FULL ROAD CLOSURE FOR WORK ZONE OPERATIONS:
A Case Study

Accelerating Construction and Reducing Crashes During the Rehabilitation of a Major Downtown Route

M-10 Lodge Freeway in Detroit, Michigan

December 2004

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Preface

This case study is one in a series of documents that examine the use of Full Road Closure in work zones. More information on this methodology, and variations of full road closure, is available in the companion document, *Full Road Closure in Work Zones—A Cross-Cutting Study* (Report No. FHWA-OP-04-009).

This case study reflects information gathered during interviews with project personnel on the M-10 rehabilitation effort in Detroit, Michigan. Information was also gathered through the Michigan DOT website. The authors greatly appreciate the cooperation of the Michigan Department of Transportation and its partners and thank them for sharing their experiences and insights from M-10 and other full closure projects.

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Introduction

State highway agencies and transportation professionals face the challenge of balancing essential roadway repairs and maintenance with mobility and safety concerns. As a result, some agencies are looking at nontraditional construction methods to rehabilitate roadways while reducing the negative impacts of construction. One such methodology achieving success is full road closure.

A full closure is the removal or suspension of traffic from a particular section of roadway for the purpose of rehabilitation and/or maintenance. Full closures may be short term, lasting for a weekend, or longer term, lasting for months or more than a year. A growing number of rehabilitation projects have been done using a full closure approach, often with similar successful results. Contractors that are given full access to the road gain efficiencies that often reduce project duration and costs as well as improve the quality of the end product. These positive effects usually lead to increased favorable public sentiment, and potentially reduce both short- and long-term user costs.

This document describes the planning, implementation, benefits, and lessons learned by the Michigan Department of Transportation (MDOT) during a rehabilitation project on Michigan Route 10 (M-10). This case study illustrates a successful application of the full closure approach. It is intended to provide transportation agency personnel and elected officials with a better understanding of the considerations necessary to implement full road closure on a project, and the benefits that can be obtained.

During the summer of 2002, MDOT performed rehabilitation on a busy downtown connector. M-10 needed full surface reconstruction, and five bridges over the road needed repair, removal, or replacement. The project covered approximately 1.3 miles of urban freeway. MDOT engineers decided to pursue a full closure in order to expedite the construction process and improve safety for both travelers and workers. MDOT had previously used a full closure approach for work on the M-10. Experience from that earlier project facilitated the successful use of full closure for the 2002 reconstruction effort.

Project Specifications and Background

M-10, also called the John C. Lodge Freeway, is a major freeway route from I-696 in Southfield to downtown Detroit. The Freeway intersects with I-94 and I-75 along the way and then terminates at West Jefferson Avenue. During 2002, MDOT reconstructed a portion of M-10 and performed work on five bridges over M-10. Figure 1 shows the project location and the alternate route recommended by MDOT. The route serves mainly commuter traffic, as well as travelers going to the downtown business district, downtown attractions such as the Joe Louis Arena, various entertainment venues, and the tunnel and bridge that span the Detroit River to connect Detroit and Windsor, Ontario.

Project specifications called for pavement removal and replacement, including shoulders and barriers. Based on their condition, some concrete sections along the route were able to remain in place, but were cold-milled and patched. Streetlights and other improvements were also included in project specifications. Table 1 shows the rehabilitation requirements for M-10 and five bridge spans included in the project specifications. The required bridge repair was extensive, and the use of full closure would allow repairs to be performed efficiently. Figure 2 shows the removal of an existing bridge deck, prior to repair.

Figure 1 – Closure and recommended alternate route for the M-10 project

Location	Requirements
M-10	Full surface reconstruction, including shoulders and barriers. Operational improvements, including streetlights and signage.
Howard Street bridge	Superstructure replacement and substructure repairs.
Porter Street bridge	Superstructure replacement and substructure repairs.
Bagley Street bridge	Concrete deck overlay and substructure repairs.
Elizabeth Street bridge	Structural removal.
Larned Street bridge	Deck patching, joint repair, and substructure repairs.

Table 1 – Rehabilitation Requirements

Figure 2 – The requirement for significant bridge repairs made full road closure an attractive option during the M-10 reconstruction

Project characteristics:

- $12.5 million total cost
- 97,900 average daily traffic
- 1 percent commercial vehicle traffic
- Reconstruction of a 1.27-mile section of roadway (7.6 lane miles)
- Project dates—July 9 through August 30, 2002.

