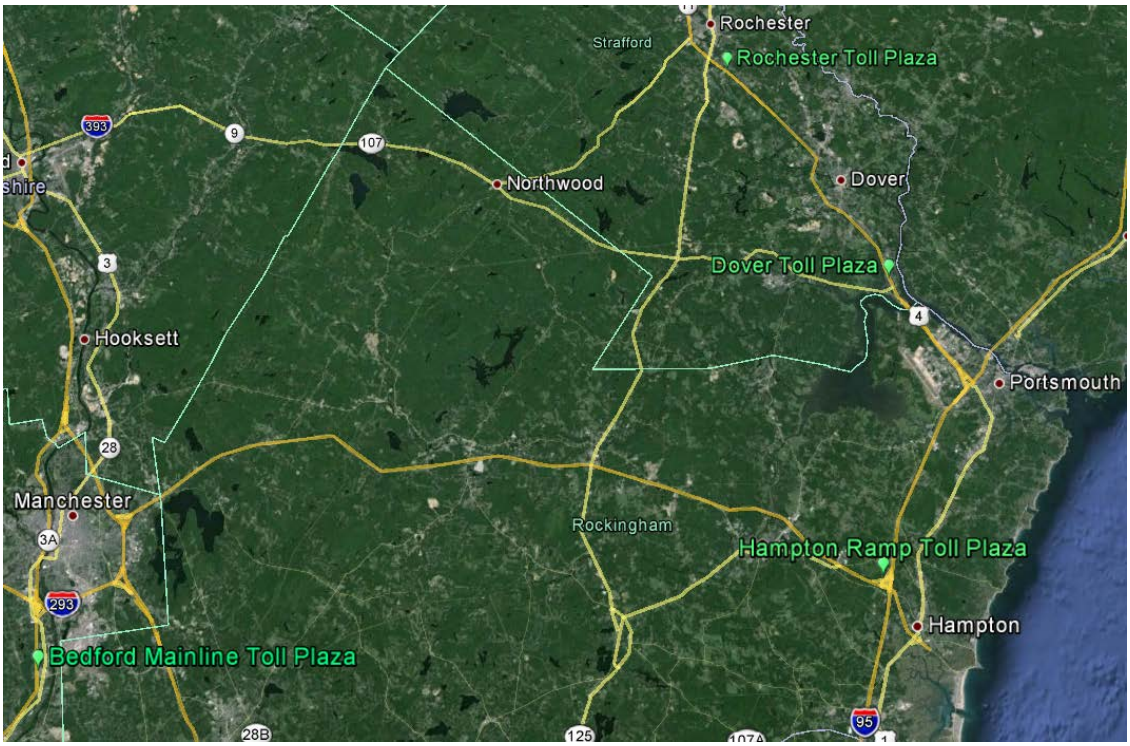
AET Feasibility Analysis and Comparative Assessment of ORT



Analysis at Bedford Mainline, Hampton Side, Dover and Rochester Toll Plazas

Presented to

New Hampshire DOT

Bureau of Turnpikes

Prepared by

HNTB

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Section 1. Executive Summary

HNTB studied the feasibility of deploying All Electronic Tolling (AET) at four selected toll plazas on the New Hampshire Turnpike System. The toll plazas were located at the Hampton Side, the Bedford Mainline, Dover and Rochester. Additionally, HNTB compared the financial performance of AET with the performance of alternative capital improvements. At all but the Hampton Side, the alternative improvement was Open Road Tolling, or ORT. Geometric constraints prohibit ORT at Hampton Side; therefore, its alternative improvement was a rehabilitation of the existing 8-lane toll plaza.

HNTB's analysis considered the financial performance under four different scenarios, each involving a unique combination of *frequency of video customer travel* and *rate of E-ZPass market share growth.*

- *Scenario 1* assumed a low frequency of video customer travel and a low rate of E-ZPass growth
- *Scenario 2* assumed a low frequency of travel and a high rate of E-ZPass growth
- *Scenario 3* assumed a high frequency of travel and a low rate of E-ZPass growth
- *Scenario 4* assumed a high frequency of travel and a high rate of E-ZPass growth

HNTB's financial analysis indicated the following:

- If the Bureau of Turnpikes desires to minimize risk, it should move forward with a conversion to ORT at all four locations. ORT generally increases net operating revenue while improving safety.
- From an AET perspective, two toll plazas—**Hampton Side** and **Dover**—did not perform well in any scenario. The loss in net operating revenue under AET at both plazas ranged from $630k to $1.8M.
- An AET conversion at the **Bedford Mainline** toll plaza could be financially feasible under two conditions: (1) the toll point would need to be relocated to a point just south of the existing Airport Access Rd. interchange; and, (2) video customers would need to exhibit a high frequency of travel. However, current FHWA guidance requires that, if the Bedford Mainline toll plaza were relocated, it must go *south of Exit 11*. Apart from this problematic option, AET is not feasible without aggressive mitigation measures such as the imposition of a video surcharge.
- An AET conversion at **Rochester** could be feasible assuming a high frequency of travel.

The feasibility of AET is heavily dependent upon the frequency of travel of video customers. AET operating costs in the "high frequency" scenarios were **approximately 40% lower** than the operating costs in the "low frequency" scenarios. The "low frequency" scenarios assumed that video customers made about one trip per month, consistent with frequencies that have been observed on some existing AET facilities. The "high frequency" scenarios assumed roughly 6 round trips per month. Though this assumption is consistent with frequencies revealed on an on-line survey conducted by the Bureau of Turnpikes, it is *not* consistent with frequencies observed at other locations that have implemented AET.

If the Bureau of Turnpikes desires to move forward with deployment of AET, it will be critical to:

- Study the trip frequencies exhibited by today's cash-paying customers in more detail.
- Consider whether it would be permissible to help enhance net revenue by incorporating such measures as across-the-board toll increases and video surcharges.

Section 2. Purpose

The purpose of this study is to assess the feasibility of converting selected toll plazas on the New Hampshire Turnpike system to All Electronic Tolling, or AET. The performance of the selected toll plazas under AET will be compared to both doing nothing (the "No-Build" option) and to making alternative capital improvements at the toll plazas (such as open road tolling, or ORT).

In this report, AET and ORT will be defined as follows:

All Electronic Tolling (AET) refers to a toll collection method where all fares are collected electronically. Vehicles typically pass under a toll gantry set while traveling at highway speeds. Vehicles that are equipped with a transponder will be detected by the toll collection system and assessed a toll automatically. Vehicles that are *not* equipped with a transponder will have an image taken of the license plate. The owner of the vehicle will be identified via a license plate trace and will be subsequently sent a bill for the trip. At no point do any vehicles stop to render payment. An example of an AET facility is depicted in Figure 1.

Figure 1 – Example of AET Facility

Open Road Tolling (ORT) refers to a mixture of conventional tolling and highway speed tolling. Vehicles that are equipped with a transponder pass under a toll gantry set while moving at highway speeds and are assessed a toll automatically. Vehicles that are *not* equipped with a transponder go through a parallel, conventional toll plaza and are required to stop to pay the toll. The conventional toll plaza may be equipped with some combination of toll attendants, automatic coin machines (ACM's), and automatic toll payment machines (ATPM's). The Hampton Mainline toll plaza, which was converted to ORT in May 2010, is depicted in Figure 2.

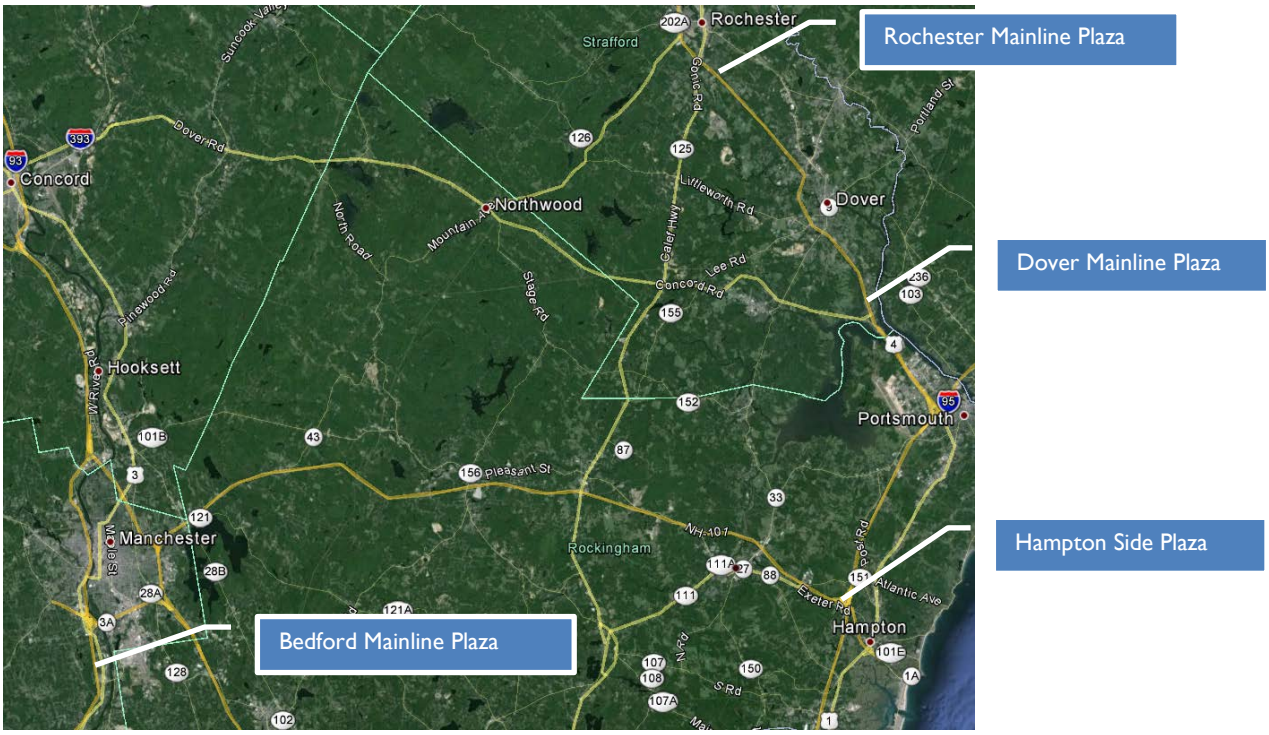
Figure 2 – Example of ORT Facility

The four plazas to be considered for AET as part of this study include:

- The Bedford Mainline toll plaza, located on the F.E. Everett Turnpike at the new Airport Access Road interchange (Exit 13).
- The Hampton Side toll plaza, located on the connector between NH Route 101 (NH-101) and Interstate 95 (I-95).
- The Dover Mainline toll plaza, located on the Spaulding Turnpike just north of the US-4 interchange (Exit 6).
- The Rochester Mainline toll plaza, located on the Spaulding Turnpike about 12 miles north of the Dover Mainline toll plaza.

The locations of the toll plazas are summarized in Figure 3.

Figure 3 – Overview of New Hampshire Turnpike Toll Plaza Locations



This study will also evaluate two of the required steps toward implementing an AET pilot at the Hooksett Ramp toll plaza. The first step is to develop a preliminary signing plan for the pilot. The second is to provide the foundation for a preliminary public outreach plan designed to provide relevant information to the public and to respond to frequently-asked questions (FAQ's) that often arise from decision makers and stakeholders.

Section 3. Background

The New Hampshire Bureau of Turnpikes has been actively engaged in recent years with modernizing their toll facilities. The Hampton Mainline toll plaza, which serves about 23 million vehicles per year, was converted to ORT in May 2010. The Hooksett Mainline toll plaza, which serves about 25 million vehicles per year, was converted to ORT three years later, in May 2013. Both conversions have been deemed successful and have been well-received by the traveling public.

Now that the busiest two toll plazas on the NH Turnpike system have been modernized, the Bureau of Turnpikes is turning its attention toward its other facilities. The four facilities examined as part of this study are the next four busiest facilities in terms of total volume of traffic. Table 1 summarizes the annual volumes and annual revenue observed at each facility examined in this study, as well as the initially converted facilities. The data is drawn from fiscal year (FY) 2013.

Table 1 – FY2013 Traffic & Revenue Summary at Selected Toll Facilities

Toll Plaza	Transactions (millions)	Revenue ($millions)
Bedford Mainline	15.98	$14.33
Hampton Side	13.27	$9.66
Dover	13.57	$9.06
Rochester	8.70	$5.76
Hampton Mainline (ORT-2010)	*22.60*	*$49.28*
Hooksett Mainline (ORT-2013)	*24.46*	*$23.07*

The Bureau of Turnpikes will evaluate both AET and ORT as alternative options for modernizing these four facilities. Both of these alternatives will be compared financially to the No-Build option that simply retains the current system of conventional toll collection.

The Bureau of Turnpikes' desire to investigate the feasibility of AET stems from a 2012 study.[1] This study, which focused on the Hooksett Ramp toll plaza, concluded that AET would be financially feasible if the Bureau were to experience some favorable response rates to video billing notices. The work associated with this report builds on the discussion initiated by the Bureau of Turnpikes for the 2012 study. It will proceed in the following manner:

- Section 4 will review existing conditions at the four toll facilities. The focus will be on examining today's cash-paying customers, since AET financial feasibility is most closely tied to the characteristics of this group and how these characteristics potentially translate into AET operations.
- Section 5 will provide an overview of the existing operations associated with collecting tolls post-travel from customers who use ORT or dedicated E-ZPass lanes on Bureau of Turnpikes facilities, but are "non-payments" in the lane (e.g. not recognized at the time of travel as valid E-ZPass customers). It is recognized that the Bureau of Turnpikes' process for handling these customers is broad and includes collecting tolls from existing E-ZPass customers via connecting a license plate image to an account, by charging the customer a nominal fee for the first notice as well as subsequent enforcement of what would be traditionally termed "violations enforcement." For simplification purposes within this report, the existing operations for these activities will be termed the "violations process". It will summarize how the process is structured, and it will review the current response rates at each level of the process.
- Section 6 will provide an overview of the various modernization options for each facility, including AET and ORT options. This section will include conceptual drawings for each location as well as preliminary cost estimates for implementation.
- Section 7 will provide an initial evaluation of AET based on comparison of existing conditions to projections of AET conditions. Certain facilities can be readily identified as potential candidates for AET based simply on how the facility performs today.

[1] The study was performed by Jacobs Engineering Group, Inc. It was documented in a memorandum dated September 13, 2012, with the following subject line: **Hooksett Ramp All-Electronic Tolling (AET) Feasibility Study – Opening Memo**.

- Section 8 will summarize the net revenue analysis against existing conditions and will compare the feasibility of ORT conversion with the feasibility of AET conversion. It will review the key assumptions associated with the analysis and will perform the "revenue neutrality" and "net revenue" tests to identify the preferred alternative. The purpose of this section is to identify the recommended alternatives for modernizing each of the four toll plazas under consideration relative to these revenue projection tests.
- Section 9 will culminate all preceding sections by compiling the quantitative analysis and doing the following:
    - Rank-ordering the toll plazas in terms of AET feasibility based on revenue neutrality projections.
    - Rating each toll plaza's AET feasibility into one of five categories based on the net revenue gaps: Very Good, Good, Caution, Poor, or Very Poor.
    - Providing a recommendation for each toll plaza concerning whether to proceed with ORT, with AET, or with maintaining existing operations.
- Section 10 will take a *qualitative* look at the implementation of AET. This section will look at the likely impact of AET on Turnpike staff, on the environment, on privacy, and on back-office operations. This section will also take a high-level look at how current New Hampshire legislation and the existing Bond Resolution could impact the implementation of AET. The analysis in this section will focus on the New Hampshire Turnpike as a whole; it will not differentiate between specific facilities on the New Hampshire Turnpike.
- Section 11 will summarize HNTB's industry survey of facilities that have already implemented AET, focusing on the various fare collection structures that are currently in use.
- Section 12 will provide a high-level review of the potential safety benefits of converting to AET.
- Section 13 will provide a preliminary signing plan to support the implementation of a pilot AET site at the Hooksett Ramp toll plaza.
- Section 14 will provide a framework for the development of a preliminary outreach plan to assist in the implementation of the AET pilot at the Hooksett Ramp toll plaza.
- Finally, Section 15 will wrap up the study with a series of conclusions and recommendations for moving forward with the modernization effort.

Section 4. Review of Existing Conditions

The primary purpose of this section is to review key characteristics of two important groups of users of the New Hampshire Turnpike: *cash-paying customers* and *violators*. The characteristics of these users reviewed in this section will all have bearing on the feasibility of AET.

4.1 Cash Market Share

The share of New Hampshire Turnpike customers that pay cash is a critical variable in AET feasibility. A majority of today's cash customers will likely be tomorrow's video customers under AET. Experience has shown that video transactions are a significant source of revenue leakage under AET. In general, lower cash market share and lower cash revenue at risk are generally more favorable to AET feasibility.

Table 2 summarizes the cash revenue as well as the cash market share (in terms of transactions) for the four facilities under consideration. All data is drawn from FY2013 annual numbers provided by the Bureau of Turnpikes.

