traffic delay are established in advance ■ Helps to ensure the news media is able to convey factual information concerning incidents and traffic delays ■ Provides advance guidance to motorists on major traffic delays and incidents	■ Requires time to develop good relationships and procedures	■ Personnel turnover or extended time between occurrences may mean procedures need to be refreshed
■ Proactive approach helps in having a readily available, well-thought out plan for detours when incidents and major traffic delays happen	■ Cost	■ Requires advance approval or authorization from the local agency for the use of the detour route in the event of an incident ■ Need a means to communicate the alternate routes to travelers when appropriate
■ Provides additional, dedicated personnel for incident management	■ Cost	■ During road projects, it is important to have people available on call who can quickly get to an incident when needed ■ Need to establish means of coordinating with existing/other incident response

	Management Strategy	Mobility Improvement	Motorist Safety Improvement	Worker Safety Improvement	Triggers for Consideration
III. Transportation Operations (TO) Strategies (Continued)					
D. Traffic/Incident Management and Enforcement Strategies (Continued)					
IIID14	Incident/emergency management coordinator	✓	✓	✓	■ Long project duration ■ Large complex project where on-going incident management is necessary ■ High public exposure/traffic volume
IIID15	Incident/emergency response plan	✓	✓	✓	■ Long project duration ■ Major/complex work zone projects where there is potential for recurring significant incidents ■ High public exposure/traffic volume
IIID16	Dedicated (paid) police enforcement		✓	✓	■ Long project duration ■ High crash rate ■ In large and complex work zone locations where enforcement is an issue or incident support is desired
IIID17	Cooperative police enforcement		✓	✓	■ Long project duration ■ High crash rate ■ In complex work zone locations where enforcement is an issue ■ May be applicable in any work zone
IIID18	Automated enforcement		✓	✓	■ Long project duration ■ Long project length ■ High crash rate ■ Where inadequate off-road space and/or no shoulders are available
IIID19	Increased penalties for work zone violations		✓	✓	■ Long project duration ■ May be applicable in any work zone

Table B.1 TMP Strategy Matrix—Mobility/Safety Improvement and Considerations for Implementation (Continued)

Potential Pros	Potential Challenges	Other Considerations
■ Provides a dedicated, responsible person for managing incidents and ensuring that traffic safety and mobility goals are met	■ Cost	
■ Prompt and appropriate response and clearance of incidents	■ Cost ■ Predicting and planning for potential incidents	■ Multi-agency coordinated effort is needed for identifying potential incidents and planning for them
■ Enhances safety of motorists and workers ■ Supports incident management ■ Promotes orderly traffic flow	■ Cost	■ Police should be adequately trained to perform their duties safely
■ Enhances safety of motorists and workers ■ Supports incident management ■ Promotes orderly traffic flow	■ Enforcement is provided on an as-available basis as reimbursement of enforcement costs is generally not provided	■ Similar to dedicated (paid) police enforcement except for the cost ■ Police should be adequately trained to perform their duties safely
■ May cost less than police ■ Promotes compliance with speed limits and other traffic regulations without the presence of police	■ Political and legal privacy issues limit use of this strategy ■ Cost	■ To effectively provide automated enforcement, a TMC should be present that can centrally coordinate the various technologies available to the agency
■ Improves safety by promoting compliance with work zone regulations		■ Requires enforcement to be effective

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15. Supplementary Notes

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16. Abstract

This Guide is designed to help transportation agencies develop and implement transportation management plans (TMPs). A TMP lays out a set of coordinated transportation management strategies and describes how they will be used to manage the work zone impacts of a road project. The scope, content, and level of detail of a TMP may vary based on an agency's work zone policy and the anticipated work zone impacts of the project. The intended audience for this Guide is the persons responsible for developing TMPs. Depending on the agency's processes and procedures, this may be agency personnel and/or contractors. Persons responsible for TMP-related policy/procedure development and revision, implementation, review, approval, and assessment will also benefit from this Guide.

This document also provides support to agencies in their efforts to implement the recently updated work zone regulations. In September 2004, the Federal Highway Administration (FHWA) published updates to the work zone regulations at 23 CFR 630 Subpart J. The updated rule is referred to as the Work Zone Safety and Mobility Rule (Rule) and applies to all State and local governments that receive Federal-aid highway funding. Transportation agencies are required to comply with the provisions of the Rule by October 12, 2007. The changes made to the regulations broaden the former rule to better address the work zone issues of today and the future.

Growing congestion on many roads, and an increasing need to perform rehabilitation and reconstruction work on existing roads already carrying traffic, are some of the issues that have lead to additional, more complex challenges to maintaining work zone safety and mobility. To help address these issues, the Rule provides a decision-making framework that facilitates comprehensive consideration of the broader safety and mobility impacts of work zones across project development stages, and the adoption of additional strategies that help manage these impacts during project implementation. The Rule requires agencies to develop an agency-level work zone safety and mobility policy to support systematic consideration and management of work zone impacts across all stages of project development. Based on the policy, agencies will develop processes and procedures to support implementation of the policy. The third primary element of the Rule calls for the development of project-level procedures to address the work zone impacts of individual projects. This includes requirements for identifying significant projects and developing and implementing TMPs for all Federal-aid highway projects. This document is the third of four guidance documents on the Rule and contains guidance, as well as many examples of how transportation agencies have developed and implemented TMPs or similar plans.

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