1.1 Work Zone Policy Statement
The Wisconsin Department of Transportation (WisDOT) is committed to promoting safety for the traveling public and workers, minimizing congestion and adverse traffic impacts, and providing for improved public satisfaction during construction, maintenance, utility, and all other activities performed on or near the WisDOT highway network. Compliance with this policy will reduce work zone crashes, travel time, and provide benefits to all stakeholders. All regional offices and statewide bureaus are responsible for implementing the portions of this policy affecting their operations.

1.1.1 Goals and Objectives
The goals and objectives of this policy are to:
- Reduce crashes in work zones.
- Provide a conducive environment for safety and mobility for workers and the traveling public.
- Minimize work zone related delays not to exceed 15 minutes above normal recurring traffic delays.
- Provide traveler information to minimize delays and improve mobility, efficiency and safety.
- Clearly define stakeholder responsibilities.
- Develop work zone training for WisDOT staff.
- Evaluate and continuously improve work zone safety and mobility performance.

1.1.2 Applicability
This policy is applicable to all work, including contracts for highway construction, railroad crossings, maintenance, and utility projects on state trunk highways, and Federal and State funded local roads improvement projects. These activities must have a Transportation Management Plan (TMP).
WisDOT will submit all TMPs to the Federal Highway Administration (FHWA) for their concurrence on all projects subject to federal oversight, both on and off the National Highway System (NHS) per the WisDOT/FHWA Federal-Aid Oversight Agreement. WisDOT must approve projects not subject to Federal Oversight, both on and off the NHS.

It is WisDOT's policy to consider work zone impacts in all phases of project development and construction. Incorporate specific mitigation strategies in the TMP during the project development process to address the characteristics of a particular project and its associated work zone impacts. Work zone data and annual project reviews will be used to evaluate work zone processes and procedures. The changes made to the TMP during construction will facilitate improvements at the project level and system-wide. Personnel involved in project development and construction should receive appropriate training periodically.

This policy supplements existing Department wide policies, standards, guidelines, processes, and practices as detailed in the FDM, Standard Specifications, Construction and Materials Manual (CMM), Traffic Engineering Operations and Safety Manual (TEOpS), MUTCD, WisDOT supplement, etc. Refer to FDM 11-50-5 for TMP preparation process.

1.2 Responsibilities

1.2.1 Bureau of Highway Traffic Operations (BTO) and Bureau of Project Development (BPD) Directors and Regional Directors
- Advocate for compliance with TMP guidelines and lane closure policies, and approve corridor and project variances to established guidelines.
- Maintain awareness of the cumulative impacts of multiple projects along a corridor.
- Advocate for funding support for mitigation strategies included in TMPs.

1.2.2 Bureau of Traffic Operations (BTO)
Revise 11-50-1.2.2 (Bureau of Traffic Operations (BTO)) review and approval guidance.
Under the leadership of BTO, the Traffic Engineering Section is responsible for (in collaboration with other bureaus and regional offices) developing, setting, communicating, and updating work zone policies, procedures, and guidelines. These responsibilities include but are not limited to:

- Review and approve TMP type 3, 4 and any with federal oversight.
- Develop and maintain work zone traffic control standards and guidelines.
- Develop work zone traffic control specifications and standardized special provisions (STSP) in coordination with the Bureau of Project Development (BPD) and regional WisDOT offices.
- Review continually the effectiveness of work zones, improve and update work zone processes, procedures and policies to ensure quality and statewide consistency.
- Review and comment on work zone traffic control and mobility exceptions for TMP type 3 and 4.
- Develop work zone training program. The training program will provide appropriate levels of detail for supervisors, project managers, project leaders, inspectors, flaggers and workers.
- Review/approve speed zone declarations when reducing speed limit for 65 mph and 70 mph facilities.
- Review/approve traffic mitigation strategies used.

1.2.3 Bureau of Project Development (BPD)
- Review Design Study Reports (DSR) for work zone TMP and identified TMP type.
- Coordinate with BTO and Region for review of TMP types 3 & 4, and for exceptions to TMP and lane closure guidelines.
- Participate with BTO in reviewing work zone effectiveness and updating work zone processes and policies.

1.2.4 Regional WisDOT Offices
The project manager in collaboration with traffic operations at the Region is responsible for developing and implementing TMP. The TMP is developed according to TMP guidance, the Facilities Development Manual (FDM), Traffic Engineering Operations and Safety Manual (TEOpS), Manual on Uniform Traffic Control Devices (MUTCD), and other supplemental policies, directives, and applicable project specific contract documents including handbooks and special Traffic Control Plans (TCP).

1.2.4.1 Project Development Chief
- Support the consideration of work zone impacts and development of TMPs early in the project development process for all projects.
- Support coordination of TMPs along corridors and between adjacent regions and neighboring states.
- Support resource availability for TMP development, mitigation strategy measures and activities.
- Inform Regional Director of all projects with significant traffic impacts.

1.2.4.2 Operations Chief
- Maintain awareness of corridor and project variances that exceed the allowable limits.
- Maintain awareness of project-specific exceptions to work zone mobility policy.
- Advocate for resource availability for TMP development and strategies measures and activities.

1.2.4.3 Regional Planners
- Identify TMP type during scoping process in collaboration with PDS and Traffic Unit.
- Identify potential strategies in scoping document.
- Identify funding needs and issues associated with the TMP.
- Coordinate scheduling of projects to minimize repetitive construction projects or activities along a segment of roadway and to minimize conflicting projects on parallel/alternate routes.

1.2.4.4 Regional Traffic/Work Zone Engineers
- Provide input into type of TMP during scoping process.
- Provide input during TMP development, implementation and conflict resolution.
- Provide input for all traffic impact assessment and mitigation decisions during project initiation, scoping, design, construction and evaluation.
- Provide input on project reviews, approval, and modification of all TMP strategies.
- Verify that traffic control measures are in conformance with MUTCD, WisDOT Standard Detail Drawings (SDD), Traffic Guidelines Manual, WisDOT Standard and Supplemental specifications.
- Verify that traffic delays are minimized and do not exceed allowable limits. If exceeded consult with
TMP team and / or project staff about possible modifications to the TMP.
- Review implementation plan with the project leader before construction.
- Verify with project staff that the contractor is complying with TMP as it relates to the handling of traffic.
- Review changes made by the contractor or project leader during construction.
- Review traffic control measures as needed to address field conditions pertaining to traffic flow, visibility, and safety.
- During TMP development review criteria in the Traffic Engineering, Operations and Safety Manual (TEOps 13-5-6) to determine if a temporary speed limit reduction is appropriate. If so, ensure that a temporary speed declaration is completed prior to implementing the reduced limit.

1.2.4.5 Project Manager/Squad Leader
Project managers and staff will ensure appropriate action is taken to reduce work zone impacts to workers and the traveling public. Responsibilities include:
- Ensure project activities conform to the TMP.
- Designate a trained person at the project level, whose responsibilities include oversight of TMP implementation.
- Determine resource needs associated with the TMP development and implementation.
- Ensure traffic control measures are in conformance with MUTCD, WisDOT Standard Detail Drawings (SDD), WisDOT Standard and Supplemental Specifications and project-specific plans.
- Ensure contingency plans are implemented if necessary.
- Facilitate project reviews, approval, and modification of all TMP strategies.
- Ensure traffic delays are minimized and do not exceed allowable limits. If exceeded consult with TMP team or Regional Work Zone Engineer about possible modifications to the TMP.
- Verify contractor complies with the TMP as related to their performance of work.
- Review changes made by the contractor or project leader during construction.
- Notify Regional Communication Managers of significant project traffic impacts due to incidents.

1.2.4.6 Project Designer/Leader
- Confirm scoping TMP type based on project needs and constraints.
- Develop content of TMP components, address mitigation and contingency plans based on needs of the project.
- Develop traffic control measures in conformance with MUTCD, WisDOT Standard Detail Drawings (SDD), Traffic Guidelines Manual, WisDOT’s Standard and Supplemental Specifications.
- Minimize traffic delays during plan development, and ensure allowable limits are not exceeded. If exceeded consult with TMP team, Project Manager/Squad Leader or Regional Traffic Engineer/ Work Zone Engineer about possible modifications to the TMP.
- Notify Project Manager and Regional Work Zone Engineer of traffic impacts during TMP and TCP development.
- Develop contract requirements to ensure contractor complies with the TMP as related to their performance of work.
- Analyze changes requested or made by the contractor during construction.
- Work to ensure necessary TMP measures are planned and implemented by the contractor.
- Coordinate with nearby projects to minimize conflicting construction activities as needed.
- Coordinate with Regional Traffic Engineer/Work Zone Traffic Engineer and regional freight coordinator to evaluate the TMP, highlight problem areas, successes and changes to the original TMP. A formal TMP follow-up evaluation report is not required on TMP type 1 & 2 projects but highly recommended on all TMP type 3 and required for all type 4 projects.

1.2.5 Other Stakeholders
It is advisable to have clear communication channels among all staff in the region to facilitate implementation of the Public Information and Outreach Plan (PIOP) and the Incident Management Plan (IMP).
- Regional Permit personnel
- Regional Maintenance personnel
- Regional Utilities personnel
- Regional Communications Manager
1.2.6 Contractor - Responsibilities
It is the contractor’s responsibility to:
- Designate a trained person, whose responsibility is to ensure compliance with the traffic control plan and other contractual provisions related to the TMP.
- Ensure contractor personnel are trained in traffic control to a level commensurate with their responsibilities.
- Work with the project leader to ensure lane closures and/or disruptions to the traveling public are minimized according to the contract.
- Perform quality control of work zones to promote consistency and ensure compliance with contract documents and guidelines.
- Recommend traffic control improvements to the project leader to address field conditions pertaining to visibility, traffic flow, worker, and motorist safety.

1.2.7 Law Enforcement
Responsibilities for law enforcement include:
- Providing active and passive enforcement of traffic laws according to work zone law enforcement mitigation contracts, to promote safety and mobility in work zones.
- Identifying unsafe traffic conditions.
- Taking appropriate measures (in coordination with the project leader) to clear work zone incidents quickly.
- Understanding of work zone traffic control and operation and additional TMP components.
- Documenting work zone incidents for future assessment of work zone impacts and process improvements.

5.1 Introduction
The Federal Highway Administration (FHWA) published a final rule on Work Zone Safety and Mobility in the Federal Register on September 9, 2004. The rule takes effect on October 12, 2007 and will affect all states and local governments that receive Federal-Aid Highway funding. The purpose of the update is to address changing times of more traffic, more congestion, greater safety issues and more work zones on our highways. These challenges require a systematic and structured approach to ensure traffic management consistency statewide. To meet these challenges the Rule requires development of Transportation Management Plan (TMP) for projects. For projects with lesser impacts, a Traffic Control Plan is sufficient to fulfill the requirements of a TMP. However, TMP elements should be documented in the Design Study Report (DSR). For projects with more significant impacts, additional TMP documentation is needed. The work zone policy statement in the Facilities Development Manual (FDM) FDM 11-50-1 addresses the Department’s goals and objectives as well as discussing where responsibilities lie when implementing the work zone rule.

5.1.1 Key Features of the Work Zone Rule
- The rule takes a policy based approach to institutionalize work zone processes and procedures,
- Emphasizes safety and mobility impacts of work zones.

5.1.2 How the Work Zone Rule Works
- It advocates for work zone considerations to be initiated as early as possible in the project delivery process.
- It underscores the adoption of policy and procedures that support systematic consideration and management (consistency) of work zone impacts.
- It encourages states and local governments to develop and implement strategies to manage impacts.
- It requires monitoring and assessing work zone performance
- It encourages the use of work zone safety and mobility data to improve policy, processes and procedures.
This document underscores the need to take necessary and reasonable measures to minimize delays on high-volume roadways while enhancing safety and mobility on all projects.

5.2 What is a TMP?

A transportation management plan is a set of coordinated transportation management strategies and describes how they will be used to manage 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 transportation operations and incident management strategies. The scope, content, and level of detail of a TMP may vary based on anticipated work zone impacts of the project. A Transportation Management Plan is required on all projects.

5.2.1 Purpose

The Wisconsin Department of Transportation (WisDOT) is committed to promoting safety for the traveling public and workers, minimizing congestion and adverse traffic impacts, and providing for improved public satisfaction during construction, maintenance, utility and all other activities performed on or near the WisDOT highway network. Compliance with this policy will reduce work zone crashes, travel time and provide benefits to all stakeholders. All regional offices and statewide bureaus are responsible for implementing the portions of this policy that affect their operations. For further details on the WisDOT policy, refer to FDM 11-50-1.

Maintaining safe flow of traffic through a work zone during construction should be planned and executed. Providing detours is often a better alternative, but, due to many reasons, it is frequently impractical and flow of traffic is maintained through the work zone. Sometimes traffic lanes are closed, shifted, or encroached upon in order to undertake construction. A transportation management plan must be developed to minimize the effect on traffic operations by providing adequate layout of traffic control devices and minimizing the frequency or duration of interference with normal traffic flow.

This document establishes guidelines for developing TMPs for all highway construction, street maintenance, and utility or construction activities performed by WisDOT, municipalities and other agencies.

Managing traffic is a continuous process that requires monitoring and updating the TMP as traffic flow or construction scheduling changes. Review the TMP at project completion to determine its effectiveness and incorporate lessons learned in future projects.

An effective TMP generally addresses project and site specific issues; with traffic impact analyses performed in accordance with WisDOT's Facilities Development Manual (FDM), Traffic Engineering Operations and Safety Manual (TEOpS), Manual on Uniform Traffic Control Devices (MUTCD) and other supplemental policies or directives.

Notify stakeholders about potential impacts early in the project initiation process to seek input and buy-in for the project. Larger projects may require the formation of a TMP Team to facilitate coordination and smooth project delivery. If a TMP Team is required, as determined by the regional project scoping team, it’s advisable to have multi-faceted and multi-disciplinary members who share a common understanding of the project goals and objectives. Occasionally, a multi-jurisdictional team may be needed for projects whose scope extends to other regions or state(s).

5.2.2 Scope of these Guidelines

The intent of this guideline is to assist regional planners, traffic engineers and designers in developing TMPs for work zones. Many of the strategies developed and discussed facilitate planning, managing, operating, and evaluating work zone safety and mobility. The guideline defines a coherent framework for integrating TMPs and traffic operation policies into the project development process and encourages consideration of TMPs at an early stage in project development. Incorporating TMP early into the project delivery process has three advantages:

- Some TMP elements require lead times and should be identified early so funds can be allocated and work planned for each element,

- Identifying TMP components early in project delivery facilitates overall project budgeting and approval processes,

- It ensures that impacts to highway users, businesses, workers and communities are minimized.

This guideline will help WisDOT develop and implement TMPs effectively and consistently statewide to enhance safety and mobility while minimizing delays caused by construction work zones.

5.3 Project Development Process

Implementation of a TMP minimizes work zone crashes and travel delay time, and allows for access needs promoting coordination within and around the work zone, improving quality, and allowing for completion of work
Traffic management is not a snapshot of the project at a particular point in time during project development, but rather a continuous activity that is revisited, refined and updated to reflect changes in project scope. Attachment 5.1 illustrates the current Project Initiation Process (PIP). It is important to identify traffic management issues earlier in project development. Preferably, the deliverables at the program level scope (Life Cycle 11) should include a preliminary TMP.

Conducting a TMP assessment during the PIP ensures that the TMP development/implementation costs are included in the project budget and encourages proper coordination and scheduling of projects along a corridor or in the region. The level of detail of the TMP assessment at this early stage depends upon the type of planning activity, the expected impacts of the project, and the availability of data.

5.4TMP Development Process

The development of a TMP is an essential part of the overall project delivery and may affect the design, construction and material used in the facility itself. The TMP depends on the nature and scope of improvement, volume of traffic, staging alternatives and the capacity available on parallel or alternate highways. A well-thought-out and carefully developed TMP for the movement of traffic through a work zone will contribute significantly to the safe and efficient flow of traffic as well as the safety of other users and workers. See FDM 11-50-1 for further details.

Develop a preliminary TMP during the program level-scoping phase before the Project Management Plan (PMP) approval stage - see the PIP process for further details. Maintain consultation with the regional traffic engineer during TMP development.

5.4.1WisTMP System

For TMP development, WisDOT has partnered with the UW TOPS lab to create a system for developing, routing, approving, and storing TMPs. The WisTMP system was built with features that have automated many parts of the approval process. The Project Manager is ultimately responsible for the TMP. The WisTMP system allows any user to view a TMP that has been created. For more information please go to: https://transportal.cee.wisc.edu/tmp/

All projects must use the WisTMP system for TMP development.

5.5Work Zone Impacts Assessment

One of the main objectives of developing a TMP is to identify work zone safety and mobility impacts and determine the appropriate approaches for mitigating and managing those impacts. Unresolved impacts can cause significant traffic delays, increase cost, create safety and mobility problems and affect project delivery. Impact assessment incorporates mitigation strategies into project delivery and reduces costs, saves time, and helps maintain traffic safety and mobility.

The degree of work zone impacts assessment depends on project complexity. Each project is different and will have different impacts. It is advisable to perform impacts assessment because the level of traffic safety and mobility is directly affected by the appropriateness of the TMP.

Work zone impacts are not limited to the actual project limits. Impacts can be far-reaching and have adverse effects on businesses, communities, schools, other roadways, highway corridor, other highway projects, and even on other regions if the project is located at critical segments on the network.

Work zone impacts assessment may include
- Conducting qualitative and/or quantitative analysis of work zone impacts.
- Evaluating the effects of alternative strategies.
- Evaluating impacts of the selected work zone management strategies.
- Assessing construction approach/staging strategies.
- Assessing constructability issues.

By assessing work zone impacts early during project delivery, the scoping team can:
- Identify and understand the work zone safety and mobility impacts of the project.
- Understand the work zone safety and mobility implications of alternative project options and design
strategies.
- Identify those projects that have greater work zone impacts and to allocate resources more effectively.
- Identify management strategies to mitigate work zone impacts of the project.
- Estimate costs and allocate appropriate resources for implementing TMP strategies.
- Understand, coordinate, and manage multiple projects and construction schedules to minimize overall impacts.
- Monitor and manage work zone impacts during construction, maintenance, and utility work, and amend or update TMP strategies if needed.
- Collect data for conducting work zone performance assessment.
- Help the Department use work zone performance assessment data to improve and update WisDOT work zone policies, procedures and practices.

In order for WisDOT to meet safety and mobility needs during highway maintenance and construction, and to meet the expectations of the traveling public and other stakeholders, it is important to systematically assess the work zone impacts of projects and take appropriate action to manage these impacts.

Depending on the scope of the TMP, factors that influence the level of impacts caused by a work zone include traffic conditions and characteristics, project characteristics, geographic/physical features, and aspects of the surrounding area (e.g., alternate routes, detours, businesses, schools, etc.). The assessment process may involve a high-level, qualitative review of these factors for some projects, and a detailed quantitative analysis using modeling and/or simulation tools for other projects. These guidelines and FDM 11-50-30 on freeway/expressway lane closure guidelines provide detailed procedures and tools to facilitate work zone assessment, evaluation and analysis. Consider the elements listed in Table 5.1 below as a guide for conducting work zone impacts assessment.

Table 5.1 Elements for consideration during preliminary work zone impact assessment

<table>
<thead>
<tr>
<th>Project length (miles)</th>
<th>Duration of project (months or years)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project location (urban, rural, suburban)</td>
<td>Traffic volume</td>
</tr>
<tr>
<td>Lane closure (policy and procedures)</td>
<td>Percent trucks</td>
</tr>
<tr>
<td>Percent reduction in capacity</td>
<td>Expected user delay</td>
</tr>
<tr>
<td>Availability of alternative routes and detours</td>
<td>Accommodation for semi on alternative routes</td>
</tr>
<tr>
<td>Potential increase in crashes</td>
<td>Road user and worker safety</td>
</tr>
<tr>
<td>Impacts on other services (transit, railroad, etc.)</td>
<td>Emergency closures</td>
</tr>
<tr>
<td>Contingency plans</td>
<td>Environmental sensitivity (Community Sensitive Design Issues - CSD)</td>
</tr>
<tr>
<td>Public/Media exposure</td>
<td>Conflicting projects (Region coordination)</td>
</tr>
<tr>
<td>Multi-jurisdiction communication (buy-in)</td>
<td>State Patrol &amp; local police involvement</td>
</tr>
<tr>
<td>Access for emergency providers, including fire, ambulance, police and hospitals</td>
<td>Businesses &amp; residential access</td>
</tr>
<tr>
<td>Access for pedestrians, bicyclists &amp; persons with disability</td>
<td>School access and school bus operation</td>
</tr>
<tr>
<td>Impacts to Over Size Over Weight (OSOW) network</td>
<td></td>
</tr>
</tbody>
</table>

5.5.1 Determine TMP Type
Selection of the appropriate TMP type represents one of the most significant decisions in planning and designing traffic control mitigation strategies. Factors that must be considered include project length, location, time when work will be performed, number of lanes, width of lanes, traffic speed, lane closures, primary or secondary oversize overweight route, and availability of adequate right of way. See the TMP type descriptions and Attachment 5.3 and Attachment 5.4 for details on determining TMP type.

TMP considerations must be made in the Concept Definition Report (CDR) and developed during program level scoping. Typically, once a TMP type has been identified, a small number of reasonable strategies will emerge for a particular project and, in many cases, only a few may be practical. After selecting the TMP type, strategies must be selected and appropriate elements for these strategies evaluated for cost effectiveness. This process
ensures reasonable solutions are not thrown out. It is equally important to evaluate the cost effectiveness of proposed strategies and their elements before selecting what elements to include in the project estimate. Some TMP elements, such as temporary traffic signals, alternate route improvements, temporary widening, etc., require lead times and should be identified early so funds can be allocated.

5.5.2 Prepare Initial TMP

When preparing the initial TMP use the most current layout of the roadways, traffic data, traffic forecasts and projections. Every project will have a wide variation of traffic mix, travel patterns, roadway conditions, terrain characteristics, and population mix that makes an all-inclusive TMP impractical in the early stages of developing a project. The TMP at this early stage in project development is only approximate. The salient details of the complete TMP become apparent as more data becomes available. Update the TMP whenever the scope of the project changes. Consult the FDM and the TEOps for details on policies, procedures and guidance. The initial TMP should include the type of TMP selected with a brief narrative on project activities, anticipated work zone impacts, proposed construction staging, etc. See Attachment 5.5 and Attachment 5.6 for further guidance. Attachment 5.2, TMP Process Flowchart, shows the TMP development process.

5.5.3 Transportation Management Team (TMT) Selection

Large projects require extensive coordination, concurrences, detailed traffic impact analysis and teamwork from all participants. The regional scoping team may add other members from the stakeholders for projects requiring TMP type 4. Preferably, the team is composed of all regional WisDOT organizational units as well as consultants. When choosing representatives for the TMT, base the selection on the purpose, goals and constraints of the project. Balance the TMT with multi-facet, multi-discipline members with varied experience and expertise to ensure successful TMP development and project success. The variety of expertise presents an effective liaison group to meet the various needs of the TMP. The TMT may include representatives from:

- Regional Project Development (design and construction)
- Regional Systems Planning and Operations
- Real Estate
- Technical Services
- Regional Communications Director
- Bureau of Traffic Operations
- Division of State Patrol
- Bureau of Project Development
- Bureau of Technical Services
- Bureau of Structures
- Office of Public Affairs
- Local Government (county and/or city)
- FHWA
- Others deemed necessary.

