FULL ROAD CLOSURE FOR WORK ZONE OPERATIONS:
A Case Study

Using Weekend Closures to Expedite Road Rehabilitation and Minimize the Impacts on Motorists and Road Builders

I-84 Banfield Freeway in Portland, Oregon

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 and from project documents following completion of an overlay project on I-84 in Portland, Oregon. The authors greatly appreciate the cooperation of the Oregon Department of Transportation and its partners and thank them for sharing their experiences and insights from the I-84 project.

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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 Oregon Department of Transportation (ODOT) during an overlay project on Interstate 84 (I-84) in Portland, Oregon. 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.

ODOT started a project in June of 2002 that included paving, striping, barrier replacement, and inlet and manhole adjustments. The project covered approximately five miles on I-84 in Portland between Interstate 5 (I-5) and Interstate 205 (I-205). The contract specifications originally called for traditional maintenance of traffic during part width construction. However after the project was let, ODOT decided to have the paving portion of the project done during two weekend full closures to expedite the project.

The full closure was a success due in large part to a well-organized public relations campaign and to the availability of many alternate routes in the area. Oregon DOT personnel received more than 50 compliments from the public after the full closure was finished.

Project Specifications and Background

I-84, also known as the Banfield Freeway, was originally scheduled for rehabilitation during the summer of 2005. In early 2002, ODOT decided to move the project up to the 2002 construction season to eliminate a serious rutting problem, and to take advantage of available funding. I-84, which serves as an interstate freight route, a major commuter route to downtown Portland, and connects into I-5 (see Figure 1), was badly rutted in all lanes due to age, heavy vehicle use, and studded tires. The ruts contributed to a hydroplaning hazard. The goal of the project was to improve the safety of the Interstate by filling the ruts and by adding a 2-inch asphalt overlay to the original concrete roadway. Overall, the project included asphalt paving, durable striping, replacement of three miles of 36-inch median barrier, and adjustments to more than 250 inlets and manholes imbedded in the roadway.

Since this section of I-84 is the busiest section of freeway in Oregon, with average daily traffic volumes from 146,000 to 180,000 vehicles, ODOT determined that all traffic lanes needed to remain open during weekday daytime hours. Consequently, night work was required, and ODOT's Community Affairs staff had to obtain a noise permit for nighttime construction from the City of Portland Noise Review Board. In early June, ODOT's construction engineers decided to accelerate the project with full closure, so that the paving as well as striping could be completed before the fall and winter rainy seasons.

The plan would involve directional closures for two weekends in August—one direction each weekend—as opposed to the 32 nights originally specified in project plans. Since the full closure would require some night work, a noise permit was still necessary. The per-

