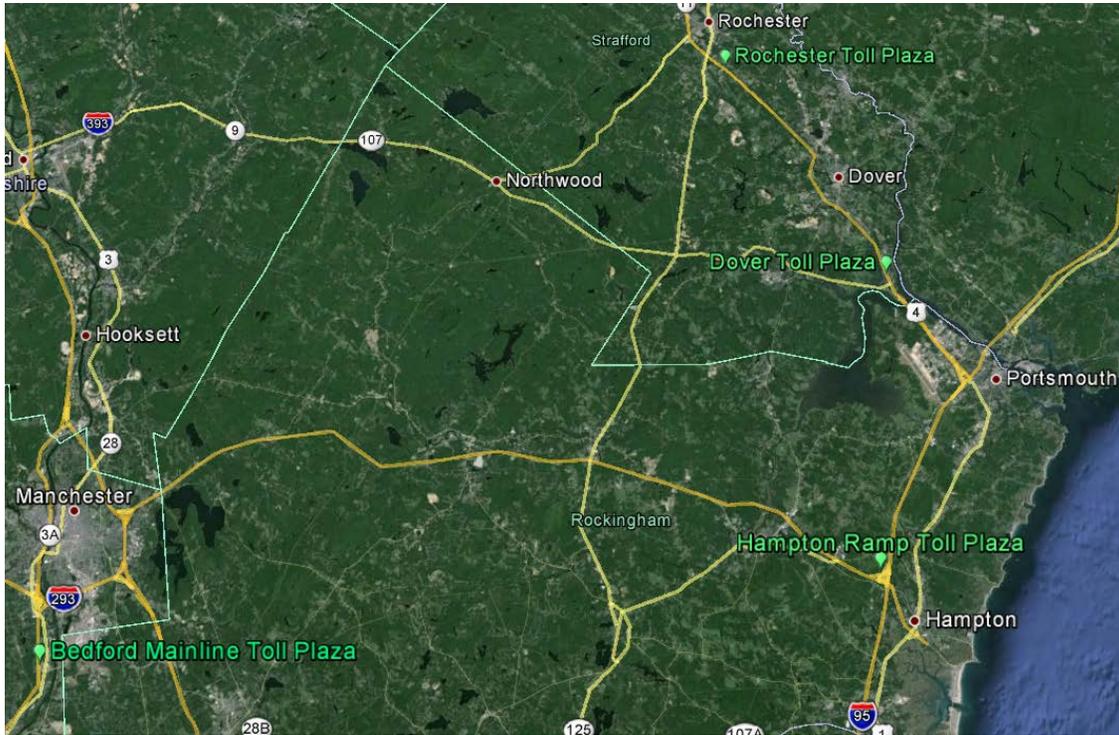


AET Feasibility Analysis and Comparative Assessment of ORT— APPENDIX



Financial Comparison of ORT vs. Rehab at Bedford Mainline, Dover & Rochester

Presented to



Bureau of Turnpikes

Prepared by



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I. Purpose

The purpose of this memorandum is to examine the relative merits of two options for upgrading three selected toll plazas on the New Hampshire Turnpike. The first option is to invest a modest amount of money in rehabilitating the plazas, while the second option is to make a greater investment in order to convert the plazas to Open Road Tolling (ORT).

II. Background

HNTB is in the process of completing a report for the New Hampshire Department of Transportation (NHDOT) entitled *AET Feasibility Analysis and Comparative Assessment of ORT*. This report focused on four toll plazas on the New Hampshire Turnpike: Bedford Mainline, Dover, Rochester, and Hampton Side. The purpose of the report was to compare two modernization options—Open Road Tolling (ORT) and All Electronic Tolling (AET). The report focused primarily on financial performance, using *net operating revenue* (i.e. gross revenue less operations costs) as the financial yardstick.