Table 2 – FY2013 Cash Market Share at Selected Toll Plazas

Toll Plaza	Cash Revenue	Cash Market Share (% of total transactions at plaza)
Bedford Mainline	$4,706,784	30.7%
Hampton Side	$3,068,241	30.0%
Dover	$2,997,307	31.0%
Rochester	$2,037,412	32.9%
Total	***$12,809,744***	***31.0%***

As Table 2 indicates, cash-paying transactions account for slightly less than one-third of all transactions at the four toll facilities under consideration. The Bedford Mainline toll plaza has the highest amount of cash revenue at stake, collecting nearly $5 million in cash in 2013. The Rochester toll plaza, while having the highest cash market share, had the lowest amount of actual cash revenue at risk in a conversion to AET.

4.2 Mix of In-State vs. Out-of-State

In August 2011, the states of New Hampshire, Maine and Massachusetts signed a groundbreaking toll enforcement reciprocity agreement. In essence, this agreement strengthens the ability of toll agencies to collect toll revenue from out-of-state violators. The agreement functions as follows:

- Each state develops its own definition of a "violator." In New Hampshire, drivers are classified as violators when they (a) have passed through toll plazas without paying, and (b) have not responded to two successive notices to render payment.
- The Motor Vehicle departments of each state agree to provide addresses to the other states to support the sending of invoices for unpaid tolls.
- Each state also defines a standard for "repeat violators" and identifies the associated penalties for these violators. At present, New Hampshire defines a "repeat violator" as someone who has exceeded 10 violations.[2] The penalty for a repeat violator is to have a registration hold placed on the vehicle used during the violation. Drivers identified as repeat violators will not be able to register such vehicle until they pay the outstanding tolls (and associated fees and fines) or otherwise resolve with the agency.
- When this definition of "repeat violator" is met, a state may petition the assistance of the other "reciprocal" states to collect the tolls. In the case of New Hampshire, it means the following:
    - If a driver from either Massachusetts or Maine exceeds the limit of 10 violations, then New Hampshire can petition the appropriate state to impose its penalties until the outstanding tolls are collected. The reciprocal state would impose its own designated

[2] Prior to January 3, 2014, the threshold was 20 violations. The analysis contained in this memorandum was drawn from the time in which the 20-violation threshold was in place. It will take some time to identify the extent to which collection of violations revenue has improved as a result of this change in policy.

penalty which would be effective until New Hampshire was satisfied that its tolls had been paid.
    - If a driver from New Hampshire was identified as having exceeded 10 violations on either the Maine Turnpike or on the Massachusetts Turnpike, then those agencies could petition New Hampshire to impose its penalties until the tolls were paid to the reciprocal agency.
- Underlying the penalty process are two key communications links:
    - Each state's Motor Vehicle department will share addresses associated with vehicle registration with other states to enable notices to be sent out.
    - Within each state, there is communication between the operator of the Turnpike and the Motor Vehicle department regarding the imposition of the penalties on violators.

This reciprocity agreement has important implications for the potential implementation of AET, since AET hinges (in part) on the ability of agencies to send bills to out-of-state residents and to compel payment. Therefore, it is important to understand the percentage of today's cash-paying that are either NH residents or residents of one of the reciprocal states. Beyond the financial benefits, these agreements provide the ability for these agencies to communicate to the public that toll recovery efforts are even working across state borders, currently a unique situation in the U.S.

Table 3 summarizes the residencies of cash-paying customers at the four selected toll facilities. The figures were drawn from a license plate survey that was conducted at each toll plaza. [3]

Table 3 – Residency Summary of Cash-Paying Customers

Toll Plaza	NH Residents	ME and MA Residents	Non-Reciprocal Residents
Bedford Mainline	75.4%	14.4%	10.2%
Hampton Side	56.8%	30.4%	12.8%
Dover	70.3%	23.7%	6.0%
Rochester	75.1%	20.8%	4.1%

As Table 3 indicates, the vast majority of drivers on these four facilities are from states that are covered by the reciprocity agreement. At the Bedford mainline and the Hampton Side facilities, nearly 90% are from within the tri-state area. At the Spaulding Turnpike facilities, the share is closer to 95%. This means that, if AET were implemented, the tools are in place to support toll collection (and the enforcement of non-payments) on all but 5-10% of the video transactions. These circumstances are very favorable compared to other examples in the region or the industry as a whole. While only one component of AET feasibility, these conditions strongly favor positive public and legislative messaging about toll collection both under current and future operations.

[3] The survey data was gathered by *Traffic Data Collection* during the month of May 2014. A total of 800 license plates were tallied for each of the four plazas—400 on a weekday (Tuesday thru Thursday) and 400 on a weekend (Saturday or Sunday).

4.3 Cash Customer Trip Frequency

A key variable in evaluating the feasibility of AET is the frequency with which video customers travel the roadway. In general, a toll facility that is used by frequent video customers will be less costly than one that is characterized by infrequent video customers. That is because, for a given number of transactions in a given month, it is cheaper to mail out fewer bills (with several transactions on each bill) than it is to mail out a higher number of bills (with fewer transactions on each bill).

As a general rule, the majority of today's cash customers will become tomorrow's video customers under AET. Therefore, it is important to try and understand the frequency with which cash customers drive on the New Hampshire Turnpike. To this end, the Bureau of Turnpikes set up an on-line survey to ask customers how frequently they travel. Drivers were informed of the survey via flyers that were distributed by toll attendants to cash-paying customers that passed through each of the toll plazas.

Overall, a total of 102 responses were received from cash-paying customers. The responses are summarized in Table 4.

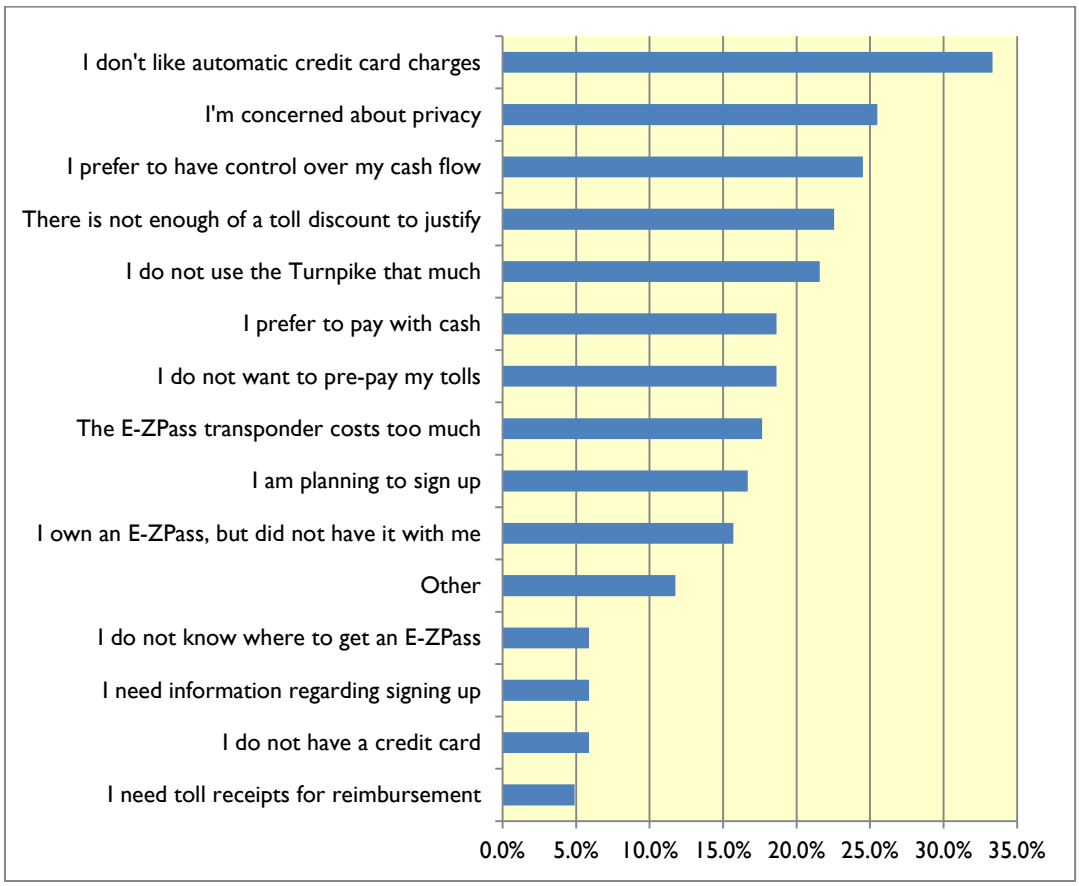
Table 4 – Frequency of Use Survey – Results Summary

Frequency	# of Responses	Percentage
Less than one time per month	8	7.8%
1-3 times per month	12	11.8%
1-2 times per week	14	13.7%
3-5 times per week	26	25.5%
6-10 times per week	21	20.6%
2 or more times per day	21	20.6%

The data in Table 4 suggests that cash-paying customers at the selected toll plazas on the New Hampshire Turnpike are fairly frequent travelers. About two-thirds of them travel *at least* three times a week. In fact, based on the responses, *the average cash-paying customer at these toll plazas makes about 15 trips per month.* This is remarkable, given that a New Hampshire-based E-ZPass would provide a 30% discount over the cash rate, in addition to providing a time savings by eliminating the need to stop and pay a toll attendant.

The on-line survey asked cash-paying customers to provide reasons for their decision to not acquire an E-ZPass. Figure 4 summarizes the responses. The figures will not add to 100%, since customers were free to provide multiple reasons to explain their decision.

Figure 4 – Reasons for Not Acquiring an E-ZPass



The following observations may be drawn from Figure 4:

- The primary reasons for not acquiring an E-ZPass are related to *control of toll payments*. One out of three said they do not like having credit card charges applied automatically, while one in four also state that they prefer to have control over their cash flow.
- Privacy concerns are also significant, being cited by one out of every four respondents to the survey.
- The percentage of those who said that "I do not use the Turnpike that much" (22%) is roughly equal to the percentage of those who stated that they travel 1-3 times per month or less (20%).
- About 16% (or one out of every six of the cash-paying respondents) said they actually have E-ZPass; they just failed to place it in their vehicle on this particular trip.

In short, the results of the on-line survey suggest that the average cash user at the selected toll plazas is a fairly frequent traveler who uses the New Hampshire Turnpike on a weekly (if not a daily) basis. This bodes well for AET, since the majority of the cash-turned-video customers would be frequent users of the roadway which would in turn minimize the number of bills being sent.

However, this result differs from the experiences of other facilities that have made the conversion to AET. A review of data from the Henry Hudson Bridge (which converted to AET in November 2012) suggested that the average video customer used the facility about 14 times per *year*, as opposed to the Bureau of Turnpike's survey suggesting a frequency of 15 times per *month*. A potential explanation for the difference is that surveys tend to elicit responses from frequent users; as such, they tend to not adequately represent the characteristics of infrequent users.

Therefore, HNTB's analysis will evaluate a range of frequencies of travel. We will evaluate an "infrequent user" scenario that more closely mimics the experiences of facilities such as the Henry Hudson Bridge, and we will also evaluate a "frequent user" scenario that reflects the survey results depicted in Table 4.

4.4 Transactions Summary

An evaluation of AET feasibility requires a detailed understanding of the types and numbers of transactions that occur at each facility. Table 5 provides a high-level overview of the transactions that occur at each of the four selected toll plazas on the New Hampshire Turnpike. The data is drawn from FY2013.

Table 5 – FY2013 Transaction Summaries at Selected Toll Plazas on the New Hampshire Turnpike

Transaction Type	Bedford Mainline		Hampton Side		Dover		Rochester	
	Volume	*% of Total*	*Volume*	*% of Total*	*Volume*	*% of Total*	*Volume*	*% of Total*
Valid ETC	10,668,697	66.8%	8,939,345	67.4%	9,074,954	66.9%	5,656,640	65.0%
Valid Cash	4,910,121	30.7%	3,979,080	30.0%	4,207,137	31.0%	2,861,400	32.9%
Non-Revenue	109,830	0.7%	109,441	0.8%	91,806	0.7%	77,296	0.9%
Non-Payments	290,667	1.8%	238,064	1.8%	191,210	1.4%	106,605	1.2%
Total	**15,979,315**		**13,265,930**		**13,565,107**		**8,701,941**	

Although the transaction totals at the four toll plazas vary, the composition of these transactions is quite similar:

- The E-ZPass share for all facilities is in the range of 65-68%.
- Non-revenue vehicles comprise a little less than 1% of all traffic.
- Non-payments comprise 1-2% of all traffic.

Table 6 provides more detail on the "Non-Payments" category at each toll plaza. Please note the following when reviewing the table:

- The italicized lines in the table represent transactions that are lost; no revenue is recovered.
- A "customer" represents a driver who has an E-ZPass account (either with New Hampshire or with another state), while a "non-customer" represents a driver who does not have an E-ZPass account.
- The various transaction types are defined in explanatory notes under the table.

Table 6 – 2013 Non-Payment Summaries at Selected Toll Plazas on the New Hampshire Turnpike

Transaction Type	Bedford Mainline		Hampton Side		Dover		Rochester	
	Vol.	%	*Vol.*	%	*Vol.*	%	*Vol.*	%
Customer Non-Payment	162,464	55.9%	134,983	56.7%	104,246	54.5%	61,424	57.6%
I-tolls	142,454	49.0%	123,668	51.9%	89,164	46.6%	52,848	49.6%
v-tolls	16,456	5.7%	8,337	3.5%	12,059	6.3%	6,692	6.3%
Unable to debit	*3,554*	*1.2%*	*2,978*	*1.3%*	*3,023*	*1.6%*	*1,884*	*1.8%*
Non-Customers Non-Payment	128,203	44.1%	103,081	43.3%	86,964	45.5%	45,181	42.4%
Unreadable	*32,759*	*11.3%*	*26,340*	*11.1%*	*22,222*	*11.6%*	*11,545*	*10.8%*
No DMV agreement	*2,513*	*0.9%*	*2,020*	*0.8%*	*1,704*	*0.9%*	*886*	*0.8%*
Plate rejected by DMV	*7,057*	*2.4%*	*5,674*	*2.4%*	*4,787*	*2.5%*	*2,487*	*2.3%*
Other rejects	*6,135*	*2.1%*	*4,933*	*2.1%*	*4,162*	*2.2%*	*2,162*	*2.0%*
Invoiced violations	79,739	27.4%	64,114	26.9%	54,089	28.3%	28,101	26.4%
Paid	60,368	20.8%	48,539	20.4%	40,950	21.4%	21,275	20.0%
Unpaid	*19,371*	*6.7%*	*15,575*	*6.5%*	*13,140*	*6.9%*	*6,826*	*6.4%*
Total Non-Payments	**290,667**	**100.0%**	**238,064**	**100.0%**	**191,210**	**100.0%**	**106,605**	**100.0%**
Recovered Non-Payments	**219,278**	**75.4%**	**180,544**	**75.8%**	**142,173**	**74.4%**	**80,815**	**75.8%**
Unpaid Non-Payments	***71,389***	***24.6%***	***57,520***	***24.2%***	***49,037***	***25.6%***	***25,790***	***24.2%***

Description of Transaction Types:

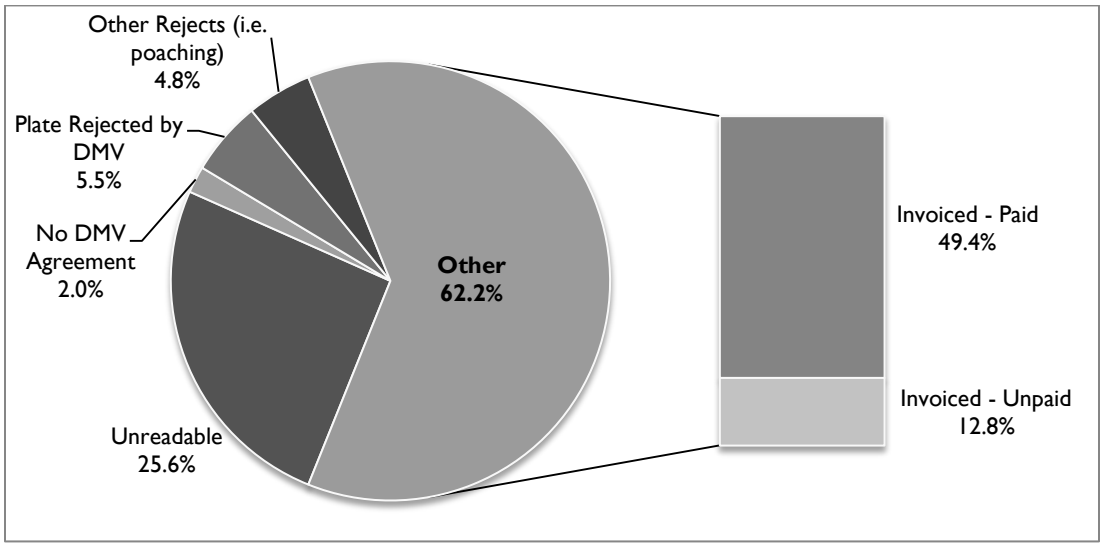
- **I-tolls**. These represent transactions in which the customer has an E-ZPass account, yet the customer did not record a valid E-ZPass transaction when passing through the toll facility. This could happen if the customer forgot to mount the E-ZPass transponder, or if the transponder was not properly mounted inside the vehicle. When this happens, cameras take a photo of the license plate, the license plate is used to identify the corresponding E-ZPass account, and the account is subsequently debited if valid and sufficient funds exist.
- **V-tolls**. These represent transactions in which the customer has an E-ZPass mounted in the vehicle, but the E-ZPass account is not in good standing at the time of the toll transaction (e.g. the balance is insufficient or the associated credit card has expired). When the customer addresses these problems within a certain window of time, the toll is paid and recorded as a v-toll.
- **Unable to debit.** These represent transactions from an E-ZPass registered with another agency, and for which the Bureau of Turnpikes is unable to post the transaction due to an invalid account status.
- **Unreadable.** These are transactions for which the license plate cannot be read for some reason. It may be obscured by snow or mud, or perhaps weather conditions hindered a clear photo.
- **No DMV agreement.** These transactions occur when a violator comes from a state with which New Hampshire does *not* have an agreement to exchange data with the Department of Motor Vehicles. Currently, NH has DMV agreements with all of the New England states as well as New York and New Jersey.
- **Plate rejected by DMV.** These represent transactions in which a license plate gets forwarded to the DMV, but the DMV does not have the license plate number in the system. As a result, the owner cannot be billed.
- **Other rejects.** These represent miscellaneous transactions that cannot be processed by payment. They include "poaching" (i.e. tailgating), cross-lane reads, and transactions that exceed New Hampshire's statutory 30-day limit for billing.
- **Invoiced violations.** Violations that result in an invoice that is mailed to the appropriate vehicle owner.