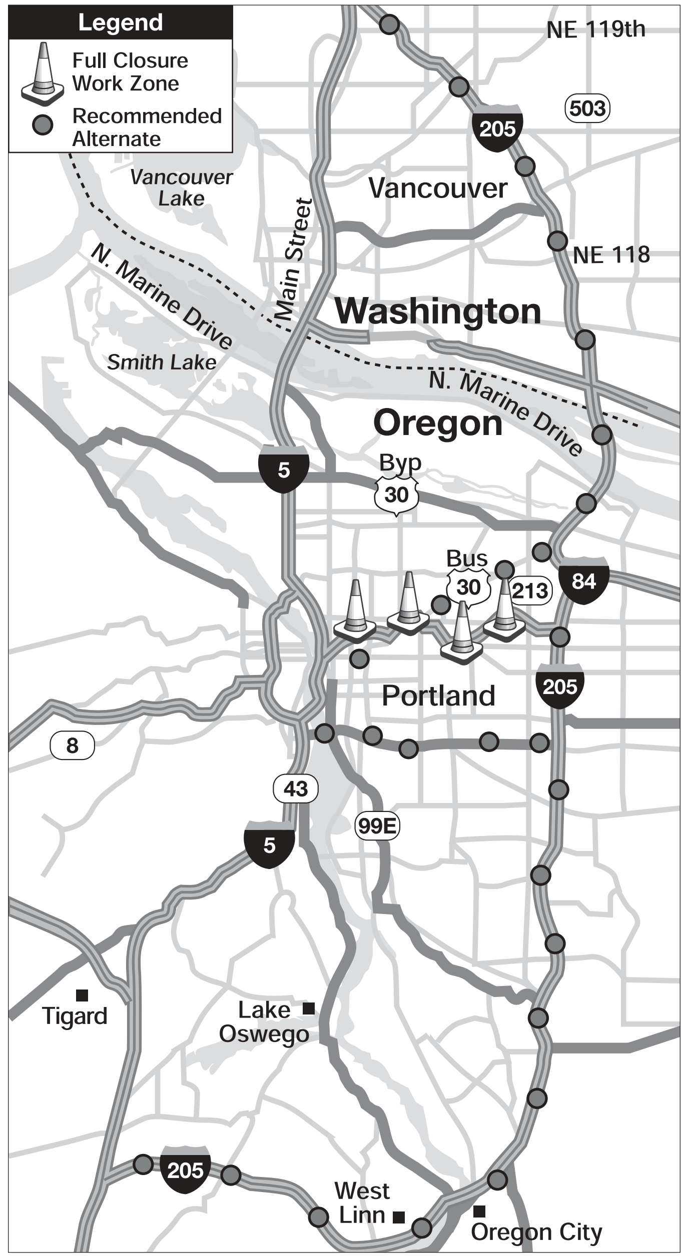

Figure 1 – Closure and recommended alternate routes for the I-84 project

mitting process normally takes from six months to one year, but the Community Affairs and Public Affairs staff acted quickly to raise awareness about the project and were able to obtain the permit in one month.

Because the contract specifications originally called for traditional maintenance of traffic during part width construction and the project had already been let, ODOT needed to modify the contract for the full closure. Since the use of full closure increased contractor efficiency and required fewer traffic control devices, ODOT was able to renegotiate the original contract at a reduced price. A change order was negotiated with the contractor, resulting in a credit back to the project of $101,000.

Project characteristics:

- $5 million total construction cost
- 180,000 average daily traffic
- 7 percent commercial vehicle traffic
- Pavement rehabilitation of 5.5-mile section of a 6-lane roadway (33 lane miles)
- Full closure dates—August 2 to August 5, and August 9 to August 12, 2002.

Why Use Full Road Closure?

The ODOT construction engineers decided to use full closure to:

1. Avoid a hydroplaning hazard to motorists traveling on the Interstate. Using full closure expedited the I-84 project and made it possible to complete the repaving and striping before the fall and winter rains.

2. Increase the safety of both workers and motorists by eliminating the worker–traffic interaction, as shown in Figure 2.

Figure 2 – Crews work without interruption on I-84 (Banfield Freeway), physically separated from traffic

Planning

The most critical component to ensuring a successful full road closure is planning. This involves developing an effective plan for traffic management, informing and collaborating with all potential stakeholders, and implementing an effective public outreach campaign. This campaign should keep the stakeholders informed and identify alternate routes or alternate modes of travel for the traveling public.

Alternate Routes

Since I-84 is one of the busiest roads in Oregon and because of ongoing work nearby on I-5 close to the I-84 interchange, traffic modeling was used to "evaluate the overall traffic patterns and changes in traffic patterns with the directional closure on the I-84 freeway."[1] This evaluation determined the impact on all major routes likely to carry the traffic diverted from I-84. ODOT also needed to identify mitigation measures that could be implemented to maintain reasonable traffic flow in the area.

Traffic conditions were analyzed in July prior to beginning the project. ODOT projected "before," "during," and "net change" in weekend peak period traffic on all routes in the corridor. ODOT used the EMME/2 traffic assignment model[2] to assess traffic conditions, with peak-period traffic volumes as the base condition. An assignment showing traffic volumes in the work area for both eastbound and westbound traffic was prepared. A "difference" assignment was developed to represent the net change in traffic on all adjacent routes.

Traffic data showed that the volumes on Saturday and Sunday were approximately 80 percent and 75 percent of a normal weekday, respectively. Five major routes were identified as receiving the majority of the traffic diversion in both directions during a full closure. The EMME/2 model and existing traffic counts estimated that traffic resulting from the I-84 closure could increase as much as 500 to 700 vehicles per hour (vph) on each of these primary routes receiving the diverted traffic.[3] Other routes were expected to increase between 100 and 500 vph. These increased levels were comparable to existing weekday peak-period traffic. To accommodate the increased demand, the signals on the alternate routes would be set to weekday peak-period settings during the closures. ODOT also developed several scenarios for the I-84 closure that included impacts on and resulting from possible I-5 closures for roadwork. Initial analysis showed ODOT that to maintain adequate traffic flow, any simultaneous closures on the two roads should only be directional closures. Based on subsequent analysis, ODOT concluded that eastbound I-84 could be closed during a southbound I-5 closure, and a westbound I-84 closure could occur with an I-5 northbound closure, with manageable impacts to area traffic.