The report concluded the following:

- At the Hampton Side toll plaza, ORT *cannot* be implemented due to geometric constraints. However, AET presented significant financial risk. Compared to a hypothetical “Do Nothing” option, converting to AET would result in a decline in net operating revenue of between \$500k and \$2 million per year. The most prudent option at this location would be to simply rehabilitate the existing facility.
- At the other three toll plazas, ORT was recommended over AET because it presented the least financial risk.
 - At Dover and Rochester, even in the most optimistic of scenarios, net operating revenue under AET was *less than* the net operating revenue under ORT.
 - At Bedford Mainline, the only way that AET was feasible was if the plaza was moved immediately south of the Airport Access Rd. interchange—a move that would violate guidance from the Federal Highway Administration.

In short, the study suggested that NHDOT should move forward with rehabilitating the Hampton Side toll plaza while converting Dover, Rochester, and Bedford Mainline to ORT. This recommendation has raised a follow-up question: Would converting these three plazas to ORT be preferable to simply rehabilitating them? That is the question that this memorandum will address.

III. Capital Costs

Table I summarizes the capital costs associated with constructing ORT facilities at all three locations. Please note the following when reviewing the table:

- At the Bedford Mainline location, the existing toll plaza will be converted to ORT. The middle lanes will be removed and converted to highway speed lanes, while the remaining tollbooths will be rehabilitated.

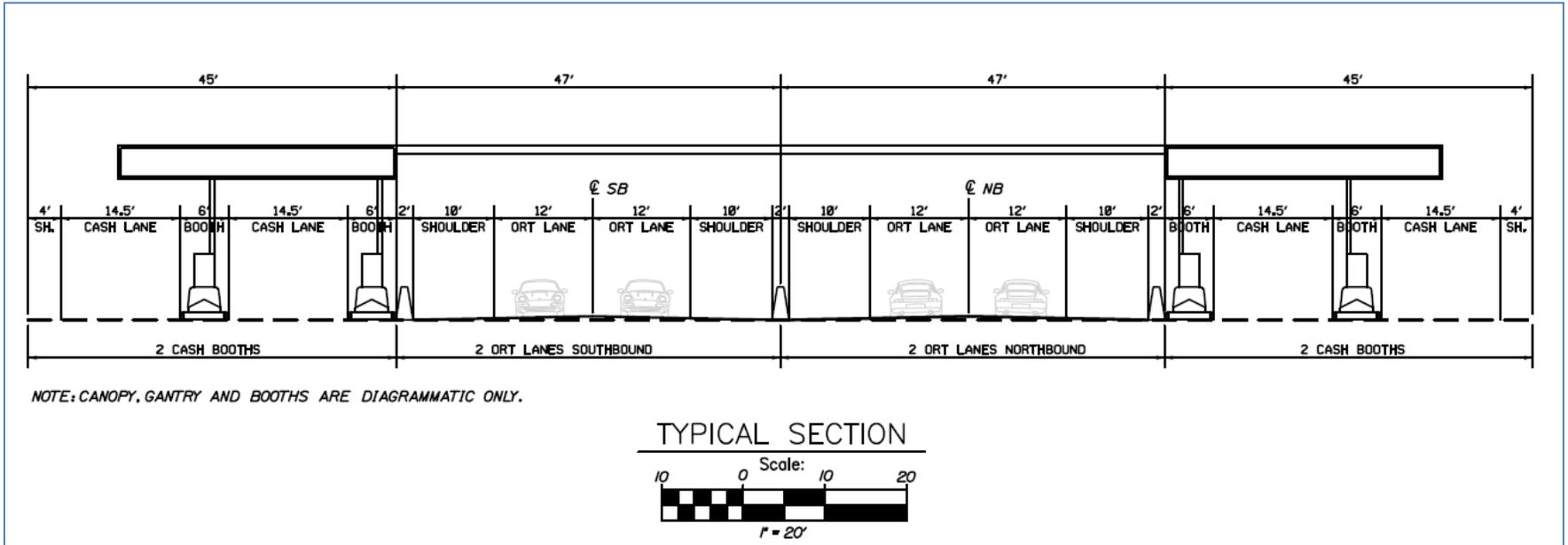
- At Dover and Rochester, the existing conventional plaza will be completely demolished and replaced with a new facility.
 - At Dover, the proposed ORT facility would be located about 400' north of the existing plaza. The move northward is intended to provide distance from the interchange immediately to the south, which will be undergoing construction within the next 5 years.
 - At Rochester, the proposed ORT facility would be located approximately 300' south of the existing facility. This move would avoid the horizontal curve that lies about one-third of a mile to the north, and it would also provide more distance between the new facility and the next adjacent interchange.
 - At both Dover and Rochester, a final location would be identified if the projects were to advance to preliminary design.
- At Bedford, the existing utility building will be modified to accommodate the conversion to ORT. At Dover and Rochester, the existing utility building will be demolished and replaced with a new utility building.