History of Repairs on M-10

Full road closure had previously been used on M-10 during a major rehabilitation in 1986 involving an 8.7-mile section of the roadway. The rehabilitation included widening the shoulders, constructing 4-foot safety walls, extending and upgrading the drainage system, cleaning and inspecting storm sewers, and performing bridge and ramp work. Each direction was fully closed during the replacement of the pavement. Extensive analysis was performed of the impacts of the closure on traffic characteristics on alternate routes. According to the results, traffic on alternate routes increased during different scenarios; however, drivers naturally shifted to better and less congested alternate routes. Also essential to the success of the first M-10 full closure was an extensive public relations campaign including radio and television ads, stakeholder task forces, posters, flyers, mailers, candy bars, and buttons. Much of the experience gained during this 1986 project facilitated the closing of the downtown section of M-10 in August 2002.

Why Use Full Road Closure?

MDOT engineers used full road closure for two reasons:

1. MDOT initially estimated that the M-10 reconstruction would take at least six months without full closure. Based on past experience, project personnel expected that using full closure would expedite the project by at least one month, enabling the project to be completed in one construction season. MDOT determined it was preferable to finish the project in one season rather than having it extend into the next construction season in the Spring. MDOT also needed to allow for some key local events to take place unhindered by the work zone and potential congestion, which compressed the window when the roadwork could occur. Through a competitive bid process using A+B (cost plus time), the contract was ultimately written for 65 days of full closure, including safety breaks, which was lower than the five month estimate. The contractor completed the roadwork in 53 days to earn some of the incentive.

2. MDOT engineers believed that using full closure would increase safety for both travelers and workers. By removing the worker/traveler interface, the opportunity for crashes in the work zone would be eliminated.

This strategy was feasible because the downtown area of Detroit has a significant number of alternate routes available to divert traffic. MDOT engineers realized that the use of these routes, including the alternate route recommended and signed by MDOT, would simplify and reduce the impacts of the M-10 rehabilitation.

Planning

A critical component to successfully using full road closure is planning. Effective planning requires evaluating and selecting traffic management strategies, informing and collaborating with all potential stakeholders, and developing and implementing an effective public outreach campaign.

Traffic Management Strategies

Four maintenance of traffic alternatives were considered during the project planning phase: (1) Traditional partial width construction; (2) Partial freeway closure with northbound lanes detoured completely and southbound lanes maintained with a temporary crossover to the northbound side; (3) Partial freeway closure, one direction at a time; (4) Total freeway closure. Traditional partial width construction was eliminated due to left and right entrance and exit ramps, extended length of time for construction, and constrained contractor access to the project, among other things. After eliminating that option, of the three remaining traffic management options, full closure offered the fewest disadvantages.

Total freeway closure was ultimately chosen based on several advantages:

- Expedited project construction time
- Increased worker and driver safety
- Ability to rehabilitate five bridge structures without additional disruptions to traffic or added costs—the full closure of the road under the bridges would eliminate the need for multiple separate lane closures for the bridgework occurring overhead
- Constructability gains such as easier access for construction work, more convenient staging areas, and less interruption on material placement.

Disadvantages of using full closure on M-10 were that it would:

- Necessitate that southbound traffic be detoured, contrary to the Detroit City Council's desire
- Possibly lead to more severe congestion on alternate routes
- Hinder access to some local entertainment venues and businesses.[1]

> *M-10, the Lodge Freeway, is the main entrance to Downtown Detroit. We chose to close an entire stretch of it in the downtown area in the summer of 2002 for reconstruction, opting to get it done quicker, at a lower cost, rather than spread the construction over two seasons. Travelers quickly found alternative routes, and the freeway reopened two months later, earlier than expected.*
> **Maryann Mahaffey, President, Detroit City Council**

From their prior experience with full closure methodology, MDOT personnel expected that congestion from the reduced capacity due to the M-10 closure would not be as significant as anticipated since MDOT observed in the past that drivers often adjust their travel routes, leading to a balancing of traffic on the network. During planning for the full closure, project personnel collected a sample of actual travel times on alternate routes during peak hours and determined that the alternate routes were reasonable in terms of time and distance traveled. Based on this assessment, MDOT did not make adjustments to designated alternate routes, as capacity was deemed adequate.