Interagency Coordination

In planning and during the full closures, ODOT needed to coordinate with other agencies that would be affected by the closures. Three of the more closely associated agencies involved with ODOT in the planning stage were the City of Portland, Port of Portland, and Tri-Met. The

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1 Oregon Department of Transportation, *Technical Memorandum – Portland Bridge Project I-84 Banfield Freeway*, July 2002.
2 EMME is a bilingual acronym for **É**quilibre **M**ultimodal, **M**ultimodal **E**quilibrium. EMME/2 was specifically designed for multimodal networks. With EMME/2, all the relevant means of transportation can be modeled in an integrated way. http://www.inro.ca/products/e2fea.pdf.
3 Oregon Department of Transportation, *Technical Memorandum – Portland Bridge Project I-84 Banfield Freeway*, July 2002.

ODOT traffic engineers coordinated with the City of Portland engineers to make the signal timing adjustments to the alternate routes. The primary route to the Portland International Airport from downtown is on I-84. Therefore, early and frequent communication efforts were crucial between ODOT and the Port of Portland, which owns and maintains the Airport. The Tri-Met mass transit agency operates a light rail system (MAX) that parallels I-84 and serves the Portland International Airport, so communication between these agencies was helpful to reduce traffic impacts on the alternative routes. ODOT's Public Affairs staff issued several media releases and held a joint media conference with Tri-Met, the City of Portland, and the Port of Portland. All three jurisdictional partners added special messages regarding the weekend closures to their websites.

Stakeholders

The list of stakeholders not only included those involved in the planning stage but also those stakeholders involved throughout the entire full closure project:

- Emergency services
- Police
- Hospitals
- Schools
- Residents/commuters
- Public/citizen associations or groups
- Local businesses
- Port of Portland
- City of Portland
- Tri-Met
- Oregon trucking firms
- Portland-metro cab companies
- Tourism bureaus
- Travel agents
- Special event planners
- Contractor working on I-5.

Public Outreach

For a full closure project to be successful, a well-organized public relations campaign is needed. Planning activities began in February, and some public outreach for the overall project began in March before the decision to use full closure. The primary activities of the public awareness campaign for the full closure project occurred in July and August. Through the campaign, ODOT worked to identify, involve, and inform all potential stakeholders. The goal of the campaign was to successfully divert approximately 160,000 drivers per weekend to alternate routes or to mass transit. The strategy was to reach key stakeholders directly. In the months prior to the weekend closures, ODOT reached stakeholders through a number of means:

- Personal telephone calls and direct mail to homes and businesses located in the corridor
- Direct mail to taxi companies, tourism bureaus, and travel agents
- Drive-time radio ads
- Freeway variable message signs
- A project website
- A telephone information line
- Media alerts/events
- An information kiosk at a large local shopping mall
- Countertop informational displays at local businesses.

Not only did the campaign get stakeholders involved, but it also gained acceptance of the project from residential neighbors despite nighttime construction work. By making the residents in the neighborhoods aware of the project, acceptance of the construction was increased. The overall cost of the campaign was less than $50,000, or less than one percent of the total construction cost.

Operations

The assumption that traffic during the full weekend closures would resemble typical weekday volumes proved correct. Given appropriate signal retimings on alternate routes, traffic moved better than expected. During the first weekend closure, the matter was complicated by a simultaneous closure of the Portland "Belt Loop" that connects with I-5. The coordination of both projects and the extensive outreach program allowed traffic to flow despite the multiple closures. The second weekend closure was complicated by the annual Providence Bridge Pedal event because the event closed some of the alternate routes planned for the full closure. Again, the coordination with event staff proved invaluable; ODOT traffic personnel indicated that fewer traffic issues resulted than normally ensued during the Bridge Pedal event. ODOT estimated that 160,000 vehicles per weekend were successfully diverted, with minimal disruptions on alternate routes. Tri-Met indicated a small increase in MAX ridership during the weekend closures, and the Port of Portland did not hear of any problems for passengers finding their way to and from the airport.

Figure 3 – Nearly 80 million pounds of asphalt were delivered in less than 100 hours

The full closures took approximately one hour to deploy. The ODOT team had maintenance workers in trucks to help with incident management. When the full closures were in place, the contractor had 60 to 70 workers on the asphalt paving. Since the project involved such a big asphalt-paving job (see Figure 3), the contractor used two asphalt plants and implemented a backup plan in case one of the asphalt plants broke down during the closures. This came in handy as one of the asphalt plants did break down during the second weekend closure. The contractor reacted to the problem quickly and transferred to the backup asphalt plant, enabling the project to be completed on time.