5.5.4 TMP Stakeholders

If the Regional Project Scoping Team determines that TMP 3 or 4 is required, a separate TMT may be created. Refer to Work Zone policy statement in FDM 11-50-1 for member responsibilities.

5.6 Inclusion In DSR

Once a TMP is developed, it is documented on the TMP request for approval worksheet and referenced in the DSR. If the project does not require a DSR, e.g. a SHRM project, complete the “Request for TMP Approval” worksheet shown at the end of this procedure and submit with any attachment to the Bureau of Project Development (BPD) project services liaison. The TMP approval process detailed below provides additional guidance on the requirements for each TMP type.

5.7 TMP Approval Process

Revise 11-50-5.7 (TMP Approval Process) routing process.

Type 1

Projects in this category may cause minimal or no traffic delays as explained in detail in Attachment 5.3 (TMP Type Selection Matrix). It is advisable to reference appropriate Standard Details Drawings or a project specific traffic control plan. No further approval is required unless the project is subject to Federal Oversight. For Federal Oversight projects, the WisTMP system will route the TMP to FHWA for review and approval.
Type 2
Projects in this category cause minimal traffic delays as explained in detail in Attachment 5.3 (TMP Type Selection Matrix) and may include: lane closures, delays exceeding criteria for short time periods, require detour, etc. Documentation is required in the WisTMP system with narrative on project description, AADT, TMP type, proposed staging and traffic control, public information, and other strategies and impacts listed in FDM 11-4-10 for the DSR. Highway expansion projects in this category should address project staging, traffic switches, and impacts to intersecting roadways. Attach the TMP worksheet to the DSR for approval. For Federal Oversight projects, the WisTMP system will route the TMP to the divisional FHWA liaison for approval.

Type 3 and 4
These projects have high public interest because they have more significant impacts. They affect more road users for a longer period during construction than type 1 and some type 2 projects. Attach to the DSR a separate document describing traffic control, transportation operations, public information & outreach, and incident management strategies for type 4 projects. The worksheet may be used as an executive summary for type 4 projects. Attachment 5.5 and Attachment 5.6 show detailed layout for documenting TMP components. Regional traffic engineers, BTO Statewide Work Zone engineers and the appropriate FHWA liaisons will review and approve TMPs in these categories. Refer to the work zone policy statement FDM 11-50-1 for details on responsibilities.

Follow-up is required at the 90 percent stage to ensure conformance with the proposed strategies in the initial TMP.

5.7.1 Project Exception
The criteria used to determine the impact of a proposed work zone will be the 15 minutes delay on freeways and expressways (FDM 11-50-30). When the delay exceeds 15 minutes above normal recurring traffic delays a project exception may be requested. The degree of detail in the exception request will vary with project complexity and expected impacts. The exception request should include project description and a short discussion on the alternative mitigation strategies that were considered and those that are recommended to minimize delay while enhancing safety and mobility.

5.7.2 Design Phase
During the design phase, the project manager implements the recommendations in the TMP to the extent possible. The project manager may be required to collect additional data and/or perform additional analyses. It is the responsibility of the project manager to consult with the TMT or regional traffic engineer when there is a need for revisions to the TMP.

5.7.3 Update TMP
Review, refine, modify and update the strategies and elements identified earlier in PIP/PMP. It is recommended to review and update the TMP at the PS&E stage to ensure compliance with initial recommendations and subsequent updates to the TMP.

5.7.4 Implement TMP
A TMP implementation plan is necessary to ensure that responsibilities and procedures identified in the TCP, PIOP, TOP, and IMP are coordinated during project development and implementation phase. Before the TMP is implemented, it is advisable to identify key personnel and their responsibilities, and provide contact information. The project manager/leader and the contractor may discuss and agree (preferably at preconstruction meeting) on how emergency operations will be carried out. Further guidance is provided in FDM 11-50-20. If the project stipulates that a daily log of traffic control operation be kept, document this requirement in the implementation plan and share information with parties before beginning construction activities.

Identify line of authority for project manager and contractor personnel responsible for traffic control. Also identify personnel assigned the TMP monitoring responsibility.

5.7.5 Monitor TMP
Include monitoring and implementation requirements in the TMP. Include or refer to appropriate WisDOT policies, standards, and procedures for TMP monitoring and implementation. Changes to TMP type 3 and 4 by the region or the contractor may need to be reviewed and approved before implementation. TMP changes that should be documented are described further in FDM 11-50-13. Some elements of TMP strategies such as media releases, notifications to target groups, brochures, flyers, newsletters, etc., may need early distribution. Additionally, motorist notification, installation of fixed message signs, signing of detour routes, putting changeable message signs in place and work zone ITS require lead time.

During construction, the region should assign an individual(s) to collect data on the TMP. The data collected
may be used to prepare a report on the successes and failures of the TMP. The data collected may include:

1. Verification of work zone setup
2. Changes that were made during construction
3. Changes that were made to the original TMP (include successes or failures)
4. Public/motorist reaction, identification of peak hours
5. Average daily delays and queues experienced
6. Frequency of complaints and the nature of the complaints
7. Crash occurrence (type and frequency)
8. Surveys/feedback
9. A track of implementation cost
10. Person(s) responsible for the implementation of TMP.

5.7.6 Post Construction Project Evaluation

Following good planning principles, the strategies should be linked to measures of performance to determine how effective the applied strategy was in promoting safety and mobility at a work zone. Use the data collected while monitoring the TMP during construction to assess the quality, performance, and effectiveness of the TMP in achieving project objectives.

Performance measures are typically applied to fulfill four functions:
- To continuously improve services i.e., to understand how the strategy is performing and whether modification of its application is necessary to improve performance.
- To strengthen accountability of either the Department’s or the Contractor’s personnel to ensure the strategy is achieving the desired effect.
- To communicate the results of strategies to the public, stakeholders, and upper management,
- To provide better information for effective decision-making, and resource allocation in the future.

Performance measures for work zones differ from one project to the next. For example, car-pooling usage would be used to measure the effectiveness of a TMP mitigation strategy such as ride share incentives. Additionally, a work zone may include new strategies, such as new technology (ITS) or innovative contracting strategies. In these instances, a unique performance measure may be developed to evaluate the effectiveness of the new strategy.

The post construction report should provide brief discussion on the following areas:
- Overall statement reflecting the usefulness of the TMP
- The changes that were made to correct oversights in the TMP
- What changes were made to the original TMP and how successful those change were
- Public reaction to the TMP, (using surveys)
- Average delay time, queue, etc., during construction
- How frequent complaints were made about the project, the nature of the complaints and how they were resolved
- Type of crashes/incidents that occurred during construction, and how they were resolved
- Recommendations or suggestions for future projects
- Highlight the areas of the TMP that were successfully implemented

Once the project is complete, the Project Manager must mark the project as complete in the WisTMP system.

5.7.7 Contingency Plans

The contingency plan lays out a course of action(s) necessary to restore or minimize traffic impacts when unexpected events (e.g., accidents, unforeseen traffic demand, inclement weather) occur in the work zone. The plan may include a decision tree, trigger points, personnel, or it may require standby equipment (See FDM 11-50-20 for further details.)

The contingency plan may include, but not be limited to the following:
- Information that clearly defines trigger points that require lane closure termination (e.g., inclement weather or when the length of traffic queue exceeds threshold)
- A decision tree which clearly defines lines of communication and authority
- Specific duties of all participants during lane closure operations
- Names, telephone numbers and cell numbers for the Regional Traffic Engineer or a designee, Project Manager/Leader, Contractor, and other personnel
- Coordination strategy (and special agreements if applicable) between the Regional Traffic Engineer, Contractor, Project Manager/Leader, DSP, Regional Maintenance Engineer, and local agencies
- Contractor's contingency plan that addresses activities under the contractor's control within the work zone
- Standby equipment

5.7.8 TMP Implementation Costs
Estimate work zone management strategy implementation costs early in the PIP/PMP development process. Including these costs in the overall project budget is critical because obtaining additional funding later may be difficult. This action potentially avoids under-allocation of funds. Where feasible, the cost estimates for the various management strategies should be itemized and documented in the TMP.

5.7.9 Conclusions and Recommendations
Highlight key findings for the selected alternative and discuss 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.

5.7.10 Appendices
Appendices may be included in the TMP to highlight areas of interest to the project manager, the contractor or other stakeholders. The appendix may include: observed, historical, and/or estimated traffic volumes, speeds, travel times, level of service, delay, and accidents; maps; staging/phasing plans; lane closure charts; and detailed analysis methodology, assumptions, parameters used; etc.

5.8 Components of a TMP
A TMP minimizes project related traffic delays and crashes by effectively applying traditional traffic mitigation strategies. The strategies may include public and motorist information, demand management, incident management, alternative routes, construction strategies and other innovative/alternative contracting strategies. Additional guidance is provided in FDM 11-50-10 and examples are available at:

http://wisconsindot.gov/Pages/doing-bus/local-gov/traffic-ops/programs/workzone/workzone.aspx

5.8.1 TMP Application
A TMP is required on all projects. Projects expected to cause minimal or no traffic delays (e.g., projects where work is done outside traffic lanes, work that involves mobile operations or work lasting a short duration, etc.) may require a brief TMP which is usually the TCP. However, the TMP for projects that may cause delays, can range in size from one to hundreds of pages depending on complexity, location, length, duration and the extent of traffic impacts within and beyond the limits of the project. Examples of such projects include: single or multi-lane closures, pavement repairs, resurfacing or freeway/expressway reconstructions.

Consider major issues such as seasonal timing, duration of work and type of construction or rehabilitation operations when developing a TMP. A simple standardized TMP is not sufficient to address the needs of all projects since variability occurs from basic simple maintenance activities to very complex construction activities.

When developing a TMP, answer the following questions:
1. What type of traffic control is required for the work zone?
2. What is the likelihood of traffic delays?
3. What other circumstances must be accommodated?
4. What staging alternatives will allow for completion of work?

Develop solutions that are balanced, objective, practical, and flexible enough to be adopted for intricate project issues. A TMP is a dynamic document that is maintained and revised as the project development process progresses. The work zone part of the Plans, Specifications, and Estimate (PS&E) will contain much of the TMP components and elements. Other TMP elements may become part of the overall project management strategies or contained within the project design features and work operations (see Attachment 5.7).
5.9 TMP Type Description

All highway construction or roadway maintenance, utility or construction activities performed by WisDOT, municipalities and local governments have been grouped into four major categories characterized by the degree of traffic impacts on mobility and safety. The categories are in a matrix based on the severity of impacts. At the lower end are type 1 projects that have little or no traffic impacts. At the high-impact end of this matrix are project types requiring detailed stand-alone TMP documentation. The matrix also provides some typical examples of projects within each TMP project type. Recommendations on elements to consider to facilitate the selection of safety and mobility mitigation strategies are provided. Below are the descriptions that identify the 4 TMP project types and differentiates the impacts the projects may have on road users, local communities and businesses. Also included are the required TMP components (see FDM 11-50-5 for details on TMP components) and elements for each project type.

Type 1
Projects requiring this TMP type have little or no impacts to the traveling public. The duration of work may be short to moderate and occur during off-peak hours. Projects may also fall in this category because work occurs on a roadway with less than 1,500 AADT or the work is outside of the traffic lanes. Work zones may involve mobile operations or short duration lane closures for less than one hour.

Required TMP components
- Traffic Control Plan (TCP),
- Public Information & Outreach as appropriate

Type 2
Projects in this category may include lane or road closures on conventional highways or freeways/expressways but cause minimal delays. Examples of projects requiring type 2 TMP include: resurfacing projects, pavement repairs, bridge deck overlays or painting that cause minimal delays or, bridge replacement on conventional highways, reconstruction with minimal delays, intersection improvements, etc.

Required TMP components
- Traffic Control Plan (TCP)
- Transportation Operations – As appropriate
- Public Information & Outreach – As appropriate
- Incident Management Plan for projects on freeways/expressways

Type 3
Type 3 projects have high public interest because they affect more road users for a longer period during construction. Potential exists for traveler delay to exceed WisDOT criteria on more than 5 days during the work. Detours may be lengthy or require improvements to surface, geometry, or traffic controls. In urban areas, reconstruction may potentially disrupt business access and pedestrian/bicycle movement. Examples of projects that require this type of TMP include: resurfacing, reconstruction, pavement replacement or reconditioning, urban or intersection reconstruction projects with unusual access needs or high traffic delays, bridge replacement, or rehabilitation, etc.

Required TMP components
- Traffic Control Plan (TCP)
- Transportation Operations
- Public Information & Outreach
- Incident Management Plan for projects on freeways/expressways

Type 4
These are long duration extensive (mega) projects with traffic and mobility impacts that may extend beyond metropolitan, regional, and state lines. Public interest is very high in these projects because traffic impacts affect a large number of road users, communities, interest groups, and businesses within the corridor and the transportation network. These are long lasting projects that require detailed staging. They typically involve multiple contracts and have significant impacts on regional and inter-regional traffic flow. Examples of projects requiring this type of TMP include: Marquette Interchange, IH 41 corridor, IH 94 N/S corridor and IH-39/STH 29 Wausau corridor.

Required TMP components
- Traffic Control Plan (TCP)
- Transportation Operations Plan (TOP)
- Public Information & Outreach Plan (PIOP)
- Incident Management Plan (IMP)

The FDM provides guidance and tools to help project managers and traffic engineers through the process of evaluating the extent of traffic impacts of a given project. The matrix that follows is yet another tool developed to provide additional guidance in determining TMP types. Use available project information to select an appropriate TMP type. If a project exhibits characteristics requiring a higher TMP, use the higher TMP type and refine mitigation strategies when additional information about the project becomes available. In addition, all interstate projects within the boundaries of a Transportation Management Area (TMA) that occupies a location for more than three days with either intermittent or continuous lane closures will require TMP type 3 or 4 mitigation strategies. The definition of TMA is provided elsewhere in this procedure.

5.10 TMP Type Selection Matrix
Traveling through a construction work zone can be difficult and often times confusing for roadway users. A well conceived, planned, and executed Traffic Control Plan could alleviate many of the difficulties and confusion. However, traffic control by its very nature, reduces roadway capacity and can potentially lead to delays and crashes (see Attachment 5.4).

Impacts to Consider – The following are among the impacts that should be analyzed:
- **User Delay** - FDM 11-50-30 describes roadways and projects where it is critical to analyze user delay. It also includes methods for conducting the user delay analysis and mitigating the delay impacts.
- **Safety** – Identify potential unusual safety hazards in the work zone that may need additional protection, such as drop-offs, obstacles, or opposing high-speed traffic. Additional protection could include temporary barrier, temporary crash cushions, and close spacing of channelizing devices. Guidelines for use of temporary concrete barrier are found in FDM 11-50-35.
- **Access to nearby properties** – Where access to business areas, schools, hospitals, or other large traffic generators will be disrupted during construction of the project, determine all of the affected facilities and their access needs. FDM 11-3 Attachment 5.10 discusses factors that may influence access.
- **Pedestrians, Bicyclists, Persons with Disabilities, Transit** – FDM 11-50-31 describes the need for pedestrian accommodation in work zones when developing a TMP.

Traffic impacts associated with reduced capacity must be evaluated early during project scoping. The WisDOT work zone policy statement (FDM 11-50-1) and the Statewide Freeway & Expressway Lane Closure & Delay Guidelines (FDM 11-50-30) provide additional guidance on minimizing traffic delays.

5.11 TMP Strategies Matrix

5.11.1 TMP Strategies Matrix Overview
The following sections provide brief summaries of a few selected strategies that designers may use when developing a Transportation Management Plan (TMP). Use work zone impact management strategies to:

1. Minimize traffic delays
2. Improve mobility
3. Improve safety for both motorist and worker
4. Reduce work duration
5. Maintain access to businesses, residents and other stakeholders

Review the strategies discussed in the following sections and adjust the TMP to address each project’s unique characteristics such as; location, traffic volume, speed, TMP type, and highway class, etc.

These strategies are not all inclusive. A few commonly used strategies are discussed in the following sections to provide a background. A more extensive list of TMP strategies is found in the TMP Management Plan Strategy Matrices found in Attachment 5.8 to 5.19. Individual strategies may fall into multiple categories. For example, portable changeable message signs (PCMS) are listed under both temporary traffic control and motorist information strategies, but they could also be listed under Work Zone ITS application as well. Consider potential benefits and challenges when selecting a strategy from the matrix.

5.11.2 Temporary Traffic Control (TTC) Strategies
Temporary traffic control strategies and devices are used to provide positive guidance and improve traffic flow
and safety through work zones. Refer to the chapter six of the MUTCD for additional guidance.

5.11.3 Innovative Contracting and Construction Strategies
The use of innovative contracting and construction strategies has maximum impact when done early in the planning and design process. Past experience shows that this strategy reduces safety and mobility impacts, has the potential to minimize delays and project duration.

5.11.4 Transportation Operation Strategies
Use transportation operations (TO) strategies to mitigate work zone impacts through the use of improved transportation operations and management of the transportation system. Demand management, corridor/network management, work zone safety management, and enforcement strategies are subsets of TO strategies but have been discussed separately in the TMP matrix for clarity.

5.11.5 Corridor/Network Management Strategies
This category includes devices, features, and management procedures used to address traffic safety concerns in work zones. Strategies may include:
- Speed Limit Reduction - Reduced work zone speed limits may improve traffic safety and help protect workers. Reduced speed limits may also be appropriate on detours where traffic volumes and conflicts are increased. Refer to the Traffic Engineering Operations and Safety Manual (TEOpS 13-05-06, “Traffic Regulations, Speed Limit, Temporary Traffic Control Zone.”
- Temporary Traffic Signals - Use this strategy in work zones in place of flaggers, which may increase safety by removing these personnel from the roadway.
- Temporary Traffic Barrier - Temporary traffic barriers provide positive physical separation between travel lanes and the adjacent work zone, or between travel lanes. Refer to FDM 11-50-35 "Temporary Concrete Barrier" for further information.
- Movable Traffic Barrier Systems - A movable traffic barrier 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 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. When considering this contact the BTO Work Zone Engineers for further guidance and approval.

5.11.6 Work Zone Intelligence Transportation System Strategies
Using intelligent transportation systems (ITS) in work zones has the potential to make traffic flow through and around work zone safer and more efficient.

5.11.7 Law Enforcement Service Strategies
The use of law enforcement in construction and maintenance work zones has proven to be effective in enhancing the safety of road users and workers.

5.11.8 Incident Management Strategies
On highways already constricted by construction, further reduction in capacity caused by incidents or vehicular breakdowns can compound adverse impacts to motorists.

5.11.9 Other Innovative Construction Strategies
These techniques involve the use of special materials or precast items to minimize the duration of construction or maintenance activities where traffic restrictions need to be minimized and when work activities need to be completed during night or weekend periods to allow reopening of travel lanes for normal weekday travel.

5.12 Accommodation of Freight
Construction staging can adversely affect larger vehicles ability to maneuver into and within the project limits.

For projects located on the OSOW Truck Route, verify that all OSOW-MT and OSOW-ST vehicles which can safely navigate in the preconstruction condition, can navigate safely during all stages of construction (see FDM 11-25-2.1.1 and FDM 11-25 Table 2.2). If unable to accommodate all required vehicles throughout construction, document these vehicles and propose mitigation techniques.
5.12.1 Multi-Trip Vehicle Dimension Consideration

Revise 11-50-5.12.1 (Multi-Trip Vehicle Dimension Considerations) to change the width from 14 feet to 15 feet.

Multiple-trip permit OSOW vehicles (OSOW-MT) exceed the legal semi truck criteria to use the highway system. The permits are not load specific or route specific and are not required to check 511 prior to commencing a trip. Multiple Trip permits authorized by Wisconsin state statutes 348.27(2) and (7) may travel on any road or over any bridge (including culverts), unless the roadway or structure has been restricted in a manner consistent with various laws authorizing local or State personnel to restrict, e.g., weight posting. The envelope for these multiple trip permits are: 16’ high; 15’ wide; 150’ long and 170k gross vehicle weight (gvw).

Lane and height restrictions that would restrict the movement of these OSOW-MT vehicles shall be identified and signed using appropriate signage. Special consideration shall be given to tight radius loop and interchange ramps to accommodate the longer vehicles.

5.12.2 Wind Tower Corridor Considerations

Revise 11-50-5.12.2 (Wind Tower Corridor Considerations) to route "Wind Tower Base" through Autoturn to confirm tracking in work zones.

Wind towers currently sections are built and shipped out of Manitowoc, WI. The typical maximum load dimensions for these loads are 15'-8" High, 205' Long, and 15'-1" Wide. The dimensions of these loads have required extensive coordination and research to identify and maintain available corridors. A map of these corridors can be found here:


On projects located on these corridors, a minimum 16’ travel lane shall be maintained in each direction. Due to the length of these vehicles, route the "Wind Tower Base" vehicle through the work zone using Autoturn to confirm off tracking will not impact the work zone.

If unable to maintain a 16’ clear width, coordinate with adjacent regions and freight section in Bureau of Highway Maintenance to ensure viable routes exist.

Document these accommodations in the Traffic Management Plan.

5.12.3 High Clearance Routes

Add 11-50-5.12.3 (High Clearance Routes) to provide information on the statewide high clearance routes for oversized loads up to 20 feet in height.

The Department has adopted statewide high clearance routes (http://wisconsindot.gov/Pages/doing-bus/eng-consultants/cnslt-rsrces/tools/planning-maps.aspx) to maintain clearance for oversize loads up to 20 feet in height. On these routes, all temporary signals, signage etc. should be positioned to not impede loads up to 20 feet in height.

5.13 Documentation of Changes to TMP

TMP documentation has an added advantage of enhancing communication amongst stakeholders by enabling sharing of information from project scoping through construction. It is therefore essential that TMP revisions be documented if there is significant change to the impacts on the traveling public or if the TMP revisions cause a contract change order. For instance, changes to lane closures should be documented if they will increase traveler delay above the 15-minute threshold on freeways and expressways. Changes to the TMP may also be generated through a proposed Cost Reduction Incentive (CRI).

Examples that may require revisions to the TMP documentation include:

- Extended duration of temporary full roadway closures into weekday or weekend peak traffic hours (example - taking an unanticipated weekend full freeway closure to erect bridge girders or to trench a culvert across the freeway)
- Additional road closure, or additional ramp closure that adds more than 15 minutes above typical travel time
- Additional closures that affect OSOW freight movement
- Changes in scope or intent of work, including work limits, work hours and time of year
- Construction stage changes that affect roadway geometry, lateral clearance, design speed, vertical clearance, lane width and roadway closures
- Extra Law enforcement contracts that were not originally anticipated
- Both positive and negative lessons learned that impact safety, traffic flow and project delivery time
- Revised detour routes that are an increase in distance and travel time for motorists compared to the original approved detour

Project engineers are encouraged to engage and confirm with the region traffic engineer and BTO to determine whether the above listed traffic impact changes warrant an official documented change to the TMP.