[1] Michigan Department of Transportation, *Memorandum – M-10 from I-75 to Griswald Street,* Maintenance of Traffic Alternatives section, undated.

Stakeholders

The list of potential stakeholders can be extensive; various stakeholders should be involved in the planning process based on the magnitude of the project. During the planning for the full closure of M-10, MDOT personnel worked with numerous stakeholders. Examples of this collaboration are provided below.

City of Detroit

MDOT project personnel involved city officials in the planning process, using their feedback in scheduling the full road closure. City officials had to be convinced of the benefits of the full closure methodology. Since this section of M-10 is adjacent to the Joe Louis Arena and serves as a travel route to the facility, officials were concerned with access during the hockey season. With the closure of M-10 in place, three of the four entrances to the sporting facility would be inaccessible. Thus, it was decided the project should begin only after the hockey season was over. This compromise to delay the start of the project would facilitate acceptance of the full closure methodology by city officials.

Local Businesses

Project personnel met with representatives from local businesses. The representatives included members from a large casino located near M-10 and personnel from General Motors Headquarters, due to their proximity to M-10. To reduce the impact of traffic diversion, temporary signs were set up to guide traffic to the casino. Other casinos in the area related their concern that more signing would be available to the casino near the closed facility. MDOT project personnel decided to erect additional signing for the other casinos to maintain equity. MDOT also considered the impact of full closure on the two border crossings present in Detroit—the Detroit Windsor Tunnel and the Ambassador Bridge—to limit impacts on cross-border shipping and travel.

Regional Coordinating Committee

The *Fix Detroit 6* Program consisted of six MDOT projects that were considered to be the highest profile projects with greatest impact to Detroit-area traffic for the 2002 construction season. M-10 was one of these projects. Prior to releasing proposals on any of the six projects included in the *Fix Detroit 6* Program, MDOT formed a regional coordinating committee including engineers from each project. The coordinating committee met to establish project start and completion dates and to examine and plan for potential impacts and special regional events. Projects were scheduled based on their overall impact on the network. Once the project schedules were established and the projects were implemented, the coordinating committee met every few weeks to coordinate closures and to assess traffic impacts.

Public Outreach

Public outreach and communication is a critical element for successfully planning and deploying a road project using a full closure approach. The *Fix Detroit 6* Program was an initiative that provided public information prior to and during rehabilitation to Detroit residents and travelers on the six major projects that were to take place during the 2002 and 2003 construction seasons. The outreach effort included distribution of fliers, television and radio ads, and coverage in local newspaper traffic columns. The cornerstone of the initiative was a comprehensive website that provided updated project information, including project plans, progress, and closures.

Operations

Deployment

Prior to the full closure, the contractor was given access to the roadway and allowed to close single lanes as needed, to survey, place signs, cover inoperable signs, and set-up preliminary lighting. M-10 was closed at midnight on the first day of the project, and local entrance ramps were closed one hour earlier. The closure process took approximately two to three hours. The contractor worked with state police to implement the closure. The process began upstream with entrance ramps closed, followed by exit ramp closures and finally through lane closures with a rolling roadblock driven through the entire site to ensure that the facility was empty.

Traffic Impact

Following deployment, congestion levels on alternate routes were generally lower than expected. Due to excess capacity existing on many of the alternate routes and redundancy present in the existing street network, no significant travel delays were observed on the alternate routes during project construction. One area, the intersection of the southbound M-10 exit ramp and Grand River Avenue (identified by the curved arrow on Figure 3), experienced congestion during the full closure. Travelers were attempting to avoid the prescribed detour at the M-10/I-75 interchange. Some complaints were filed by local businesses; however, no changes were implemented.