Benefits / Impacts of Full Road Closure

Duration

Without using full closure, ODOT estimated that the paving portion of the project would have taken 32 nights. Using full closure reduced the paving portion of the project to two full weekends. Traveler exposure to adverse conditions created by the need to rehabilitate the roadway was reduced from 32 days to 4.7 days. Utilizing full closure for the I-84 project resulted in a time savings of more than 85 percent.

Cost

Project personnel cited that the use of full closure was cost-effective for both ODOT and the contractor. Project personnel estimated that ODOT saved approximately $101,000 by using full road closure. ODOT attributed the savings to increased contractor efficiency (70 percent of the savings) and reduced traffic management costs (30 percent). Given that the decision to use full closure was made after the project was let, the full cost reduction resulting from the use of full closure was not realized. Project personnel noted that if full closure had been originally planned for, the cost could have been reduced considerably more through the competitive bid process. The $101,000 figure is an estimate and does not account for user cost; no quantitative analysis or estimate was available to measure the full cost savings resulting from the use of full closure.

Quality

On the I-84 rehabilitation, project personnel cited that a smoother ride was achieved because of fewer transverse joints. With the weekend full closures, the transverse joints that would have occurred at the end of each paving shift were eliminated. It will be seen whether the need for fewer joints will prolong the life cycle of the road. Project personnel believe that a quieter ride was achieved through full width construction, which improved public satisfaction with the overall project.

Safety

Data are not available on any crashes on alternate routes that could be attributed to the full closure. ODOT believes that safety was increased since the traffic–worker interaction was eliminated. Safety of workers and drivers was also cited as a reason for using full weekend closures. Removing the traffic–worker interaction helped to ensure that no crashes took place at the project location; the project resulted in no serious injuries. The Oregon DOT project team noted that several crashes occurred during the barrier improvement portion of the project that took place in the same segment of I-84, after the full closure and under traffic. This indicates that the use of full closure may have prevented crashes during the paving portion of the project.

Public Sentiment

Project personnel related that positive public sentiment was achieved with the use of full closure. While no formal survey was performed, ODOT received more than 50 phone calls and e-mail messages from travelers and citizens who were pleased with the project. ODOT did not receive any complaints, which project personnel noted is unusual for a project of this size and location.

Mobility

The full closure did not have a major impact on mobility throughout the city of Portland. This aspect of the project was a success because of the availability of alternate routes, signal coordination on the alternate routes, and proper signage.

Issues and Lessons Learned

Alternate Routes

The availability of alternative routes is critical to the success of a full closure project.

Traffic was less congested than the traffic model predicted, possibly due to trip elimination or mode diversion.

Adequate Lead-Time

Project personnel should allow adequate lead-time for project planning and coordination.

With the contract having been approved on June 22, inadequate lead-time was an issue affecting project personnel. Although the rehabilitation was completed with no major issues, the project team related that stress resulted from not having adequate time to plan for full road closure. With more lead-time it would have been beneficial to include the barrier replacement, inlet and manhole work, and striping in the work done during the full closure. The project development team did not have enough lead-time to plan for every aspect of the project.

Project Scope

Plan for the use of full closure prior to letting the contract.

The project scope of work originally called for the maintenance of traffic during paving operations. Project cost would have been reduced considerably by the competitive bid process, had the contract specifications called for bids based on the use of full closure.

Contingency Planning

Develop contingency plans for a variety of events that could delay rehabilitation during a full closure.

Contingency plans were important in making the full closure run smoothly. Two asphalt plants supplied material to the project site. During the second weekend closure (eastbound paving) one plant broke down. An alternate plant, which was part of a backup plan, was used to complete the project without delay. As with any project, needing to implement a contingency plan can create additional costs. For the I-84 project, the backup plant was farther away, so using the plant increased the cost of transporting materials. These costs were borne by the contractor. A contingency plan is particularly important for full closure projects since they generally have strict dates for reopening roads, and missing those deadlines may result in significant penalties to the contractor, negative public relations, and/or traffic problems.

Traffic Control Within the Work Zone

Consider establishing an agreement with the contractor on construction vehicle speeds within the work zone.

With the elimination of other vehicle traffic on the closed road, workers may tend to drive construction vehicles at high speeds. These unsafe speeds can pose a hazard to other personnel working on the closed roadway.

Summary

Use of the full closure method on I-84 was an innovative idea that was deemed to be a success. With the availability of many alternate routes, signal timing changes on the alternate routes, a large-scale public outreach effort, and the communication between agencies, ODOT's use of full closure on I-84 resulted in timely completion of the project with increased quality and reduced risk for workers and motorists. 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 quality and 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.

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