Examples of changes that may not need revised TMP documentation may include:
- Planned long-term closures that are extended for short durations compared to their original planned closure schedule
- Lane closure time period that does not cause additional travel delay
- Unanticipated, but STOC-approved temporary overnight full roadway closures

Document the addendum to the TMP and share via:
1. E-mail to Regional PDS and Traffic (who signed the original TMP) and Statewide Bureaus (BPD/BTO), and FHWA if Federal Oversight project, describing the changes. The original TMP documentation/approval worksheet should be attached to the e-mail.
2. Revised TMP documentation/approval worksheet noting the changes. This also could be transmitted by e-mail.

References
1. Wisconsin Department of Transportation, Work Zone Policy Statement, June 7, 2007
2. Transportation Management Plan Guidelines, State of California, Department of Transportation
3. Traffic Management in Work Zones Interstate and Other Freeways, State of Ohio, Department of Transportation
4. Traffic Management Guideline for Work on Roadways, Ministry of Transport, British Columbia
5. Traffic Control Plan/Design, State of Indiana, Department of Transportation
6. Traffic Management Plan, Forest Road, New Mexico Tech.
10. Implementing the Rule on Work Zone Safety and Mobility, FHWA
11. Work Zone Public Information and Outreach Strategies, FHWA
12. Developing and Implementing Transportation Management Plans in Work Zones, FHWA
13. Meeting the Customer’s Needs for Mobility and Safety during construction and Maintenance Operation
18. Department of Civil Engineering, McMaster University, Hamilton, Ontario, Canada, Effect of Darkness on the Capacity of Long-Term Freeway Reconstruction Zones, Ahmed F. AL-Kaisy & Fred L. Hall
19. Virginia Transportation Research Council, Sponsored by Virginia Department of Transportation, Guidelines for Developing Transportation Management Plan in Virginia, Richmond, June 2005
21. Facilities Development Manual, Wisconsin Department of Transportation
22. Traffic Engineering Operations and Safety Manual (TEOpS), Wisconsin Department of Transportation
23. WisDOT work zone policy statement FDM 11-50-1

LIST OF ATTACHMENTS

| Attachment 5.1 | Project Initiation Process & Project Management Plan |
| Attachment 5.2 | TMP Process Flowchart |
| Attachment 5.3 | TMP Type Selection Matrix |
| Attachment 5.4 | Example TMP Type Mitigation Strategies and Elements |
| Attachment 5.5 | TMP Potential Elements Check List |
| Attachment 5.6 | TMP Documentation Example Layout |
| Attachment 5.7 | TMP Documentation and Request for Approval |
| Attachment 5.8 | Temporary Traffic Control Strategy Matrix |
| Attachment 5.9 | Traffic Control Devices Strategy Matrix |
| Attachment 5.10 | Public Information Strategy Matrix |
| Attachment 5.11 | Motorist Information Strategy Matrix |
| Attachment 5.12 | Innovative Contracting and Construction Strategy Matrix |
| Attachment 5.13 | Transportation Operations Strategy Matrix |
| Attachment 5.14 | Corridor/Network Management Strategy Matrix |
| Attachment 5.15 | Work Zone Safety Strategy Matrix |
| Attachment 5.16 | Incident Management and Enforcement Strategy Matrix |
| Attachment 5.17 | Other Innovative Construction Strategy Matrix |
| Attachment 5.18 | Oversize/Overweight Strategy Matrix |
| Attachment 5.19 | Identifying and Managing Utility Conflicts Strategy Matrix |

FDM 11-50-10 Components of a Transportation Management Plan

October 3, 2016

10.1 Components of a Transportation Management Plan

A Transportation Management Plan (TMP) may include public and motorist information, demand management/transportation operation, incident management, alternative routes, construction strategies and other innovative/alternative contracting strategies. Type 1 projects may have one or two of the TMP components while a type 4 project will require all components to be discussed and included in the TMP.

Refer to FDM 11-50-15 for further discussion on work zone traffic control plan process.

10.2 Public Information & Outreach Plan (PIOP)

WisDOT has a major role in ensuring the public is informed about traffic impacts related to construction activities. Accurate and timely reporting of project information to the public is a valuable element of the overall TMP strategy. A public information and outreach plan (PIOP) lays out clear and concise strategies and procedures to reach out to the traveling public and other stakeholders with information about existing traffic operations and planned changes due to proposed project activities. The PIOP must be updated throughout the project life cycle to address issues as they arise.
Regional offices perform public information and outreach activities and implement the overall PIOP in coordination with the Office of Public Affairs (OPA). PIOP is used to ensure that:

- Stakeholders are informed about the project and its impacts
- OPA is aware of all PIOP issues
- Communities, businesses, and schools directly impacted by the project are informed about the project's impacts through participation
- Road users are informed in a timely manner of possible negative impacts and where possible information on alternate routes is given
- Emergency response agencies (e.g., law enforcement, ambulance service providers, hospitals, city and county officials) are informed of changes that might affect their operations

10.2.1 PIOP Requirements

Each project presents varying degrees of challenges. Freeways/Expressways, and high-volume urban locations with commercial access requirements and pedestrian/bicycle traffic present the most challenges and require the most extensive PIOP. Minor rural projects on low volume roads will not require as much detail. A PIOP may consist of any of the following basic items: (see Attachment 10.1)

- Media news release
- Public meetings or speaker forums
- Stakeholder and emergency response agencies meetings
- Notices to the traveling public (Radio, TV, print media)
- Brochures and mailers, videos, slides, presentations, etc.
- Paid advertising
- Special notification to targeted groups
- Telephone hotline
- Public information center
- Traveler information
- Portable changeable message signs (PCMS)
- Dynamic message signs (DMS)
- Ground mounted signs
- Planned lane closure signs
- Portable work zone traveler information systems (ITS)
- Other affected group information
- Other methods including the Internet and social media

10.3 Transportation Operations Plan (TOP)

Transportation Operations Plan (TOP) is a set of strategies adopted for the sustained operations and management of the work zone impact area. TOP includes the identification of strategies that are used to mitigate impacts of the work zone on the highway corridor/network. See Attachment 10.2 for a list of example strategies.

The scope of the TOP components is determined by the characteristics of the project and should be considered in concert with other safety and mobility strategies. Develop TOP if lane or road closures on freeways, expressways, other Corridors 2020 routes, or urban arterials may cause delays that exceed the criteria of FDM 11-50-25, cause access restrictions or unusual safety concerns. Mitigation strategies are further described in FDM 11-50-30 and FDM 11-50-40.

10.4 Work Zone Incident Management Plan (IMP)

A Work Zone Incident Management Plan (IMP) is a set of strategies used to help the contractor and the Department respond appropriately to incidents during construction within a reasonable timeframe in order to maintain safe traffic flow through the work zone. These strategies include monitoring traffic conditions within the work zone and adjusting traffic operations based on changing conditions. IMPS address unplanned events or incidents for TMP project type 2 and 3 on freeways/expressways, and are included in all TMP type 4 projects to ensure effective management of responses within the work zone. Formal IMP documents are not required for TMP type 2 and 3 projects on conventional highways, but if the project has detours or other temporary access restrictions on priority routes, coordinate with emergency service providers regarding incident and access planning. Modify and update the IMP to address field issues as they occur. The IMP is part of the TMP and is
submit or upload to the online WisTMP system at the time of the Design Study Report (DSR) submittal to Bureau of Project Development (BPD).

Key points to remember when using the IMP:
- IMPs serve as a plan and not a procedure.
- IMPs are applicable to any traffic incident or backup that occurs on any highway.
- IMPs are flexible and can be adapted based on the type of incident since no two projects are the same, apply experience and judgment in each situation.

IMP reference resources:
- Wisconsin Emergency Traffic Control and Scene Management Guidelines
- Emergency Traffic Control and Scene Management Field Operations Guidelines
- Regional Incident Management Coordinator Field Operations Guidelines
- Crisis Communication Management Plan
- Emergency Traffic Operations Plan
- Incident Command Flowchart

It is the intent of WisDOT to minimize impacts and delays to motorists and to promote safety in work zones. Planning for traffic incidents that occur within work zones is a critical component of reducing delay and increasing the safety, mobility, and reliability of the highway system. The level of complexity of the IMP depends upon the duration, complexity, and impacts of the project in the corridor/network. Long-term, complex reconstruction projects necessitate a comprehensive effort with procedures and processes to support the project. Short-term projects on lower-volume roads may simply require a meeting and/or ongoing coordination with the appropriate local or regional emergency response agencies.

Below are questions listed to help identify the appropriate elements within the IMP:
- How will this project impact emergency response in this corridor?
- Are there access issues for responding to incidents within the work zone?
- If an incident closes the highway in one or both directions, how will traffic be rerouted?
- Are there strategies to minimize project impacts on response agencies?
- Are there strategies to minimize incident impacts on the public?
- Are there procedures that would enhance incident clearance and safety?
- How will project personnel coordinate and assist emergency responders?

If additional strategies are needed to ensure stakeholders’ needs are met during construction, the strategies should be identified, documented, and implemented. They may include:
- Contact list for construction and utility personnel (Emergency Contact Sheet)
- Procedures for communicating during an incident (Communication Flow Chart)
- Procedures for updating response agencies on traffic control changes,
- Emergency access requirements,
- Variable message signs or other traveler information strategies,
- Emergency routes to be used in the event of a long-term incident.

On projects with multiple stages, develop a plan for each stage of the project. Document and distribute the procedures and recommended strategies to all response agencies and construction personnel. Plan and budget strategies that require implementation (e.g., signing, ITS devices, and Freeway Service Team) as part of the project and are implemented at the start of the project. Training and follow-up sessions will be necessary to ensure that all agencies and construction personnel are familiar with the procedures in the plan. Review, revise, and update the procedures as necessary throughout the life of the project.

Identify on any project the minimum requirement, whether a traffic migration strategy already exists, and determine the role of the contractor in the implementation. Project staff or the contractor should also contact appropriate response agencies in the corridor to discuss their concerns with the proposed work zone and agree to procedures and strategies that will support the IMP. This communication and coordination is essential for any work zone. On more complex projects, coordination will become more formalized and require the involvement of more stakeholders. It will necessitate a greater commitment of time and resources on the part of the contractor.

**10.4.1 Developing an Incident Management Plan (IMP)**

Develop the IMP once the TMP type is determined. The level of IMP required is based on TMP type depending
on if the project is on a freeway/expressway and the duration or the project (i.e., not needed for maintenance-
type work).

The following process illustrates the common steps in developing an IMP:

1. Determine if there is a work zone incident management plan in place for the corridor
2. Identify response agencies
3. Meet with agencies to identify: existing protocols, concerns/issues, goals and objectives
4. Determine appropriate level of detail including availability of access points
5. Evaluate strategies
6. Recommend actions
7. Provide documentation to all response agencies via the IMP

If the construction project has multiple stages, the IMP should account for changes in project limits, ITS device
locations, and contact information. Each construction project presents unique problems for emergency
responders and the management of incidents that occur in the work zone.

10.4.1.1 Identify Stakeholders

In order to ensure work zones are safe and minimize the impact and delay to the traveling public, the plan
should be developed in a collaborative effort with the emergency response and the public safety community and
incorporated in the IMP. Planning for incidents that occur within work zones is a critical component for reducing
delay and increasing the safety and reliability of the transportation system. Identify special events that may
occur during construction and could affect work times. Acquire special event coordinator contact information.

10.4.1.2 Components

Each IMP provides a quick, in-the-field reference for response personnel. A standard- format IMP ensures fast,
effective, and consistent responses to incidents. Use the format listed below as the standard table of contents
when developing each IMP for each TMP Type, note that the lists are not necessarily comprehensive. The
recommendations of each section are described more in depth below.

TMP Type 2 Projects
- Project Summary
- Emergency Contact Information with STOC number
- Inserts from the Emergency Alternate Routes Operations Guide (if available) or other Alternate Route
  Maps
- Project Location Map

TMP Type 3 Projects
- Project Summary
- Emergency Contact Information with STOC number
- Communication Flow Chart
- Inserts from the Emergency Alternate Routes Operations Guide (if available) or other Alternate Route
  Maps
- Available Barricade/Ramp Gate Locations for Ramp Closures if not already identified
- Project Location Map

TMP Type 4 Projects
- Project Summary
- Roles and Responsibilities
- Emergency Contact Information
- Support Services for Work Zone Mitigation (if available)
- Communication Flow Chart
- Inserts from the Emergency Alternate Routes Operations Guide (if available) or other Alternate Route
  Maps
- Available Barricade/Ramp Gate Locations for Ramp Closures if not already identified
- Activation of Traveler Information Systems
- Emergency Access, Pullout and Traveler Information Equipment Locations Map
- Project Location Map
- Appendices
  a. Emergency Alternate Route Maps (develop or insert if already available)
  b. Emergency Access, Pullout and Traveler Information Equipment Location Map
  c. Project Location Map

10.4.1.2.1 Project Summary
Describe the project summary and description in the IMP. It may simply be the description used in the TMP document. Describe the location and type of project, the number of construction stages including closure locations and anticipated dates and special events that may affect the work zone. Also include a brief description of traffic volumes and any extraordinary circumstances that need to be accounted for.

10.4.1.2.2 Roles and Responsibilities
This section of the plan outlines the potential role of those agencies that could be involved in the response to an incident on the freeway. In addition, the day-to-day operational and/or project-related roles of each agency are summarized. An example incident agency role and responsibility table is included as Table 10.1.
### Table 10.1 Example Incident Agency Role and Responsibility

<table>
<thead>
<tr>
<th>Agency</th>
<th>Day-to-Day Operational and/or Project-Related Roles</th>
<th>Potential Role in Freeway Incident</th>
</tr>
</thead>
</table>
| WisDOT – Statewide Traffic Operations Center (STOC) | Coordinate and communicate lane and ramp closures for maintenance and construction projects  
  Monitor traffic camera information  
  Operate state-maintained PCMS               | Manage Incidents from STOC  
  - Watch for traffic problem areas on the freeway  
  - Locate/verify incidents  
  - Provide traveler information  
  - Provide information to US 41 Team Communication Officer |
| County Sheriff’s Department                | Responsible for patrolling the freeway  
  Primary agency for traffic enforcement and incident response                                 | Generally first responder on scene  
  Establish incident command at incident scenes  
  Contact additional responders as necessary  
  Provide traffic control  
  Investigate crash scene                   |
| Wisconsin State Patrol                    | Responsible for patrolling the freeway  
  Primary agency for traffic enforcement and incident response  
  Monitor traffic camera information          | Generally first responder on scene  
  Contact additional responders as necessary  
  Provide traffic control  
  Investigate crash scene  
  Provide Recon Team and CMV Specialists (MCSAP)  
  Fond du Lac Post Communication Center  
  - Watch for traffic problem areas on the freeway  
  - Locate/verify incidents  
  - Provide traveler information  
  - Provide information to US 41 Team |
| County Highway Department                | Primary agency responsible for freeway maintenance                                                                   | Provide traffic control assistance during incidents  
  Assist with incident clean-up               |
| County Department of Emergency Management | No day-to-day operational responsibilities for the freeway system                                                     | Help coordinate large scale incidents (e.g. HAZMAT)  
  Provide incident responders with additional resources if needed |
| Local Transit                             | Operate local bus routes on city streets                                                                                | Reroute buses around incident or congestion as necessary |

#### 10.4.1.2.3 Emergency Contact Information

The following list identifies contact information for emergency response agencies that will be responsible for responding to or designating response for incidents involving their agency. Complete the contact information sheet at the Pre-con meeting by the project team. **Table 10.2** is an example agency emergency contract table. The contact list is organized as follows:

- Project Team & State Government
- Project Contracts
- Other Agencies
- County Agencies
- City or Village Agencies

### Table 10.2 Example Agency Emergency Contact Table

<table>
<thead>
<tr>
<th>AGENCY</th>
<th>CONTACT</th>
<th>OFFICE</th>
<th>CELL/OTHER</th>
</tr>
</thead>
<tbody>
<tr>
<td>STATE TRAFFIC OPERATIONS CENTER (STOC)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>STOC</td>
<td>Main Number</td>
<td>800-375-7302*</td>
<td>414-227-2166 (Office)</td>
</tr>
<tr>
<td></td>
<td>Responders</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Wis. State Patrol Emergency</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>State Patrol Dispatch</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>State Patrol Officers</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>_____ County Sheriff</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>_____ County Sheriff</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>_____ Police Dept.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>_____ Police Dept.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>_____ Fire Dept.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>_____ EMS</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DOT REGION MANAGEMENT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Regional Duty Officer</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>RIMC</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>DOT Supervisor – PDS</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>DOT Manager – PDS</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Regional Director</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maintenance Supervisor</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Traffic Supervisor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>COUNTY PERSONNEL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>On call Maintenance</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>_____ County Commissioner</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PROJECT STAFF</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Project Field Office</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Project Leader</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Project Manager</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Region Communication Manager</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRIME CONTRACTOR</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Specialized Equipment Contractor</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
10.4.1.2.4 Support Services for Work Zone Mitigation

TMP Types 3 or 4 often employ mitigation contracts for services such as law enforcement, freeway service teams, emergency response services, traffic control or capacity improvements on alternate routes, and multimodal improvements. Reference the TEOpS 6-3-5 for more details on the process to follow in determining need and scope for mitigation contracts.

10.4.1.2.5 Communications Flow Diagrams

Interagency communication flows ensure that information is shared in a consistent and accurate manner when an incident occurs. It is imperative that all responding agencies have a clear understanding of this document. The following communication flow diagrams were created to illustrate the communication flows that exist between agencies during the reconstruction project. All communication flows are assumed to be two-way.

The communication flow diagrams do not represent a hierarchy for responding agencies. Rather, the communication flow diagrams are meant to illustrate the initial flow of communication between agencies. An example communications flow diagram is provided as Attachment 10.3.

10.4.1.2.6 Emergency Alternative Routes

If the corridor does not already have emergency alternate routes established, identify project-specific alternate routes with each work zone on the highway system. Consistency in selecting alternate routes is an important aspect of the program. Use the following criteria to help evaluate potential alternate routes:

- Use state highways whenever possible
- Consider long truck routes when available
- Avoid alternate routes with weight restrictions
- Avoid height restrictions imposed by bridge clearances, power lines, etc.
- Avoid routes that require traffic to make 90-degree turns
- Avoid at-grade railroad crossings, especially those with a high number of trains
- Avoid four-way stops
- Select routes that carry traffic in the same general direction as the interstate
- Minimize length of alternate routes
- Consider routes with coordinated signal timing plans or avoid routes with multiple uncoordinated signals
- Avoid traversing residential areas and school zones
- Carefully consider all route options and closure requirements at interchanges, especially system interchanges

Based on these criteria, identify a preliminary list of emergency alternate routes for freeway segments within a given study area. Evaluate potential routes to ensure that the roadway can handle freeway-type traffic volumes. Conduct a field review of potential emergency alternate routes to confirm route selection. For further guidance in determining appropriate alternate routes, contact the STOC.

Provide brief explanation of emergency alternate routes.
Example: The preferred alternate routes for I-94 are the existing frontage roads. These provide quick access by traffic and limit the amount of adverse travel. If traffic back-ups extend beyond the listed access points, longer alternate routes can be implemented.

Explain alternate routes in detail below and provide alternate route maps (as shown in Attachment 10.4).

Example: For SB: Traffic can be diverted west on WIS-100 (Ryan Rd) to WIS-36, southwest on WIS-36 to US-45, south on US-45 to WIS-20 and then east on WIS-20 back to I-94. For NB: Traffic can be diverted west on WIS-20 to US-45, north on US-45 to WIS-36 to WIS-100 (Ryan Rd) and then east on WIS-100 back to I-94.

If traffic backups extend beyond the access points of the barricade locations listed, longer alternate routes can be implemented.

Provide information on who needs to be contacted for each alternate route option.

Example: Contact STOC, State Patrol, Racine County, Village of Caledonia when alternate routes are implemented. See Contact list.

See Attachment 10.4 for Emergency Alternate Route Map for an example.

10.4.1.2.7 Available Barricade/Ramp Gate Locations for Ramp Closures

If not already identified in the Regional Emergency Alternate Routes Operations Guides, a list of the available locations of barricades/ramp gates shall be included on the Emergency Access, Pullout and Traveler Information Equipment Location Map as shown in Attachment 10.5. During an incident, the Incident Commander organizes the ramp closures.

Table 10.3 Available Barricade Location Example Table

<table>
<thead>
<tr>
<th>Highway Ramp &amp; Direction</th>
<th>Number of Barricades</th>
<th>Distance from Work Zone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ex. Hwy KR to I-94 East (SB) ramp</td>
<td>1 ramp gate</td>
<td>1 mile</td>
</tr>
</tbody>
</table>

10.4.1.2.5 Activation of Traveler Information Systems

Contact STOC at 800-375-7302 for activation of traveler information systems such as, 511 updates, Dynamic Messaging Signs (DMS), Portable Changeable Messaging Signs (PCMS) and Traffic Incident Alerts (TIAs). Also, for DMS special signage and considerations contact the Control Room Engineer.

Regularly review and revise the IMP to monitor current practices, identify, and resolve issues to minimize frequency of incidents and severity. Assign an individual(s) on complex projects with the responsibilities of ensuring the IMP is up to date.

LIST OF ATTACHMENTS

Attachment 10.1 Public Information and Outreach Plan Checklist
Attachment 10.2 Transportation Operations Plan Checklist
Attachment 10.3 Example Communications Flow Diagram
Attachment 10.4 Example Emergency Alternative Route Maps
Attachment 10.5 Example Emergency Access, Pullout, and Traveler Information Equipment Location Map

FDM 11-50-15 Work Zone Traffic Control Plan Process

This procedure explains the process used to develop a work zone traffic control (WZTC) plan. The overall process is shown in Attachment 15.1. The text below explains some of the more significant actions in this process.

15.1 Project Scope

This refers to the Project Scoping Process described in FDM 3-1-10. Traffic engineers from the region Planning & Operations Section need to be included in this initial scoping process.
15.2 Traffic Control (T.C.) Scope
The Project Manager will collect all input received during scoping and begin developing the traffic control scope. Refer to the Design Plan Review Checklist for Work Zone Traffic Control in FDM 11-50 Attachment 20.2.

15.3 Construction Under Traffic
Early in the process the feasibility of constructing the project under traffic must be addressed. The designer must consider issues such as length of construction with a detour and without, and the preferences of local officials and the public.

15.4 Detour Required?
The region Project Development Section and the Planning and Operations Section (traffic staff) will determine if the project will have a detour and where it will be. This will be done with input from local officials and other Department staff as appropriate. Designers must also determine who will sign the detour (a contractor or state forces) and what improvements (if any) the detour route needs to accommodate the increased traffic.