Table I – ORT Capital Cost Estimates

Cost Category	Bedford	Dover	Rochester
Roadway Construction	\$1,081,000	\$2,920,000	\$3,808,000
Maintenance of Traffic	\$450,000	\$438,000	\$571,000
Median Concrete Barrier	\$523,000	\$850,000	\$850,000
Miscellaneous Items	\$719,000	\$438,000	\$571,000
Drainage & Water Pollution control	\$472,000	\$438,000	\$571,000
Mobilization	\$164,000	\$292,000	\$381,000
signing and Striping	\$370,000	\$255,000	\$255,000
Contingency	\$205,000	\$292,000	\$381,000
Construction Subtotal	\$3,984,000	\$5,923,000	\$7,388,000
Engineering (Pre-Constr. & Constr.)	\$797,000	\$1,195,000	\$1,488,000
Sign Structure	\$400,000	\$150,000	\$150,000
ORT Installation	\$1,300,000	\$1,300,000	\$1,300,000
Cash Tollbooth Rehab	\$782,000	n/a	n/a
Cash Tollbooth Construction	n/a	\$1,000,000	\$1,000,000
Utility Building Modifications	\$400,000	n/a	n/a
Utility Building Construction	n/a	\$600,000	\$600,000
Demolition	\$450,000	\$750,000	\$600,000
Tunnel	n/a	\$700,000	\$700,000
Grand Total	\$8,113,000	\$11,618,000	\$13,226,000

Figure 1 on the following page presents a typical cross-section of the ORT facility considered for both Dover and Rochester. A preliminary traffic analysis at both locations indicates that 2 cash lanes in each direction will be adequate throughout the design period. The facility also provides 2 highway-speed lanes in each direction, consistent with the number mainline lanes approaching the plaza.

Figure I – Typical Cross Section of Proposed ORT Facilities at Dover and Rochester



In order to compare ORT with a “rehabilitation” option, it was necessary to develop the estimated cost of rehabilitating the plazas at Bedford Mainline, Dover, and Rochester. The development of these costs was a joint effort by NHDOT staff and HNTB.

- The estimate for rehabilitating the Bedford Mainline plaza was completed by NHDOT. They reviewed the Hooksett contract (which involved rehabilitation of the lanes that were *not* converted to ORT) and estimated a construction cost of \$130,325 per lane. Given that the existing Bedford plaza is 12 lanes wide, the estimated rehabilitation cost would be **\$1,563,900**.
- NHDOT also did a baseline estimate for the Dover and Rochester plazas. However, at NHDOT direction, HNTB estimated additional costs associated with three major improvements: strengthening the canopies to accommodate new lane use signs, upgrading the concrete bumpers to improve employee safety, and building a new tunnel to replace the existing 72” reinforced concrete pipe. HNTB assumed that the new tunnel at each plaza would be a box culvert offset to the north of the existing tunnel. Stairs would be provided to every other cash booth in order to safely provide toll collector access. This improvement would require extending the existing islands in order to accommodate the new stairway.