Several important observations may be drawn from Table 6:

- Customer non-payments account for nearly two-thirds of all non-payments. A "Customer non-payment" occurs when an E-ZPass customer passes through the toll facility without recording a valid E-ZPass payment.
- About half of all non-payments are image tolls or "I-tolls." Although the transaction when first recorded is a non-payment, it soon becomes a payment.
- Another 4-6% of all non-payments are violation tolls or "v-tolls." Like an I-toll, these transactions begin as non-payments but soon become payments.
- Roughly one-third of all non-payments are from so-called "non-customers," or drivers that do not have an E-ZPass account. This study assumes that *what happens to these customers most closely resembles what will happen with video transactions after conversion to AET.*

At the four selected toll plazas on the New Hampshire Turnpike in 2013, a total of 291,489 non-payments were recorded from non-E-ZPass customers. Figure 5 provides a detailed breakdown of these non-payments.

Figure 5 – Summary of Non-Payments from non-E-ZPass Customers in 2013



Two important conclusions are evident from Figure 5:

- Roughly one out of every three non-payments from these users of the New Hampshire Turnpike never gets billed to the customers. Either the image was unreadable, or the image was rejected by the toll system for some reason, or the DMV rejected the request, or the image was from a state with which New Hampshire has no data-sharing agreement.
- Of the images that did get invoiced, roughly three-fourths ultimately resulted in payment of the tolls. However, the net effect is that **only half of the tolls owed by non-E-ZPass violators ultimately get paid.**

This has significant implications for AET. If this performance holds true for video tolls—that is, if less than half of the video images ultimately result in payment of tolls to the Bureau of Turnpikes—then the revenue loss may render AET infeasible. However, the population of video customers under AET will be much broader than the population of violators. This payment rate can be viewed as a lower boundary in the range of possible payment rates. In practice, AET agencies generally report somewhat higher compliance rates. This trend seems to match up with the fact that the population of video customers under AET will be composed on both customers who willingly pay cash today and a much smaller group who continue to choose to be handled through enforcement remedies.

This section has provided an overview of the extent to which violators have responded to the billing process. However, this process actually has multiple levels, and each level has a different associated fee and a different response rate. These levels will be discussed in detail in the next section.

Section 5. Overview of Violations Process

The purpose of this section is to review how violators currently respond to the violation billing process. The following bullets provide a high-level summary of the Bureau of Turnpikes' current violations process:

- Notices are distributed each month to people with outstanding violations. There is no minimum threshold; even a single violation will trigger a notice. The first invoice is typically issues within 3-4 weeks of the unpaid transaction. By NH state law, the Bureau of Turnpikes has 30 days to issue the first invoice. Beyond that time constraint, the notice cannot be issued.
- The first invoice simply asks the driver to render payment for the unpaid tolls from the preceding month. A $1.00 fee is added to cover postage and handling costs.
- If the first invoice is not paid within 30 days, a second invoice is sent for the unpaid tolls. The associated fee increases to $1.50.
- If another 30 days passes without payment, then a third invoice is sent. At this point, the driver is officially considered to be a "violator." The third invoice carries an administrative fee of $25 *per unpaid transaction*.
- If violations continue and accumulate to New Hampshire's definition of a repeat violator (currently 10 or more violation transactions), then the Bureau of Turnpikes can petition the Department of Motor Vehicles (DMV) to impose punitive action. This applies not only to New Hampshire residents, but to all residents that lie within the tri-state reciprocity agreement (New Hampshire, Maine, and Massachusetts). Each state imposes its own penalties on the identified violators.
    - In New Hampshire and Massachusetts, it involves a registration **hold**; drivers will be unable to renew the registration of the violating vehicle until the delinquent tolls are paid.
    - In Maine, punitive action involves a registration **suspension**. The Maine Bureau of Motor Vehicles notifies the violator that he has 10 days to pay the delinquent tolls. If this deadline passes, then the violating vehicle will be considered "unregistered" until the delinquent tolls are paid.
- For violations that occur with residents of Rhode Island, Vermont, Connecticut, New York, and New Jersey, the Bureau of Turnpike can petition the states' respective Department of Motor Vehicles to acquire the address tied to the registration of the violating vehicle. All invoices (first, second, and violation) may be sent to these residents, and outstanding toll payments can even be forwarded to collections. However, the Bureau does not have any punitive measures at its disposal to compel payment from residents of these states.

Table 7 summarizes the response rates to violations as documented by reports provided by the Bureau of Turnpikes. This data is drawn from 2011 and 2012, which represent the last years for which complete

data related to payment of violations was available.[4] This data is drawn from the entire New Hampshire Turnpike system; it is not specific to any particular toll plaza.

Table 7 – Violations Response Rate by Level of Notice, 2011-2012

Fiscal Year	Notice Level	# Created	# Paid	# Written Off	%Paid
2011	1st Notice	241,209	84,820	n/a	35.2%
	2nd Notice	156,206	45,178	n/a	28.9%
	Violations Notice	110,853	60,583	50,628	54.7%
	Net Payment Summary - FY11				
	# of Notices Ultimately Paid		*190,581*		
	# of 1st Notices Sent		*241,209*		
	Net Payment Rate		*79.0%*		
2012	1st Notice	271,885	90,852	n/a	33.4%
	2nd Notice	181,027	54,506	n/a	30.1%
	Violations Notice	126,437	73,343	53,184	58.0%
	Net Payment Summary - FY12				
	# of Notices Ultimately Paid		*218,701*		
	# of 1st Notices Sent		*271,885*		
	Net Payment Rate		*80.4%*		
2013	1st Notice	382,820	149,998	n/a	39.2%
	2nd Notice	232,770	76,762	n/a	33.0%
	Violations Notice	155,995	75,592	80,468	48.5%
	Net Payment Summary - FY13				
	# of Notices Ultimately Paid		*302,352*		
	# of 1st Notices Sent		*382,820*		
	Net Payment Rate		*79.0%*		
2011-2013 Total	1st Notice	895,914	325,670	n/a	36.4%
	2nd Notice	570,003	176,446	n/a	31.0%
	Violations Notice	393,285	209,518	184,280	53.3%
	Net Payment Summary - FY11-13				
	# of Notices Ultimately Paid		*711,634*		
	# of 1st Notices Sent		*895,914*		
	Net Payment Rate		*79.4%*		

Two important observations may be drawn from Table 7:

- The response rates for each level were quite consistent from 2011 through 2013.
- In all years, approximately 80% of violators that received a notice ultimately paid their bill.

[4] Violations reports are constantly being updated, since violations by definition introduce a lag between the date of travel and the date on which payment is rendered. When this study began in early 2014, payments for violations were still being totaled for trips taken in 2013. Therefore the 2013 data was not considered.

- The response rate jumps significantly from the "2nd Notice" level to the "Violations Notice" level. This may be due to the threat of a registration hold or suspension that could be imposed on violators that lie within region covered by the tri-state reciprocity agreement (i.e. Maine, New Hampshire, and Massachusetts, as discussed in Section 4.2)

In general terms, the response rate to today's billings can be summarized as follows: roughly one-third respond to the first invoice, a little less than one-third respond to the second invoice, and about half respond to the third invoice. In the end, over three-fourths of the violations transactions that ultimately get distributed end up yielding a payment over the course of the three-level invoicing system.

The AET feasibility model developed by HNTB is based in part on two key assumptions:

- First, that under AET, the Bureau of Turnpikes will continue to use three-level invoicing system currently in place.
- Second, video customers will respond to video billing to a similar degree that today's violators respond to notices sent in the mail. The response rates of today's violators will be considered a lower boundary; a reasonable upper limit was selected to investigate the sensitivity of toll revenue to response rates.

Section 11 will review how other agencies that have deployed AET have chosen to implement an invoicing system.

Section 6. Toll Plaza Upgrade Options

This study evaluated two potential upgrade options at each of the four selected toll plazas.

- At Bedford Mainline, Dover, and Rochester, the two potential upgrade options were *ORT* and *AET*.
- At the Hampton Side, the two potential upgrade options were *replacing in kind* and *AET*. ORT was not considered at this location. As Figure 6 illustrates, this toll plaza provides less than 1300' feet between the merge point approaching the toll plaza and the diverge point downstream of the toll plaza. This simply does not provide enough room to (a) separate cash from E-ZPass traffic, (b) conduct conventional tolling operations for cash customers, and (c) allow cash and E-ZPass traffic to merge again prior to the point at which traffic again separates.

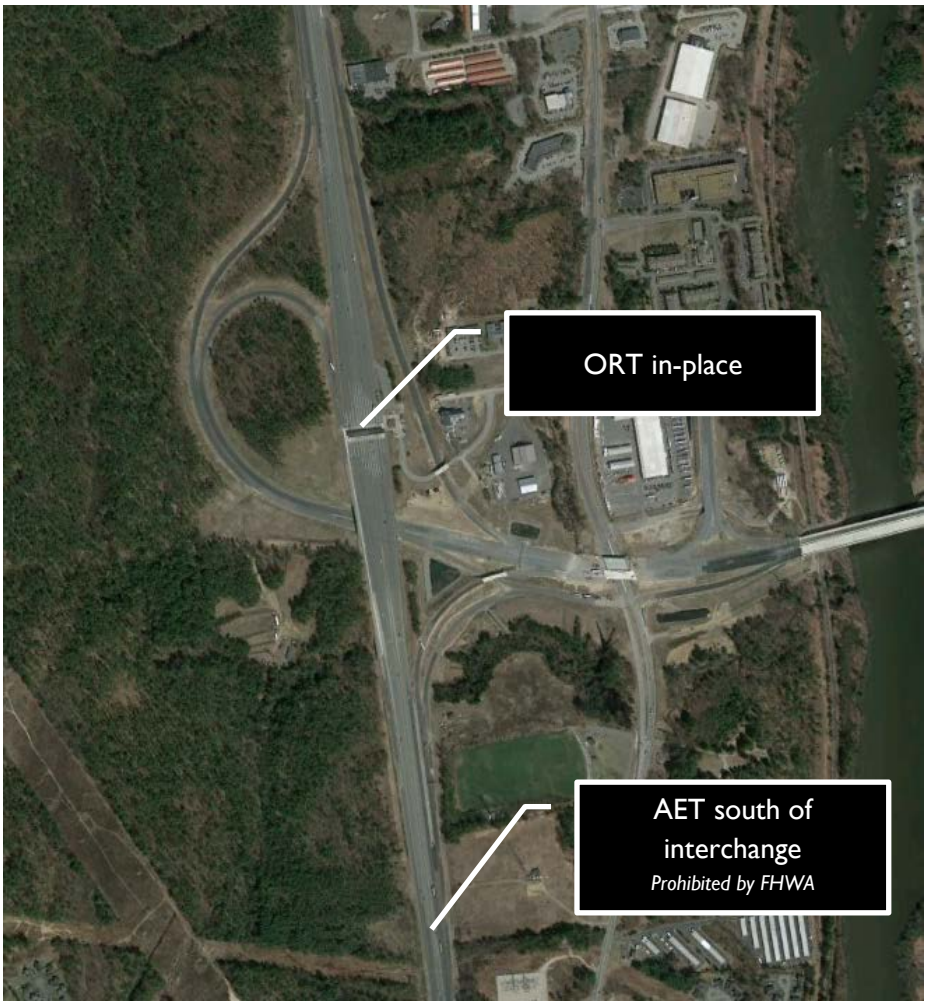
Figure 6 – Overview of Hampton Side Facility

The following sections will provide more detail on the upgrade options at each of the four toll facilities. Conceptual drawings will be provided for ORT facilities, and high-level cost estimates will be provided for all upgrade options.

6.1 Bedford Mainline Toll Plaza Upgrades

The options for modernizing the toll facility at Bedford Mainline differed slightly from the other locations. While the ORT option would be constructed in-place, the AET option would actually involve placing the AET toll equipment to the south as part of a standalone AET toll point. Figure 7 illustrates the locations of the potential upgrades.

Figure 7 – Upgrade Options & Locations at Bedford Mainline



Two notes are in order when reviewing the locations identified in Figure 7:

- For financial reasons, AET cannot be implemented at the existing plaza location. The Manchester Airport Access Rd. (MAAR) opened in November 2011, providing vehicles destined for Manchester International Airport with a new toll-free access point. One consequence of this new interchange was that traffic at the Bedford Mainline toll plaza dropped by over 11%, or nearly 2 million vehicles per year. For an AET facility to be financially viable, much of this lost traffic would need to be recaptured by moving the plaza to the south of the MAAR interchange.
- However, FHWA—in a memorandum to NHDOT dated April 11, 2014—stated that relocating to the region cited in Figure 7 would not be acceptable. The Administration said that drivers must have the opportunity to access the MAAR toll-free. For this reason, if the Bedford Mainline toll plaza were to be relocated southward, it would need to be moved south of Exit 11.

6.1.1 Bedford Mainline ORT (in-place)

In 2010, the NH Department of Transportation developed a concept plan for ORT at the Bedford Mainline toll plaza. This plan is depicted in Figure 8.

Figure 8 – Conceptual Layout for ORT at Bedford Mainline

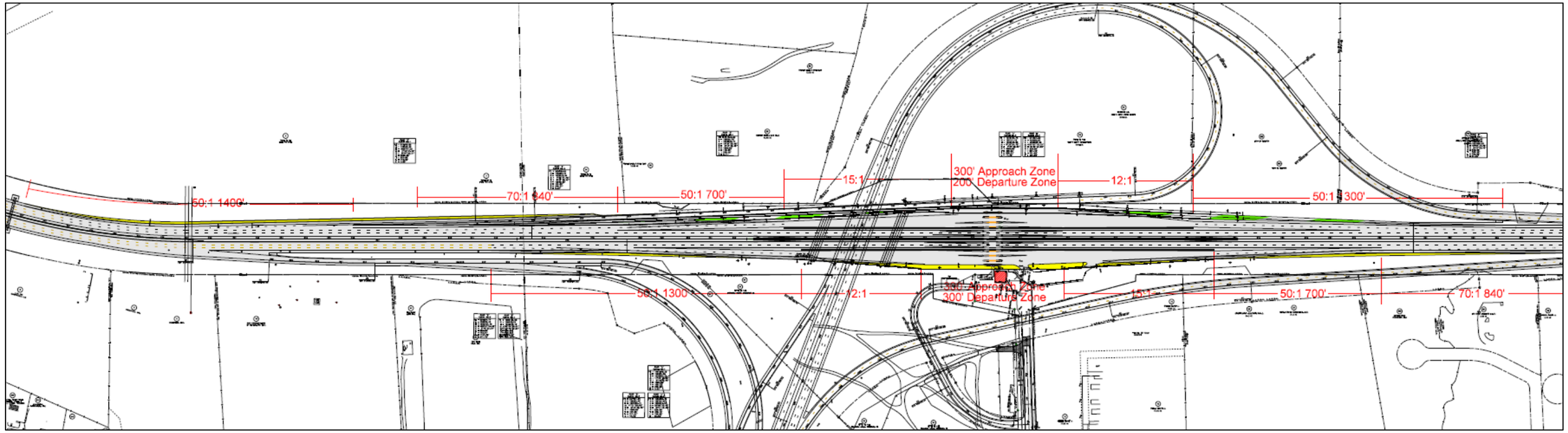


Table 8 provides a summary of the cost estimate for converting the existing plaza at Bedford Mainline to ORT. The initial estimate developed by NHDOT was $6.9 million. HNTB increased this estimate slightly in order to incorporate pre-construction engineering costs and additional costs associated with demolishing the center 6 lanes of the existing toll plaza and with rehabilitating the cash tollbooths that remain after conversion to ORT. [5]

Table 8 – ORT Cost Estimates for Bedford Mainline (provided by NHDOT and supplemented by HNTB)

Cost Category	Estimated Cost (in 2014 dollars)
Roadway Construction	$1,081,000
Maintenance of Traffic	$450,000
Median Concrete Barrier	$523,000
Miscellaneous Items	$719,000
Drainage & Water Pollution control	$472,000
Mobilization	$164,000
Signing & Striping	$370,000
Contingency	$205,000
Construction Subtotal	*$3,984,000*
Engineering (Pre-Constr. & Constr.)	$797,000
Sign Structure	$400,000
ORT Installation	$1,300,000
Cash Tollbooth Rehab	$782,000
Utility Building Modifications	$400,000
Demolition	$450,000
Grand Total	**$8,113,000**

6.1.2 Bedford Mainline AET (at new location)

HNTB developed a concept-level cost estimate for demolishing the existing facility at Bedford Mainline and building a new AET facility just south of the Airport Access Rd. interchange. To be conservative, HNTB assumed that this facility would be built on a section of roadway with 3 lanes in each direction. Since the F.E. Everett Turnpike transitions to 2 lanes in each direction prior to the next interchange to the south (Bedford Rd.), it is possible that a smaller AET gantry set could be built at slightly less cost. However, even if a toll point were positioned in the narrower section of roadway, it would be prudent to build a gantry set of sufficient width that it could accommodate future widening of the F.E. Everett Turnpike.