15.5 Develop Staging Plan
Based on scoping decisions, designers develop a staging plan on how traffic will be handled (staged) throughout the life of the project. The staging of the construction work and the traffic handling are often dependent on each other. Therefore, planning for construction operations and planning for traffic handling need to be considered together.

15.6 SDDs Adequate
If the traffic control can be handled entirely by Standard Detail Drawings (SDDs), then designers will submit a list of those drawings to the region traffic engineer for review and concurrence. This list shall then be considered to be the final traffic control plan. For many projects a useful addition to the plan is a project overview sheet with a line drawing showing locations to use details of the SDD’s. Such a drawing is useful to illustrate how the SDD’s relate to each other and to ensure that no necessary traffic control details are overlooked. It also helps the contractor and project manager to determine exactly what will be needed on the project. If the SDD’s do not adequately deal with the traffic control requirements, then a preliminary traffic control plan & details will be prepared.

15.7 Prepare Preliminary T.C. Plan & Details
The preliminary plan should detail the exact traffic patterns, types of devices to be used, taper lengths, spacing, etc. However, since these are preliminary sheets, it is not necessary to show each individual traffic control device. Designers must also identify which SDDs will be needed in the plan. Special provisions are usually not necessary at this point.

15.8 Preliminary Plan & Details Review
The designer meets with region personnel (and central office staff and others if necessary) to review the preliminary drawings before proceeding on the final Traffic Control Plan. This review will aid the traffic control plan designer.

15.9 Finished Traffic Control Plan & Review Meeting
It is recommended that this step become a new milestone in the project development process. The meeting can be an actual face to face meeting, a teleconference or some combination. The designer’s WZTC checklist (see FDM 11-50-20) should be completed by this time and brought to the plan review meeting. The plan and special provisions at this stage shall be complete with all the detail and information necessary for PS&E except that quantities are not necessary at this time. Designers should document the results of this meeting, including meeting participants, place a copy in the region files, and send a copy to the Bureau of Project Development (BPD) project development engineer for Central Office Files. The date of this meeting shall also be documented in the PS&E plan letter.

15.10 Contractor Involvement
In rare instances the Wisconsin Transportation Builders Association (WTBA) may be used as a resource on traffic control issues. Contractor involvement in the WZTC process shall be limited to such topics as, general constructability, production rates, and timing constraints. Contractor involvement should be coordinated with the WTBA.

15.11 Bureau of Traffic Operations Involvement
The decision to involve the Bureau of Traffic Operations (BTO) on a project shall be determined by the region Planning & Operations Section. The region Planning & Operations Section will act as the liaison.
Projects that may require BTO input into a traffic control plan include, but are not limited to, plans that contain traffic control staging, complex urban or rural projects, projects that involve at-grade railroad crossings, politically sensitive projects, and highly unique situations that require a statewide perspective. BTO shall be involved in the review and approval of temporary speed zone declarations when reducing the speed limit from 65 and 70 mph.

LIST OF ATTACHMENTS

Attachment 15.1 Work Zone Traffic Control Plan Process

FDM 11-50-20 Safety and Design in Work Zones June 30, 2017

20.1 General Requirements

This procedure is intended to assure the maximum safety of motorists, pedestrians, and construction workers on all WisDOT construction projects.

The guidance for the design of work zone traffic control is found in Part 6 of the MUTCD. Part 6 contains national requirements for all roads, with the consideration that a state trunk highway has characteristics and traffic volumes greater than the minimum type of roadway which Part 6 addresses. For this reason statewide policy has been developed concerning long term work zone traffic control on the state trunk highway system. When WisDOT administers projects on the local system, the devices used must meet WisDOT specifications and the minimum requirements of Part 6; however, the layout for the work zone traffic control itself should meet the maintaining authority's policy which may differ from WisDOT policy.

20.2 Use of Standard Detail Drawings

Standard Detail Drawings have been developed which can be used for typical situations. The designer must be sure the situation is as shown in the detail and that there are no unusual characteristics of the project which make the detail not appropriate. If the project has unusual characteristics, the information on the detail should be used as a typical method for controlling traffic and the appropriate modifications made in the development of a project specific detail. Designers should note the standard detail drawings show only the traffic control items needed, they do not reflect the geometric layouts of the crossovers or temporary roadways. Each crossover or temporary roadway needs to have the geometric layout information and quantities required for the construction of the temporary roadway listed elsewhere in the plan.

20.3 Traffic on Divided Roadways

When planning construction projects on divided highways, all feasible alternatives that would maintain one-way operation on each roadway should be considered. These include the following options.

- Construction under traffic
- Placing traffic on existing or renovated shoulders
- Constructing temporary bypasses
- Detouring traffic to other routes

If one of these alternatives is determined to be feasible, its cost should be compared to the alternative of providing a means of separating two-way traffic on one roadway of the divided roadway. Maintaining one-way traffic on each roadway is the preferred method of control unless the construction operations do not allow it.

Two-lane, two-way operation (TLTWO) on one roadway of a normally divided highway shall be used only after careful consideration of other available methods of traffic control. Where the TLTWO is used, the traffic control plan shall include provisions for the separation of opposing traffic.

When the TLTWO is used on one roadway of a normally divided highway, it is not sufficient to separate traffic with only centerline striping, raised pavement markers and complimentary signing. Typically, the separation of opposing traffic in this situation includes the use of either tubular markers, drums or concrete barriers in addition to other items mentioned above.

In the transitions at the ends of the TLTWO, the typical traffic control plan will include a variety of the commonly available types of traffic control devices depending on the situation. Concrete barriers should be considered for use in high speed and relatively high traffic volume situations.

20.4 Crossover Design (Construction)

The crossover design guidance in this section pertains to a construction crossover as shown in Figure 20.1, Figure 20.2, Figure 20.3 and SDD 15D11 (not a maintenance crossover), which is shown in SDD 11A1. There are two types of construction crossovers shown in SDD 15D11 - temporary crossovers and crossovers to
remain in place.

The typical temporary crossover roadway show a 4:1 side slope. This type of crossover is intended for use in a construction season or contract. Occasionally there is more than one contract that will require the use of a crossover constructed in a previous contract. However, at the end of the contract(s) using the crossover, the crossover is removed and the median restored.

The typical crossover roadway to remain in place has a 10:1 or flatter side slope for high-speed facilities. This type of crossover is intended to remain in place after the construction contract(s) is completed. Occasionally there is more than one contract that will require the use of a crossover constructed in a previous contract(s). However, at the end of the contract(s) the crossover will remain in place for future use. During rare situations where a permanent cross is used on a lower speed facility, follow the slope guidance in FDM 11-45-2.6.2.

Construction traffic control is the same for temporary crossovers and crossovers to remain in place. Crossovers that remain in place require traffic control after construction that makes clear to drivers that the crossover is not open and that using the crossover is not allowed.

Identify the station location and construction crossover type for each installation in the plan.

**20.4.1 Location of Crossover**

When locating the crossover, be sure the superelevation can fit in with the existing pavement. Locate it far enough away from intersections and interchanges to allow traffic to normalize prior to potential conflicting traffic from an intersection or ramp. Typically a lane closure is prior to a crossover so enough space must be provided to allow the lane closure to occur outside the interchange or intersection area. Physical constraints such as bridges, marshy median areas, bridge piers, etc., also influence the locations of the crossover. The location of the crossover should be such that the height of both roadways is approximately the same. Terrain must be suitable for a crossover - adequate decision sight distance, median width, and minimal difference in elevation of the opposing lanes, preferably in a tangent section of the roadway.

**20.4.2 Crossovers to Remain In Place**

Cost savings may be realized if some crossovers on freeway projects are left in place after the project is completed. Because these crossovers are designed to carry Interstate traffic, they are constructed with a high-type pavement that adds to the cost. If crossovers are left in place, this cost may be partially recovered as a cost savings to future construction. Crossovers also leave options open for emergency construction and remain available for future transportation operations plans, including incident management.

Crossovers left in place must be closed with positive separation when not in use, unless the opening is designed to be left open and an exception is obtained from FHWA. The following are some examples where it may be advisable to leave temporary crossovers in place:

- Major River Crossings. At these locations, there is usually one preferred location where a crossover can be placed and any future work would require the rebuilding of the same configuration.
- Locations with Physical Constraints. In some instances, certain factors (e.g., sight distance problems, closely spaced structures, nearby interchanges, elevation differences between lanes) limit where a crossover can be built. Even though projects may be at different locations, the location of a crossover may be set by these limitations.
- Future Projects in Same Area. If structure work is scheduled for one year and roadway work anticipated in the next five years, the same crossover may be used for both projects. Another example would be a series of structures that are rehabilitated over several years.
- In the area of a long bridge, if the long bridge is damaged the crossover could be used for emergency rerouting of traffic.
- Use for future work if a project is programmed in the near future (2-4 years) and the crossover is in an appropriate location.

When encountering situations as outlined above, the designer should:

- give consideration to leaving the temporary crossovers in place after the project is completed, include provisions in the contract to close the crossover during the time it is not in use
- discuss these provisions at the regular coordination meeting
- obtain FHWA and BTO/BPD concurrence

**20.4.2.1 Criteria for Crossovers to Remain in Place**

There are times when it is useful to leave a temporary median crossover in place after the construction is complete. Although it is not WisDOT policy to leave all median crossovers in place, there is merit in looking at
crossovers on a case by case basis to determine if removal is appropriate. Concerns about leaving a crossover in place include:

- Drainage such as culvert sizing, culvert apron endwall (10:1 slope or flatter) according to FDM 11-45-2, and consideration of vane drains
- Snow melt running onto the travel lanes
- Illegal U-turn usage
- Future maintenance, including the periodic field review of the flexible tubular marker condition
- Life of the surface without traffic on it
- Appropriate location for future use. It may not be appropriate to install a permanent crossover where flood maps indicate a potential flood area
- Side slopes/end slopes shall be 10:1 or flatter when a crossover is left in-place after construction

Typically, there are issues using temporary barrier in permanent crossovers (adequate length of need, adequate length of barrier system for proper function, end treatments, etc.). It is not recommended that temporary barrier be used in permanent crossovers without discussion with BPD.

When leaving a crossover in place the following design parameters must be considered:

- Safety
- Alignment, desirable degree of curve, width
- Cross slope for drainage to median
- Median drainage, pipe size, design frequency
- Pavement thickness and type to support traffic and resist weathering during non-use
- Delineation when not in use (See SDD 15D11 - Traffic Control, Single Lane Crossover for an example) and provide appropriate signing to disallow U-turns

### 20.4.3 Design Elements

Evaluate these design elements for the installation of a construction crossover. Many of the items listed below are shown on Figure 20.1, Figure 20.2 and Figure 20.3. Traffic control for a single lane crossover is on SDD 15D11.

1. Determine appropriate location(s) for the crossover early in the design process to allow subsurface investigation to take place at the same time as the roadway subsurface investigation.
   a. Conduct subsurface exploration/investigation in the crossover area, which may include power and/or hand borings.
      i. Many times the median becomes a location where waste material or other debris may be deposited. There is no way of knowing the depth and extent of possible poor soils without an investigation.

2. Provide a construction drawing in the plan showing the various design elements.

3. Fore slope design.
   a. Temporary crossover - provide a 4H:1V fore slope or flatter.
   b. Crossover that remain in place - provide a 10H:1V fore slope or flatter.

4. Show the curve radii at each end of each crossover roadway. If the pre-construction posted speed is 65 or 70 mph on the roadway, design the radius of curve based on the posted speed, but it should not be less than 4000 feet.

5. Provide a sag curve in the crossover between the mainline roadways. This may become more challenging when the mainline roadways are at different elevations and the median width is narrow. Drainage must flow away from each mainline roadway to prevent water/ice from forming on the mainline.

6. Show profile elevations in each direction and on each side of the proposed roadway, typically where the pavement marking edge line would be installed. Provide an elevation at least every 50 feet along curved sections, and 100 foot spacing on tangent sections.

7. When the profiles indicate that water ponding may occur it is recommended to consider a slotted drain installation. Contact BPD Roadway Standards Section, Drainage Unit for assistance in the design and installation of slotted drains. The crossover is a rather large impermeable area and is generally difficult to get the surface water removed from the pavement quickly and surface drains must be considered.
Pay particular attention to drainage in areas of cross slope rotation. One-lane crossovers typically have reverse curve alignments where the cross slope rotates from 2-percent left to 2-percent right. With a 2-percent cross slope, it is not necessary for this transition to be in the curve. It may be in the tangent at a location that is more favorable for drainage.

8. Pavement Structure. A pavement design is not required for crossovers, but the pavement structure should provide a practical, maintenance-free pavement for its intended surface life considering the soil conditions and estimated ESALs. A pavement crossover configuration is typically in the form of an X for a median width of 50 feet or wider (see Figure 20.1). A pavement crossover configuration may be in the form of a rectangle (large block) when the median width is less than 50 feet (see Figure 20.3).

Experience has shown that a five-inch or six-inch thick HMA pavement over 12 inches of base aggregate dense has performed well on interstates and other high volume roadways throughout the state. Four or five inches of HMA over 10 or 12 inches of base aggregate dense is typically used for all other roads.

   a. Temporary crossover - HMA pavement is recommended and will accommodate efficient removal. Use Asphalitic Surface Temporary bid item. Experience has shown that an HMA mix with 19 mm, 25 mm, or 37.5 mm aggregate is preferable since it can be placed in a single layer up to six inches thick (see Standard Spec 460.3.2).

   b. Crossovers to remain in place - may be HMA or concrete pavement.

      i. If using HMA for crossovers to remain in place, use the HMA Pavement bid items. The pavement can be placed in one or multiple layers.

      ii. If using jointed plain concrete pavement, then local aggregates may be used in the concrete mix even if the adjacent pavement will be constructed with high performance concrete.

9. Traffic control for on-ramps and off-ramps. Refer to SDD 15D7 for exit ramp traffic control where the exit crosses the median. Refer to SDD 15D8 for entrance ramp traffic control where the entrance crosses the median.

Part 6 of the MUTCD states "the basic safety principles governing the design of permanent roadway and roadsides should also govern the design of temporary traffic control zones." The goal should be to route traffic through such areas using geometrics and traffic control devices comparable to those for normal highway situations.
Figure 20.1 Eastbound Crossover
20.5 Speed Limits During Construction

Some motorists respond to a reduced speed, while others do not see a need to slow down. This may cause a differential in speed among drivers which is at times more dangerous than consistent higher speeds. Studies
have indicated motorists will drive the speed they feel comfortable driving. Unless there appears to be a physical limitation to their speed they will typically not reduce their speed unless there is an enforcement presence. Part of the difficulty in enforcing lower speeds is the difficulty of stopping a vehicle in the work zone. This means enforcement must be stationed on either end of the work zone to ticket vehicles.

In 1994, Wisconsin legislature passed a law doubling the fines in work zones for certain moving violations. Speeding in a work zone is one of the violations for which the fine is doubled. For this law to be effective, reduced speed limits must be warranted, consistently set, and clearly posted in the work zone. On projects which have tourist traffic, congested conditions, major traffic volumes or other factors which make speed or other moving violations a major concern, the sign "Fines Double in Work Zones" (W21-61 or W21-62) may be placed on either end of the project.

Accepted practice has been to reduce the speed limit on some roads while the road is under construction, especially at times of work activity. The speed reduction is typically limited to 10 mph below the regular posted speed limit on the rural 70 or 65 mph freeways and expressways. It is normally not recommended to reduce the speed on a rural freeway which is normally posted at 55 mph. On some freeways in urban areas a reduction from 55 mph to 45 mph may be warranted if geometrics during construction are modified from the preconstruction situation. Cases where the speed is usually reduced include where traffic is shifted over to run two-way on a two lane roadway. The rural speed limit (typically 70 or 65 mph) should be reduced because of the crossover geometrics and, at times, narrowed lanes and shoulders. The length of the reduced speed zone should be as short as feasible. The public seems to understand this sort of speed reduction.

A reduction in regulatory speed limit on a rural 2 lane highway normally posted at 55 mph is not needed in most cases. If the method of construction and staging of traffic requires a reduced speed, it should most frequently be handled by posting an advisory speed at the geometric problems.

If a decision is made to reduce the regulatory speed, the MUTCD recommends a maximum speed reduction of 10 mph. Refer to the temporary traffic control zones speed reduction policy in the Traffic Engineering, Operations and Safety Manual (TEOpS 13-5-6) for further details.

Factors to consider when exploring a reduced regulatory speed include proximity of the work to the traffic lanes, separation method of vehicles from the work area, and type of work being performed.

Where only one lane is closed and workers are not present, conformance to a reduced speed is poor.

More detailed guidance and criteria for reduced work zone speed limits are provided in Traffic Engineering, Operations and Safety Manual (TEOpS 13-5-6).

Safety of motorists through a work zone can be handled by a combination of advisory speeds and the actual speed limits. Workers need to be protected, but staging to remove traffic from areas near the workers, or providing positive separation such as barrier is a better way to enhance worker safety than is a reduced speed zone.

The reduction in speed should be considered on a case by case basis and must have region traffic approval and a declaration prepared to make the speed enforceable. If reducing speed from 70 or 65 mph, a temporary speed zone declaration shall be completed and approved by the Bureau of Traffic Operations.

Projects with anticipated capacity or other traffic handling problems typically have extra enforcement.

In some cases, some of the design elements of the temporary traffic control are designed at less than the posted speed. In these cases, if the feature is isolated or at a spot location, this can be handled by posting an advisory warning sign with a subsign with the appropriate speed.

### 20.6 Lights on Drums

[Attachment 20.1](#) presents WisDOT's policy for the use of Type "C" Steady-Burn Lights on traffic control drums.

### 20.7 Design of Traffic Control Plans

A checklist for use in the design of traffic control plans is included in [Attachment 20.2](#).

#### 20.7.1 Signing

On STH projects all warning signs which represent a changed condition are to be orange and black except the No Passing Zone Pennant (W14-3), Object Marker (W5-52) and RR X-ing Ahead (W10-1). This is generally noted by changing the code to WO instead of W and including the general note "WO signs are the same as W signs except the background is orange". If there are existing yellow and black warning signs in place, they do not need to be changed to orange as long as the condition being warned of still exists. Any signs which are no longer applicable due to the traffic control should be covered or removed. All diamond shaped signs are 48" x 48" unless space constraints such as a narrow median or terrace do not allow this size sign to be used.
### 20.7.2 Modification of Type I and Type II Signs

Revising 11-50-20.7.2 (Modification of Type I and Type II Signs) to measure one sign covering per location.

At times, an existing message on a freeway guide sign or other permanent signs need to be altered or the sign covered if it is no longer appropriate. Indicate conflicting permanent signs to be covered on the traffic control sheets, and clearly show the sign or the part of the sign to be covered. List signs required to be covered should be listed in the quantities with the appropriate sign covering details. Under some circumstances, there may be multiple cycles of covering and uncovering throughout the course of construction staging. The sign covering will be measured separately for each cover/uncover cycle. In addition, list the number of cycles in the quantities and, if necessary, indicate the stage the sign will be covered and uncovered. For route assemblies, measure one sign covering per location.

Do not write special provisions that make covering type II signs incidental. Table 20.1 is an example table format that can be used for covering signs for traffic control in the miscellaneous quantities sheets.

#### Table 20.1 Covering Signs for Traffic Control Example Table

<table>
<thead>
<tr>
<th>Stage</th>
<th>Traffic Control Covering Signs Type I</th>
<th>Traffic Control Covering Signs Type II</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Each</td>
<td>Number of Cycles</td>
</tr>
<tr>
<td>Stage 1</td>
<td>a * b</td>
<td>a</td>
</tr>
<tr>
<td>Stage 2</td>
<td>a * b</td>
<td>a</td>
</tr>
<tr>
<td>Stage 3</td>
<td>a * b</td>
<td>a</td>
</tr>
<tr>
<td>Stage 4</td>
<td>a * b</td>
<td>a</td>
</tr>
<tr>
<td>TOTAL</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### 20.7.3 Custom Sign Details

When a new sign with a special message is needed, a detail for that sign needs to be developed and included in the plan. Examples of these types of messages include:

- HWY XX BRIDGE
- UNDER CONSTRUCTION
- EXPECT DELAYS
- USE ALTERNATE ROUTE
- 40 TON WEIGHT LIMIT
- 10 FEET MAX WIDTH
- 6 MILES AHEAD
- HWY XX CONSTRUCTION
- BEGINNING "DATE"
- USE ALTERNATE ROUTES

On some projects it may be advisable to sign an alternate route or construction bypass.

### 20.7.4 Pavement Marking

The use of temporary raised markers to supplement the temporary line is very helpful, especially in areas where the alignment is changed from the existing condition and crosses different colors of pavements. Temporary raised markers provide unique wet night reflectivity throughout the project life, however, they are not resistant to snowplows so the season of the project must be carefully considered to be sure the markers will stay in place, or there are provisions in the contract to replace the markers after a snowplow removes them. The feasibility of using temporary raised markers depends on the need for additional guidance based on the geometric difficulty of navigating the work zone during different stages.

The plan should provide for the removal of existing markings. On relatively new asphaltic surfaces, removable non-reflective black mask-out tape may be used to cover the existing markings.

### 20.7.5 Channelizing Devices

Channelizing devices are used to guide drivers through work zones and prevent them from entering restricted areas. Channelizing devices include:

- drums
- tubular markers
- barricades
- cones, and
- other devices.

For information on channeling devices for pedestrians see FDM 11-50-31. Each device has a target value which is how formidable it appears to drivers. The higher the target value the more likely the driver will respect the device. Drums are the Department’s preferred channelizing device in work zones.

20.7.5.1 Drums
Drums have a high target value and provide a consistent dimension regardless of orientation to traffic. Use drums as the primary channelizing device for lane closures, lane shifts, shoulder closures, and ramp closures. For placement of lights on drums see FDM 11-50-20.6.

20.7.5.2 Flexible Tubular Markers
Use flexible tubular markers to divide opposing traffic lanes. For spacing information see SDD 15d6. Tubular markers may also be used where space restrictions do not allow for the use of other more visible devices or where specific conditions such as high wind may require a device that can be secured in place.

20.7.5.3 Barricades
Use Type III barricades to prevent drivers from entering restricted areas, by placing in the closed traffic lane, closed shoulders, across closed roadways, or at closed ramps. In areas where the roadway is closed to through traffic, barricades are staggered to allow access to businesses and residents. Type II barricades are useful in low speed situations and for pedestrian guidance. Type II and III barricades may also have signs placed on them.

20.7.5.4 Traffic Control Cones
42-inch traffic control cones may be used to delineate and channelize traffic through the tangent section or activity area of lane closures and to mark specific hazards. Also, the 42-inch traffic cones may be used during flagging operations on two-lane two-way roadways.

42-inch Traffic Control Cones are allowed as channelizing devices and may be used in the following situations:
- On an urban project where there are space and/or sight restrictions.
- Any duration of work where the use of a plastic drum would restrict proposed lane widths to less than 11 feet including shy distance.

42-inch traffic control cones are not allowed in the following situations:
- Lane tapers
- Shoulder closures
- To delineate Temporary Traffic Signal Trailers, Message Boards or Arrow Boards
- To delineate roadside materials or equipment.