Table 2 summarizes the rehabilitation cost estimates for the Dover and Rochester plazas.¹

Table 2 – Estimated Rehabilitation Costs for Dover and Rochester

Cost Category	Dover	Rochester
Existing Tunnel Decommissioning	\$ 30,000	\$ 30,000
Boiler Installation	\$ 30,000	\$ 30,000
Booth Restoration	\$ 156,000	\$ 117,000
Canopy Strengthening (for signs)	\$ 160,000	\$ 120,000
Canopy Signs	\$ 228,000	\$ 171,000
Canopy Restoration (lane level)	\$ 32,000	\$ 24,000
Canopy Lighting Replacement	\$ 113,000	\$ 85,000
Signal Replacement	\$ 32,000	\$ 24,000
Toll Island Restoration	\$ 8,000	\$ 6,000
Safety Bumpers Improvement	\$ 175,000	\$ 125,000
Tunnel Construction	\$ 459,000	\$ 358,000
Construction Subtotal	\$ 1,423,000	\$ 1,090,000
Maintenance of Traffic	\$ 213,000	\$ 164,000
Contingency	\$ 213,000	\$ 164,000
Mobilization	\$ 142,000	\$ 109,000
Pre-Construction Engineering	\$ 142,000	\$ 109,000
Construction Engineering	\$ 142,000	\$ 109,000
Total Project Cost	\$ 2,275,000	\$ 1,745,000

Table 3 summarizes the capital costs of both ORT conversion and of rehabilitation. The table presents both the total cost and the annualized cost (assuming that the costs are financed at 4.0% for a 20-year period).

¹ It should be noted that HNTB has not independently inspected the Dover and Rochester plazas, and the cost estimate does not constitute a *recommendation* from HNTB to perform the specified upgrades. Rather, Table 2 simply provides an estimated cost to do the repairs that NHDOT has deemed to be important.

Table 3 – Capital Costs of Proposed Improvements

Plaza	ORT Conversion Cost		Rehabilitation Cost	
	Total	Annualized	Total	Annualized
Bedford Mainline	\$8,113,000	\$597,000	\$1,564,000	\$115,000
Dover	\$11,618,000	\$855,000	\$2,275,000	\$167,000
Rochester	\$13,226,000	\$973,000	\$1,745,000	\$128,000

As Table 3 indicates, the capital costs associated with ORT conversion are roughly 5 times greater than the rehabilitation costs at Bedford and Dover, and about 7.5 times greater than the rehabilitation costs at Rochester. From a purely capital cost perspective, rehabilitation is the most cost-effective solution. However, many other factors should be weighed when identifying the best alternative. These factors will be discussed in the sections that follow.

IV. Net Revenue

Section 8 of the *AET Feasibility Analysis* report discussed the financial metric referred to as **net revenue**. “Net revenue” is calculated by taking gross toll revenue and subtracting out both operations and maintenance (O&M) costs and capital costs. The calculation is typically performed on a year-by-year basis, using the annualized capital costs calculated in the preceding section. For purposes of this analysis, the net revenue test will compare the net revenue under ORT (using the ORT-related capital costs) with net revenue under existing conditions (using the rehabilitation-related capital costs). For ORT to be the clearly preferred option, it should satisfy the following test:

$$\frac{\text{(Gross Revenue – (Operations \& Maintenance Costs + Capital Costs))}_{\text{ORT}}}{\text{(Gross Revenue – (Operations \& Maintenance Costs + Capital Costs))}_{\text{existing}}} \geq 1$$

Table 4 provides a comparison of net revenue under ORT with net revenue under existing conditions. It focuses on revenue and cost projections for 2015.