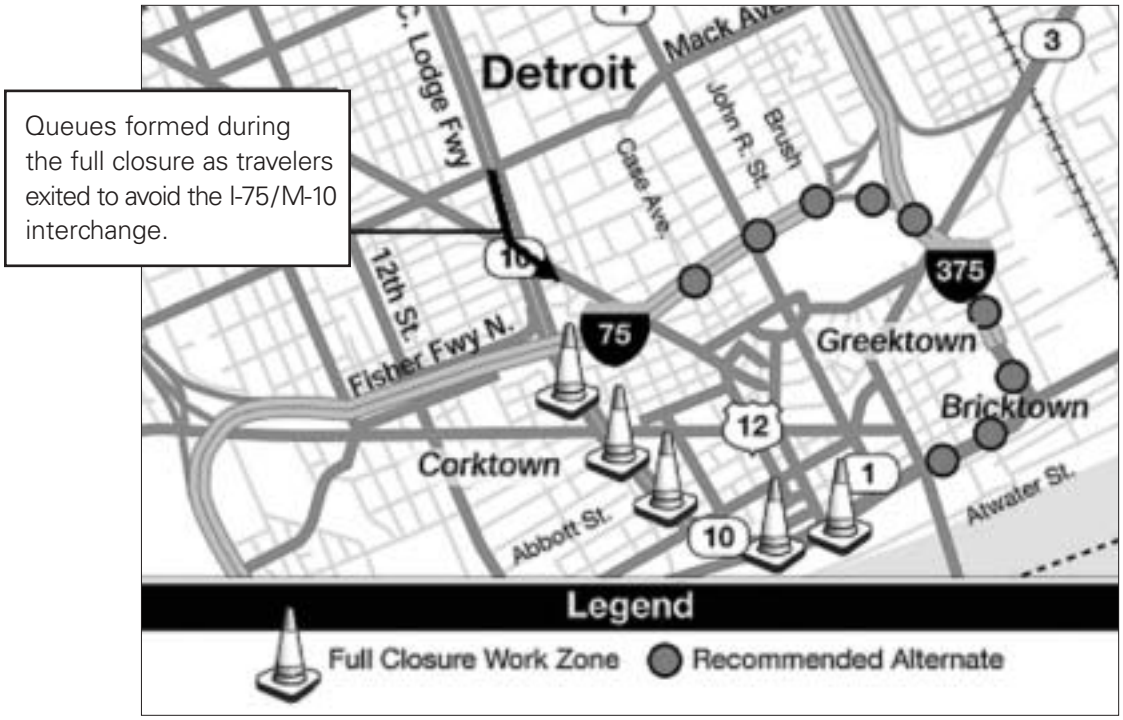


Figure 3 – Delays occurred off of one exit during the full closure

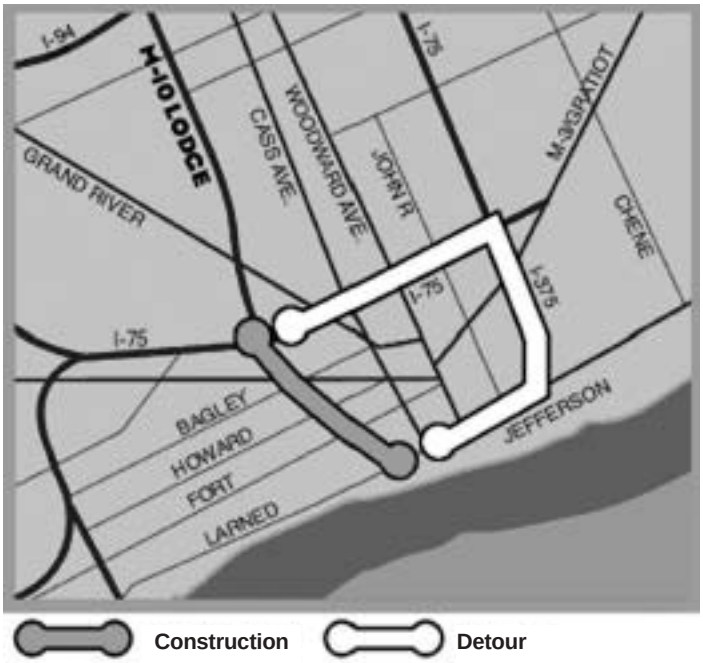
Traveler Information

The MDOT website, specifically the *Fix Detroit 6* initiative, provided travelers with daily updates to current conditions and alternate route advisory information. Travelers were provided with the opportunity to sign up for electronic detour alerts by route. Beyond the Internet, the *Fix Detroit 6* initiative included distribution of more than 850,000 fliers in the Sunday edition of the *Detroit Free Press* newspaper. The fliers highlighted the project purpose, the project status, and locations of alternate routes. Television and radio covered the M-10 project, detailing alternate route locations for travelers. Traffic reports on various media outlets and local transportation columnists provided significant coverage of the closures.

