Abridgment

Traffic Management During the I-195 Providence River Bridge Repair Project

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Many states in the Northeast no longer can overlook their aging, overly congested urban highways. However, rebuilding these highways is not simply design and construction. Today's major highway reconstruction projects require the skills of a wide range of transportation professionals, responsible not only for rebuilding the highway, but also for managing the transportation needs of the affected commuters. Realizing this, the Rhode Island Department of Transportation (RIDOT) called on traffic engineers, transportation planners, transit officials, local police officers, community liaison staff, and public relations consultants to develop a traffic-management plan for the I-195 Providence River Bridge Repair Project. To meet the needs of commuters in Rhode Island and Southeastern Massachusetts, traffic management strategies were compiled, selected, and implemented to move people through and around the project area. These strategies included education (public information and community liaison activities), traffic engineering (coordination of traffic control signals and emergency routes), enforcement (monitoring and enforcing speed limits), and ridesharing and transit (carpool matching, free bus service and park-and-ride lots). The traffic management strategies presented are not all-inclusive. They are intended to present the strategies and actions that were both successful and unsuccessful for RIDOT. Each reconstruction project is unique. Traffic-management strategies must be selected to conform to the project area and the project's characteristics.

In developing strategies for traffic management, it was particularly important to consider the packaging and compatibility of the action with other current highway construction projects and the tourism industry in both Rhode Island and Massachusetts. Already apparent for parking and traffic circulation in, around, and approaching the downtown Providence area was the adverse short-term impact of a major Capital Center construction project less than 1 mi away. Further impacts were unknown but could be anticipated from several other construction projects in the downtown area. The solution to these issues could result in major gridlock in the cities of Providence and East Providence.

As a result of these concerns, the Federal Highway Administration (FHWA) Division Office proposed an aggressive plan of mitigative measures described as "the four E's": engineering, enforcement, education (public relations effort), and emergency actions.

ENGINEERING STRATEGIES

The first step was to use existing traffic counts and run the Texas queuing model QUEWZ (*1*). The magnitude of the problem at this early design stage surprised all of the participants and demonstrated the need to formulate a transportation systems management (TSM) plan.

Existing peak-hour volumes were exceeding 5,100 vehicles per hour and were carried by three lanes with many on-off merges and weave points. Both inbound and outbound traffic volumes were nearly equal in this 1-mi section of the Interstate. If a major disruption occurred, traffic could potentially back up into Massachusetts and create downtown gridlock. In addition, during the height of the summer season, Cape Cod-bound traffic would make weekend construction almost as difficult as weekdays and could prove counterproductive.

For these reasons it was felt that the maximum diversion that could be expected would be 500 vehicles per hour during the 8:00 a.m. to 9:00 p.m. hours. The overall goal would be to divert 5 percent of the total daily volume or approximately 7,000 vehicles per day. Since the project would still have at least three open lanes in each direction, it would be essential to optimize the capacity of these three narrow lanes. To achieve this goal it would be necessary to remove many conflicting weaves and on-off movements as well as slow the traffic down to 30 mph. A type of "poor man's" ramp-metering would be used by police enforcement.

Three 11-ft lanes of traffic in each direction were maintained between 6 a.m. and 7 p.m. Two open lanes in each direction were maintained at night between 7 p.m. and 6 a.m. To facilitate increased traffic flow on the Memorial and Labor Day weekends, three lanes were open from 6 a.m. Friday morning to 7 p.m. Tuesday evening. For the July 4th holiday, three lanes remained open from 6 a.m. Friday, June 30, to 7 p.m., Wednesday, July 5th.

The project was reconstructed in four stages, which enabled the contractor to maintain three lanes of traffic in each direction during each stage. Each stage included an individual completion date with liquidated damages of $2,500 per day for work beyond that date.

Park-and-Ride Facilities

The Rhode Island Department of Transportation (RIDOT) maintains 21 park-and-ride lots on major routes throughout the state. During the planning phase, RIDOT identified a total of 21 additional sites, both in Rhode Island and Massachusetts, for consideration as commuter lots during the construction period. Most of the sites required RIDOT to lease private property. Because of the time constraints imposed for the planning of traffic mitigation alternatives, only five sites were selected and only one required leasing of private prop-

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erty. Free express-bus service was provided at four of the sites.

Free Express Bus Service

To entice as many East Bay and southeastern Massachusetts commuters as possible to park their vehicles and use mass transit, the Rhode Island Public Transit Authority (RIPTA) provided free express-bus service from four RIDOT park-and-ride lots that were designated free service lots.

Total cost to provide free bus service for 26 weeks was approximately $148,000. FHWA provided 90 percent of the cost for the first 4 weeks and the state matched the 10 percent remainder. For the remaining 22 weeks of service, the costs were split 50/50 between FHWA and the state, costing approximately $62,000 each.

RIPTA began the free express-bus service at three of the park-and-ride lots the week of May 15, 1989. During the first week the contractor conducted design improvements to one of the leased parking lots.

Total ridership for the service was 80,610 passenger trips, an average of 651 passenger trips per day. With a total service cost of $148,000, the cost per trip was $1.84.

ENFORCEMENT STRATEGIES

The enforcement program was one of the best "E's" in terms of maintaining capacity and reducing delay. The program generally consisted of two elements: (a) free towing and assistance on I-195 to keep the roadway clear; and (b) strict enforcement of the 30-mph speed limit to meter traffic and allow rapid passage of emergency vehicles.