Table 4 – Net Revenue Comparison, ORT vs. Existing, 2015 (in \$1000’s)

	ORT				Existing				Δ In Net Revenue (ORT - Ex.)
	Gross Revenue	Capital Cost	O&M Cost	Net Revenue	Gross Revenue	Capital Cost	O&M Cost	Net Revenue	
Bedford Main	\$14,692	\$597	\$2,534	\$11,560	\$14,695	\$115	\$2,554	\$12,026	(\$466)
Dover	\$9,085	\$855	\$1,992	\$6,238	\$9,061	\$167	\$2,008	\$6,886	(\$648)
Rochester	\$6,149	\$973	\$1,621	\$3,555	\$6,135	\$128	\$1,655	\$4,352	(\$797)
Total	\$29,925	\$2,425	\$6,147	\$21,353	\$29,891	\$410	\$6,216	\$23,264	(\$1,911)

NOTE – Some totals may not appear to add properly due to rounding

As Table 4 indicates, a transition to ORT would yield an estimated decline of \$0.5 million per year at Bedford Mainline, \$0.6 million per year at Dover, and \$0.8 million per year at Rochester. This decline

can be attributed entirely to the fact that ORT is more costly to build. Even though ORT is expected to slightly increase gross revenue at each plaza, and even though it is expected to slightly reduce O&M costs, these improvements are not enough to offset the higher capital costs associated with ORT.

Thus, a net revenue analysis is not sufficient to justify converting to ORT. However, the change in net revenue is modest (an average loss of about \$650k at each toll plaza), and there are numerous other factors to consider when evaluating whether ORT is the best option for the future. These factors are discussed in Sections V thru IX.

V. Travel Time Savings

Under Open Road Tolling, vehicles equipped with an E-ZPass—which comprise over two-thirds of all vehicles using the New Hampshire Turnpike—can travel through the tolling point at highway speed. This eliminates the need for E-ZPass vehicles to decelerate to about 25 miles per hour and pass through a conventional E-ZPass lane. As a result, all E-ZPass vehicles save about 25-30 seconds of travel time whenever they pass through an ORT plaza.²

Table 5 summarizes two key values for each of the three toll plazas being considered for conversion to ORT:

- *Travel time savings.* This represents the total number of vehicle-hours saved by converting to ORT. It is a high-level estimate which assumes that there is minimal congestion at the plaza under existing conditions. A more precise number would require the use of a traffic simulation model such as *Vissim*.
- *Value of travel time savings.* This figure represents the public benefit of saving travel time through the plaza. It assumes that people value travel time at half the value of the prevailing wage rate in New Hampshire.³

The estimates are based on traffic projections for 2015.

Table 5 – Travel Time Benefits of ORT, 2015

Plaza	Travel Time Saved (vehicle-hours)	Value of Travel Time Savings
Bedford	87,000	\$966,000
Dover	72,900	\$809,000
Rochester	48,400	\$538,000
Total	208,300	\$2,313,000

As Table 5 illustrates, converting to ORT at all three plazas would save the traveling public over 208 thousand hours in 2015, yielding a public benefit of over \$2.3 million. The value of the travel time savings

² Travel time savings are based on the assumption that vehicles take 1600 feet (0.30 miles) to decelerate from 65 mph down to 25 mph, then require another 1600' to accelerate back to 25 mph. Using the harmonic mean, this yields an average speed of 36.1 mph through the toll facility. At this speed it takes a vehicle 1.01 minutes to travel 3200'. The same vehicle traveling at 65 mph can traverse 3200' in 0.56 minutes. The difference is 0.45 minutes, or about 27 seconds.

³ Wage data for the State of New Hampshire can be obtained from the Bureau of Labor Statistics, at this web address: http://www.bls.gov/oes/current/oes_nh.htm.

in 2015 (\$2.3 million) is slightly greater than the annualized cost of constructing the three facilities (about \$2.1 million). And the value of travel time savings will increase over time as the volume of E-ZPass traffic continues to grow each year. HNTB estimates that, by 2026, this value would grow to \$2.8 million per year.