Table 9 summarizes the estimated conceptual costs associated with an AET facility at Bedford Mainline.

[5] NHDOT's estimate initially assumed a "Cash Tollbooth Rehab" cost of $400k. However, subsequent analysis by NHDOT indicated that, in the Hooksett Mainline conversion project, the cost of rehabilitating a tollbooth is approximately $130,325 per lane. At Bedford Mainline, six toll lanes would need to be rehabilitated as part of an ORT conversion. Therefore, the estimated overall "Cash Tollbooth Rehab" cost would be ($130,325*6) = $782,000. Demolition costs are based on an estimate of $75k per lane.

Table 9 – AET Cost Estimates for Bedford Mainline

Cost Category	Estimated Cost (in 2014 dollars)
Demolition	$ 1,000,000
Civil / Site Infrastructure	$ 1,340,000
Toll Equipment	$ 1,800,000
Administrative Building Upgrade	$ 200,000
Contingency	$ 1,085,000
Construction Subtotal	*$ 5,425,000*
Pre-Construction Engineering	$ 434,000
Construction Engineering	$ 434,000
Total Project Cost	**$ 6,293,000**

6.2 Hampton Side Toll Plaza Upgrades

As the introduction to this section noted, ORT is *not* an option at the Hampton Side. If AET is found to be infeasible, then the existing toll plaza would simply be rehabilitated to maintain current functionality. The costs associated with each alternative are cited below.

6.2.1 Hampton Side Rehabilitation

The existing toll plaza at the Hampton Side is 8 lanes wide, with 4 lanes oriented toward each direction. At present, the toll plaza is configured with 2 dedicated E-ZPass lanes and two cash lanes in each direction. The E-ZPass lanes are located in the middle two lanes of each approach, while the cash lanes are located on either end. The configuration is illustrated in Figure 9.

Figure 9 – Configuration of Hampton Side Toll Plaza

An analysis of traffic by HNTB confirmed that an 8-lane toll plaza of this size should be adequate for the foreseeable future. Therefore, HNTB evaluated the cost of rehabilitating the existing toll plaza, which was originally built as a 5-lane plaza in 1975 and was expanded to 8 lanes in 2004. The purpose of the rehab project would be to extend the life of the facility by about 25 years. The cost estimates for the rehab are summarized in Table 10.

Table 10 – Rehabilitation Estimates for Hampton Side

Cost Category	Estimated Cost
Surface Slab Repair / Replace	$ 133,000
Structural Slab Repair / Replace	$ 8,000
Tunnel Crack Repair / Epoxy	$ 4,000
Canopy Repair & Structural Steel Paint	$ 200,000
Booth & Bumper Repairs	$ 100,000
Construction Subtotal	*$ 445,000*
Contingency (25%)	$ 111,000
Subtotal	*$ 556,000*
Pre-Construction Engineering (10%)	$ 45,000
Construction Engineering (10%)	$ 45,000
Total Project Cost	**$ 646,000**

6.2.2 Hampton Side AET (same location)

HNTB estimated the cost of demolishing the existing toll plaza at the Hampton Side and replacing it with an AET facility at the same location. Table 11 summarizes the estimated costs associated with an AET toll point at the Hampton Side. It was assumed that the AET toll point at this location would need to span three lanes in each direction. This is because each approach to the Hampton Side toll plaza is fed by three lanes, as Figure 6 clearly illustrates. [6]

Table 11 – AET Cost Estimates for Hampton Side

Cost Category	Estimated Cost
Demolition	$ 1,000,000
Civil / Site Infrastructure	$ 1,340,000
Toll Equipment	$ 1,800,000
Administrative Building Upgrade	$ 200,000
Contingency	$ 1,085,000
Construction Subtotal	*$ 5,425,000*
Pre-Construction Engineering	$ 434,000
Construction Engineering	$ 434,000
Total Project Cost	**$ 6,293,000**

Since the estimated size of an AET toll point at Hampton Side is the same as the estimated size at Bedford Mainline (3 lanes in each direction), the estimated project cost is also the same.

6.3 Dover Toll Plaza Upgrades

As indicated by Table 5, the Dover toll plaza and the Hampton Side toll plaza both handle a similar volume of traffic—approximately 9 million transactions in 2013. It is therefore not surprising that the plazas are sized and configured the same. The Dover toll plaza, just like the toll plaza at Hampton Side, is 8 lanes wide. It provides four lanes (two cash and two dedicated E-ZPass) in each direction.

[6]These three approach lanes gradually widen to four lanes at the plaza, in order to match the number of tollbooths.

The Dover toll plaza is located just north of Interchange 6 on the Spaulding Turnpike. Its position relative to the interchange is illustrated in Figure 10.

Figure 10 – Location of Dover Toll Plaza

6.3.1 Dover ORT

HNTB assumed that the ORT toll plaza would be located just north of the existing toll plaza. Challenges associated with the existing tunnel would necessitate the relocation of a new toll facility. Thus, this analysis assumes the new facility would be located *approximately 400' north* of the existing facility. If the Bureau of Turnpikes were to decide to move forward with ORT at Dover, then a more detailed location analysis would be in order.

HNTB's traffic analysis indicated that an ORT facility at Dover would require two ORT lanes and two cash lanes. Figure 11 presents a cross-sectional view of the proposed facility. Figure 12 (on the page following Figure 11) presents a concept plan of an ORT facility at this location. The plaza will operate with 2 ORT lanes in the opening year, consistent with the number of mainline lanes approaching the plaza in each direction. The facility will be designed to easily transition to 3 travel lanes in each direction if, in the future, NHDOT wished to eliminate cash collection and convert to full AET.

Figure 11 – Typical Cross Section of Proposed ORT Facilities at Dover and Rochester

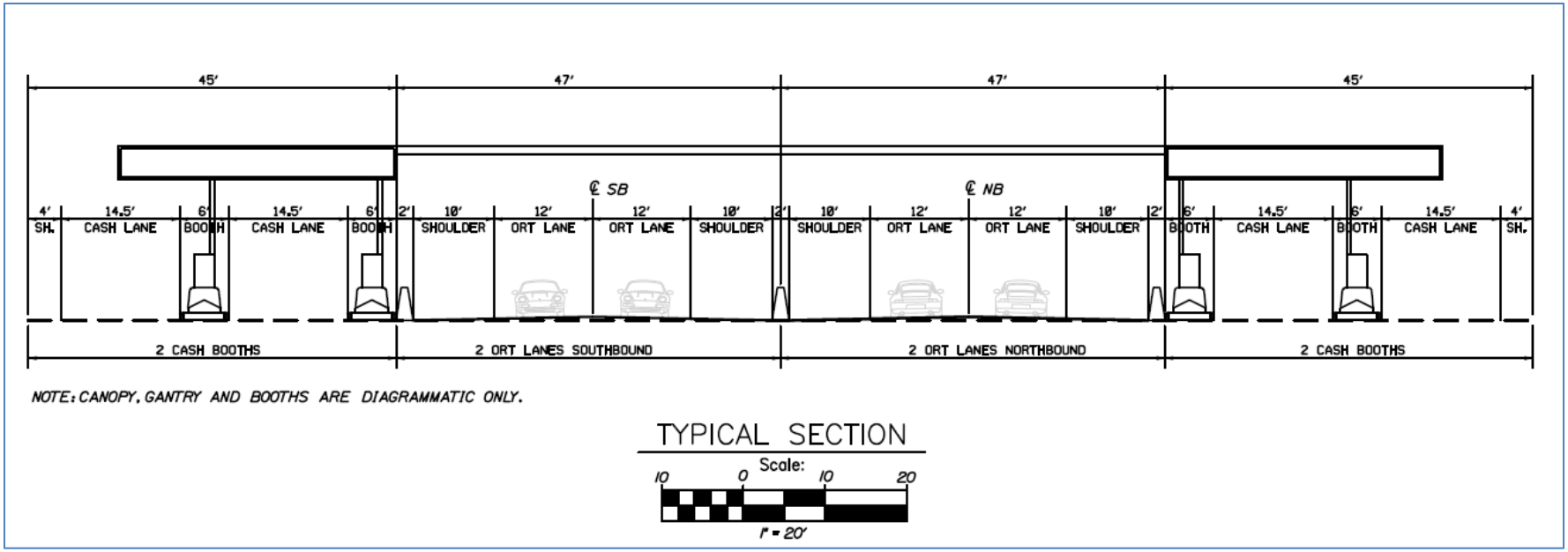
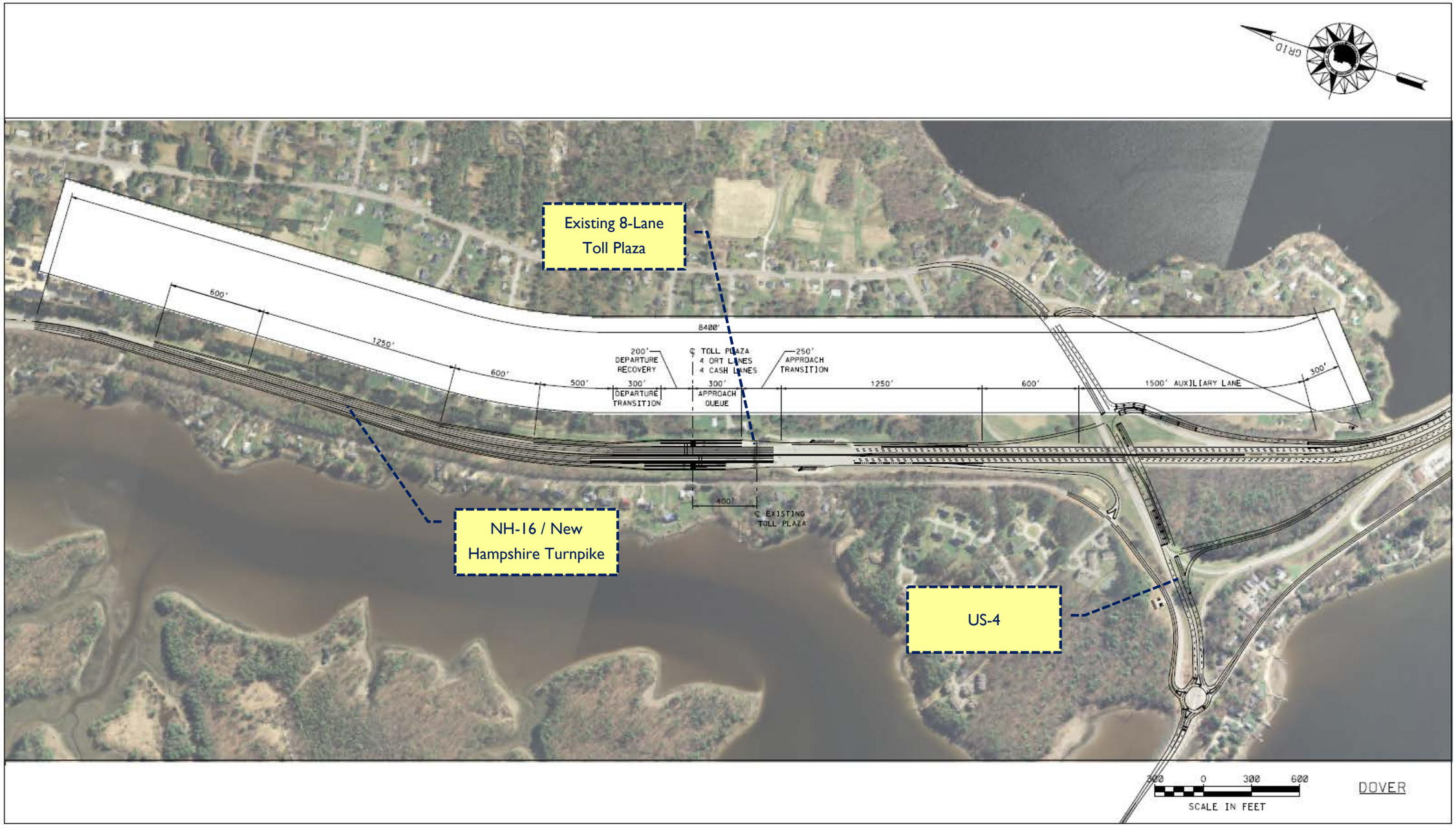


Figure 12 – Conceptual Layout for ORT at Dover



As Figure 12 illustrates, an ORT facility at Dover would need to be built north of the existing toll plaza site in order to accommodate the programmed improvements at Interchange 6. The proximity of the plaza to Interchange 6 will necessitate detailed signing to make the required decisions clear to the driving public. For example, signage would need to inform southbound vehicles destined for US-4 to use the cash lanes, regardless of whether they have an E-ZPass. Southbound vehicles passing through the ORT lanes would be barrier-separated from the cash lanes until beyond the exit ramp to US-4.

Table 12 summarizes the estimated costs associated with constructing an ORT facility at Dover. The table presents two options.

- Option 1 involves building a tunnel to support employee access to all tollbooths. It also assumes a relocated utility building to house all mechanical equipment and to provide room for employee breaks.
- Option 2 involves building an overhead walkway to provide employee access to all tollbooths. It also incorporates some room to provide office space and break rooms for employees. It assumes that a smaller utility building will still need to be constructed to house such items as mechanical equipment, bathroom facilities, and a safe.

The net revenue analysis in this document (see Section 8.5.3) will be based on Option 1, though no decision has been made to determine which is preferred by the Bureau of Turnpikes.

Table 12 – ORT Cost Estimates for Dover

Cost Category	Option 1	Option 2
Roadway Construction	$2,920,000	$2,920,000
Maintenance of Traffic	$438,000	$438,000
Median Concrete Barrier	$850,000	$850,000
Miscellaneous Items	$438,000	$438,000
Drainage & Water Pollution control	$438,000	$438,000
Mobilization	$292,000	$292,000
Signing & Striping	$255,000	$255,000
Contingency	$292,000	$292,000
Construction Subtotal	*$5,923,000*	*$5,923,000*
Engineering (Pre-Constr. & Constr.)	$1,195,000	$1,195,000
Sign Structure	$150,000	$150,000
ORT Installation	$1,300,000	$1,300,000
Cash Tollbooth Construction	$1,000,000	$1,000,000
Utility Building Construction	$600,000	$450,000
Demolition	$750,000	$750,000
Tunnel	$700,000	n/a
Overhead Walkway	n/a	$1,500,000
Grand Total	**$11,618,000**	**$12,268,000**

6.3.2 Dover AET

HNTB estimated the cost of installing an AET toll point to the north of the existing Dover toll plaza, which would be immediately followed by demolition of the existing facility.[7] Table 13 summarizes the estimated costs associated with an AET facility at Dover. It was assumed that the AET gantry at this location would need to span three lanes in each direction. Though the existing toll facility is fed by only two lanes in each direction, a new AET facility would need to accommodate three lanes to support any future widening of the Spaulding Turnpike. Therefore, the costs are identical to the costs estimated for Bedford Mainline and for Hampton Side.