Contractor requests to replace plastic drums with 42-inch channelizing devices should not be allowed unless changes in proposed construction will restrict the lane widths as described above.

20.7.5.5 Vertical Panels
Consider using vertical panels when a project stage will remain in place for multiple years or where mounting other traffic control devices is impractical. In both cases contact the Regional Work Zone Engineer for further guidance.

20.7.5.6 Concrete Barrier Temporary Precast
Temporary concrete barrier may act as a channelizing device, see the requirements in FDM 11-50-35 for use.

20.7.5.7 Temporary Lane Separators
Consider using temporary lane separators when a location needs greater attention, such as a gore. Flexible tubular markers or vertical panels may be used in conjunction with temporary lane separators. Contact the Regional Work Zone Engineer for further guidance when considering this device.

20.7.6 Temporary Portable Rumble Strips (TPRS)
Temporary Portable Rumble Strips (TPRS) are traffic control devices used to alert motorists of changing roadway conditions. TPRS consist of textured rubber strips placed perpendicular to the direction of travel and
weigh approximately 110 pounds. TPRS are not fastened or adhered to the pavement and are able to be placed with two workers. A 2016 speed study performed on a rural two-lane flagging operation during off-peak hours using TPRS in Wisconsin resulted in a daily average 85th percentile speed reduction of 5 MPH, a daily average reduction of speed violators by 45%, and a daily average of motorists braking of 33%.

Advantages of TPRS
- Increase driver awareness through audible and vibratory alert of upcoming conditions
- Increase compliance to standard traffic control devices
- Increase braking and reduced speeds
- Ease of installation and removal
- Reusable

Disadvantages of TPRS
- May cause erratic or avoidance maneuvers by drivers
- May cause rough ride or hazard for motorcycles
- May move due to inadequate installation
- Nearby residents may complain due to noise

TPRS are required for stationary flagging operations. Refer to SDD 15c12 for layout details.

References:

20.7.7 Work Area Ingress and Egress
Ingress to and egress from work areas presents significant challenges. Hazards are compounded when the roadway carries high traffic volumes, high heavy vehicle percentage or operates at high traffic speeds. Safety challenges include:
- Motorists following construction vehicles into the work area;
- Deceleration of construction vehicles as they enter the work area and acceleration as they exit and enter open traffic lanes;
- Proximity of workers on foot to ingress and egress locations.

In order for roadway construction projects to maintain safe operations, there must be procedures to allow for safe and efficient passage of work vehicles into and out of the work area and for motorists to travel through the work zone. Effectively addressing safe ingress and egress at the project level requires planning during the project development phase and implementing traffic control plans throughout the entire project. Therefore designing work area ingress and egress is a critical aspect of the design process and should be considered when developing the TMP during planning and design phase of project development.

Consideration must be given to addressing how the contractor will safely move personnel, materials, and equipment into and out of the work area with minimum disruption. Proper work area ingress and egress improves safety for both the workers inside the work area and the traffic which may be traveling adjacent to the work area. Proper work area ingress and egress plans will:
- Allow for completion of intended work in the stage
- Minimize the impacts of slow construction vehicles on through traffic
- Reduce the number of vehicles following construction vehicles into the work zone
- Provide access control for driveways, intersections, and interchanges
- Improve communication with emergency responders; and
- Separate workers on foot from construction vehicles accessing the work zone.

Providing safe work area ingress and egress is mandated by the FHWA's Final Rule on Temporary Traffic Control Devices (23 CFR 630 Subpart K § 630.1108 e). Proper work area ingress and egress is unique to every project and each project will have different requirements.

The design of ingress and egress points on a project with positive protection such temporary concrete barrier has safety and operational impacts to the work zone. Openings in this type of construction may potentially...
expose blunt ends to traffic.

**20.7.7.1 Work Area Ingress and Egress Maps**

The location of the work area ingress and egress points should be considered early in project development when developing the staging plan. Consider the following characteristics when identifying work area ingress and egress locations:

- Traffic characteristics (volume, speed, lane distribution, etc.)
- Lane and shoulder width
- Presence of concrete barrier, guardrail, crash cushions
- Pavement condition (joints), location of storm sewer structures (inlets, manholes)
- Adequate space for signs (type I, type II, fixed message)
- Stopping sight distances
- Location of horizontal or vertical curves
- Lighting
- Roadway geometry between travel lane and work zone
- Type of work to be performed in the area (for example, excavation for storm sewer or above grade - obstructions such as piling or bases for bridges, signs or lights)
- Weaving patterns between access points, intersections and/or interchanges (for example, access locations cannot be placed within 1,500 feet of interchanges)
- Emergency responders accessing the work zone
- Number of ingress/egress points to improve communication with emergency responders and delivery personnel
- Size, frequency and timeframe of deliveries
- Road restrictions for truck sizes
  - OSOW restrictions on Interstates or State Highways
  - County or City restrictions on local roads

**20.7.7.2 Traffic Control Construction Details for Work Area Ingress and Egress**

Provide a traffic control construction detail for work area ingress and egress on high profile public interest, especially on high speed, high volume projects. These construction details should be unique to each project but consider the following characteristics as well:

- Advanced warning signing and spacing
  - Fixed message and traffic control signs for trucks entering or exiting
  - Ingress and egress identification signing for emergency responders
- Channelizing device layout and spacing
- Temporary pavement marking layout
  - Identify locations for temporary raised pavement markers (RPM's)
- Concrete barrier layout
  - Exposed ends must be protected with approved end treatments
  - Identify locations for glare screens
- Acceleration and deceleration lane length and width
- The grade for the acceleration and deceleration lanes
- Taper rates or lengths
- Nighttime operations may require additional lighting
- Provide a procedure for when the ingress or egress is not in use
  - Barricades with “Lane Closed/Road Closed/Bridge Out” signs
  - Channelizing devices
  - Covering inappropriate signs or installing fixed message signs over existing signs
- If necessary, develop a procedure for flagging and/or stopping traffic to allow ingress and/or egress.
- Tracking pads
- Parking/stopping locations or loading/unloading areas.
Consider the adequacy of tapers to allow construction vehicles to slow down before entering the work area, or conversely to merge at an appropriate speed upon exiting the work area. Improper design of work area ingress and egress points can cause traffic speeds to drop as merging construction vehicles impact the flow of through traffic. The slower speed may lead to rear end or run off the road crashes in the queue that form well away from the ingress and egress points.

**20.7.7.3 Other Design Considerations - Work Area Ingress and Egress**

In addition to the development of work area ingress and egress maps and construction details, there are many other work area ingress and egress elements which must be considered during the design phase. The elements to be considered can be categorized as design tasks, traffic control enhancements, traffic operations impacts, and construction operations effects. The elements listed below vary from project to project and are not all inclusive of potential construction ingress or egress operations.

**Design Tasks:**
- Development of work area ingress and egress plan for each individual construction stage
- Design of temporary haul roads
- Temporary fence or gates required during active and inactive operations
- Display the work zone clear zone requirements on the construction staging typical sections

**Traffic Control:**
- Proper guide sign placement for entrance and exit ramps
- Use of traffic control drums, type III barricades, flexible tubular markers, temporary raised pavement markers (RPM’s),
- Use of temporary precast concrete barrier, end treatments or guardrail
- Utilization of PCMS or DMS during active access operations
- Locating speed limit reduction signs and speed trailers in advance of ingress locations

**Traffic Operations:**
- Signalization needs including temporary signals, vehicle detection, or signal phasing
- Ramp meter operation for ingress and egress near entrance ramps
- Physical turn restrictions for trucks at intersections or other ingress and egress locations
- Staged overhead clearances with utility wires, signal arms, sign bridges and bridges
- Pavement marking modifications
- Construction traffic speed differential with the posted speed upon re-entering travel lane
- CCTV camera utilization
- Work area ingress and egress restrictions during adverse road conditions

**Construction Operations:**
- Safe contractor parking locations outside clear zone, acceleration or deceleration lanes, and local roads
- Deceleration and acceleration lane shall be clear of debris and/or dirt that can be tracked onto the roadway through roadway sweeping and/or tracking pad installation
- Deceleration and acceleration lanes should be properly delineated from live traffic lanes and should be accessible at all times when in use
- Consider specialized construction operations such as bridge demolition, deck pours, crane mobilizations, beam setting, lighting, etc.
- Provide maps for truck drivers for clear work area ingress and egress, and establish good communication with truck drivers
- Staging of heavy equipment inside the work area
- Anchoring temporary concrete barrier if needed to protect a hazard or work area

**References:**
- Manual on Uniform Traffic Control Devices (MUTCD)
- FHWA’s "Guidelines on Work Zone Access and Egress" AASHTO Roadside Design Guide
20.7.8 Traffic Control Quantities

When developing the traffic control quantities, include Traffic Control 643.5000. This item covers the installation, repositioning, and removal of the traffic control devices. However, Traffic Control 643.5000, does not include providing the devices and each project will need to include the individual bid items for each device that are used on the project. For sign covering see FDM 11-50-20.7.2.

20.8 Entrance and Exit Ramps within Lane Closures

The entrance and exit ramp design guidance in this section pertains to locations that are affected by lane closures as shown in SDD 15d15. Interchanges affect how the work zone operates especially when volumes are higher on the mainline and/or the ramp. Limitations do exist on the standard detail drawings and each location must be examined to determine the best option, which may require the development of specific details for each project. Work with your regional traffic section when determining the best treatment for a specific interchange.

20.8.1 Design Elements

Evaluate the following design elements when lane closures will impact interchanges:

1. Determine where the interchanges are located.

2. For each location determine:
   a. Location of work
   b. Closed lane
   c. Volumes
   d. Truck percentage
   e. Existing geometry

3. When work occurs within a right lane closure provide a parallel ramp entrance and exit ramp as shown in SDD 15d15-a and SDD 15d15-e.

4. If the work is near the end of the ramp, determine if the ramp can be closed.
   a. Consider if the location is used regularly for emergency vehicles as an access point to the mainline or for hospitals in the area.
   b. Determine a detour for traffic that has lost access to and from the mainline facility.
   c. If the ramp must remain open and a physical barrier is present that prevents the creation of a parallel entrance ramp, provide enough acceleration length as possible. SDD 15d15-c may be used in this case.

5. When work occurs within a left lane closure examine the existing geometry to determine if additional traffic control is needed.
   a. If the location has a parallel entrance ramp design or an auxiliary lane is present and will remain in operation, the existing traffic control may be adequate.
   b. For locations that do not have a parallel entrance ramp or auxiliary lane, determine if the combined volume of the mainline and ramp is approaching the capacity of the single open lane. If the closure will be in place long term and is cost effective use SDD 15d15-b to create a parallel entrance ramp with temporary pavement.
   c. Interchanges that include loops and ascending ramps may create issues for merging traffic to find gaps. Consider using a lower capacity threshold for the mainline traffic that allows gaps for the merging traffic. Work with your regional traffic section to determine the lower threshold. If that capacity is exceeded than the use of SDD 15d15-b would be warranted.
   d. If the closure is in place intermediate duration or less use SDD 15d15-d.
   e. For exit ramps the existing geometry and traffic control may be adequate.

6. When a left lane closure occurs on a facility that has 3 lanes or more, additional traffic control will not be needed, unless more than 1 lane is closed. If mainline traffic is reduced to a single lane then see #4 of this section.

7. When mainline traffic has been shifted to either the median or outside shoulder, the ramp alignment
will potentially need to be shifted to maintain proper merging geometrics. This may require temporary grading and asphalt paving.

Locations that have high truck volumes consider extending the temporary parallel entrance ramps for a longer acceleration lane.

For exit ramps consider the potential of traffic backing onto the mainline during construction.

**References:**
- Manual on Uniform Traffic Control Devices (MUTCD)
- Southwest Improvement Guide 7-25-50

**20.9 Pavement Drop-off Protection**
A drop-off is considered a change in elevation parallel to an adjacent travel lane. Common locations of drop-offs are between adjacent lanes of traffic, at pavement edges, on bridge decks, or between a work area and the sidewalk. Adjacent lane drop-offs are particularly dangerous for motorcycles. Drop-offs need to be properly protected to ensure vehicles and pedestrians can safely traverse the work zone. In order to fulfill this goal, certain traffic control devices can be utilized. Use SDD 15d39 when drop-offs are anticipated.

Refer to **FDM 11-50-35** for the requirements of using CBTP at drop-offs.

**References:**
- Manual on Uniform Traffic Control Devices (MUTCD)

**LIST OF ATTACHMENTS**
- Attachment 20.1 Policy for the Use of Type "C" Steady-Burn Lights on Traffic Control Drums
- Attachment 20.2 Work Zone Traffic Control Plan Review Checklist

**FDM 11-50-30 Statewide Freeway & Expressway Lane Closure & Delay Guidelines**

**30.1 Introduction**

Maintaining safe flow of traffic through a work zone during construction should be carefully planned and executed to improve work zone safety and minimize inconvenience and protect motoring public. Providing detours is sometimes a preferred alternative, but, for many reasons it is frequently impractical for freeway and expressway traffic, and traffic flow is maintained through the work zone. Traffic lanes may be closed, shifted, or encroached upon in order to provide room for construction or maintenance activities. When this happens, the remaining lanes available should be evaluated for expected work zone capacity and how they will perform under the demand volume on the roadway during the closure. A transportation management plan (TMP) must be developed to promote safety and minimize the impacts on traffic operations according to the final rule on Work Zone Safety and Mobility established by FHWA in September 2004 [1]. See **FDM 11-50-5** and **FDM 11-50-10** for further details.

This document includes guidelines for planning typical lane closures and methodologies for considering regularly occurring high volume periods with special considerations for holidays and planned special events. These guidelines also include suggested procedures and methodologies to estimate the capacity of a roadway segment, determine traffic demand, and estimate queues and delays using traffic volume data. Once these factors are determined, necessary mitigation strategies can be developed in order to alleviate or eliminate user delay during a lane closure. Guidelines for emergency maintenance and construction operations and night freeway work operations are discussed and strategies are referenced for further investigation. **Attachment 30.1** is a flowchart of the Lane Closure Analysis Process and shows the typical course of action that should be taken in evaluating lane closures. The following process will be described in detail throughout the document.

1. Determine route-specific maximum delay guideline and recommended lane closure times
2. Estimate capacity under proposed lane closure (using Table 30.3 and other factors)
3. Estimate hourly demand profile (traffic volumes)
4. Estimate queues and delays using appropriate tools
5. Identify appropriate mitigation strategies
6. Plan and prepare for special conditions

30.2 Lane Closure System (LCS)

The Lane Closure System (LCS) is a web-based system for the request and approval of lane closures on all state trunk networks (STN). The LCS was developed for the purpose of streamlining and enhancing the ability to track lane and shoulder closures on the STN. The system enhances communication between the Department and freight operators by providing advance notification on roadways with width restrictions to facilitate route planning. The benefits of LCS include:

- Enhanced coordination of activities to reduce back-ups and potential conflicts (i.e. multiple activities can utilize the same closure; avoid lane closures during a special event; avoid right lane closure near a left lane closure on the same roadway)
- Eliminating duplications and inefficiencies by streamlining information into one system
- Providing link to historical data that can be used to make informed decisions

All lane and shoulder closures and restrictions require approval by the Regional Traffic Engineer (RTE) or Regional Traffic Supervisor. Include the LCS Standardized Special Provisions (STSP) in the specials. Lane closure entry and training are located on the internet at the Wisconsin TransPortal System.

30.3 Special Events and Holiday Work Restrictions

Special events that generate traffic in addition to normal traffic volumes should be considered in developing the transportation management and lane closure plans. A special event is defined as an event that generates a certain minimum attendance threshold according to the location of the event shown in Table 30.1.

<table>
<thead>
<tr>
<th>Location of Special Event</th>
<th>Population of Influence Area</th>
<th>Minimum Attendance (per day)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major Metropolitan Area</td>
<td>Over 500,000</td>
<td>30,000</td>
</tr>
<tr>
<td>Urbanized Area I</td>
<td>50,000 – 500,000</td>
<td>15,000</td>
</tr>
<tr>
<td>Urbanized Area II</td>
<td>20,000 – 50,000</td>
<td>10,000</td>
</tr>
<tr>
<td>Rural Area</td>
<td>Under 20,000</td>
<td>5,000</td>
</tr>
</tbody>
</table>

The contractor shall not close a lane(s) in the direction on approaches to the event in the 2 hours before an event and in the outbound direction for 2 hours after an event ends unless the lane closure is part of an acceptable long-term traffic control staging for the project. An illustrative list of specific events that may apply is provided for the Regions in Table 30.2.

<table>
<thead>
<tr>
<th>All Regions</th>
<th>Region Specific</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major holidays</td>
<td>Summer Fest</td>
</tr>
<tr>
<td>Major recreational destinations</td>
<td>Brewer games</td>
</tr>
<tr>
<td>Major shopping malls</td>
<td>EAA fly-in</td>
</tr>
<tr>
<td>Farm progress days</td>
<td>Packer football home games</td>
</tr>
<tr>
<td>Major auctions</td>
<td>Badger football home games</td>
</tr>
<tr>
<td>Concerts</td>
<td></td>
</tr>
<tr>
<td>Tournaments</td>
<td></td>
</tr>
<tr>
<td>Gun deer season</td>
<td></td>
</tr>
<tr>
<td>County fairs</td>
<td></td>
</tr>
</tbody>
</table>

- Freeway and expressway lane closures are not allowed on the following holidays, other than accepted long-term traffic control staged projects:
- Easter
- Memorial Day
- Fourth of July
- Labor Day
- Thanksgiving
- Christmas
- New Years Day

- Freeway lane closures are not permitted after noon on the day preceding a holiday. For holiday weekends, freeway lane closures are not permitted after noon on the day preceding the holiday weekend until 6:00 AM (or after the peak hour traffic volumes occur) the day after the holiday weekend. See FDM 19-15-40.1 for more details.

- Permitted freeway lane closure times may vary when high attendance is expected for special events. The actual permitted periods of lane closures at locations influenced by increased traffic due to special events will depend on the assessment of roadway capacity available compared to expected demand volumes including additional traffic generated by the special event.

- Freeway shoulder closures shall follow the same restriction times as lane closures during special events.

30.4 Peak Hour Restrictions

Peak hours are defined as the hours of the day that observe the largest utilization of capacity, which may cause user delay. Peak hour times vary depending on the location of the roadway and the types of users traveling on the roadway. In developed, urbanized locations, there is typically a morning and evening peak period during the weekdays. Consult the Regional Traffic Engineer or the LCS planning tool for peak hour restrictions for the particular roadway segment being analyzed. No lane closures shall be permitted for short-term or short duration maintenance, utility, surveying or law enforcement reconstruction operations during normal peak periods unless peak hour volumes are below 1,600 passenger cars per hour per lane (pcphpl) and accepted by the Regional Traffic Engineer.

30.5 Estimate Capacity Under Proposed Lane Closure

It is critical to estimate the capacity and traffic volume in each direction for hours of the day that proposed work operations will cause lane closures. Delays are expected in rural lane-restricted areas when the entering traffic volume exceeds 1,600 pcphpl. This is roughly equivalent to 1,280 vehicles per hour per lane with 20 percent heavy trucks. Highly urbanized areas with lane restrictions may be able to accommodate higher traffic volumes, possibly up to 1,800-2,000 pcphpl. Varying local conditions and site specific conditions need to be considered when determining an appropriate capacity figure to be used and the Regional Traffic Engineer should be consulted.

TRADAS planning data and freeway operations ATMS data can be used to determine traffic volumes being carried through a highway segment on a given day of week during a certain month. The user can then analyze the segment by reviewing the times when the roadway segment demand is under or over capacity during normal operating conditions. Reference lines for capacities of 1,500 vphpl and 1,800 vphpl are provided on the output table as a point of reference for the user; however, the approximate capacity of the chosen segment should be calculated and compared to the volumes provided by the lane closure planning tool output table. Once the capacity thresholds are established for the anticipated conditions, the recommended hours for the lane closure can be determined. This information is provided in an output table and suggested lane closure times are provided in a textbox.

Factors that will reduce traffic capacity in work zones:

1. Restricting lanes in one direction from 3 to 2, or from 2 to 1, will reduce capacity by as much as 800 pcphpl (from 2,400 pcphpl down to 1,600 pcphpl) in rural areas and by 400-600 pcphpl (from 2400 pcphpl down to 1,800-2,000 pcphpl) in highly urbanized, aggressive driving areas.

2. Poor geometrics in median crossover alignment, forming a lane restriction, shifting traffic to an existing shoulder, or uneven terrain will reduce capacity by as much as 200-300 pcphpl.

3. Construction activity close to the live traffic lane. One reference suggests as much as 160 pcphpl less volume when workers and construction equipment are operating right next to the live traffic lane.

4. Lane width less than 12 feet (i.e. an 11-foot lane will reduce capacity by 3%, a 10.5-foot lane will reduce capacity by 5%). Shoulder width less than 6 feet will also reduce capacity of an adjacent lane.

5. High volume of heavy trucks. Each truck is approximately equivalent to 2 cars. Typical heavy truck
volume on freeways in Wisconsin is about 20%.

6. Random incidents (i.e. flat tire, patrolman stopped vehicle, crash, gawking at some activity on the side of the road, etc.). In general, if a freeway experiences greater than 25,000 ADT (2-way) and only one lane of traffic is provided in a direction during peak traffic periods, serious traffic delays will result.

Table 30.3 Capacity Calculation

<table>
<thead>
<tr>
<th>Site Conditions</th>
<th>Rural</th>
<th>Urban</th>
</tr>
</thead>
<tbody>
<tr>
<td>Choose one</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Short-term construction</td>
<td>Start at 1600 pcphpl</td>
<td>1600 pcphpl</td>
</tr>
<tr>
<td>Long-term construction</td>
<td>Start at 1550 w/ crossover (1750 w/o crossover)</td>
<td>1750 pcphpl</td>
</tr>
<tr>
<td>Choose any that apply</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Close, Intense Construction Activity Proximity (Large number of work vehicles, workers, noise/dust)</td>
<td>Subtract</td>
<td>Up to 160</td>
</tr>
<tr>
<td>Construction Activity Less Intense than Average (Guardrail/barrier installation, pavement repairs at intermittent spot locations, work activity across median)</td>
<td>Add</td>
<td>Up to 160</td>
</tr>
<tr>
<td>11’ lane width</td>
<td>Multiply</td>
<td>0.97</td>
</tr>
<tr>
<td>10.5’ lane width</td>
<td>Multiply</td>
<td>0.95</td>
</tr>
<tr>
<td>Shoulder width &lt; 6’</td>
<td>Multiply</td>
<td>0.97</td>
</tr>
<tr>
<td>Heavy Vehicle/Truck Volume</td>
<td>Multiply</td>
<td>(1-%Truck)</td>
</tr>
<tr>
<td>Onramp within 1500’ downstream of lane closure taper</td>
<td>Subtract</td>
<td>Hourly ramp volume (600 max)</td>
</tr>
</tbody>
</table>

The normal starting point in developing traffic control options is to determine the number of traffic lanes that will be needed to handle the expected traffic demand. Table 30.3 and the factors described above should be used to estimate the capacity of each open lane. This early check of available roadway capacity is critical because the vast majority of additional delay due to a work zone occurs if the traffic demand exceeds the available capacity for any appreciable length of time.