VI. Fuel Consumption

HNTB developed detailed simulation models of the Hooksett toll plaza as part of a detailed ORT analysis. These models suggested that, on an average day, ORT would reduce fuel consumption through the plaza by about 1.7%. Based on this finding, Table 6 summarizes the amount of fuel consumption that would be saved by converting to ORT, and it estimates the amount of money saved (based on an average fuel price of \$3.07 per gallon).⁴ It is based on traffic projections for 2015.

Table 6 – Fuel Saving Benefits of ORT, 2015

Plaza	Fuel Saved (gallons)	Value of Fuel Savings
Bedford	19,800	\$61,000
Dover	16,600	\$51,000
Rochester	11,000	\$34,000
Total	47,400	\$146,000

Converting the Bedford Mainline, Dover, and Rochester plazas to ORT would save over 47,000 gallons of fuel per year, at a collective benefit to the traveling public of nearly \$150,000. This benefit to customers is compounded by a benefit to the environment of consuming less fuel.

VII. Accident Reduction

Section 12 of the *AET Feasibility Analysis* contained two key statistics regarding the safety benefits of Open Road Tolling.

- Data from seven different plazas on Florida’s Turnpike indicated a **60% reduction** in accidents following conversion to ORT.
- Data in the first two years following the ORT conversion at the Hampton Mainline plaza indicated an **85% reduction** in accidents.

NHDOT provided HNTB with a summary of accidents that were recorded in the vicinity of the three toll plazas from 2009 through 2013. This review indicated the following:

- **Bedford** – 90 accidents recorded;
- **Dover** – 20 accidents recorded;
- **Rochester** – 19 accidents recorded.

⁴ This represents the most recent average fuel price for New Hampshire, as of 10/31/2014. The prices are from www.newhampshiregasprices.com.

In short, a total of 129 accidents were recorded over a five-year period. This yields an average total of about **26** accidents per year. If we assume that these three plazas will experience the same rate of crash reduction as Hampton experienced (85%), then we could expect to reduce this total by about **22 accidents per year**. The expected annual reduction would be 15 accidents at Bedford, 4 accidents at Dover, and 3 accidents at Rochester.

This crash-saving benefit of ORT provides a significant economic benefit to the State of New Hampshire. To get a sense of the magnitude of this benefit, consider the following:

- In 2010, the National Highway Traffic Safety Administration (NHTSA) recorded a total of 5.4 million vehicle crashes.⁵
- The NHTSA subsequently conducted a study on the societal and economic costs of accidents. Their final report, entitled *The Economic and Societal Impact of Motor Vehicle Crashes*, was based on data collected during 2010. The report’s Executive Summary notes, “In 2010 the total economic cost of motor vehicle crashes in the United States was \$277 billion.” As the report subsequently states, these losses include lost productivity, medical costs, legal and court costs, emergency service costs (EMS), insurance administration costs, congestion costs, property damage, and workplace losses.⁶
- If we divide the total economic cost (\$277 billion) by the total number of accidents (5.4 million), the average economic cost per accident is about **\$51,000**.

If we take the average economic cost (\$51,000 per accident) and multiply it by the expected number of accidents to be reduced by ORT (22 accidents per year), then we can estimate an economic benefit of **\$1,122,000 per year**. These benefits would be allocated as follows:

- Bedford: 15 accidents reduced * \$51,000 per accident = \$765,000 saved per year
- Dover: 4 accidents reduced * \$51,000 per accident = \$204,000 saved per year
- Rochester: 3 accidents reduced * \$51,000 per accident = \$153,000 saved per year

VIII. Assessment of Costs vs. Benefits

Table 7 takes the change in net revenue at each plaza (as calculated in Table 4) and adjusts it based on the public benefits identified in Sections V through VII. As with the preceding tables, the figures are based on 2015 projections of traffic.