Table 13 – AET Cost Estimates for Dover

Cost Category	Estimated Cost
Demolition	$ 1,000,000
Civil / Site Infrastructure	$ 1,340,000
Toll Equipment	$ 1,800,000
Administrative Building Upgrade	$ 200,000
Contingency	$ 1,085,000
Construction Subtotal	*$ 5,425,000*
Pre-Construction Engineering	$ 434,000
Construction Engineering	$ 434,000
Total Project Cost	**$ 6,293,000**

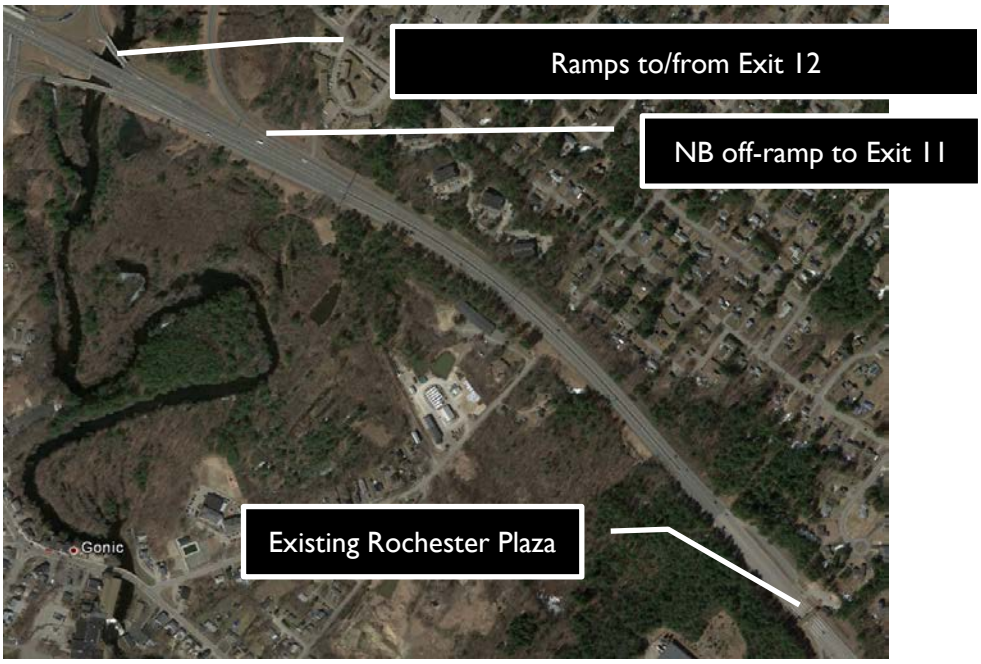
6.4 Rochester Toll Plaza Upgrades

As indicated by Table 5, the Rochester toll plaza is the least-traveled of the four toll plazas included in this study. On an annual basis, it carries roughly two-thirds of the volume that is handled at the Hampton Side or at Dover. Therefore, it is also the smallest of the four existing toll plazas being analyzed, with only three toll lanes serving each direction. During peak periods, the toll plaza is typically configured with 2 cash lanes and 1 dedicated E-ZPass lane in each direction.

The Rochester toll plaza is located about two-thirds of a mile south of Exit 11. Its position relative to the interchange is illustrated in Figure 13. Like the Dover toll plaza, the Rochester toll plaza is fed by two mainline lanes in each direction.

[7] The new toll point would need to be constructed first, so that testing of the new facility could be conducted while tolls continue to be collected at the existing toll plaza. Once the new toll point is operational, conventional toll collection would cease and the plaza would be demolished and removed in stages.

Figure 13 – Location of Rochester Plaza



6.4.1 Rochester ORT

HNTB assumed that an ORT toll plaza would be located about 500' south of the existing toll plaza. Because of its distance from Exit 11, an ORT facility at this location would require little or no modification to the interchange ramps.

HNTB's traffic analysis indicated that an ORT facility at this location would only require one ORT lane and two cash lanes. However, FHWA guidance states that the number of ORT lanes through a facility should be equal to the number of mainline lanes approaching the facility.[8] To be consistent with this guidance, HNTB recommends having two ORT lanes and two cash lanes at Rochester. Figure 14 provides a concept plan illustrating how an ORT facility of this size would fit at this site.[9] The concept plan assumes that the ORT facility will be located approximately 300' south of the existing plaza. [10]

As with the Dover drawing, the drawing shows 3 ORT lanes through the plaza for sake of clarity. This is to illustrate that the facility will be designed to accommodate a smooth transition to 3 ORT lanes in the future, if and when the Spaulding Turnpike is widened to three lanes. In the meantime, the plaza will operate with 2 ORT lanes in each direction, consistent with the existing number of mainline lanes.

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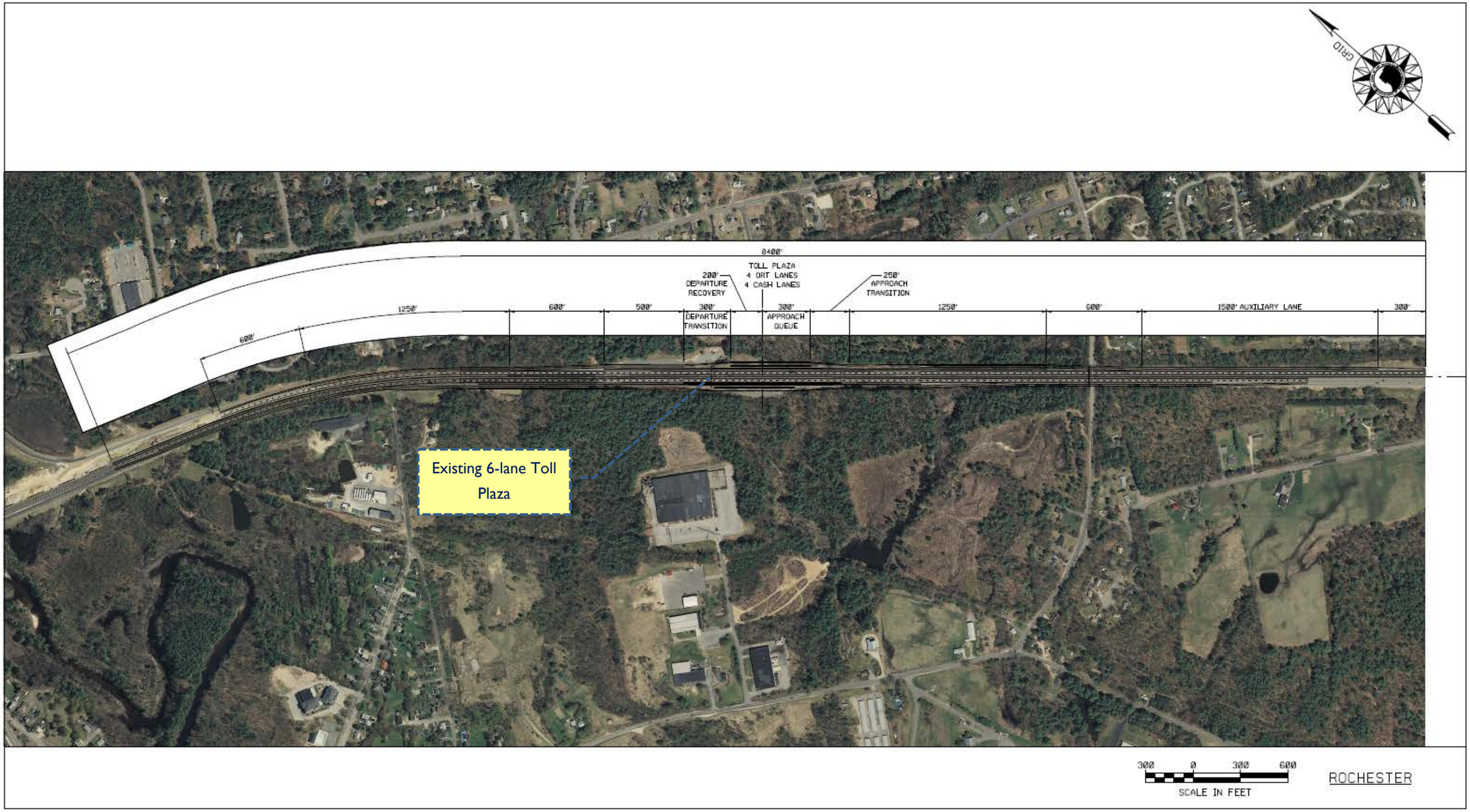
[8] Note that this is a *recommendation*, not a *requirement*. HNTB has designed ORT facilities in Hampton, Hooksett, and New Gloucester (ME) in which the number of ORT lanes was *less* than the number of mainline lanes. The final configuration will need to consider project cost considerations, traffic operation needs, and long-term traffic trends, as well as timing of future AET conversion.

[9] A cross-sectional view of the proposed ORT facility at Rochester is illustrated in Figure 11.

[10] A move to the north could introduce complications associated with being located closer to a horizontal curve and to an adjacent interchange. However, locating the plaza northward is a possibility that could be considered during the preliminary design stage.

Figure 14 – Conceptual Layout for ORT at Rochester



As Figure 14 illustrates, an ORT facility at Rochester would stretch for a total length of just over 1.5 miles. Unlike the proposed ORT facility at Dover (see Figure 12), this toll plaza would not require any unique signage; the median barrier would not restrict the ability of customers using the ORT lanes to access the adjacent interchange.

Table 14 summarizes the estimated costs associated with constructing an ORT facility at Rochester. As with Dover, two options for construction will be presented. The first involves construction of a tunnel to provide employee access to the tollbooths, while the second involves construction of an overhead walkway. Both options involve the construction of a new, relocated utility building, though the building associated with the "overhead walkway" option is smaller.

As with Dover, the net revenue analysis contained in Section 8.5.3 is based on Option 1, though no final determination has yet been made on which option is preferred by the Bureau of Turnpikes.

Table 14 – ORT Cost Estimates for Rochester

Cost Category	Option 1	Option 2
Roadway Construction	$3,808,000	$3,808,000
Maintenance of Traffic	$571,000	$571,000
Median Concrete Barrier	$850,000	$850,000
Miscellaneous Items	$571,000	$571,000
Drainage & Water Pollution control	$571,000	$571,000
Mobilization	$381,000	$381,000
Signing & Striping	$255,000	$255,000
Contingency	$381,000	$381,000
Construction Subtotal	*$7,388,000*	*$7,388,000*
Engineering (Pre-Constr. & Constr.)	$1,488,000	$1,488,000
Sign Structure	$150,000	$150,000
ORT Installation	$1,300,000	$1,300,000
Cash Tollbooth Construction	$1,000,000	$1,000,000
Utility Building Construction	$600,000	$450,000
Demolition	$600,000	$600,000
Tunnel	$700,000	n/a
Overhead Walkway	n/a	$1,500,000
Grand Total	**$13,226,000**	**$13,876,000**

6.4.2 Rochester AET

HNTB estimated the installing a new AET toll point in the vicinity of the existing toll plaza at Rochester, followed by demolition of the existing facility. Table 15 summarizes the estimated costs associated with an AET toll point at Rochester. As at Dover, it was assumed that the AET gantry set at this location would need to span three lanes in each direction in order to accommodate any future widening activity on the Spaulding Turnpike. Consequently, the estimated cost (at a concept level) is identical to the cost at Dover.

Table 15 – AET Cost Estimates for Rochester

Cost Category	Estimated Cost
Demolition	$ 1,000,000
Civil / Site Infrastructure	$ 1,340,000
Toll Equipment	$ 1,800,000
Administrative Building Upgrade	$ 200,000
Contingency	$ 1,085,000
Construction Subtotal	*$ 5,425,000*
Pre-Construction Engineering	$ 434,000
Construction Engineering	$ 434,000
Total Project Cost	**$ 6,293,000**

6.5 Cost Estimate Summary

Table 16 summarizes the cost estimates for the various upgrade alternatives.

Table 16 – Capital Cost Estimate Summary of Toll Facility Upgrades

Toll Plaza	Alternative	Est. Capital Cost
Bedford Mainline	ORT (in-place)	$ 8.11 M
	AET (at new location)	*$ 6.29 M*
Hampton Side	Rehabilitate existing plaza	$ 0.65 M
	AET (at existing location)	*$ 6.29 M*
Dover	ORT (in-place)	$ 11.62 M
	AET (at existing location)	*$ 6.29 M*
Rochester	ORT (in-place)	$ 13.23 M
	AET (at existing location)	*$ 6.29 M*

Section 7. Initial AET Evaluation based on Existing Conditions

It is possible to make a preliminary assessment of AET feasibility based on an evaluation of certain existing conditions. This section will provide a preliminary assessment at the four facilities under consideration for AET. Subsequent analysis will assess the validity of this preliminary assessment.

This section will assess each toll plaza from the perspective of six different metrics. Each toll plaza will be assessed one of the following ratings with respect to each metric.

- **Very good.** This rating suggests that the facility is very well positioned in this metric and meets or exceeds others who have converted or plan to convert.
- **Good.** This rating indicates that the metric generally favors AET feasibility. The facility shares similar ratings with other existing or planned AET conversions.
- **Caution.** This rating is neutral. The metric does not necessarily favor feasibility, but neither does it indicate that AET is not feasible.
- **Poor.** This rating indicates a higher risk with AET. Some measures will likely be required in order to mitigate the risk.

- **Very poor.** This rating suggests that AET could introduce significant risk. It is likely that a combination of additional time and aggressive mitigation strategies will be required to address this risk.

In addition to rating each toll plaza in light of the selected metrics, the following subsections will also rank-order the toll plazas within each metric. Thus, if each toll plaza is considered "Good" with respect to a particular metric, the rank ordering will provide additional detail within that rating.

7.1 Cash Revenue at Risk

AET fundamentally involves converting from cash toll collection to video toll collection. The less cash revenue that a particular toll plaza collects, the less revenue that is at risk upon conversion to video toll collection. Therefore, toll facilities that collect relatively low amounts of cash revenue are generally more favorable to converting to AET. With each facility and agency financial situation, the relative importance and value of these ranges can vary significantly. This measurement should be viewed accordingly and represents only one of the metrics involved.

Based on experience at other facilities, HNTB will use the following guidelines in assessing its ratings:

- Very good – $0 to $2 million per year at risk
- Good – $2 to $5 million per year
- Caution – $5 to $10 million per year
- Poor – $10 to $15 million per year
- Very poor – greater than $15 million per year

Table 17 summarizes the cash revenue collected at each of the four facilities under consideration for AET. It also provides a rank ordering of the four facilities.

Table 17 – Cash Revenue at Risk, FY2013

Toll Plaza	FY2013 Cash Revenue	Rating	Rank Order
Bedford Mainline	$4,706,784	Good	4
Hampton Side	$3,068,241	Good	3
Dover	$2,997,307	Good	2
Rochester	$2,037,412	Good	1

Based on the metric of *Cash Revenue at Risk*, all facilities are rated as "Good." Rochester is clearly the most highly-rated among the group, since it collects the least amount of cash revenue. Bedford Mainline is the riskiest among the group, having collected nearly $5 million in cash in 2013.

7.2 E-ZPass Market Share

The transition to AET is easier when cash users make up a lower share of overall traffic. This means that the higher a facility's E-ZPass market share, the greater a facility's feasibility for conversion to AET.

HNTB will use the following guidelines in assessing feasibility with respect to E-ZPass market share:

- Very good – 80% to 100% E-ZPass usage
- Good – 70% to 80% E-ZPass usage
- Caution – 60-70% E-ZPass usage
- Poor – 50-60% E-ZPass usage
- Very poor – less than 50% E-ZPass usage

Table 18 summarizes the E-ZPass market share in 2013 at each of the four facilities under consideration for AET. It also provides a rank ordering of the four facilities.

Table 18 – E-ZPass Market Share, FY2013

Toll Plaza	FY2013 E-ZPass%	Rating	Rank Order
Bedford Mainline	66.8%	Caution	3
Hampton Side	67.4%	Caution	1
Dover	66.9%	Caution	2
Rochester	65.0%	Caution	4

The four facilities have very similar E-ZPass market share percentages. All are rated as "Caution," since all lie in the range of 60-70%. The Hampton Side is ranked the highest, since its E-ZPass market share is the highest. But its market share of 67.4% is not significantly greater than the lowest-ranked facility at Rochester, with a market share of 65.0%.

7.3 Cost per Cash Transaction

One potential advantage of converting to AET is the opportunity to save on costs associated with cash fare collection. Facilities that spend a significant amount of money on fare collection can potentially benefit from converting to video tolling.

In general, facilities that have a high cost per cash transaction are more favorable to AET. HNTB will use the following guidelines in assessing feasibility with respect to the cost per cash transaction:

- Very good – 60¢ to $1.00
- Good – 45¢ to 60¢
- Caution – 30¢ to 45¢
- Poor – 15¢ to 30¢
- Very poor – 0¢ to 15¢

Keep in mind that these ratings pertain to *AET feasibility*. They do **not** reflect an assessment of current operations. A facility that has a low cost per cash transaction is operating efficiently, which is a positive characteristic with respect to current operations. But it is a *negative* characteristic with respect to AET feasibility, since it suggests little opportunity to save on operations costs.

Table 19 summarizes the cost per cash transaction at each of the four facilities under consideration for AET and provides a rank ordering of the four facilities. All data was drawn from 2013.

Table 19 – Cost per Cash Transaction Impact on AET Feasibility, FY2013

Toll Plaza	FY2013 Cost per Cash Transaction*	Rating**	Rank Order
Bedford Mainline	25.6¢	Poor	3
Hampton Side	26.2¢	Poor	2
Dover	23.7¢	Poor	4
Rochester	33.5¢	Caution	1

*Per-transaction costs encompass labor costs associated with fare collection as well as toll processing and banking costs. Unit costs provided directly by the Bureau of Turnpikes.

**The term *Poor* does not suggest that the current operation is inefficient. Rather, it indicates that current operations are relatively cost-effective, leaving little opportunity to save money on operations costs.

As Table 19 illustrates, three of the toll plazas have very similar per-transaction costs, all of which lie in the vicinity of 24-26¢. Because these costs are relatively low, their rating in terms of AET feasibility is "Poor." The only facility with a rating of "Caution" is the Rochester toll plaza, whose per-transaction cost for cash fare collection is about 30% higher than at the other three facilities.