The Highway Capacity Manual 2010 [2], Equation 10-9 can be used to determine the resulting adjusted capacity of the roadway lane:

\[ Ca = \left\{ \left[ \left(1,600 + I\right) \times f_{HV} \times f_{LS} \right] \times N \right\} - R \]

where:
- \( Ca \) = adjusted mainline capacity (veh/h);
- \( I \) = adjustment factor for type, intensity, and location of the work activity (ranges from -160 to +160 pc/h/ln);
- \( R \) = adjustment for on-ramps;
- \( f_{HV} \) = adjustment for heavy vehicles as defined in HCM Equation 10-8;
- \( f_{LS} \) = adjustment for lane/shoulder widths;
- \( N \) = number of lanes open through the short-term work zone

Assumes starting capacity of 1,600. Use 1,550 or 1,750 where appropriate. Refer to Table 30.3.

30.6 Estimate Hourly Demand Profile (Traffic Volumes)

Volume data is collected using the many automatic traffic recorders (ATR) located on the State Trunk Highway System, which are monitored daily by a telemetry system and inserted into the WisDOT TRADAS program for further analysis based on time-of-day, day-of-week and year.

If the demand of the chosen roadway segment is within the capacity of the open lanes during the desired dates and times of the lane closure, then the lane closure is appropriate. If the chosen dates and times of the roadway
segment are not within capacity during the planned closure time, the user should consider appropriate closure
days and times that have lower volumes. When not feasible to choose days and times with lower volumes,
queues and delays must be estimated as described later in the procedure. One must take into account data
errors in the volume data, and it is recommended to look at an average of similar days and times in case a
special event or incident affected the volume data depicted during the analysis period. If no data is available, an
adjacent roadway segment may be chosen if they have similar AADTs, surrounding environments and
topographic characteristics. One must take into account any entrance or exit ramps that would change the
volumes at the segment in question. If the adjacent roadway is not suitable, an overall average of the roadway
segment may be sufficient to determine typical volume trends for an average day. The Regional Traffic Engineer
should be consulted to provide expertise on demand for roadway segments in the Region.

It can be expected that actual traffic demand during periods of roadway work will be less than during non-roadwork
conditions, especially for long-term construction projects and where extensive public information about the work
is provided. Factors that may achieve a reduction in demand include the use of automated devices such as
highway advisory radio (4-20% reduction in demand) and dynamic message signing (8-25% reduction in
demand), and public information campaigns (20-30% reduction in demand in urban areas). Other factors that
may reduce demand on a facility are availability of alternate routes, available routes, a high percentage of
commuter traffic using the facility, or when significant queues are present and traffic is able to divert to another
system or alternate route.

Weather also plays an important role in demand calculations. Motorists will adjust to major storms by
anticipating them and the hourly distribution will change. Weather will also deter some trips from occurring, but
weather will definitely change the capacity of the work zone.

If night work is proposed or considered, see the Night Freeway Work Operations subsection under the Plan &
Prepare for Special Conditions section.

30.7 Estimate Queues and Delays Using Appropriate Tools

Work zone capacity can be considered a rather consistent value for the use of macroscopic delay modeling,
where travel demand is generated by a more careful analysis of upstream activities because of advance warning signs
notifying drivers of work ahead. Traffic flow changes in many entrance/exit ramps upstream of work zones must
be accounted for to effectively predict work zone queue lengths. Observed volume reduction at initial queue
development where exits to alternate routes are available ranged from 10 to 30 percent. Additional details are
also found that consideration of entrance/exit ramps upstream of the work zone could significantly improve the
estimation of delay due to work zone activities. However, this depends on the drivers’ knowledge of the
downstream traffic conditions and their knowledge of alternate routes.

Results of estimated queues and delays analysis should be compared to the statewide delay guidelines of no
more than 15-minute delay above the normal travel time between city nodes and within each city node. Refer to
the Corridor Delay map in Attachment 30.2 for the designated city nodes. Research and experience by other
transportation agencies has concluded that when a queue length in excess of a mile is sustained for a 30-
minute period, the work zone is likely to be unacceptable during that period.

The following software programs are recommended for use in determining queue lengths and delay and are
described in more detail below:

1. Work Zone Capacity and Analysis Tool (WZCAT) - For simple projects (typically TMP Type 1, 2 and
sometimes 3) that may have smaller work zone lengths or shorter durations, usage of the HCM
methodology would be appropriate. The current version of WZCAT uses HCM methodology to
calculate delay due to work zone operations based on two inputs. One input is "work zone capacity"
which is simply the capacity estimated for the work zone and the second input is demand which is
traffic volume usually estimated from a single detector location upstream of the work zone. This tool is
limited by the use of only a single detector location, and it does not take into account the impact of
heavy vehicles on queue estimations. As a result, the UW Traffic Operations and Safety Lab research
report on the WZCAT program offered reduction factors that can be applied to the demand in order to
improve the delay estimation provided by the tool. These demand reduction factors are similar to those
described in the Estimate Hourly Demand Profile Section of these guidelines.

2. QuickZone - For more intermediate projects (typically TMP Type 2, 3 or 4), the QuickZone program
developed through FHWA may be used to estimate travel delay caused by work zones. Users can
compare the impacts of construction staging and phasing alternatives, work times, lane closures,
traffic diversions, and various mitigation strategies. The software requires the user to input a fairly
large amount of data, including creation of a network of links and nodes which can be time consuming,
construction location, times, duration, detour routes, and traffic volumes. The software can then be
used to determine vehicle delay and delay costs, queue lengths and construction costs. This additional data input makes the software more appropriate to be used for larger, more complex construction projects. For small single lane or ramp closures, the user will need to decide if the extra capabilities of the software are worth the extra time needed to input the data, compared to some of the other packages and methods.

3. **Lane Closure Capacity Analysis Tool (LCAT)** - This tool is intended for simple and intermediate projects where their characteristics are within the assumptions made during the simplified analysis. Twenty-four hour, off-peak and nighttime single and dual lane closures results for the different highway segments of the freeways and expressways system are provided for typical spring, summer and fall seasonal traffic volumes grouped in Monday-Thursday, Friday, Saturday and Sunday. Results include vehicle delay and queue lengths for the mainline, speed assessment on alternate routes, and total user delay cost. For more information see:

   [http://transportal.cee.wisc.edu/closures/devel/](http://transportal.cee.wisc.edu/closures/devel/)

4. **Quadro** - For intermediate to complex projects (typically TMP type 3 and 4). Similarly to QuickZone, users can compare the impacts of construction staging and phasing alternatives, work times, lane closures, traffic diversions, and various mitigation strategies. This software is the base of the LCAT.

5. **Microsimulation Programs** - For larger, more complex projects (typically TMP Type 4), a microsimulation program may be appropriate to determine the extent of queuing and user delays. The Paramics software, developed by Quadstone Limited, is a microscopic stochastic simulation model that is very comprehensive and has the potential for application to a wide set of freeway, arterial, and network situations. Individual vehicles are modeled in fine detail for the duration of their entire trip, providing traffic flow, travel time and congestion information, as well as enabling the modeling of the interface between drivers and ITS. These programs will provide a more detailed analysis, however, the programs require detailed traffic data, and appropriate calibration measures and can take an extensive amount of time to create a working model.

The estimated delay from one of the previously mentioned programs should be compared to the WisDOT standard acceptable delay criteria in [Attachment 30.2](#). If the estimated delay does not exceed the acceptable delay of 15 minutes above the normal travel time, then the lane closure is appropriate for the days and times depicted. However, if the estimated delay exceeds the acceptable delay, the days and times of lane closure should be adjusted or additional mitigation strategies should be considered and steps 1 through 4 should be repeated.

An example calculation using the HCM method to estimate queue length and delay of a work zone is shown below:

**Example:**

A maintenance operation will require a closure of the median lane of a three-lane urban freeway segment for a total of seven hours. Work activity will involve a large number of work vehicles close to traffic. Heavy Vehicle/Truck adjustment factor is 0.9. Data obtained from a nearby traffic counter during the previous two weeks were used to estimate the following demand pattern (columns A and B):

<table>
<thead>
<tr>
<th>Time</th>
<th>Traffic Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>B</td>
</tr>
<tr>
<td>1200</td>
<td>1800</td>
</tr>
<tr>
<td>1300</td>
<td>1900</td>
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<td>9900</td>
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<tr>
<td>9400</td>
<td>10000</td>
</tr>
</tbody>
</table>

**Solution:**

Determine average capacity of work zone configuration as $1600vphl - 160vphl * 0.9 * 2$ lanes = $2600vph$ (1,300 vphpl). (The 160 is subtracted from the capacity to account for the intensity of the activity and multiplied by the truck adjustment factor and number of lanes in work zone as shown in Table 30.3). Late lane merging is used so all three lanes are open upstream of the site, $N = 3$.

Length of queue, in feet, is determined by $L = Qlv/N$

$Q = number$ of vehicles in queue at time $t$;

$N = number$ of open lanes upstream of the site; and

$lv = average$ length of vehicle (30 feet)
A queue of 3.0 miles is undesirable and other mitigative options should be considered, such as revising the work hours or reducing the demand volume by providing traveler information to encourage use of alternate routes.

Use the following thresholds to evaluate project queue length:

1. For queues less than 0.75 miles, the work zone impacts are acceptable.
2. For queues greater than 0.75 miles and less than 1.5 miles, the work zone impacts are acceptable if the queue exceeds 0.75 miles for two hours or less. Where queues are expected to exceed 0.75 miles for any period of time, additional advanced work zone warning signing should be specified.
3. For queues longer than 0.75 miles for more than two hours or longer than 1.5 miles for any period of time, the work zone impacts are unacceptable. Alternate strategies shall be considered per the provisions of this policy.
4. A vehicle will be considered part of a queue if its average operating speed is approximately 10 mph or less. Discretion is required by DOT personnel during both the analysis portion and field evaluation of the implemented work zone in determining what constitutes a queue. In general a condition that causes driver frustration due to stop and go operations should be considered a queue.

30.8 Identify Appropriate Mitigation Strategies

If congestion and delays are anticipated it is effective and desirable to develop and implement a well planned public information campaign. The public will be more tolerant of delay if they are informed of it in advance, and they may take other routes.

Possible mitigation strategies include but are not limited to:

1. Public information campaign.
2. Develop, sign and advertise alternative routes.
3. Ramp metering or close certain ramps at critical time periods.
4. Use changeable message signs to inform travelers of delay ahead and to consider an alternate route (messages may be operator-controlled or triggered by portable work zone ITS sensor data).
5. Highway advisory radio (flashing lights on signs when travelers should tune in).
6. Encourage use of alternative travel modes.
7. Temporary pullouts for disabled vehicles.
8. Incident response planning with state, county, local police, and private contracts for towing, pushing, fuel, flat tires, overheating, etc.

See the Estimating Hourly Demand Profile section for discussion of traffic volume reductions that can be expected as result of some of these mitigation strategies.

In areas with higher commuter traffic, it may be beneficial to concentrate mitigation funds on public information campaigns together with signing and possible capacity and operational improvements (i.e. signal timing improvements, turn lane improvements, etc.) on alternate routes that regular commuters will most likely use until construction work is complete on their regular route. On segments with higher volumes of non-commuter traffic, highway advisory radio and changeable message signs may be used in addition to help inform travelers of the work zone ahead and perhaps divert their travel routes.

Other more funding-intensive strategies may be to widen bridges, reconstruct shoulders into driving lanes, or add temporary lanes for bi-directional or single-direction traffic. There are also contracting methods to potentially reduce the total time that will be required for the construction or maintenance operation. Further discussion on alternative/innovative contracting methods can be found in FDM 11-2.

30.9 Plan and Prepare for Special Conditions

30.9.1 Emergency Maintenance and Construction Operations

Emergency maintenance and construction operations are inevitable. If emergency maintenance cannot wait until off-peak times, different types of materials and construction methods and equipment that have been identified as reducing lane occupancy during maintenance should be considered. These include high early strength concrete for patching, use of a pavement patching machine, quick drying paint (Fast Dry Acrylic Waterborne applied at 10 mils rather than 15 mils), temporary marking tape and special-purpose mobile equipment such as a device that automatically places and retrieves cones.

The Regional Traffic Engineer or Regional Incident Management Coordinator shall be notified of the emergency maintenance and direct the contractor to follow certain procedures and requirements in order to minimize delay of traffic caused by the closures. The Regional Communications Manager shall also be notified so information can be provided to the media and public.

30.9.2 Night Freeway Work Operations

Whenever high levels of safety, minimal congestion, and access to a work area are not achieved through traditional daytime work zone traffic control and mitigation practices, the feasibility of night work should be evaluated along with other traffic management strategies. It is necessary to have reduced traffic volumes and rapid setup and removal of the traffic control pattern on a nightly basis or there are no advantages to conducting night work. If the construction operation must occupy the roadway for more hours than is provided for night work, or if the temporary traffic pattern requires too great an effort to deploy and remove so that an adequate amount of work cannot be accomplished, no advantage is gained, and normally the night work option should not be considered further.

To enhance the success of night work, the work hours should coincide with the lowest periods of traffic flow and should allow operations to be completed in time for traffic patterns to be returned to daytime conditions prior to the start of the morning peak. Night work can take place any time after the end of the evening peak and last prior to the start of the morning peak. Effective public information efforts are also essential to keep motorists and residents informed regarding traffic plans and impacts on the community. Finally, it must be ensured that materials, equipment, repairs, supervision, and special support services can all be obtained at night as necessary to support the work activities.

Advantages of night work
- Construction cost increases may be offset by increased productivity and decreased highway user costs.
- Reduced interference from traffic increases productivity and can benefit worker safety
- Longer work shifts at night may increase productivity
- Cooler night temperatures may enhance the quality of concrete placed and finished at night
- Driver anger, frustration, and vehicle operating costs may be reduced because of fewer traffic delays
- Fuel consumption and air quality is improved with night work because vehicle emissions are typically reduced because of reduced congestion, shorter delays, and fewer stops.

Disadvantages of night work
- Construction costs are typically more expensive (15-20% increase) because of overtime and night-premium pay, extra lighting expense where needed, added traffic control costs, and increased material costs.
- Reduced visibility and potentially greater difficulty communicating with supervisors and/or technical support staff
- Longer setup/takedown times for traffic controls and lighting
- Motorist fatigue and impairment is a greater concern at night. Workers may be less alert during long nighttime work hours.
- Community concerns associated with night work include noise, glare from work lights, and changes in traffic patterns that impact residential neighborhoods.

Recommendations for enhanced safety in work zones can be found in NCHRP Report 476 “Guidelines for Design and Operation of Nighttime Traffic Control for Highway Maintenance and Construction” at:


Chapter 2 of the report illustrates design requirements for various traffic control devices and safety features, highlighting the use of channelizing and guiding devices, fixed signing, changeable message signs, arrow panels, flagging operations, vehicle protection, worker protection and lighting requirements.

30.9.3 Cost Analysis

While this cost analysis is offered as a method to choose among alternative solutions to a single construction or maintenance problem, it must be noted that this analysis is only an aid to the decision-making process and does not replace past experiences and engineering judgment. A worksheet similar to that shown in Table 30.4 should be used to identify as many costs as accurately as possible. Although this method can be used to compare more than one option, it is especially helpful to determine the cost differences between daytime and nighttime work.

**Table 30.4 Sample Cost Identification Worksheet**

<table>
<thead>
<tr>
<th>Objective</th>
<th>Factor</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Option 1</td>
</tr>
<tr>
<td>Traffic Control</td>
<td>Setup/Takedown</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Device Costs</td>
<td></td>
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<tr>
<td></td>
<td>Maintenance</td>
<td></td>
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<tr>
<td></td>
<td>Pedestrian Accommodation</td>
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<td></td>
<td>Enforcement</td>
<td></td>
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<tr>
<td></td>
<td>Detour/Alternate Route Upgrade</td>
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<tr>
<td>Lighting</td>
<td>Planning</td>
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<tr>
<td></td>
<td>Hardware Costs</td>
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<td>Installation</td>
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<td></td>
<td>Maintenance</td>
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<td>Constructability</td>
<td>Labor</td>
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<td>Labor Premiums</td>
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<td>Incentive Clauses</td>
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<td>Materials</td>
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<td>Equipment</td>
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<tr>
<td>User</td>
<td>Traffic Delay Costs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Vehicle Operating Costs</td>
<td></td>
</tr>
</tbody>
</table>

References

1. The Final Rule on Work Zone Safety and Mobility was published on September 9, 2004 in the Federal
Register.


5. Traffic Management in Work Zones Interstate and Other Freeways was published July 18, 2000.

LIST OF ATTACHMENTS

Attachment 30.1 Lane Closure Analysis Process
Attachment 30.2 Corridor Delay Map

FDM 11-50-31 Temporary Pedestrian Accommodations  April 16, 2015

31.1 Introduction

The Manual on Uniform Traffic Control Devices (MUTCD), 2009, Section 6A.01 states -“The needs and control of all road users (motorists, bicyclists, and pedestrians within the highway, or on private roads open to public travel, including persons with disabilities in accordance with the Americans with Disabilities Act of 1990 (ADA), Title II, Paragraph 35.130) through a TTC (Temporary Traffic Control) zone shall be an essential part of highway construction, utility work, maintenance operations, and the management of traffic incidents.”

http://mutcd.fhwa.dot.gov/pdfs/2009r1r2/pdf_index.htm

Per MUTCD Section 6D.01, if the TTC zone affects the movement of pedestrians, adequate pedestrian access and walkways shall be provided. If the TTC zone affects an accessible and detectable pedestrian facility, the accessibility and detectability shall be maintained along the alternate pedestrian route.

In addition, per MUTCD Section 6D.02, when existing pedestrian facilities are disrupted, closed, or relocated in a TTC zone, the temporary facilities shall be detectable and include accessibility features consistent with the features present in the existing facility.

Pedestrian and bicycle facilities are critical transportation routes for communities. They allow people to travel from one place to another, stimulate business districts by encouraging shopping, keep communities safe by providing more activity on the street, and enhance community health and well-being.

The range of pedestrians in a work zone can vary widely and includes the young, the elderly, and people with disabilities such as audio, visual, or mobility impairments. All pedestrians need protection from potential injury and must be provided a smooth, firm, stable, slip-resistant, and continuous hard surface with a clearly delineated travel path (without abrupt changes in grade or terrain). Pedestrian facilities parallel or crossing the work zone must provide these characteristics.

This guideline supplements FDM 11-46-1 “Bicycle and Pedestrian Elements Affecting Complete Streets” and is intended to minimize conflict between competing construction activities that produce unsafe or inconvenient conditions for pedestrians and bicyclists in work zones.

31.2 Project Scoping/Planning

Collect general information on the project, especially pedestrian and bicycle volumes if possible. The surrounding land uses will also be an indicator for pedestrian and bicycle travel. Identify stakeholders (e.g. walking, jogging, and cycling groups, etc.), who may be affected and need to be notified about the status of the project. Include other groups such as water and utility companies that may have a project scheduled concurrently to discuss how advance utility work may impact pedestrian travel. Provide pedestrian accommodations during utility relocations and begin discussions during the permitting process.

31.3 Transportation Management Plan / PS&E

Include a detailed pedestrian description in the transportation management plan (TMP), refer to FDM 11-50-5. Also include a pedestrian traffic control plan clearly showing pedestrian diversions and necessary traffic control devices with locations of barricades, signage and channelizing devices. If a detour is provided, include signage for the detour and attach an approved detour plan, when necessary. Also, attach necessary construction details for non-standard items such as temporary curb ramps, temporary surfaces with detectable edging, channelizing devices, etc. If using non-standard items in the design, include special provisions in the contract documents.
31.4 Design Considerations

Identify existing pedestrian volumes, ages, and pedestrian generators, including shopping centers, schools, playgrounds, parks, housing, hospitals, churches, and concurrent work beyond the project limits that may influence the staging of construction. It is preferred to separate pedestrian movement from both work zone activity and adjacent traffic. Additional field data may be required to provide adequate design information to build an ADA compliant temporary facility.

As you develop your TMP, consider the available non-motorized data to develop a comprehensive pedestrian mitigation strategy. There are three primary considerations in planning for pedestrian safety in work zones on highways and streets:

1. Provide a safe, convenient travel path for pedestrians that replicates as nearly as possible the characteristics of the existing sidewalks. If necessary provide an alternate accessible pedestrian route.
2. Avoid creating pedestrian paths that lead pedestrians into direct conflict with work vehicles, equipment or construction operations.
3. Avoid creating pedestrian paths that lead pedestrians into direct conflict with mainline traffic moving through or around the work zone.

The TMP process needs to evaluate traffic patterns: vehicles, pedestrians, and bicyclists travelling parallel to the work zone and crossing the work zone. Operating speed is another consideration in selecting the most effective treatment (e.g. using positive protection devices to separate the work zone from pedestrians, or using a wider buffer space or fence, between vehicular traffic, workers, and pedestrians). Provide positive protective barrier devices for pedestrians diverted into a portion of the street used concurrently by moving vehicular traffic.

Positive Protective Devices: FHWA defines them as devices which contain and/or redirect vehicles and meet the crashworthiness criteria contained in National Cooperative Highway Research Program (NCHRP) Report 350 found at:


These devices are used to minimize vehicle intrusion into workspace or pedestrian walkways.

In business districts with heavy pedestrian traffic, provide adequate illumination and reflectorization especially in canopied walkways and walkways under bridge structures. It may be necessary to provide curb ramps (see FDM 11-46-10 and SDD 15D30) to maintain accessibility.

When determining pedestrian needs in the proposed work zone, consider information obtained during the public input process and through field visits to understand travel patterns and access to facilities in the work zone.

In work zones:
- Provide walkways that are clearly marked and if temporary pedestrian barriers are required they should be continuous, rigid, and detectable to blind or low vision persons to navigate. See FDM 11-45-2 and FDM 11-50-35.
- If sidewalk is available on both sides of the road, stage sidewalk replacement/closure so one side of the sidewalk is accessible at any given time. Utilize temporary pedestrian surface and curb ramps when required to maintain pedestrian access.

Also, keep:
- Clear pedestrian headspace, minimum 7 ft.
- Walkways free from pedestrian hazards such as holes, debris, abrupt changes in grade or terrain and clear of equipment.
- Sidewalks clear of obstructions such as construction traffic control signs and other construction materials. Features should not intrude into the usable width of the sidewalk or temporary pedestrian facility.
- Access to bus stops if possible; otherwise consider relocation of bus stops.

Design temporary pedestrian facilities to meet accessibility criteria to the maximum extent feasible. Where pedestrians routes are closed, pedestrian route detours are to be provided; however, detours are a last resort. See FDM 11-46-5 for pedestrian circulation path and pedestrian access route accessibility criteria.