Information seekers also had the option of receiving project/route specific detour information via e-mail as significant changes occurred. Figure 4 shows a map of a recommended detour and other project information that was provided to travelers through the *Fix Detroit 6* website.

Signage

Signs, including changeable message signs (CMS), were deployed three weeks prior to the M-10 full closure. Before the implementation of the full closure, the contractor was allowed to close a single lane at night or on weekends to place signs, cover temporarily invalid signs, and install CMS.



Current Detours

Complete Closure:

- M-10 LODGE FRWY. BETWEEN I-75 AND COBO HALL IS NOW COMPLETELY CLOSED

Northbound:

- Jefferson Ave. to N-375 to southbound I-75 to northbound M-10 Lodge Frwy.

Southbound:

- North I-75 to south I-375 to Jefferson Ave.

Time Span

- Construction begins July 2002
- Completion October 2002

Details

- Total reconstruction of 1.1 miles of north and southbound M-10 (Lodge Freeway), from I-75 to Griswold Street in Detroit

Figure 4 – Detour route and current project information provided to travelers on the Michigan DOT *Fix Detroit 6* website

Benefits/Impacts of Full Road Closure

Duration

MDOT estimated that if traffic had been maintained using traditional methods, the project would have taken longer than six months, while using full closure enabled the contractor to complete the project in only 53 days (71 percent reduction). Full road closure allowed the contractor complete access to the facility. This greatly increased the staging area and reduced the need for maintenance of traffic set-up and removal during various stages of the project. Some congestion occurred on the road network during the M-10 rehabilitation, particularly at an intersection near one of the M-10 exit ramps. However, given the reduced project time frame resulting from full road closure, MDOT felt that overall user costs were lowered.

Cost

Beyond basic signage diverting traffic from M-10, additional enhancements to alternate routes were not required, which kept overall project costs low. While no quantitative information was available on cost savings for all work items, MDOT engineers said that the cost for traditional maintenance of traffic would have added to the total project cost significantly. Typically, the maintenance-of-traffic costs for an MDOT project of this size are approximately 5 to 10 percent of the total project cost. The maintenance-of-traffic costs for M-10 were estimated at 1.3 percent of the bid price for project costs.

Productivity

The full closure of M-10 allowed the contactor to perform full width construction, which expedited the contractor's production. Project personnel cited that workers seemed to be more productive since they did not have to interact with active traffic.

Safety

Project personnel related that safer conditions for both workers and travelers were achieved through full road closure. Data are not available on any crashes on alternate routes that could be attributed to the full closure. There were a few incidents of vehicles crashing into barriers that blocked entrance ramps to the closed portion of M-10. However, no serious injuries occurred.

Issues and Lessons Learned

From the 2002 M-10 project and other full closure projects in the past few years, MDOT personnel have drawn the following lessons:

Contracting

Agencies should consider the potential unpredictability of the schedule prior to using full road closure and time-based bidding.

MDOT personnel found that road rehabilitation projects involving a significant amount of utilities, especially projects with older utility lines that are not precisely located, may incur unpredictable delays. Agencies should consider the potential unpredictability of the schedule prior to using full road closure and time-based bidding. For the M-10 reconstruction, an addendum was made for the Howard Street Bridge deck replacement, which had many utilities on the structure. The work on the Howard Street Bridge was not part of the full closure nor subject to the A+B requirements of the contract because project personnel anticipated delay due to the extensive utility work.

Alternate Routes

MDOT personnel related that, after about two weeks, traffic redistributes to use the network more effectively, thereby reducing the amount of congestion expected on recommended alternate routes.

Although MDOT is required to recommend state roads as official alternate routes, experience has shown that traffic will divert to various routes within the network. However, it is critical to have adequate alternate routes available to accommodate the diverted traffic volumes.

Signing Confusion

There are usually several freeway projects underway in the Detroit area at any one time. Multiple signing for all these projects may lead to motorist confusion, particularly if long advance signing distances are employed.

On a previous full closure freeway project, MDOT had provided signs for an excessively long advance distance. Motorist feedback on that project indicated that the actual point of closure was unclear to motorists; even though only a small section of freeway was closed, motorists thought the entire route through the city was closed. Having learned from that, MDOT provided advance signing on the M-10 project sufficient to allow diversion to alternate routes, but did not go out into the suburbs to display early advance signing.