7.4 Cash Collection Costs as Percentage of Cash Revenue

The previous section looked at the per-transaction cost of cash fare collection. Another perspective on the cost of cash fare collection is the *percentage of cash revenue consumed in the cost of cash fare collection*. This measure essentially looks at cash collection *costs* as a percentage of cash *revenue*. Facilities that spend a high percentage of cash revenue on the process of collecting the money could benefit from a conversion to AET. Conversely, facilities at which cash collection costs are relatively minor as a percentage of cash revenue may not experience a significant benefit from AET.

HNTB will use the following guidelines in assessing feasibility with respect to this measure:

- Very good – 40% to 50% of cash revenue consumed by cash fare collection costs
- Good – 30% to 40%
- Caution – 20-30% E-ZPass usage
- Poor – 10-20% E-ZPass usage
- Very poor – less than 10%

Table 20 summarizes the percentage of cash revenue consumed by cash fare collection costs at each of the four toll plazas under consideration for AET.

Table 20 – Cash Collection Costs as a Percentage of Cash Revenue, 2013

Toll Plaza	% of Cash Revenue Spent on Cash Collection	Rating	Rank Order
Bedford Mainline	26.7%	Caution	4
Hampton Side	34.0%	Good	2
Dover	33.3%	Good	3
Rochester	47.1%	Very good	1

The following observations may be drawn from Table 20:

- In general, this measure paints a slightly different picture of AET feasibility compared to the measure of "Cost per Cash Transaction." Overall, the four toll plazas do not spend a lot of money on a per-transaction basis. However, the cash tolls for passenger cars are relatively low—$1.00 at Bedford and 75¢ at the other three toll plazas. As a result, cash fare collection costs make up a fairly significant portion of cash revenue.
- Because the Bedford Mainline toll plaza has the highest fare, it has the lowest percentage of cash collection costs. Therefore, its ranking with respect to AET feasibility is the lowest.
- Rochester, which spends nearly half its cash revenue on the process of cash fare collection, ranks the highest of the four toll plazas with respect to AET feasibility.

7.5 Share of Out-of-State Traffic

A major challenge associated with AET is collecting money from out-of-state customers. While many agencies have the ability to compel in-state residents to respond to a video bill through state legislation, they typically do *not* have a lot of tools to compel payment from out-of-state residents. Therefore, facilities that have a high percentage of out-of-state customers could face greater revenue leakage after conversion to AET.

However, as Section 4.2 discussed, the states of New Hampshire, Maine and Massachusetts signed a toll enforcement reciprocity agreement in August 2011. This agreement strengthens the ability of the New Hampshire DOT to collect video toll revenue from residents of the two "reciprocal" states. Therefore, for purposes of this metric, "out-of-state" customers are defined as customers that are not residents of New Hampshire, Maine, or Massachusetts.

HNTB will use the following guidelines in assessing feasibility with respect to the share of out-of-state traffic:

- Very good – 0% to 10% of cash customers are from out-of-state
- Good – 10% to 25%
- Caution – 25% to 35%
- Poor – 35% to 50%
- Very poor – greater than 50%

Table 21 summarizes the share of cash-paying customers that come from out-of-state. As noted in Section 4.2, the data was drawn from a license plate survey of cash-paying customers that was conducted at each toll plaza.

Table 21 – Share of Out-of-State Customers, 2013

Toll Plaza	% of Cash Customers from Out-of-State	Rating	Rank Order
Bedford Mainline	10.2%	Good	3
Hampton Side	12.8%	Good	4
Dover	6.0%	Very good	2
Rochester	4.1%	Very good	1

As Table 21 illustrates, the vast majority of cash-paying customers lie within the tri-state reciprocity area. Consequently, all four toll plazas are rated as "Very good" with respect to this metric. The Rochester toll plaza, which is geographically situated furthest from any non-reciprocal states, has the lowest percentage of cash-paying customers from out-of-state (4.1%).

7.6 Baseline Estimated Revenue Loss

It is possible to evaluate existing conditions and make a high-level estimate of the "baseline" percentage of revenue that would be lost upon conversion to AET. This estimate may be calculated as follows:

- Take the percentage of revenue at each toll facility that comes from cash-paying customers; and,
- Multiply it by the estimated percentage of video revenue that will go uncollected after conversion to AET. (As illustrated in Figure 5, this figure is estimated to be approximately **50.6%** for the Bureau of Turnpikes.)

This is a "baseline" calculation in that it does not include any mitigation measures. For example, if an agency were to promote E-ZPass usage (e.g. through eliminating or reducing the cost of transponders) as part of its AET conversion, then the percentage of revenue from cash-paying customers would likely go down. Similarly, if the Commissioner of the New Hampshire DOT were to enter into reciprocal agreements with other states for the collection of tolls and fees, then the estimated percentage of uncollected video revenue would likely go down as well. [11] In short, the baseline estimate of revenue loss presents an initial estimate of the potential percentage of revenue loss; mitigation measures could reduce this number. [12]

HNTB will use the following guidelines in assessing feasibility with respect to the baseline estimate of revenue loss:

- Very good – 0% to 4% of revenue estimated to be lost due to AET conversion, pre-mitigation
- Good – 4% to 8%
- Caution – 8% to 12%
- Poor – 12% to 16%
- Very poor – 16% or more

[11] New Hampshire State Law (RSA 237:16-c) grants authority to the Commissioner to enter into such agreements.

[12] To illustrate, let's assume that a particular plaza had an E-ZPass market share of 70% of revenue. If this share grew to 80% as a result of the conversion to AET, then the baseline estimated revenue loss would diminish from 13.5% down to 9.0%.

Table 22 calculates the estimated percentage of revenue loss associated with each toll plaza. It then rates each toll plaza according to the standards listed above, and it rank orders the four toll plazas among themselves.

Table 22 – Estimated Baseline Percentage of Revenue Loss, 2013

Toll Plaza	% of Revenue from Cash	% Unpaid Video Transactions	*Baseline Est. Revenue Loss*	Rating	Rank Order
Bedford Mainline	32.8%	50.6%	*16.6%*	Very Poor	2
Hampton Side	31.7%	50.6%	*16.0%*	Poor	1
Dover	33.0%	50.6%	*16.7%*	Very Poor	3
Rochester	35.3%	50.6%	*17.9%*	Very poor	4

As Table 22 illustrates, the expected revenue loss at all four toll plazas (based on existing conditions) is in the range of 16-18%. This means that all four toll plazas are rated as either "Poor" or "Very poor" with respect to this metric. The Rochester toll plaza has the lowest rating because it has the highest percentage of its revenue that is derived from cash-paying customers.

7.7 Initial AET Evaluation – Summary

Section 7 has evaluated each toll plaza in light of six different metrics, each of which has a bearing on AET feasibility. All metrics were calculated based on conditions observed in 2013. Table 23 summarizes each toll plaza's rating with respect to each of the six metrics. To develop a numerical score, the ratings were assigned a score of 1 (for "Very poor") up to 5 (for "Very good"). The scores were used to develop an average score for each toll plaza. This average score was then used to determine an overall feasibility assessment for each facility. Scores were assigned as follows:

- Average Score between 1 and 1.5 – *Very Poor*
- Average Score between 1.5 and 2.5 – *Poor*
- Average Score between 2.5 and 3.5 – *Caution*
- Average Score between 3.5 and 4.5 – *Good*
- Average Score between 4.5 and 5 – *Very Good*

Table 23 – Preliminary Assessment of AET Feasibility

Metric	Bedford Mainline	Hampton Side	Dover	Rochester
Cash Revenue at Risk	Good	Good	Good	Good
E-ZPass Market Share	Caution	Caution	Caution	Caution
Cost per Cash Transaction	Poor	Poor	Poor	Caution
Cash Collection Costs as % of Cash Revenue	Caution	Good	Good	Very good
Share of Out-of-State Traffic	Good	Good	Very good	Very good
Baseline Estimated Revenue Loss	Very poor	Poor	Very poor	Very poor
Overall	**Caution** Ave. = 2.83	**Caution** Ave. = 3.17	**Caution** Ave. = 3.17	**Caution** Ave. = 3.50

According to a *preliminary* review of performance relative to the six metrics identified in this section, all toll plazas would be categorized as "Caution."

- The Rochester toll plaza would appear to be the best candidate for AET. The cost of cash collection at this location is relatively high; nearly half of cash revenue is consumed by the cost of collecting the revenue. This suggests that there is potential for cost savings upon conversion to AET. When this is coupled with the fact that Rochester collects the least cash revenue (and therefore has the least cash revenue at stake), it appears that AET has the potential to be viable at this location.
- The Bedford Mainline toll plaza scored the lowest. The biggest problem for this toll plaza (as well as Hampton Side and Dover) is the fact that it rated "Poor" or "Very poor" in both "Cost per Cash Transaction" (suggesting that AET provides little opportunity for operational cost savings) and in "Baseline Estimated Revenue Loss" (with preliminary estimates of 16-17% revenue loss upon conversion to AET). This suggests that AET could create a situation where revenues decline yet operating costs hold steady. This would not bode well for AET feasibility.

Section 8. Net Revenue Analysis

Section 7 of this report contained a preliminary assessment of AET feasibility based on a review of six key metrics. This provided some initial insight; however, to really determine AET feasibility, it is necessary to perform a comprehensive financial assessment. This assessment involves not only considering existing conditions, but predicting how these conditions will change upon conversion to AET. It also requires an understanding of how both revenue and operating costs are likely to change once the method of toll collection is changed. This section will examine these dimensions of converting to AET and will provide a detailed analysis of its financial implications at each of the four selected toll plazas.

Additionally, this section will compare AET to an alternative capital improvement. At three of the toll plazas—Bedford Mainline, Dover, and Rochester—the alternative capital improvement will be Open Road Tolling, or ORT. At the Hampton Side, the alternative improvement will be rehabilitating the existing conventional toll plaza, whose original construction dates back to 1975. Please see Section 6 for a detailed description of the alternative capital improvements and their associated costs.

8.1 Basis of Evaluation

This study will employ two different financial metrics in its assessment of AET feasibility—"revenue neutrality" and "net revenue." These two metrics are described below.

8.1.1 Revenue Neutrality (Gross Revenue minus O&M Only)

For AET to be considered feasible, it should achieve *revenue neutrality* as defined by the following equation:

$$(\text{Gross Revenue} - \text{Operations \& Maintenance Costs})_{AET} \geq (\text{Gross Revenue} - \text{Operations \& Maintenance Costs})_{existing}$$

This calculation, which is performed on an annual basis, is independent of capital costs. It simply says that net operating revenue *after* conversion to AET should be greater than or equal to net operating revenue under existing conditions. This study narrowly defines "Operations and Maintenance Costs" (or "O&M" costs) as the costs involved in collecting fare revenue.

- In existing conditions, O&M costs involve the cost of collecting E-ZPass revenue, of collecting cash revenue in the tollbooths, and of operating the violations processing center.
- In an AET scenario, O&M costs involve the cost of collecting E-ZPass revenue and of all aspects of collecting video tolls. Video toll collection costs include video image review, account maintenance costs, billing costs, and credit card fees.

8.1.2 Net Revenue (Gross Revenue minus O&M and Capital Costs)

This financial metric is slightly more comprehensive than revenue neutrality. It adds in an assessment of capital costs, as illustrated by the following formula:

$$(\text{Gross Revenue} - (\text{Operations \& Maintenance Costs} + \text{Capital Costs})_{AET} \geq (\text{Gross Revenue} - (\text{Operations \& Maintenance Costs} + \text{Capital Costs})_{existing}$$

To calculate annualized capital costs, HNTB took the capital costs developed in Section 6 and amortized them over 20 years. Based on guidance provided by the Bureau of Turnpikes, it was assumed that the capital costs could be financed by bonds at an annual rate of 4%.

8.2 AET Assumptions

Any revenue analysis that encompasses a broad period of time must be built on a reasonable set of assumptions. This section will review the critical assumptions employed by this study in its analysis of a conversion to AET.

8.2.1 Time Period

Per the scope of work, the study will evaluate both revenue neutrality and net revenue for a 12-year period spanning from 2014 through 2026. By looking at several years, it is possible to evaluate whether AET feasibility may improve over time. It is possible that, at some facilities, AET may best be implemented at a later date when conditions are more favorable.

8.2.2 Traffic Growth

Jacobs Engineering Group, Inc. (Jacobs) has developed unique traffic growth forecasts for each of the four facilities examined in this study. These forecasts, taken from a memorandum provided to the Bureau of Turnpikes on December 20, 2013, are summarized in Table 24. [13]

Table 24 – Traffic Growth Forecast for 2014-2026

Year	Bedford Mainline	Hampton Side	Dover	Rochester
2014	0.94%	2.09%	2.06%	4.81%
2015	1.81%	0.99%	-1.80%	1.80%
2016	1.81%	0.99%	-0.75%	0.80%
2017	1.81%	0.99%	4.67%	0.80%
2018	1.71%	0.99%	1.70%	0.70%
2019	1.61%	0.90%	0.70%	0.70%
2020	1.61%	0.90%	0.70%	0.70%
2021	1.61%	0.90%	0.70%	0.70%
2022	1.61%	0.90%	0.70%	0.70%
2023	1.61%	0.90%	0.70%	0.70%
2024	1.61%	0.90%	0.70%	0.70%
2025	1.61%	0.90%	0.70%	0.70%
2026	1.61%	0.90%	0.70%	0.70%

8.2.3 E-ZPass Market Share Growth

The 2012 AET study cited above also provided forecasts for growth in E-ZPass market share. However, these forecasts seemed to be quite conservative (i.e. low) from HNTB's perspective. The annual growth figures are generally lower than the growth that has been observed in recent years, and the estimates of maximum E-ZPass market share are lower than market shares that have already been observed at other facilities in the northeast.

Therefore, HNTB's analysis will consider a *range* of values for E-ZPass growth.

- On the low end will be the 2012 AET study forecasts, with modest year-over-year growth and a fairly low estimate of maximum E-ZPass penetration.

[13] The memorandum does not have a title. Its subject line is *New Hampshire Turnpike System Traffic and Toll Revenue Forecast Update*. The forecasts in this memorandum only ran through 2024. For purposes of this study, HNTB assumed that the growth rates for 2025 and 2026 would be identical to the growth rate projected for the year 2024.

- On the high end will be a set of forecasts developed by HNTB that are more consistent with actual trends observed in recent years at each toll plaza.

Table 25 summarizes the forecasts for E-ZPass market share for 2014 through 2026. [14]

Table 25 – E-ZPass Market Share Projections, 2014-2026

Year	Bedford Mainline		Hampton Side		Dover		Rochester	
	low-end	*high-end*	*low-end*	*high-end*	*low-end*	*high-end*	*low-end*	*high-end*
2014	66.77%	66.77%	67.39%	67.39%	66.90%	66.90%	65.00%	65.00%
2015	67.95%	68.12%	69.06%	68.74%	68.47%	68.45%	66.51%	66.77%
2016	68.93%	69.43%	70.46%	70.04%	69.75%	69.94%	67.76%	68.44%
2017	69.71%	70.69%	71.57%	71.30%	70.76%	71.37%	68.75%	70.01%
2018	70.28%	71.89%	72.39%	72.49%	71.54%	72.74%	69.48%	71.48%
2019	70.78%	73.05%	72.91%	73.64%	72.02%	74.05%	69.95%	72.84%
2020	71.28%	74.16%	73.36%	74.74%	72.52%	75.30%	70.37%	74.11%
2021	71.73%	75.22%	73.76%	75.78%	73.02%	76.49%	70.79%	75.28%
2022	72.18%	76.22%	74.11%	76.77%	73.52%	77.62%	71.16%	76.35%
2023	72.58%	77.18%	74.41%	77.71%	73.97%	78.69%	71.53%	77.31%
2024	72.98%	78.09%	74.66%	78.60%	74.42%	79.71%	71.85%	78.18%
2025	73.33%	78.94%	74.70%	79.43%	74.50%	80.00%	72.17%	78.95%
2026	73.60%	79.75%	74.70%	80.00%	74.50%	80.00%	72.40%	79.62%

8.2.4 Trip Frequency

As Section 4.3 noted, trip frequency is a critical variable in evaluating the feasibility of AET. As a general rule, AET feasibility at a given facility is improved if the existing cash customers (most of whom will become video customers under AET) tend to be frequent users of the facility.

Table 26 summarizes the assumptions relative to trip frequency.

- The "Low" column is a profile that is characteristic of a facility where video customers tend to be infrequent users. This was the profile that HNTB used to evaluate some facilities in New York State, based on data available from the Henry Hudson Bridge. Average usage was about 14 times per year, or a little over once per month.
- The "High" column is the profile that was observed from the results of the on-line survey (as discussed in more detail in Section 4.3). It represents an upper end of expected frequency of use. Based on the responses to the on-line survey, the average cash customer is a very frequent user, making about 166 trips per year (or roughly 14 trips per month).

[14] Note that the low-end E-ZPass figures do not exactly match the figures cited in Jacobs' report. This is because, in this report, the E-ZPass market share is calculated as a proportion of *all* transactions, including all non-payments (such as I-tolls and violations). The basic formula employed by this study for E-ZPass market share is valid E-ZPass transactions divided by total transactions (including cash, valid E-ZPass, non-revenue transactions, and all non-payments).