In preparation for the start of bridge repairs, RIDOT included a stipulation in its contract that required two tow trucks on site to remove breakdowns and vehicles involved in collisions quickly. To respond immediately to accidents or breakdowns, two tow trucks were positioned on each side of the highway on a 24-hr per day basis.

Strict enforcement of the 30-mph speed limit proved to be the most effective TSM strategy. As noted in the Highway Capacity Manual (HCM), maximum capacity can be achieved at 30 mph for design speeds greater than 60 mph. RIDOT was able to take advantage of this speed-flow characteristic because of the short work-zone length. Ticketing took place in a coned-off breakdown lane before the work zone. This resulted in minimum traffic disruption, and also functioned as a "poor man's" ramp-metering by slowing the remaining traffic down to the posted speed.

The need for (and number of) officers required depended on the work operations underway. At the beginning of Phase II, this usually resulted in one additional officer during peak-hour traffic—total of three police cruisers, 24 hr per day. Approximately 16,000 hr were budgeted—592-hr per week—at an estimated cost of $216,720.

EDUCATION STRATEGIES

A Providence-based public relations agency developed a public communication campaign to increase public awareness and to foster the development of travel contingency plans. The Providence River Bridge project represented the first time an outside source had been contracted by RIDOT for communications assistance.

The public relations campaign primarily consisted of a public information program that included project briefings with elected and appointed officials, emergency medical technicians, and other special interest groups. Advertising in newspapers and on radio was also included. The agency also worked with companies in the Providence and East Bay areas to discuss flextime alternatives and to conduct focus groups to assess the impact of the project on the business and employee communities.

The public information effort cost $270,386. The FHWA funded 90 percent of this cost and RIDOT provided the balance.

EMERGENCY ACTION STRATEGIES

An emergency plan strategy was developed by RIDOT consisting of three basic elements that were designed to

- Map an emergency route in case of gridlock,
- Identify variable message–signing sites and standard messages, and
- Monitor rescue vehicle operations.

Since the choice of alternate routes was very limited, RIDOT encouraged off-peak travel on I-195. To minimize rush-hour traffic and ensure travel when three-lane passage was available, RIDOT suggested that I-95 to I-195 be driven during the daylight hours of 9:30 a.m. to 3:30 p.m.

With the work zone in place, the available width of the roadway was reduced from 49 ft to 33 ft. If an accident or deck failure occurred in the work zone, it was possible that all three lanes in one direction could be closed. Therefore, at the suggestion of FHWA, RIDOT planned emergency detour routes for use when the roadway was closed.

TRAFFIC OBSERVATIONS

After 6 months, traffic barriers were removed and I-195 reconstruction was completed. In general, little change was observed in the driving habits of local commuters. Backups during peak hours were kept to $\frac{1}{2}$ mi with a maximum of 1 mi on some occasions. Automobile commuters did change their departure times, but not in significant numbers. Traffic volumes compared before and during the months of construction indicated that approximately 13.5 percent of the traffic shifted during the morning and afternoon peak periods. During construction there was a drop in hourly traffic volumes in the peak travel period of the day because of increased carpooling, flextime, and traffic diversion.

The RIDOT Planning Division monitored traffic at 16 locations before, during, and after construction. The data collected showed no major traffic diversion through any phase of construction. There was some minor diversion over the Point Street and Henderson bridges accounting for a total of approximately 7 percent diversion during the project.

Overall, as a direct result of the bridge deck replacement project, there were no major changes in travel patterns.

Staff from RIDOT's Planning Division conducted visual vehicle occupancy counts on I-195 before, during, and after construction to determine whether commuters altered their traveling behavior. The data for the morning downtown commute showed that the number of high-occupancy vehicles increased during construction. Because the high-occupancy vehicle rate did not decrease in the months following the construction, it appears that several of the commuters continued carpooling after construction.

The average number of persons per vehicle increased slightly during construction. Automobile occupancy rate averages are as follows:

Month	*Average Rate*
May	1.12
June	1.18
August	1.19
November	1.16

SUMMARY AND CONCLUSIONS

The experience gained in mitigating traffic congestion during reconstruction of the I-195 viaduct using various TSM strategies was analyzed as it applied to this high-volume urban interstate facility. This particular work-zone area was less than $\frac{1}{2}$ mi in length. Similar, longer projects, up to several miles, may not work out in the same manner.

Based on the measured traffic volumes, occupancy counts, and transit usage counts, it appears that there was very little change in commuter driving habits. This does not imply that commuters should not be given opportunities to change their commuting habits through various transportation alternatives. What it does mean is that the alternative transportation opportunities offered should be proportional to the cost of providing the necessary TSM strategies. If TSM planning is sufficiently flexible, then future needs can be addressed as demand increases. Of the $5.9 million project cost, $635,000 (11 percent) was spent on TSM activities, not including the cost of constructing the park-and-ride facilities that were retained permanently.

Each reconstruction project has its problems and institutional framework for mitigating impacts. Project planners and engineers must ensure that the selected strategies are compatible and that they do not compete with each other. The lessons learned on this project were as follows:

- TSM strategies to reduce construction impacts can be very costly and produce only minor benefits.
- Despite its minimal effect on traffic reduction, carpooling was a low-cost traffic management strategy for RIDOT to undertake.
- Strict enforcement of a reduced speed limit (by issuing citations) can have a dramatic impact on capacity of short-length work zones. For this project, the enforcement program was the most cost-effective strategy for maintaining capacity and reducing delay.

REFERENCE

1. C. Dudek and S. Richards. *Traffic Capacity Through Work Zones on Urban Freeways*. Report FHWA/TX-83/20-292-1. Texas Transportation Institute, Texas A&M University, College Station, Tex. 1982.

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