Summary

Overall, the M-10 reconstruction and use of full road closure was considered a success. The decision to use full road closure, based on the constrained time frame for the project, resulted in overall reduced user costs, conditions that were likely safer for both workers and travelers, and reduced maintenance of traffic costs. Past experience with the use of full road closure allowed engineers to anticipate potential effects from closing a portion of M-10 for rehabilitation. Due to this past experience, MDOT did not perform quantitative analysis of the impacts of the full closure. However, engineers pointed to a lack of complaints by travelers, reduced project duration, and improved safety as the ultimate measures of success. For transportation professionals who must rehabilitate roadways and reduce the impacts of work zones on workers and motorists, full road closure is one potential method that can achieve both goals. With adequate planning, public outreach, stakeholder involvement, and alternate routes, full road closure has the potential to simultaneously accelerate projects, improve safety, and reduce costs.

Other Selected FHWA Work Zone Publications

- *Work Zone Best Practices Guidebook* (FHWA-OP-00-010) (2000)

- Best Practices Fact Sheets
  - Fact Sheet 1: *Oregon's QuickFax Service* (FHWA-OP-00-022) (2000)
  - Fact Sheet 2: *Customer Driven Construction in Illinois* (FHWA-OP-00-023) (2000)
  - Fact Sheet 3: *Work Zone Safety Awareness Week* (FHWA-OP-00-024) (2000)
  - Fact Sheet 4: *Delaware's Survival Plan for the I-95 Shutdown* (FHWA-OP-00-025) (2000)
  - Fact Sheet 5: *Innovation During Bridge Rehabilitation Improves Mobility* (FHWA-OP-01-008) (2001)
  - Fact Sheet 6: *Work Zone Best Practices Guidebook* (FHWA-OP-01-009) (2001)
  - Fact Sheet 7: *Compendium of Work Zone Research, Development and Technology Transfer* (FHWA-OP-02-054) (2002)
  - Fact Sheet 8: *Ohio Keeps Motorists and Road Rehabilitation Moving Forward* (FHWA-OP-03-190) (2003)
  - Fact Sheet 9: *Arkansas Uses Public Outreach to* Pave The Way *During Interstate Rehabilitation* (FHWA-HOP-04-031) (2004)

- *Shorter Duration, Safer Work Zones, More Satisfied Travelers: Successful Applications of Full Road Closure in Work Zones* (FHWA–OP-03-086) (2003)

- *Full Road Closure for Work Zone Operations: A Cross-Cutting Study* (FHWA–OP-04-009) (2003)

- *Intelligent Transportation Systems in Work Zones: A Cross-Cutting Study* (FHWA-OP-02-025) (2002)

- Intelligent Transportation Systems in Work Zones Case Studies
  - *Work Zone Traffic and Incident Management System: Keeping Traffic Moving During Reconstruction of the Big I, a Major Interstate-Interstate Interchange in Albuquerque* (FHWA-OP-04-072) (2004)
  - *Work Zone Travel Time System: Reducing Congestion with the Use of a Traffic Management Contract Incentive During the Reconstruction of Arizona State Route 68* (FHWA-HOP-04-032) (2004)
  - *Real-Time Work Zone Traffic Control System: Using an Automated Traffic Information System to Reduce Congestion and Improve Safety During Reconstruction of the I-55 Lake Springfield Bridge in Illinois* (FHWA-HOP-04-018) (2004)
  - *Dynamic Lane Merge System: Reducing Aggressive Driving and Optimizing Throughput at Work Zone Merges in Michigan* (FHWA-HOP-04-033) (2004)

- *Informed Motorists, Fewer Crashes: Using Intelligent Transportation Systems in Work Zones*

- *Positive Protection: Reducing Risk, Protecting Workers and Motorists* (2003) Joint publication with AASHTO, ARTBA, AGC, ATSSA, LHSFNA

- *Creating Safer Work Zones: Five Brochures* (FHWA-SA-03-007) (2003)

- *Compendium of Work Zone Research, Development, and Technology Transfer Projects 1997 to 2002* (FHWA-OP-02-053) (2002)

- *Methods and Procedures to Reduce Motorist Delays in European Work Zones* (FHWA-PL-01-001) (2000)

To obtain a copy of a publication, visit our website at http://www.fhwa.dot.gov/workzones.

Notes

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FHWA-HOP-05-013