Table 26 – Trip Frequency Summary

Trip Frequency	Frequency Scenario	
	Low	High
Annual	75.0%	24.0%
Monthly	22.0%	30.0%
1-5x per week	1.5%	20.0%
5-10x per week	0.8%	10.0%
10-15x per week	0.4%	7.0%
15-20x per week	0.2%	5.0%
20+x per week	0.1%	4.0%
Overall	14.1 trips per year	165.8 trips per year

8.2.5 Video Surcharges

Many agencies that have implemented AET have chosen to apply a surcharge to video customers in order to help cover costs and revenue impacts associated with video tolling. In other words, agencies often take the cash rate *before* conversion and increase it by a certain percentage in order to establish a new "video rate."

The direction from the Bureau of Turnpikes at the onset of the study was that *no new surcharges would be assessed to the existing cash rates*. The video rates under AET would be identical to the existing cash rates. Thus, the Bureau of Turnpikes would employ the following rate structure under AET:

- E-ZPass customers with a NH-based account would pay the current E-ZPass fare
- Video customers would pay the same fare that cash customers pay today. At present, cash rates for passenger cars are approximately 42% higher than the E-ZPass rate. Cash rates for commercial vehicles are approximately 11% higher. Video customers would also pay the administrative fees described in the next section.
- E-ZPass customers with an account based *outside* of New Hampshire would also pay the same toll rate that cash customers pay today. However, they would not be required to pay any administrative fees.

8.2.6 Billing and Fee Structure

Per direction from the Bureau of Turnpikes, this study assumed that the billing structure under AET will be essentially the same as the billing structure that is currently in place to handle violators. The process under AET is assumed to consist of three levels of invoicing, described below. Please note that all fees are applied on a *per-transaction* basis.

- **Level 1**. At the beginning of the month, an invoice will be sent for all video transactions recorded during the preceding month. A $1.00 video processing fee will also be assessed at this level.
- **Level 2**. If no response is provided to the first invoice, a second invoice will be sent out a month later. This invoice will include all tolls from the first invoice with a $1.50 fee added.
- **Level 3**. If no response is provided to the second invoice, then a third invoice will be sent out a month later. This invoice will include all unpaid tolls from the second invoice in addition to a $25.00 administrative fee.

8.2.7 Response Rates to Video Billing

As Section 5 noted, this study assumes that, under AET, video customers will respond to video in a similar manner in which today's violators respond to the violations billing process. The existing response rates are 36.4% to the first invoice, 31.0% to the second invoice, and 53.3% to the third and final invoice. The net response rate (i.e. the overall response after all steps have been taken) is 79.5%. Therefore, HNTB's analysis built upon this net response rate of 79.5%.

The data from NHDOT did not differentiate between violators that resided within the tri-state area and those who resided in other states. However, it is expected that drivers who reside with the tri-state area would be more likely to reply than non-residents, since residents can be compelled to pay via the possibility of a registration hold. Therefore, HNTB developed an estimated "response profile" for both residents that live within the reciprocity area and those that do not. This profile was built on the following assumptions:

- Non-residents are expected to have a net response rate of 50% (as compared to just over 75% for the population as a whole).
- Non-residents overall account for 8.8% of all violations, as suggested by the license plate survey data (discussed in Section 4.2).

Table 27 summarizes the response rates that HNTB used in its feasibility model. The model assumed initially that *under AET, video customers receiving a notice in the mail will respond similarly to how violators currently respond to billing notices.* Therefore, the numbers in Table 27 represent a lower limit; HNTB believes that video customers will tend to respond more favorably than today's violators. By differentiating between "residents" and "non-residents," it is possible to explore how the results could change if other states were brought under the reciprocity umbrella.

Table 27 – Assumed Lower-Limit Response Rates to Video Billing, Residents vs. Non-Residents*

Notice Level	Resident	Non-Resident	Overall
1st Notice	40.0%	25.5%	38.7%
2nd Notice	32.0%	20.5%	31.0%
Violations Notice	55.0%	15.5%	51.5%
Net Total	*81.6%*	*50.0%*	*79.5%*

*The term "resident" refers to a driver who resides within the tri-state area covered by the toll reciprocity agreement (Maine, New Hampshire, and Massachusetts).

In order to investigate the impact of uncertainty in this important variable, HNTB evaluated a range of response rates. We also differentiated between response rates from reciprocal states and response rates from all other states. Table 28 summarizes the AET response rates assumed by this study. For each level, and for each type of customer (reciprocal vs. non-reciprocal), the table shows the expected response rate along with a low-end estimate (documented in Table 27) and a high-end estimate.

Table 28 – Assumed Response Rates to Video Billing

Invoice Level	Reciprocal States			Non-reciprocal States			Overall		
	low	expected	high	low	expected	high	low	expected	high
Level 1	40.0%	50.0%	60.0%	25.5%	35.5%	45.5%	38.7%	48.7%	58.7%
Level 2	32.0%	39.5%	47.0%	20.5%	28.0%	35.5%	31.0%	38.5%	46.0%
Level 3	55.0%	60.0%	65.0%	15.5%	20.5%	25.5%	51.5%	56.5%	61.5%
Overall	**81.6%**	**87.9%**	**92.6%**	**50.0%**	**63.1%**	**73.8%**	**79.5%**	**86.3%**	**91.4%**

8.2.8 AET-Related Operations & Maintenance Costs

In order to evaluate AET feasibility, it is necessary to make some assumptions regarding the costs associated with operating and maintaining an AET system. The key operational costs associated with AET are summarized below. Because these costs are uncertain, this study will assume that the costs could fall within a range of possible values. For each cost item, HNTB assumed a minimum cost, an expected (or "most likely") cost, and a maximum cost. The range of potential costs is derived from HNTB's experiences with other agencies that either are considering or have already implemented AET.

- **Account maintenance costs.** This is the cost to maintain a video account on a monthly basis. The study assumed that this cost could range from 75¢ per account-month up to $1.25 per account month. The expected value was $1.00.
- **Image review costs.** The implementation of AET involves the use of an OCR system to automatically review all license plate images and capture the critical information (including the plate number, the plate type, and the state). The study assumed the following costs associated with OCT:
    - A fixed cost of 4.4¢ would be assessed to all images reviewed by the OCR system. The assumed range around this figure was from a low of 1.0¢ per image to a high of 6.0¢ per image.
    - A variable cost of 15.7¢ would be assessed to each image that was successfully identified. The assumed range was from 9.0¢ to 20.0¢ per successful image.
    - The study assumed that 50% of all images would be successfully identified. The range associated with this variable was from 40% to 75%.
- **Mailing costs.** The study assumed that all monthly mailings would cost from 50¢ to $1.00 per mailing, with an expected value of 74¢. These costs compound themselves if customers don't respond to their invoices. For example, if a video customer travels one time during the year, but he doesn't respond until the third invoice, then the associated mailing cost would be approximately $2.22 (74¢ per mailing multiplied by three mailings). As a result, the mailing costs are closely related to the assumed response rates summarized in Table 28. A higher response rate to the first invoice will tend to lower total mailing costs.

8.2.9 Fee Forgiveness

Section 8.2.6 identified the fees associated with the first two levels of billing and the fine assessed at the third level. However, in the current violations process, the Bureau of Turnpikes often forgives these fees

and fines for various reasons. Therefore, HNTB assumes that a certain portion of the fees and fines associated with AET will also be forgiven. Similarly, rating agencies often apply a significant discount (typically referred to as a "haircut") to fee and fine revenues when scrutinizing AET impacts to agency financials. These discounts can be similar in equivalent magnitude as the forgiveness rates referenced for this variable. Therefore, both reasons suggest that limited value should be placed on revenues from fees and fines where waiving or forgiveness policies exist.

Table 29 summarizes the levels at which today's fees are forgiven at each of the four facilities under consideration. It reveals that forgiveness levels under existing conditions hover at around 71%. HNTB therefore assumed that, under AET, about 71% of all fees and fines would be forgiven. To account for uncertainty, HNTB evaluated a range of uncertainty associated with this variable. It was assumed that the Bureau of Turnpikes would forgive at least 50% of fees and fines, and could forgive as much as 90%.

Table 29 – Fee Forgiveness Levels, Existing and AET

Toll Plaza	Existing	AET
Hampton Side	72%	Range of 50%-90% (expected value of 71%)
Bedford Mainline	77%	
Dover	69%	
Rochester	66%	

8.2.10 Year 1 Jump in E-ZPass Usage

A limited number of AET facilities (such as the Golden Gate Bridge, as discussed in Section 11.6) have noted a measurable increase in transponder usage upon conversion to AET. Other facilities have seen little-to-no increase. For purposes of this analysis, HNTB assumed that there would be a year 1 growth of 1.25% in E-ZPass market share, in addition to the normal year-over-year growth in E-ZPass (summarized in Table 25). However, to account for uncertainty in this variable, HNTB evaluated a range of values from 0% to 3%.

8.3 ORT Assumptions

The ORT analysis involved considerably fewer assumptions than the AET analysis. This is because ORT does not involve a fundamental transformation in the way in which tolls are collected. Fundamentally, the only change is that E-ZPass customers can pass through the facility at highway speeds, as opposed to slowing down to 10-20 mph. For cash customers, the toll collection experience is basically unchanged.

The two basic ORT-related assumptions employed by HNTB are as follows:

- The ORT analysis assumed that the expected year 1 increase in E-ZPass market share would be 2.1%. This was based on an analysis of E-ZPass market share trends at Hampton and Hooksett in the year following their conversion to ORT. However, HNTB also evaluated the potential impact of this variable ranging from as low as 1.0% to as high as 3.0%.
- The ORT analysis assumed that the conversion to ORT would increase the number of violations by roughly 70%. This was based on an analysis of increases in violations following the conversion to ORT at Hampton and Hooksett. However, it is important to note that the baseline

percentage of violations is only about 0.4-0.6%. Thus, increasing the number of violations by 70% still leaves a very low violations rate of about 0.9% after conversion to ORT.

8.4 Analytical Framework

This section will describe the framework by which conversions to AET and ORT will be evaluated and compared.

8.4.1 AET Framework

The AET feasibility assessment evaluated four scenarios. Each scenario involved a unique combination of E-ZPass growth rates (as summarized in Table 25) and frequency-of-travel assumptions (as summarized in Table 26). These scenarios are summarized below.

- **Scenario 1** – Low E-ZPass growth, low frequency of travel
- **Scenario 2** – High E-ZPass growth, low frequency of travel
- **Scenario 3** – Low E-ZPass growth, high frequency of travel
- **Scenario 4** – High E-ZPass growth, high frequency of travel

Each scenario had a collection of cost- and revenue-related variables that were modeled not as *fixed* values, but as a *range* of values. The various ranges were based on HNTB's professional experience on other AET assessments throughout the country. The variables and their associated ranges, which were discussed in Section 8.2, are summarized in Table 30.

Table 30 – Summary of Cost- and Revenue-Related Variables Modeled with Uncertainty

Variable	Low	Expected	High
Account Maintenance Cost ($ per account-month)	75¢	$1.00	$1.25
OCR Fixed Costs ($ per non-ETC transaction)	1.0¢	4.4¢	6.0¢
OCR Variable Costs ($ per successful image review)	9.0¢	15.7¢	20.0¢
OCR Success Rate	40%	50%	75%
Mailing Cost	50.0¢	74.0¢	$1.00
Fee Forgiveness	50%	71%	90%
Year 1 Jump in E-ZPass Market Share – AET	0.00%	1.25%	3.00%
Response Rate – Residents from Reciprocal States			
Level 1 Notice	*40.0%*	*50.0%*	*60.0%*
Level 2 Notice	*32.0%*	*39.5%*	*47.0%*
Level 3 Notice	*55.0%*	*60.0%*	*65.0%*
Response Rate – Residents of Non-Reciprocal States			
Level 1 Notice	*25.5%*	*35.5%*	*45.5%*
Level 2 Notice	*20.5%*	*28.0%*	*35.5%*
Level 3 Notice	*15.5%*	*20.5%*	*25.5%*

HNTB employed Monte Carlo simulation in order to calculate a reasonable range of results. Each simulation run generated three key outputs for each facility (Bedford Mainline, Hampton Side, Dover, and Rochester) during each year (2014 through 2026). These three key outputs for both net revenue and revenue neutrality were:

- A pessimistic result (technically referred to as the "80th percentile" output)

- An expected result (the "50th percentile" output)
- An optimistic result (the "20th percentile" output)

The results in this report generally focus on providing a range of values, from the pessimistic result to the optimistic result. The "expected" result was calculated but was only be used when comparing results with ORT in Section 8.5.3. More details concerning Monte Carlo simulation and its application to this effort can be found in Appendix A.

8.4.2 ORT Framework

The ORT analysis will not include a range of results, since only one variable—the expected year 1 jump in E-ZPass market share—will have uncertainty that will be built into the revenue model. Subsequent analysis indicated that this variable only had marginal impacts on revenue neutrality and net revenue. Therefore, the ORT analysis will only present the results for the "expected" outcome.

For comparison purposes, ORT results will be presented for all 4 scenarios described in Section 8.4.1. However, the results of the ORT analysis are not related to frequency of travel because there is no video billing (other than for violators). Therefore, the ORT results of Scenarios 1 and 3 (both of which assume low E-ZPass growth) are identical, as are the results of Scenarios 2 and 4 (both of which assume a high E-ZPass growth).

8.5 Feasibility Calculations

The results of HNTB's financial analysis will be presented in the following order:

- Section 8.5.1 will compare AET to No-Build on the basis of *revenue neutrality*. Recall that revenue neutrality does not incorporate an assessment of capital costs.
- Section 8.5.2 will compare ORT to No-Build, also on the basis of revenue neutrality. By comparing the relative performance of ORT vs. No-Build with AET vs. No-Build, it will be possible to assess how ORT stacks up against AET as a path for modernizing the toll plazas considered in this study. [15]
- Section 8.5.3 will compare ORT to AET on the basis of *net revenue*. This section will evaluate whether the capital cost savings associated with AET are sufficient to make it favorable to ORT. [16]
- Section 8.5.4 will present a summary of the key observations and conclusions to be drawn from the financial analysis.

8.5.1 Revenue Neutrality – AET vs. No-Build

Table 31 summarizes the revenue neutrality calculation for Scenario 1, which assumes a low frequency of travel and a low rate of E-ZPass growth. A negative value in the table indicates that net operating revenue (that is, gross revenue less operating and maintenance costs) under AET is lower than net operating revenue in the no-build condition.

[15] No revenue neutrality comparison for ORT will be made at Hampton Side, since ORT is not an option at this location.

[16] At Hampton Side, the comparison will evaluate AET vs. rehabbing the existing facility and maintaining it as a conventional toll plaza.

Table 31 – Scenario 1 Revenue Neutrality, AET vs. No-Build—Low Frequency, Low E-ZPass Growth

	Expected Change in Revenue Neutrality (in $thousands)			
Year	***Hampton Side***	***Bedford Mainline***	***Dover***	***Rochester***
2014	-1806 to -1526	-1404 to -1008	-1816 to -1519	-977 to -769
2015	-1721 to -1453	-1318 to -928	-1702 to -1423	-953 to -749
2016	-1661 to -1401	-1257 to -870	-1624 to -1357	-920 to -722
2017	-1621 to -1367	-1211 to -824	-1647 to -1377	-903 to -708
2018	-1606 to -1355	-1176 to -790	-1648 to -1377	-893 to -700
2019	-1596 to -1348	-1140 to -754	-1649 to -1380	-884 to -693
2020	-1602 to -1355	-1111 to -729	-1657 to -1388	-876 to -686
2021	-1616 to -1370	-1087 to -707	-1671 to -1402	-870 to -681
2022	-1633 to -1385	-1083 to -701	-1687 to -1417	-864 to -677
2023	-1653 to -1402	-1094 to -711	-1704 to -1432	-861 to -675
2024	-1669 to -1417	-1109 to -721	-1717 to -1443	-862 to -677
2025	-1686 to -1431	-1133 to -738	-1726 to -1449	-864 to -680
2026	-1696 to -1439	-1154 to -753	-1733 to -1454	-866 to -681

The following observations may be drawn from Table 31:

- All revenue neutrality calculations yield results that are negative. This means that, under Scenario 1, AET is expected to yield a loss in operating revenue (that is, gross revenue less operations and maintenance costs).
- The Hampton Side facility has the greatest expected revenue loss. In 2014, the loss is between $1.5 and $1.8 million. The expected loss is less in 2026, but not significantly less.
- Rochester loses the least money under AET. Its expected losses are about half of what is expected at the Hampton Side.
- The expected losses generally decline over time, until the time at which E-ZPass market share reaches its assumed peak. Once that occurs, annual losses are expected to slowly climb again.

Table 32 provides the same data for Scenario 2, which assumes a low frequency of travel with high E-ZPass growth.