Communicate blocked routes, alternate crossings, signs, and signal information to pedestrians with visual disabilities by using devices such as audible information devices, accessible pedestrian signals, barriers, and channelizing devices that have a detectable edge. When using channelization to delineate the pedestrian walkway through the work zone, use a continuous detectable edge. With respect to the channelizing devices, the bottom surface shall be no higher than 2 inches above the ground, and the top surface shall be no lower
than 32 inches above the ground. Where multiple channelizing devices are aligned to form a continuous guidance pedestrian channelizer, the connection points should be smooth to optimize long-cane and hand trailing. See Chapter 5 “Designing Pedestrian Facilities”, of the Wisconsin Guide for Pedestrian Best Practices: http://wisconsindot.gov/Documents/projects/multimodal/ped/guide-chap5.pdf

The use of flaggers on the arterials to assist at crossings may be beneficial during certain construction stages as a spotter to help pedestrians at non-signalized intersections. Use flaggers for short or intermittent situations in addition to other work zone control devices. If necessary, include these types of services as well as advance public notification of sidewalk closures in the contract special provisions and plans.

At locations where adjacent alternate temporary walkways cannot be provided, post appropriate signs at the limits of construction and in advance of the closure at the nearest crosswalk or intersection to divert pedestrians across the street. Advance signing encourages crossings at intersections and not at midblock. If the placement is too far in advance, the signs will be ignored and pedestrians will likely travel into the work zone. When determining crossing placement, observe adjacent land uses, travel patterns, and origins and destinations for proper location of temporary crossings.

31.4.1 Temporary Pedestrian Accommodation
Incorporate a detail showing where temporary pedestrian accommodation will be located. Use signing to direct pedestrians to safe and accessible street crossings in advance of a temporary traffic control zone.

Place signs at intersections so that pedestrians, particularly in high-traffic-volume urban and suburban areas, are not confronted with mid-block work sites that will force them to skirt the temporary traffic control zone or make a mid-block crossing. Whenever mid-block crossing is necessary, provide a clearly marked pedestrian crosswalk with temporary pavement marking and signs that do not interfere or conflict with work zone traffic control signs.

Pedestrians will generally not retrace their steps to make a safe crossing, so providing temporary curb ramps and advance warning of sidewalk closures at intersections for safe pedestrian crossings is necessary. For typical layout for pedestrian accommodation refer to FDM 11-45-3.4.1 and SDD 15D30.

Provide a smooth, firm, stable, slip-resistant and continuous hard surface throughout the entire length of the temporary pedestrian facility. Minimize abrupt changes in grade or terrain that could cause tripping or be a barrier to wheelchair use. Verify that accessible crossings are maintained throughout the work zone.

31.4.2 Sidewalk Diversion, Detours and Closures
If pedestrians must be diverted or detoured from their normal path, select an alternate route that may be on a temporarily closed parking lane next to the work zone, sidewalk on the opposite side of the roadway, or a path around the block. Generally, a route on the same side is best.

There are cases where a temporary barrier between traffic and the pedestrian detour route must be spelled out in the TMP and be included in the specials.

Closing pedestrian sidewalk or pathways is undesirable. However, if the sidewalk must be closed; locate the alternative pedestrian access route in the same alignment or corridor to provide pedestrian travel continuity or access to buildings along the route. For instance if a parking lane is available or a traffic lane can be temporarily closed, a sidewalk diversion could be used instead of closing the sidewalk and placing a detour. When a detour is required, provide pedestrian crossings preferably at intersections, not at midblock locations. A staging plan is critical for this alternative because accommodation can be challenging if the crosswalks are to be disturbed. When selecting the alternate route, provide a temporary traffic barrier if adjacent to traffic or construction equipment.

Use detectable channelizing devices to delineate the route and use positive protection to separate pedestrians from vehicular traffic. Protect pedestrians from hazards such as holes, cracks, debris, light pole bases, terrace furniture, street fixtures, overhead fixtures, etc. Maintain a 5 ft wide path, 4 ft minimum, for wheelchair access and provide temporary curb ramps where necessary. When it is not possible to maintain a width of 5 ft throughout the entire length of the pedestrian route, provide a 5 ft × 5 ft passing space at least every 200 ft, to allow individuals in wheelchairs to pass. However, a 4 ft minimum clear width needs to be maintained. See SDD 15D30 for details.

A crosswalk closure may be necessary at times, see SDD 15D30 for recommendations on how to provide accommodations at the crossing. Any temporary pedestrian crosswalk provided shall be accessible (Refer to MUTCD 6F.13 http://mutcd.fhwa.dot.gov/pdfs/2009r1r2/pdf_index.htm).
31.4.3 Pedestrian Separation in the Work Zone

When pedestrians are required to navigate the work zone, consideration needs to be given to potential hazards. Excavations, drop-offs, manholes, etc. that exist near the pedestrian pathway require delineation, covering or shielding. Consider pedestrian fences or other protective barriers to prevent pedestrian access into a work zone (tape, rope, barrels or plastic chain are not adequate). Temporary work on sidewalks (e.g., utility openings, vaults, and sidewalk reconstruction) also needs to be barricaded. Verify that adequate sight lines are provided between pedestrian and drivers at intersections, midblock crosswalks and other potential conflict points. Potential pedestrian vehicle sight obstructions include safety fences, boundary fences, bridge abutments, buildings, street furniture, queued vehicles, work vehicles, work equipment, and other local features. Refer to FDM 11-10-5.1 for additional sight distance information.

31.4.3.1 Temporary Concrete Barrier

In locations where pedestrians may be vulnerable to impact by errant vehicles, separate foot traffic from vehicular traffic with positive protection. Temporary concrete barrier may be needed due to increased risk for vehicle intrusion into temporary pedestrian pathway on high-speed roadways. Install a temporary concrete barrier (SDD 14B7) channelizing device, if the location meets the guidelines in FDM 11-45-1. Barrier deflection details and warrants are explained in detail in FDM 11-45-2. If temporary concrete barrier is used to protect pedestrians, ensure that it is firmly anchored and interlocked. Interlocking the barrier allows the device to perform as tested and prevents pedestrians from straying from the channelized path.

Research and experience have shown that vertical curbs cannot prevent vehicle intrusions onto sidewalk. As a result, a normal vertical curb is not a satisfactory substitute for temporary concrete barrier protection where needed. There are instances when temporary barriers may be necessary to prevent pedestrians from unauthorized movements into the active work area and to prevent conflicts with traffic by eliminating the possibility of mid-block crossings.

31.4.3.2 Channelizing Devices

Use pedestrian channelizing devices or fencing to delineate an alternate route. When pedestrian channelizing devices are needed to identify the path of pedestrian travel around or through the work zone, use retroreflective material for improved night time visibility on the top and bottom. Devices used to channelize pedestrians must be detectable to users of long canes and visible to persons having low vision. See MUTCD 6F.63 for additional guidance (http://mutcd.fhwa.dot.gov/pdfs/2009r1r2/pdf_index.htm).

The MUTCD prohibits the use of tape, rope, barrels, or plastic chain strung between devices because they are not detectable. Close joints between channelizing devices to prevent canes or small wheels from being trapped, to reduce the risk of tripping, and to facilitate safe hand trailing. Furthermore, when used as a sidewalk closure mechanism, channelizing devices must run the entire width of the sidewalk without gaps.

31.4.3.2.1 Detectable Edging

Include detectable edging as defined in MUTCD 6F.74 (http://mutcd.fhwa.dot.gov/pdfs/2009r1r2/pdf_index.htm) and SDD 15D30. When it is determined that a facility needs to be accessible and detectable by pedestrians with visual disabilities, provide a continuously detectable edging throughout the length of the facility such that it can be followed by pedestrians using long canes for guidance. This edging is to protrude at least 6 inches above the surface of the sidewalk, with the bottom of the edging placed a maximum of 2 inches above the surface. Provide continuous edging throughout the length of the facility except for gaps at locations where pedestrians or vehicles will be turning or crossing. Firmly attach the edging to the ground or to other devices. Interconnect adjacent sections of the edging such that the edging is not displaced by pedestrian or vehicular traffic or work operations, and such that it does not constitute a hazard to pedestrians, workers, or other road users.

Examples of detectable edging for pedestrians include:
- Prefabricated lightweight sections of plastic, metal, or other suitable materials
- Sections of lumber
- Formed-in-place asphalt or concrete curb
- Prefabricated concrete curb sections
- Continuous temporary traffic barrier or longitudinal channelizing barricades
- Chain link or other fencing equipped with a continuous bottom rail

Match the color of the detectable pedestrian edging to the color of the adjacent channelizing devices or traffic control devices, if any are present. Otherwise, provide orange, yellow or white detectable edging.

31.4.4 Signage

Provide signage to alert pedestrians of sidewalk closures, diversions, or detours at an accessible controlled
crossing point in advance of construction impacts. Ensure the sign does not block access to ramps or push buttons. Additional signs downstream may be needed to reinforce the message. Install a type III barricade across the full width of the sidewalk with a sidewalk closed sign; if the sidewalk is detoured, include a detour sign. Mount traffic control signs and other control devices at least 7 ft above the finished surface of the temporary pedestrian route. In addition, ballast for the signs and devices should not extend into the pedestrian walkway narrowing the path to less than 4 ft.

31.4.5 Temporary Surfaces
Provide a smooth, firm, stable, slip-resistant and continuous hard surface throughout the entire length of the temporary walkway. Compacted soils, aggregate, and sand are not to be used as a surface course for temporary sidewalks (Figure 31.1). These materials present challenges to pedestrians especially those with disabilities. Examples of smooth, continuous hard surfaces include asphalt, slip resistant metal plates and 3/4 inch plywood.

![Figure 31.1 Temporary Pedestrian Surface](image)

Construct temporary sidewalks across unimproved streets and drives designed in accordance with Chapter 5 “Designing Pedestrian Facilities”, of the Wisconsin Guide for Pedestrian Best Practices:


Construct and maintain temporary sidewalks so there are no abrupt changes in grade or terrain that could cause a tripping hazard or could be a barrier for wheelchair use. Maintain temporary sidewalks to ensure that joints in the sidewalk have a vertical difference in elevation of no more than 1/4 inch and that the horizontal joints have gaps no greater than 1/2 inch. The grade of the temporary sidewalk should parallel the grade of the existing sidewalk or roadway and the cross slope be no greater than 2 percent. Any change of level, which exceeds 1/4 inch height, must be beveled at 45 degrees. For closed trenches, temporary paving surfaces, walking surfaces, steel plates, etc., provide a smooth finished, firm, slip-resistant walking surface made even with surrounding sidewalks.

Pavement joints in the sidewalk are to be closed and flush to prevent tripping and to reduce the possibility of canes or small wheels getting trapped in gaps or spaces. If drainage openings are located within the pedestrian route, the grating should run perpendicular to the sidewalk and must be narrow enough that a sphere greater than 1/2 inch in diameter will not pass through it.

31.4.6 Temporary Curb Ramps
Provide temporary curb ramps to enable pedestrians to negotiate curbs safely when they are diverted to temporary routes in the roadway (Figure 31.2). Temporary curb ramps are to be the full width of the temporary route, with a 5 ft recommended width and a minimum width of 4 ft.
All curb ramps are to be firm, stable, and have a non-slip surface. Design curb ramps to have free draining surfaces with a maximum cross slope of 2 percent. The cross slope for midblock crosswalks can match the longitudinal slope of the roadway up to a maximum of 5 percent.

When a curb ramp is installed parallel to the curb, provide a minimum 4 ft by 4 ft platform at curb level to allow pedestrians to turn 90 degrees before descending the ramp. Indicate the type of curb ramp that is to be installed on the pedestrian accommodation plan.

Temporary curb ramps are to be concrete, asphalt, or commercially available prefabricated ramps and provide a safe path of travel for mobility-impaired pedestrians at all locations where ramps have been temporarily removed or required to route pedestrians. For projects with winter layover, construct curb ramps out of concrete with cast iron detectable warning fields. Design temporary curb ramps to:

- Be constructed such that installation and removal will not damage existing pavement, curb and/or gutter
- Have a slope less than or equal to 8.33 percent
- Meet existing surfaces without gaps, while accounting for drainage of the roadway
- Have a transition between ramps and the street surface that is smooth such that no lip exists at the base of the ramp
- Include edge protection where there is a drop-off greater than 3 inches

Example calculation

Given:

Max Slope (S) = 8.33%
Max Cross slope (“C”) = 2%
Curb height (H) = 6”

Then,

Run (R) = H/(S - C)
R = 6”/(8.33% - 2%) = 7’ 11”

(dimension S, C, and H are project specific)

31.4.7 Overhead and Protrusion Protection

If construction is planned to occur above pedestrian walkways, protect pedestrians from falling debris (Figure 31.3). If a canopied walkway is required, cover the entire width of the walkway and where necessary, light the travel path and ramps for night use. If necessary, extend the length of the canopy to meet field conditions.
Provide a minimum of 7 ft of headroom for canopied walkways. Objects with leading edges of more than 27 inches and not more than 80 inches above the walk (such as signs) are not to protrude more than 4 inches into the pedestrian pathway. Maintain proper sight distances at intersections and crosswalks.

31.4.8 Access to Bus Stops, Businesses, Residence, etc.
Maintain accessibility to all pedestrian traffic generators in the vicinity of the work area. If the pedestrian facility currently has a bus stop that will be impacted by the work zone, consult the appropriate bus operator to develop strategies to mitigate disruptions during all stages of construction. When necessary, provide a drawing of this plan, and if the plan layout deviates from the layout of the Temporary Bus Stop Pad shown in SDD 15D30 sheet “b”, provide the details necessary to properly construct it. If the construction zone is extensive and will impact multiple stops, it may be necessary to arrange for a shuttle or establish a temporary route that transports pedestrians safely around the work area. When feasible, same side stop relocation is preferred for temporary bus stops.

31.4.9 Temporary Pedestrian Signal Accommodations
When temporary signals are installed as part of a construction project, consider providing pedestrian heads and call buttons for pedestrians. If an alternative pedestrian pathway is provided and requires pedestrians to cross multi-lane intersections, pedestrian walk phase may need timing adjustment.

31.5 References
10. Accommodating Pedestrian in Work Zones, U.S. Department of Transportation, FHWA-SA-03-011
12. Americans with Disabilities Act (ADA), (http://www.ada.gov/)


FDM 11-50-32 Road User Costs  March 4, 2013

32.1 Introduction
Road User Costs in the work zone are added vehicle operating costs and delay costs to highway users resulting from construction, maintenance, or rehabilitation activity. They are a function of the timing, duration, frequency, scope, and characteristics of the work zone; the volume and operating characteristics of the traffic affected; and the dollar cost rates assigned to vehicle operations and delays.

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. In addition to considering road user costs for the present construction needs, the analysis procedure provides the tools to determine future road user costs based on future construction needs. By understanding the major factors influencing road user costs, the analyst can take steps to minimize the effect of planned future rehabilitation activities on highway users.

Road User Costs play an important role in computing -
- “Enhanced” Liquidated Damages (FDM 11-2-1.6)
- Interim Liquidated Damages (FDM 11-2-1.7)
- Incentives/Disincentives (FDM 11-2-1.8)
- Cost per unit of time specified in Cost-Plus-Time bidding (FDM 11-2-1.9)
- Lane rental fee assessments for the failure to open a lane (or shoulder) in Lane Rental specifications (FDM 11-2-1.5)

The contractor’s failure to complete a contract or reopen a lane of traffic on time results in damages in terms of delay and cost to the motoring public and the Department. Desirably, these damages will never be imposed because it is preferable to avoid high road user costs by adhering to the completion dates and allowable work hours provided in the contract.

Road user costs that are more than the amounts shown as Liquidated Damages in standard spec 108.11 shall be approved by the Supervisor of the Traffic Design Unit in the Bureau of Traffic Operations and, if the project is on the National Highway System or subject to FHWA review, by the FHWA.

Road user costs can be used in Benefit/Cost ratios, Life Cycle Cost Analyses, and selecting the most appropriate project delivery method (i.e., Incentive/Disincentive, Interim Liquidated Damages, A+B Bidding, Lane Rental, detour selection, etc.).

32.2 Road User Cost Computation
Road user costs can be estimated using a number of different techniques. These techniques are classified either as simulation models (such as QUEWZ, Quadro, and Quick Zone) or by manual technique, (such as tables, graphs, or hand calculations). Various models and techniques are used by other state DOTs.

Contact your Region Traffic Engineer or the Bureau of Traffic Operations for the current information on computing road user costs.
35.1 Introduction
The following procedure establishes design guidelines for the use of Concrete Barrier Temporary Precast (CBTP). CBTP is effective in providing positive separation between traffic and the work area. When used appropriately, CBTP has the potential to reduce the severity of crashes. However, the CBTP itself and the proximity of the end of the CBTP can also be a hazard to traffic. Whenever feasible, it is preferable to remove the hazard and avoid the need for CBTP. Typical reasons for use of CBTP are:

- To separate high-speed vehicular traffic from the work area, especially at locations that place workers at increased risk from motorized traffic
- To shield a hazard
- To protect vehicles from embankments or drop-offs
- To separate opposing directions of traffic

35.2 Factors to Consider
In this procedure, situations are listed that would typically justify CBTP. However, each project has a unique set of factors that should be considered. These factors include:

1. Speed and volume of traffic
2. Vertical and horizontal alignment of the roadway
3. Severity of the hazard, obstacle, or dropoff/slope adjacent to the roadway
4. Lateral clearance to the hazard, obstacle, or dropoff/slope
5. Duration of exposure to the hazard
6. Nature of the work zone (e.g., whether it is a stationary work zone, at a spot location, or a moving work zone)
7. Hazard that would be presented by the barrier itself and by the barrier installation and removal activity

For example, greater lateral clearance to a hazard results in a lesser need to shield the hazard with CBTP. Where a range of distances for the desired lateral clearance is listed in this procedure, consider factors such as traffic speed/volume and duration of exposure to determine appropriate lateral clearance for a project, and whether CBTP should be used.

35.3 Guidelines for CBTP Use
If the work area closure is anticipated to last more than three continuous days and nights without a change to the traffic control layout or staging, CBTP is recommended for the following situations:

1. A bridge deck or culvert replacement/rehabilitation where any of the following conditions is anticipated to exist for more than three consecutive days and nights:
   - Full-depth holes in the deck
   - Railing removed
   - Confined/restricted work area

2. Dropping/removing a bridge deck over roadway if the work activity is more than three consecutive days and nights

3. A bridge painting project over the roadway

4. To separate counter directional traffic where two or more lanes in each direction are provided during the work and posted speed limit $\geq 45$ mph

Depending on the significance of the factors listed at the beginning of this procedure, other common situations which may justify CBTP, include:

A. Spot (or isolated) locations where the work area closure will last for more than three continuous days and nights without a change to the traffic control layout or staging, and either of the following conditions is anticipated:
   - Exposed hazard that is at the same spot for more than three consecutive days and nights and is closer to an open traffic lane than:
     1. 15 - 20 feet on freeway or expressway
2. 10 - 15 feet on non-freeway/expressway where the posted speed limit is >= 45 mph

3. 8 - 10 feet if AADT is less than 1,500 or the posted speed limit is less than 45 mph

- Examples include footings, abutments, and construction activities such as false work.

The distance between the edge of the open traffic lane and the work is less than 6 feet (4 feet if non freeway/expressway) and the work is anticipated to continue for more than three consecutive days and nights at the same spot location.

If the work area closure and hazard will last for extended length of time (e.g., more than 2 months), lateral clearance should be greater than noted above, or CBTP should be considered.

Whenever feasible, it is preferable to remove the hazard and avoid the need for CBTP. Where the hazard cannot be removed, an option in lieu of CBTP to shield some hazards is to use attenuators, or crash cushions as described in FDM 11-45-1.

**Table 35.1 Drop-offs to Commonly Justify CBTP**

<table>
<thead>
<tr>
<th>Depth of Drop off (in)</th>
<th>Freeways/Expressways 60 - 70 mph</th>
<th>Freeways/Expressways 45 - 55 mph</th>
<th>Non Freeways/Expressways 45 - 55 mph</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 - 12</td>
<td>0-2</td>
<td>0-2</td>
<td>0-2</td>
</tr>
<tr>
<td>13 - 24</td>
<td>0-4</td>
<td>0-4</td>
<td>0-4</td>
</tr>
<tr>
<td>25 - 36</td>
<td>0-12</td>
<td>0-8</td>
<td>0-4</td>
</tr>
<tr>
<td>&gt; 37</td>
<td>0-20</td>
<td>0-20</td>
<td>0-8</td>
</tr>
</tbody>
</table>

* For dropoffs on the outside of a horizontal curve or taper, or where the dropoff will last for extended length of time (e.g., more than 2 months), provide greater offset than shown in the table. Otherwise, consider CBTP. Whenever feasible, provide a minimum 2-foot lateral offset between the edge of the traffic lane and any dropoff. Where this is not feasible, a maximum dropoff of 6 inches may be acceptable without using CBTP. Provide a sloped edge of aggregate or other temporary fill material at the dropoff.

For roadways with posted speed limit, less than 45 mph consider the factors listed in the beginning of this procedure to determine if a barrier is warranted.

The need for CBTP to protect from drop-offs may be avoided by using aggregate or other temporary fill material to increase the lateral offset and/or to provide a 3:1 or flatter slope adjacent to the pavement or shoulder. Even if adequate lateral offset is provided, a sloped edge is desirable. Provision of temporary fill material at the pavement edge should be specified on Construction Details in the plan.

C. At freeway/expressway crossover entrances to prevent vehicles from entering opposing traffic lanes (as shown on SDD 15D5). CBTP should also be considered at crossover exits that will be in place for more than one week, as shown on SDD 15D10 where AADT is >=20,000.

D. Other situations where a combination of severity of hazard, high traffic volume, geometric concerns, and/or long duration of exposure exist.

### 35.4 CBTP Anchoring Requirement/Deflection Distance

Although CBTP is designed to prevent an errant vehicle from entering a construction work zone, research tests have shown lateral deflection of the barrier after a vehicular hit. The barrier shall be anchored if the distance to a 2-foot or greater dropoff is steeper than 3H:1V, and:
1. The posted speed is 45 mph or greater and the dropoff is less than 4 feet from the side of the barrier closest to the dropoff
2. The posted speed is 40 mph or less and the dropoff is less than 2 feet from the side of the barrier closest to the dropoff

For example, the edge of a bridge deck or a dropoff at the edge of pavement.

The values shown below are recommended buffer space behind a freestanding concrete barrier installation. Refer to SDD 14B7 for additional guidance.