Table 7 – Comparison of Net Revenue Loss with Public Benefits, 2015 (in \$1000’s)

	Bedford Mainline	Dover	Rochester	Overall
Δ In Net Revenue (ORT minus Existing)	(\$466)	(\$648)	(\$797)	(\$1,911)
Travel time savings	\$966	\$809	\$538	\$2,313
Fuel consumption savings	\$61	\$51	\$34	\$146
Crash reduction economic benefit	\$765	\$204	153	\$1,122
Net benefit (or loss)	\$1,326	\$416	(\$72)	\$1,670

⁵ See Table 4 of the NHTSA document entitled *Traffic Safety Facts – Research Note*, available on-line at <http://www-nrd.nhtsa.dot.gov/Pubs/811552.pdf>.

⁶ Ibid, pg. 5

As Table 7 illustrates, the public benefits more than outweigh the loss in net revenue at Bedford Mainline and Dover. At Rochester, the public benefits are virtually identical to the change in net revenue, leading to a net loss of just \$72,000. In fact, at all locations except Rochester, the travel time savings alone are sufficient to cover the decline in net revenue associated with converting to ORT. When all locations and all forms of public benefits are combined, the public benefits of ORT exceed the loss in net revenue by about \$1.7 million per year.

In short, when viewed through a broader lens that includes quantifiable public benefits, ORT appears to be the clear preferred alternative at Bedford Mainline and Dover, and it appears to be neutral in terms of net benefits at Rochester. However, the advantages of ORT extend to other areas as well. Some of these additional areas in which ORT is clearly preferable to conventional toll collection are discussed in the following section.

IX. Qualitative Benefits of ORT

The preceding section identified some ways in which the public can financially benefit from a conversion to ORT. However, the benefits of ORT cannot all be expressed in terms of dollars and cents. Some of the benefits that are more qualitative but just as real include the following:

- **Improving customer service.** Highway-speed tolling is a feature that E-ZPass customers in the northeast have come to enjoy—and to expect. Converting to ORT is an effective way to satisfy customer expectations.
- **Laying the groundwork for AET.** Converting to ORT does not preclude a subsequent conversion to AET. In fact, the opposite is true; converting to ORT paves the way for a future transition to AET. Once the highway-speed toll gantry is in place, it will be easy to retrofit it to support AET, if the Bureau of Turnpikes wishes to make that conversion sometime in the future. Though video tolling creates unacceptable revenue leakage today, it may be replaced in the future by an alternative (i.e. cell phone technology⁷) that poses significantly less risk to revenue. In short, ORT can facilitate a transition to AET when the technology improves to the point that it becomes financially viable.
- **Consistency.** The Bureau of Turnpikes has already converted its two busiest plazas (Hampton Mainline and Hooksett Mainline) to ORT. Continuing this conversion at other locations will help ensure that the Bureau's customers have a consistent, high-quality travel experience on the New Hampshire Turnpike.

In short, converting to ORT will provide E-ZPass customers with the level of service they've come to expect while keeping the door open to a future conversion to AET.

⁷ For an example of a firm that is developing an application that essentially enables a cell phone to function as a transponder, see www.geotoll.com.

X. Conclusion

From a net revenue perspective, rehabilitating the toll plazas at Bedford Mainline, Dover, and Rochester seems like the most feasible option financially. On an annual basis, ORT is expected to yield approximately \$1.9 million *less* in net revenue at all three plazas combined, based on projected volumes for 2015. However, ORT produces public benefits in terms of time savings, fuel savings, and accident reduction. It is reasonable to expect that these public benefits will total approximately \$3.6 million per year, thus exceeding the loss in net revenue. Moreover, converting to ORT still lays the groundwork for a potential future conversion to AET, all the while providing E-ZPass customers with the same high level of service that they've grown accustomed to at Hampton Mainline and Hooksett Mainline.

For these reasons, HNTB recommends that the Bureau of Turnpikes move forward with a conversion to ORT at Bedford Mainline, Dover, and Rochester.