When shielding hazards above ground:

<table>
<thead>
<tr>
<th>Posted Speed</th>
<th>Deflection Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 mph or less</td>
<td>2 ft</td>
</tr>
<tr>
<td>45 mph or greater</td>
<td>4 ft</td>
</tr>
</tbody>
</table>

When shielding Drop-offs:

<table>
<thead>
<tr>
<th>Posted Speed</th>
<th>Deflection Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 mph or less</td>
<td>2 ft</td>
</tr>
<tr>
<td>45 mph or greater</td>
<td>- Vertical Drop-off 6” or less and no traffic below: 2 ft</td>
</tr>
<tr>
<td></td>
<td>- Vertical drop-offs greater than 6”: 4 ft</td>
</tr>
</tbody>
</table>

When used as a Temporary Median Barrier separating opposing traffic lanes:

<table>
<thead>
<tr>
<th>Posted Speed</th>
<th>Deflection/Shy Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>40 mph or less</td>
<td>0 ft minimum but 2 ft preferred</td>
</tr>
<tr>
<td>45 mph or greater</td>
<td>1 ft minimum but 2 ft preferred</td>
</tr>
</tbody>
</table>

Where lateral displacement of the barrier cannot be tolerated, anchor the barrier to the underlying pavement surface according to the details in SDD 14B7.

35.5 Intersection Sight Distance

When specifying the need for CBTP, it is recommended that the designer check all side road approaches to ensure the CBTP does not restrict intersection sight distance. This is especially critical when the roadway segment has horizontal and vertical curves that may further affect sight distance. Provide appropriate turning radii in urban areas to accommodate school buses and other large vehicles. Install portable crash cushions so the end of the cushion is located at least 50 ft from the intersecting side road. The intersection may need grading to minimize drop-offs.

35.6 CBTP End Treatments

35.6.1 Clear Zone

For the purpose of determining the need for end treatment for temporary precast concrete barrier in work zones, the following clear zones are appropriate. Where a range of minimum to desirable clear zone is noted, consider traffic volume, speed, and duration of exposure to determine appropriate clear zone for the project. For stage switches and short-term work operations of no more than 24 hours duration, lesser clear zone than the minimum noted may be allowed. For end treatment barrier installations in place for extended length of time (e.g., more than 2 months), a greater clear zone should be considered.

- Freeways and expressways: 15’ minimum, 20’ desirable
- Other highways (non-freeway/expressway): 10’ minimum, 15’ desirable
- Other highways with AADT less than 1500 or non-construction speed limit of 45 mph or less: 8’ minimum, 10’ desirable
- Bridge projects with temporary traffic signals, one open lane shared by both directions: 12’ from the open traffic lane

35.6.2 Barrier Flare

The most desirable treatment for the exposed end of CBTP is to flare the barrier away from open traffic lanes to the edge of the clear zone as defined above. Cost effective flare rates range from 4:1 (low speed roadways) to
8:1 (high speed roadways). Longer flare rates increase the number of impacts while shorter flare rates increase the severity of crashes. For additional guidance, refer to Roadside Design Guide. The recommended flare rates are shown below.

- 8:1 for operating speed of 45 mph or more
- 6:1 for operating speed of 40 mph or less

Often it is not possible to flare the barrier to the edge of clear zone due to space limitations or need for construction vehicles and equipment to access the work area. If the barrier is not flared to the edge of clear zone and speeds are 35 mph or greater, temporary grading may be required for uneven ditch sections or NCHRP Report 350 Test Level 3 approved sand barrels or portable crash cushion should be provided as the barrier end treatment. The Roadside Design Guide contains recommended barrier end placement examples in non-level shoulders and medians.

35.6.3 Construction Work Operations and Traffic Stage Switches Near Flared Barrier

Even if the barrier is flared away from traffic, the barrier may have to be straightened and the barrier end moved closer to traffic to complete some work operations and traffic stage switches. If the barrier end would be located within the clear zone for longer than 24 hours and speeds are 35 mph or greater, one of the following treatments should be done:

1. Provide a portable crash cushion
2. Taper traffic to the shoulder or adjacent lane to provide more lateral clearance to the barrier end
3. Remove the barrier and stockpile it off the work site

35.6.4 Crash Cushion or Sand Barrels.

As indicated earlier in this procedure, if it is not possible to flare the barrier to the edge of the clear zone and speeds are 35 mph or greater, then NCHRP Report 350 Test Level 3 approved portable crash cushion or sand barrels should be provided as the barrier end treatment. Install an approved crash cushion or sand barrels on the exposed end of the barrier if within the clear zone. These end treatments are designed to absorb energy of an impacting vehicle by reducing the impact force to acceptable levels. A crash cushion or sand barrels are required on the upstream end for divided or one-way facilities, and on both ends for all two-way facilities, including temporary two-way facilities, such as in freeway counter-directional operations. The types of crash cushions currently used are listed in the WisDOT Approved Products List.

Sand Barrels consist of a group of free-standing barrels and are discussed in FDM 11-45-1. When selecting the crash cushion or sand barrels, consider the frequency of nuisance hits.

40.1 General

Excessive speeds in highway construction work zones can adversely affect the safety of the work force and the motorists. There are a number of methods for slowing traffic to acceptable speeds in work zones, including flagging, regulatory and advisory signing, changeable message signs, flashing lights, lane width reductions, law enforcement, etc. Past experience has shown that law enforcement techniques are effective in reducing speeds in work zones and provide valuable assistance in removing disabled vehicles from the roadway. Law enforcement activities can be in the form of:

- Stationary Patrol Cars
- Police Traffic Controller (Officer does flagging)
- Circulating Patrol Car
- Stationary Patrol Car - Lights On
- Stationary Patrol Car - Radar On
- Freeway Service Team Support

On any construction project, the method of constructing the project and the method of handling traffic should be resolved early in the project development process. The following guidelines are presented to assist the designer in identifying when specialized law enforcement techniques might be warranted.

40.2 Type of Facility

Generally use of law enforcement officials on a continuing basis is warranted only on freeways or Interstate roadways where traffic volumes are in excess of 25,000 - 30,000 AADT and lanes are closed in peak periods. Where lane closures are limited to off-peak periods, a higher AADT (approximately 35,000) is typically
considered a minimum threshold volume to justify extra law enforcement. Reduction of work zone traffic speeds requires the existence of an enforceable speed limit. If the desirable speed is less than the legal posted speed than the speed limit must be lowered. The State Traffic Engineer has the authority to reduce the legal speed limit by up to 10 mph on State Trunk Highways. Designers should work with their Region Traffic Sections to determine if the speed limit should be reduced and to establish a temporary speed zone declaration.

40.3 Type of Work

Construction projects considered for law enforcement techniques should involve a concentrated work effort over major segments of the project. If actual construction is not visible, credibility of the work zone speed reduction is questioned, thereby reducing its effectiveness. Also, to be effective, the construction work must allow space for law enforcement officials to stop violators at the point of infraction. If sufficient shoulder area does not exist, consideration should be given to the construction of temporary "pull-off" areas.

These guidelines are intended for the long term contractual type law enforcement activities. They are not intended to limit the short term use of law enforcement agencies for construction control on applications such as lane closures, traffic lane switching, etc. Proposed use of law enforcement techniques shall be included in the TMP.

40.4 Support Services for Work Zone Mitigation

Refer to Traffic Guidelines Manual (TGN) 6-3-5 Law Enforcement Mitigation for further assistance on determining when to use law enforcement support for work zones.

FDM 11-50-45 Pavement Marking

45.1 General

Guidance on pavement marking selection for various pavement types is in chapter 3 of WisDOT's Traffic Engineering Operations and Safety Manual (TEOps):


45.2 Pavement Marking Selection

45.2.1 Selection of Material on New or Resurfaced Pavements for Long Line Markings

The selection of material is based on the type of pavement and the expected life of the pavement. The initial cost for durable markings is relatively expensive, but their use on new pavements is justified because of their durability and the likelihood that the pavement surface will not require short-term maintenance. Placement of durable markings means the roadway does not need to be re-marked on an annual basis. This reduces the exposure of a marking crew to traffic and minimizes disruptions to the traveling public.

There are some situations when the use of durable markings (such as epoxy, or preformed plastic tape) is not cost effective. These are listed below:

1. When the pavement marking will be removed or covered for traffic control staging within the next three years
2. When the surface life or pavement maintenance practices would prevent the pavement marking material from attaining its life expectancy (at least 3 years)
3. Late Season Markings - Marking durability is jeopardized by cold pavement temperatures below 40 degrees Fahrenheit. For this reason, permanent markings shall not be placed after November 15 and before April 15 (refer to Standard Spec 646.3.4.1). An exception to this will be when the Pavement Marking Late Season bid item is added to the contract by special provision (refer to FDM 19-07-1.2)
4. Avoid the use of preformed plastic tape on highway projects with a length of three miles or less when adjoining lane line marking is epoxy
5. Whenever short bridge pavement approaches to bridge decks are constructed as part of bridge rehabilitation, place the same type of marking as leading up to the bridge deck

Table 45.1 provides guidance for the required pavement marking for various types of new pavement or resurfaced highways and roadways. For highway, roadway or surface types not listed designer should consult with the Regional Signing/Marking Engineer.
### Table 45.1 Required Permanent Pavement Marking for Newly Paved or Resurfaced Roads

<table>
<thead>
<tr>
<th>Roadway Type</th>
<th>Surface Type</th>
<th>Edge Line</th>
<th>Center Lines</th>
<th>Lane Lines, 2' and 3′ segments and Gore</th>
</tr>
</thead>
<tbody>
<tr>
<td>Freeway</td>
<td>Concrete</td>
<td>Epoxy</td>
<td>N/A</td>
<td>380AW Tape Grooved</td>
</tr>
<tr>
<td>Freeway</td>
<td>Asphalt</td>
<td>Epoxy</td>
<td>N/A</td>
<td>380AW or 380AW-5 Tape Grooved *</td>
</tr>
<tr>
<td>Freeway</td>
<td>Open-graded</td>
<td>Epoxy on Scarification</td>
<td>N/A</td>
<td>380AW Tape Grooved *</td>
</tr>
<tr>
<td>Expressway</td>
<td>Concrete</td>
<td>Epoxy</td>
<td>N/A</td>
<td>380AW-5 Tape Grooved</td>
</tr>
<tr>
<td>Expressway</td>
<td>Asphalt</td>
<td>Epoxy</td>
<td>N/A</td>
<td>380AW or 380AW-5 Tape Grooved *</td>
</tr>
<tr>
<td>Expressway</td>
<td>Open-graded</td>
<td>Epoxy on Scarification</td>
<td>N/A</td>
<td>380AW Tape Grooved *</td>
</tr>
<tr>
<td>Multilane Divided</td>
<td>Concrete</td>
<td>Epoxy</td>
<td>N/A</td>
<td>380AW-5 Tape Grooved</td>
</tr>
<tr>
<td>Multilane Divided</td>
<td>Asphalt</td>
<td>Epoxy</td>
<td>N/A</td>
<td>380AW or 380AW-5 Tape Grooved *</td>
</tr>
<tr>
<td>Multilane Divided</td>
<td>Open-graded</td>
<td>Epoxy on Scarification</td>
<td>N/A</td>
<td>380AW or 380AW-5 Tape Grooved *</td>
</tr>
<tr>
<td>Greater than Four Lane Undivided</td>
<td>Concrete</td>
<td>Epoxy</td>
<td>Epoxy</td>
<td>Epoxy</td>
</tr>
<tr>
<td>Greater than Four Lane Undivided</td>
<td>Asphalt</td>
<td>Epoxy</td>
<td>Epoxy</td>
<td>Epoxy</td>
</tr>
<tr>
<td>Greater than Four Lane Undivided</td>
<td>Open-graded</td>
<td>Epoxy on Scarification</td>
<td>Epoxy on Scarification</td>
<td>Epoxy on Scarification</td>
</tr>
<tr>
<td>Greater than Four Lane Undivided</td>
<td>Seal Coat</td>
<td>Waterborne Paint</td>
<td>Waterborne Paint</td>
<td>Waterborne Paint</td>
</tr>
<tr>
<td>Four-lane Undivided</td>
<td>Concrete</td>
<td>Epoxy</td>
<td>Epoxy</td>
<td>Epoxy</td>
</tr>
<tr>
<td>Four-lane Undivided</td>
<td>Asphalt</td>
<td>Epoxy</td>
<td>Epoxy</td>
<td>Epoxy</td>
</tr>
<tr>
<td>Four-lane Undivided</td>
<td>Open-graded</td>
<td>Epoxy on Scarification</td>
<td>Epoxy on Scarification</td>
<td>Epoxy on Scarification</td>
</tr>
<tr>
<td>Four-lane Undivided</td>
<td>Seal Coat</td>
<td>Waterborne Paint</td>
<td>Waterborne Paint</td>
<td>Waterborne Paint</td>
</tr>
<tr>
<td>Two-lane</td>
<td>Concrete</td>
<td>Epoxy</td>
<td>Epoxy</td>
<td>N/A</td>
</tr>
<tr>
<td>Two-lane</td>
<td>Asphalt</td>
<td>Epoxy</td>
<td>Epoxy</td>
<td>N/A</td>
</tr>
<tr>
<td>Two-lane</td>
<td>Open-graded</td>
<td>Epoxy on Scarification</td>
<td>Epoxy on Scarification</td>
<td>N/A</td>
</tr>
<tr>
<td>Two-lane</td>
<td>Seal Coat</td>
<td>Waterborne Paint</td>
<td>Waterborne Paint</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Note:** Tape placement requires a minimum of five calendar days wait period prior to grooving asphalt pavement. Designer needs to add calendar days to engineering estimate.

#### 45.2.2 Selection of Material on Existing Pavements for Long-Line Markings

In the past worn out markings were maintained by using paint. At some locations, however, the amount of traffic caused the paint to last less than a year so markings needed to be repainted more than once a year. On a life cycle basis, durable marking materials are cost effective for maintaining pavement markings on highways where routine maintenance or a scheduled reconstruction or resurfacing will not interfere with the life of the marking. Anticipated crack filling or joint sealing operations should be considered in both the selection of material and the placement of the lines. Refer to Table 45.2 for guidance on the selection of material on existing pavements.
Consider removing existing marking as an option after two restripes or a total of three layers of marking or when marking shows distress from snow plow activity before remarking. Check with the Regional Signing/Marking Engineer for a recommendation if pavement marking removal is necessary.

Using a durable material on these routes will meet driver expectations for good delineation provided by pavement markings, and will eliminate annual exposure of a slow moving painting crew to traffic.

**Table 45.2 Selection of Material on Existing Pavements for Long-Line Markings**

<table>
<thead>
<tr>
<th>Estimated Pavement Life</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt; 2 Years</td>
<td>Waterborne Paint</td>
</tr>
<tr>
<td>&gt; 3 Years</td>
<td>High-build Waterborne Paint</td>
</tr>
<tr>
<td>&gt; or = 3 Years</td>
<td>Epoxy or with 380AW-5 Series Grooved Tape *</td>
</tr>
</tbody>
</table>

* 3M Wet Reflective Tape 380AW-5 Wet Reflective Contrast Tape shall be used to supplement sprayed epoxy markings at the end of lane lines on concrete and faded asphalt freeways/expressways according to SDD 15C10. This product shall be placed in a 120-mil grooved slot.

**45.2.3 Selection of Material for Special Marking on New or Existing Pavements**

Special markings include but are not limited to; stop and yield lines, arrows, parking spaces, crosswalks, some channelizing lines, chevrons, diagonals, handicap ramps, and word and symbol markings. For WisDOT employees special provisions are available at the BTO Website:


for grooved preformed plastic and grooved preformed thermoplastic.

**FDM 11-50-50 Signals**

50.1 General

Control devices in this category include traffic and pedestrian control signals, beacons, lane use control signals, lift bridge and swing bridge signals and gates, emergency traffic control signals, and railroad crossing signals and gates, all of which are either pre-timed or traffic actuated.

50.2 Traffic Signal Investigation

As part of the scoping process for a highway improvement project, the designer must consider whether traffic signals are anticipated within the project design life. If signals are currently located within the project area, it is very likely that signal operations/controls will require modification and updating.

Table 50.1 and Table 50.2 are NOT signal warrants, but are a guide for determining if special intersection treatments or signals may be needed within the design life of the project. If the current or projected volumes come close to or exceed the suggested minimum threshold AADT volumes on both the major and the minor street listed in Table 50.1 or Table 50.2, notify the region traffic personnel that special intersection treatment or safety improvements may be needed. Case 1 is related to the volume of intersecting traffic through-put of an intersection. Case 2 is related to the lack of gaps, or continuous traffic, on the major street that may cause excessive delay on the minor street.

Table 50.1 should be used when the 85th percentile or posted speed exceeds 40 mph, or when the intersection lies in an area having a population of less than 10,000. Table 50.2 should be used in conjunction with facilities not covered by Table 50.1. When the traffic volumes are approached or exceeded in the following tables, the traffic section will evaluate possible solutions such as: the need for a four-way stop, improved signing, geometric changes, traffic signals, roundabouts or other improvements.

**Table 50.1 Minimum Threshold Traffic Volumes for Case 1 & 2 (typically rural)**

<table>
<thead>
<tr>
<th>Lanes per Approach</th>
<th>Case 1</th>
<th>Case 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Major St.</td>
<td>Minor St. (2-way ADT)</td>
<td>Minor St. (2-way ADT)</td>
</tr>
<tr>
<td>Minor St. (2-way ADT)</td>
<td>Major St. (2-way ADT)</td>
<td>Minor St. (2-way ADT)</td>
</tr>
<tr>
<td>Lanes per Approach</td>
<td>Case 1</td>
<td>Case 2</td>
</tr>
<tr>
<td>------------------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td></td>
<td>Major St. (2-way ADT)</td>
<td>Minor St. (2-way ADT)</td>
</tr>
<tr>
<td>Major St.</td>
<td>1</td>
<td>5,600</td>
</tr>
<tr>
<td>Minor St.</td>
<td>2</td>
<td>6,700</td>
</tr>
</tbody>
</table>


**Table 50.2 Minimum Threshold Traffic Volumes for Case 1 & 2 (typically urban)**

Region traffic personnel will evaluate the intersection for meeting various traffic signal warrants. The designer may have to provide information to the traffic personnel on the proposed design such as: adjacent parking, bus pullout bays, approach grades, lane widths, number of lanes, speed, percent trucks, design hour volumes, turning movement volumes and intersection layout showing access and sight distance. Part IV, Section C of the Manual on Uniform Traffic Control Devices (MUTCD) shows a complete list of the traffic signal warrants.

Traffic control signals should not be installed unless one or more of the traffic signal warrants are met. The satisfaction of a warrant or warrants is not in itself justification for a signal. If signals are to be installed on portions of the State Trunk System or on connecting highways, a region traffic engineer must submit a recommendation on the matter (form DT1199 and Signal Investigation Report, also see the Traffic Signal Design Manual) for approval by the State Traffic Engineer before the signals may be incorporated into the project.

**50.3 Design Standards**

The design of traffic signal systems shall conform to the Department's "Traffic Signal Design Manual." Contact the person named below for information on how to obtain this manual.

- State Traffic Signal Systems Engineer
- Bureau of Traffic Operations, Rm 501
- P. O. Box 7986
- Madison, WI 53707-7986
- (608) 261-5845

This manual is also available on the dotnet for WisDOT staff and on the extranet for non-WisDOT staff.

**FDM 11-50-55 Signing**

**55.1 General**

Signs are essential when special regulations apply at specific places or at specific times only, or when hazards are not self-evident. They also provide information concerning highway routes, directions, destinations, and points of interest. Signs are classified in accordance with their basic function as either regulatory, warning, or guide signs. For a detailed description of the various types, the reader is referred to the Wisconsin Manual of Traffic Control Devices (WMTCD).

The basic requirements of a street or highway sign are that it be legible to those using it and that it be understood in sufficient time to permit a proper response. This requires a high degree of visibility, lettering and/or symbols of adequate size, and a brief legend for quick comprehension by the approaching driver. Standardized colors and shapes are specified so that the several classes of signs can be promptly recognized. Simplicity and uniformity in design, position, and application are important and necessary considerations in this regard.

Each standard sign should be displayed only for the specific purposes as prescribed in the WMTCD. Before any new or reconstructed highway, temporary route or detour is opened to traffic all necessary signing should be in place. Signs required by road conditions or restrictions should be removed when those conditions are no longer present or the restrictions are removed. Uniformity of application is as important as standardization with respect
to design and placement. Identical conditions should always be marked with the same type of sign irrespective of where those particular conditions occur.

### 55.2 Reflective Sheeting For Highway Signs

All types of reflectorized signs on state and local projects administered by WisDOT shall have standard Type SH, Type F and Type H reflective sheeting backgrounds regardless of whether or not federal funds are used to finance the signing.

- **Type SH** (super high intensity prismatic) shall be used as background and lettering material for all Type I signs, except yellow.
- **Type F** (fluorescent high intensity prismatic) material shall be specified as the background material for the following applications:
  1. Orange work zone traffic control signs.
  2. Yellow warning signs.
  3. Yellow overhead Type 1 signs.
  4. Fluorescent Yellow-Green school signs.

Use of Type F (fluorescent yellow-green) material, other than for these four applications, will require detailed justification and Central Office Traffic Section approval prior to submittal of the PS&E.

- **Type H** (Prismatic high intensity sheeting) shall be used for the background and lettering material of all other Type II and Type III reflectorized signs and for the message elements, except when Standard Black is used for the message elements.

Additional information regarding permanent signing reflective sheeting is provided in FDM 15-1-20.10.

### FDM 11-50-60 Lighting

#### 60.1 General

WisDOT takes a conservative approach to the use of lighting, primarily because of the high cost of installation, coupled with the long-term maintenance and energy expenditures involved. There are several cases where safety concerns have been evaluated and lighting is always installed. These are:

- at signalized intersections
- at roundabouts
- the Milwaukee area freeways

Other than these, lighting is typically not installed unless it can be proven that the lack of illumination is the cause of the accidents/confusion at the site and the installation of lighting is the only remedy. The Traffic Engineering, Operations and Safety Manual (TEOpS 11-3-1) describes the policy and the approval process for lighting on State Highways.

Local units that are insistent upon WisDOT providing the lighting for various locations on the State Highway systems can be accommodated and the lighting included as part of the construction contract if the local unit will pay for the installation and all future maintenance and energy costs involved. This is accomplished with a permit. The permit policy and process are described the Traffic Engineering, Operations and Safety Manual (TEOpS chapter 11):

WisDOT also makes provisions for the lighting of major bridges in communities by installing necessary conduit, etc., during construction of the bridge. However, lighting of such bridges is the responsibility of the community, and all costs relating to installation, maintenance, and operation must be assumed by them.

A related topic concerns the use of breakaway supports for lighting installations as well as for signs and traffic signals. WisDOT has adopted the 1985 AASHTO Standard Specifications on the subject, which delineate requirements for the usage and design of such devices. The primary criterion of breakaway supports is that they allow the luminaire, sign, or signal to be safely displaced by a vehicle impact (from any possible direction and/or by any portion of the vehicle) without hazardous intrusion into the passenger compartment or causing a more serious accident (such as overturning the vehicle or directing it back into traffic, etc.).

Various release mechanisms have been developed, utilizing slip planes, plastic hinges, fracture elements, and combinations thereof. Since product costs vary considerably, contact the Central Office Traffic Section in this regard. For installations within the clear zone (as well as for those beyond the clear zone, where the need exists), the designer should employ the least hazardous breakaway support that can be economically obtained.