Table 32 – Scenario 2 Revenue Neutrality, AET vs. No-Build—Low Frequency, High E-ZPass Growth

	Expected Change in Revenue Neutrality (in $thousands)			
Year	***Hampton Side***	***Bedford Mainline***	***Dover***	***Rochester***
2014	-1821 to -1535	-1376 to -977	-1810 to -1509	-964 to -755
2015	-1744 to -1468	-1253 to -865	-1684 to -1403	-925 to -724
2016	-1675 to -1408	-1138 to -759	-1579 to -1315	-873 to -681
2017	-1607 to -1350	-1017 to -648	-1559 to -1297	-829 to -646
2018	-1542 to -1294	-904 to -543	-1497 to -1244	-787 to -612
2019	-1472 to -1232	-784 to -433	-1423 to -1181	-748 to -581
2020	-1410 to -1179	-672 to -331	-1351 to -1120	-712 to -552
2021	-1356 to -1133	-557 to -225	-1277 to -1057	-679 to -526
2022	-1294 to -1079	-451 to -127	-1228 to -1022	-650 to -502
2023	-1253 to -1053	-348 to -38	-1229 to -1027	-626 to -484
2024	-1253 to -1059	-289 to 1	-1241 to -1038	-612 to -477
2025	-1273 to -1077	-290 to 0	-1251 to -1046	-622 to -487
2026	-1285 to -1088	-294 to 0	-1260 to -1054	-632 to -496

Table 32 highlights the following:

- For the year 2014, the results for Scenario 2 are nearly identical to the results for Scenario 1. This simply means that the potential impact of higher rates of E-ZPass growth won't be felt until the later years.
- For the year **2026**, the results for Scenario 2 are significantly better than for Scenario 1.
    - At Hampton Side, Dover, and Rochester, the expected losses are roughly 25% lower than Scenario 1.
    - At Bedford—where AET implementation involves a relocation of the mainline toll plaza (see Section 6.1)—the expected losses under Scenario 2 are about 85% less than under Scenario 1.
- The proposed Bedford Mainline toll plaza nearly achieves revenue neutrality in the years 2024-2026.

In short, Table 32 could be summarized as follows: Even though using a higher E-ZPass growth rate improves the outlook for AET, the overall results still suggest that AET under Scenario 2 does not result in a positive net revenue neutrality situation.

Table 33 provides the revenue neutrality results for Scenario 3, which assumes a *high* frequency of travel and *low* E-ZPass growth.

Table 33 – Scenario 3 Revenue Neutrality, AET vs. No-Build—High Frequency, Low E-ZPass Growth

	Expected Change in Revenue Neutrality (in $thousands)			
Year	***Hampton Side***	***Bedford Mainline***	***Dover***	***Rochester***
2014	-957 to -881	-249 to -130	-981 to -906	-406 to -355
2015	-908 to -834	-182 to -64	-920 to -849	-395 to -345
2016	-876 to -802	-133 to -15	-877 to -807	-378 to -328
2017	-854 to -782	-92 to 27	-888 to -819	-370 to -321
2018	-844 to -777	-60 to 60	-884 to -820	-366 to -317
2019	-833 to -774	-26 to 93	-885 to -827	-363 to -314
2020	-837 to -782	4 to 117	-890 to -834	-359 to -310
2021	-846 to -792	36 to 137	-901 to -844	-356 to -307
2022	-857 to -804	54 to 146	-912 to -855	-353 to -306
2023	-870 to -816	57 to 147	-923 to -865	-352 to -307
2024	-879 to -825	58 to 149	-931 to -873	-352 to -309
2025	-888 to -833	53 to 145	-934 to -875	-353 to -312
2026	-892 to -836	51 to 145	-936 to -876	-352 to -312

It is helpful to compare Table 33 with Table 31, since both are based on an assumption of a low-end rate of E-ZPass growth. The only difference between the two scenarios is the assumed frequency of travel. In comparing these tables, the following may be observed:

- At all toll plazas, in all years, the "change in revenue neutrality" is better (that is, less negative) in Scenario 3 than Scenario 1. In other words, the loss in net operating revenue is lower when a higher frequency of travel is assumed. The reason for this is that AET operating costs are significantly lower under a "high frequency" scenario as compared to a "low frequency" scenario.
- At all toll plazas in Scenario 3, the expected decline in revenue neutrality is $1 million or less throughout the study period.
- At Hampton Side and at Dover, the "high frequency" scenario (Scenario 3) improves the expected change in revenue neutrality by about $700k to $750k compared to the "low frequency" scenario (Scenario 1). At Rochester, the improvement is more modest (closer to an improvement of about $400k to $500k).
- The toll plaza that presents the best results in the "high frequency" scenario is Bedford Mainline. Financially speaking, AET at Bedford essentially achieves revenue neutrality in Scenario 3. [17]

In sum, Table 33 demonstrates that, all else being equal, AET feasibility is greatly improved if today's cash-paying customers tend to be very frequent travelers. As noted earlier, this is because it much more cost-effective to collect tolls from a *few* video customers (most of whom travel a lot) than it is to collect tolls from *a lot* of video customers (most of whom travel only a handful a times per year). A detailed look at the cost projections reveals that the cost to process a video transaction in a high-frequency scenario was about *one-third* the cost of processing a video transaction in a low-frequency scenario, all else being equal.

[17] Recall that the Bedford analysis assumes that, in an AET scenario, the plaza would be relocated immediately south of the MAAR interchange, as described in Section 6.1.2. This option is currently prohibited by FHWA due to its compromising toll-free access to the MAAR.0

Table 33 provides the revenue neutrality results for Scenario 4, which is the most optimistic scenario. It assumes a *high* frequency of travel as well as a high level of E-ZPass growth.

Table 34 – Scenario 4 Revenue Neutrality, AET vs. No-Build—High Frequency, High E-ZPass Growth

	Expected Change in Revenue Neutrality (in $thousands)			
Year	***Hampton Side***	***Bedford Mainline***	***Dover***	***Rochester***
2014	-969 to -893	-237 to -120	-982 to -908	-402 to -351
2015	-924 to -850	-148 to -32	-914 to -843	-385 to -336
2016	-886 to -813	-65 to 49	-855 to -788	-359 to -311
2017	-850 to -778	23 to 137	-843 to -775	-340 to -293
2018	-814 to -744	105 to 218	-810 to -743	-322 to -276
2019	-774 to -704	192 to 304	-768 to -703	-305 to -261
2020	-740 to -671	271 to 383	-729 to -665	-289 to -246
2021	-713 to -645	355 to 467	-686 to -623	-275 to -233
2022	-676 to -609	432 to 543	-654 to -607	-262 to -221
2023	-650 to -599	509 to 613	-656 to -614	-251 to -213
2024	-650 to -608	567 to 639	-664 to -621	-241 to -212
2025	-664 to -622	576 to 644	-669 to -626	-249 to -221
2026	-671 to -629	585 to 654	-675 to -632	-257 to -229

The critical observation from Table 34 is this: Even in the most optimistic scenario, all toll plazas (with the exception of Bedford Mainline) are expected to experience a decline in revenue neutrality following conversion to AET. The table presents a range of outcomes for all toll plazas over a 12-year span of time. In all cases, again with the exception of Bedford Mainline, even the upper end of the range is negative.

In short, it is difficult to envision a scenario in which implementing AET by itself would satisfy the requirement for revenue neutrality at any plaza except Bedford Mainline. Implementation would need to be accompanied by some sort of revenue enhancement strategy. This strategy could take one of the following forms:

- Relocating the toll plaza to an area that experiences more traffic that can be tolled in order to increase gross revenue, as is required at Bedford Mainline.
- Increasing E-ZPass penetration, in order to both reduce operating costs and reduce revenue leakage.
- Increasing the rate or fees associated with tolls assessed to video customers
- Increasing toll rates across the board, both for E-ZPass and video customers

8.5.2 Revenue Neutrality – ORT vs. No-Build

The purpose of this study was not only to evaluate the feasibility of converting to AET, but also to compare AET with an alternative conversion. At Bedford Mainline, Dover, and Rochester, the alternative conversion was to Open Road Tolling, or ORT. The Bureau of Turnpikes has already completed two successful ORT conversions at the mainline toll plazas in Hampton (May 2010) and Hooksett (May 2013). One purpose of this study was to evaluate whether such a conversion would be the best modernization option at other toll plazas as well.

As noted in the introduction to Section 6, ORT was *not* considered as a modernization option at Hampton Side, primarily due to geometric constraints. Therefore, the only modernization option considered at Hampton Side was to rehabilitate the existing toll plaza and maintain the current method of conventional fare collection.

Table 35 summarizes the revenue neutrality results for Scenarios 1 and 3, both of which are based on an assumption of low E-ZPass growth. Unlike the AET analysis, the ORT analysis only contains the "expected" value. The variables that were used to model uncertainty did not generate a sufficiently wide range of results to warrant an evaluation of the range of possible outcomes.[18]

Table 35 – Scenario 1&3 Revenue Neutrality, ORT vs. No-Build—*Low E-ZPass Growth*

	Expected Change in Revenue Neutrality (in $thousands)			
Year	***Hampton Side***	***Bedford Mainline***	***Dover***	***Rochester***
2014	Not Applicable	9.3	40.5	45.9
2015		15.9	39.4	47.4
2016		11.4	39.0	50.3
2017		13.5	37.3	49.4
2018		13.8	42.5	50.0
2019		9.3	36.9	51.6
2020		6.3	33.9	53.2
2021		8.3	29.9	55.6
2022		4.3	26.2	56.8
2023		-6.0	22.4	56.7
2024		-4.0	22.0	54.0
2025		-11.5	26.7	51.3
2026		-11.1	27.1	51.7

The bottom-line message of Table 35 is clear: Under the low E-ZPass growth rate scenarios, ORT yields a positive change in revenue neutrality at every toll plaza and in virtually every year. The only exception is at Bedford Mainline, which would be expected to lose roughly $5-$10k per year in 2023-2026.[19] This predicted result is consistent with the experience at Hampton and Hooksett following their conversions to ORT. Although violations made a small uptick, the overall financial picture improved.

Table 36 summarizes the revenue neutrality results for Scenarios 2 and 4, both of which are based on an assumption of high E-ZPass growth.

[18] As noted in Section 8.3, the only variable in the ORT analysis that was assigned a range of values was the year 1 increase in E-ZPass usage. This was assigned a range spanning from 1% to 3%, with an expected value of 2.1%. This range did not cause a large deviation between the 20th percentile outcome and the 80th percentile outcome. While the AET analysis yielded a range spanning $100k or more (even up to $600k in some instances), the range in the ORT analysis typically spanned $10k or less.

[19] In context, this is a negligible number, representing less than 0.1% of gross revenue.

Table 36 – Scenario 2&4 Revenue Neutrality, ORT vs. No-Build—High E-ZPass Growth

	Expected Change in Revenue Neutrality (in $thousands)			
Year	***Hampton Side***	***Bedford Mainline***	***Dover***	***Rochester***
2014	Not Applicable	9.3	40.4	42.1
2015		15.9	39.4	40.6
2016		10.8	39.0	39.2
2017		17.5	41.0	40.1
2018		12.4	41.6	42.0
2019		18.9	43.0	42.3
2020		14.4	37.7	43.0
2021		19.5	43.7	44.3
2022		16.8	37.7	46.2
2023		10.3	28.9	47.2
2024		1.5	26.5	39.6
2025		-8.2	26.8	29.9
2026		-11.0	22.7	24.4

It is readily apparent that the figures in Table 36 are very similar to the figures in Table 35. In other words, the financial feasibility of ORT is **not** closely related to the rate of E-ZPass growth. Whether the E-ZPass market share increases at a fast rate or at a slow rate, ORT generally yields a positive change in revenue neutrality. This positive change is primarily related to the "year 1" jump in E-ZPass usage that is typically effected by an ORT conversion. This jump yields a modest decline in operating costs, since the average cost of processing an E-ZPass transaction (calculated in this study at 10.3¢) is much cheaper than the average cost of processing a cash transaction (24¢ to 34¢, depending on location).

In short, the financial picture following an ORT conversion appears to be better than the financial picture following an AET conversion. This is unambiguously true at Dover and Rochester. At Bedford Mainline, there are some instances (e.g. years 2018-2026 in Scenario 4) in which AET yields a more positive change in revenue neutrality than ORT. However, HNTB believes that Scenario 4, while providing a helpful "upper limit" with respect to trip frequency, is extremely unlikely. Survey results commonly skew toward frequent users, since those are the customers that are most likely to take the time to respond. Therefore, it seems clear that ORT yields less financial risk from a revenue neutrality standpoint.

8.5.3 Net Revenue – ORT vs. AET

When comparing ORT vs. AET, the "revenue neutrality" assessment often favors ORT. This was clearly the case for the four toll plazas under consideration. However, one advantage of AET is its lower capital cost. Because it typically has a narrower footprint and does not require the construction of tollbooths, an AET facility generally costs less than its ORT counterpart. This was illustrated by the costs summarized in Table 16.

Therefore, when comparing AET and ORT, it is often beneficial to make a more comprehensive assessment of costs that considers the implications of *capital* costs as well. The "net revenue" calculation, defined in Section 8.1.2, takes capital costs into account. As described, capital costs are

amortized over 20 years, and under this measurement, those resulting annual costs are added to the O&M costs in the calculations. So all else being equal, a proposed improvement with a lower capital cost will be more feasible (from a net revenue perspective) than a proposed improvement with a higher capital cost.

The charts in this section will compare the net revenue projections under AET with the net revenue projections under ORT. Unlike Section 8.5.1, the tables in this section will not present a *range* of results for AET. Rather, the results contained in this section of the report will focus in the "expected" value. The purpose of focusing on the expected value (as opposed to considering a range of values) is to provide a better comparison with the ORT results. However, when reviewing the results for AET, it is important to keep in mind that the actual AET number could lay $100k or more on either side of the expected value due to variability in the inputs.

Table 37 compares the expected change in net revenue for AET with the expected change for the alternative improvements considered in this study. The table draws from Scenario 1, which assumes a low frequency of travel and a low rate of E-ZPass growth. The alternative that is most favorable from a net revenue perspective is the alternative that has the highest (or least negative) value.

Table 37 – Change in Net Revenue (AET vs. Alternative), Scenario 1 – Low Frequency, Low E-ZPass Growth

	Expected Annual Change in Net Revenue (in $thousands)							
	Hampton Side		Bedford		Dover		Rochester	
Year	*AET*	*Rehab*	*AET*	*ORT*	*AET*	*ORT*	*AET*	*ORT*
2014	-2,139	-48	-1,568	-439	-1,971	-639	-1,213	-791
2015	-2,060	-48	-1,485	-432	-1,867	-640	-1,191	-790
2016	-2,004	-48	-1,425	-438	-1,794	-641	-1,162	-789
2017	-1,966	-48	-1,380	-435	-1,814	-643	-1,146	-788
2018	-1,947	-48	-1,346	-435	-1,807	-637	-1,137	-787
2019	-1,925	-48	-1,308	-440	-1,803	-642	-1,129	-785
2020	-1,937	-48	-1,275	-442	-1,819	-646	-1,122	-784
2021	-1,957	-48	-1,235	-440	-1,835	-650	-1,116	-781
2022	-1,975	-48	-1,230	-444	-1,850	-654	-1,110	-780
2023	-1,993	-48	-1,252	-455	-1,866	-658	-1,105	-779
2024	-2,009	-48	-1,267	-453	-1,879	-658	-1,100	-783
2025	-2,024	-48	-1,288	-460	-1,886	-653	-1,101	-786
2026	-2,033	-48	-1,306	-460	-1,892	-653	-1,106	-786

The following observations may be drawn from Table 37:

- All of the net revenue figures are negative. This is because the figures represent a change in net revenue *compared to the "No-Build" condition*. The only capital costs associated with the "No-Build" condition are the rehab costs, which are roughly 60-80% lower than the capital costs

associated with either ORT or AET. Therefore, the "improved" condition will always include an annualized capital cost that is considerably higher than the annualized capital cost carried by the "No-Build" condition. As a result, the "improved" condition will always have less net revenue than "No-Build," all else being equal.

- At every facility, in every year, the alternative improvement (i.e. rehab at Hampton Side and ORT at Bedford, Dover, and Rochester) performs better than AET in terms of minimizing the loss in net revenue.
- The difference is most apparent at Hampton Side. Under AET, the expected loss of net revenue is about $2M. The rehab, on the other hand, is only expected to lose about $48k per year, which simply represents the annualized cost of the rehabilitation itself.
- The facility with the smallest net revenue gap is Rochester. That facility is expected to have a net revenue gap of about $1.1M under AET and about $0.8M under ORT.

In short, all improvements cost money to implement and will therefore yield a negative change in net revenue. However, the non-AET improvements do not introduce significant losses from revenue leakage. As a result, they all have a much lower loss in net revenue compared to the AET alternatives. Therefore it can be said that in Scenario 1, the capital cost savings of AET do not provide enough financial benefit to overcome the impact of revenue leakage of AET.

Table 38 compares the expected change in net revenue associated with Scenario 2, which assumes a low frequency of travel and a *high* rate of E-ZPass growth.

Table 38 – Change in Net Revenue (AET vs. Alternative), Scenario 2 – Low Frequency, High E-ZPass Growth

	Expected Annual Change in Net Revenue (in $thousands)							
	Hampton Side		Bedford		Dover		Rochester	
Year	*AET*	*Rehab*	*AET*	*ORT*	*AET*	*ORT*	*AET*	*ORT*
2014	-2,159	-48	-1,550	-472	-1,973	-647	-1,206	-802
2015	-2,087	-48	-1,432	-466	-1,856	-648	-1,170	-804
2016	-2,022	-48	-1,321	-471	-1,758	-648	-1,122	-805
2017	-1,959	-48	-1,206	-464	-1,740	-645	-1,083	-806
2018	-1,898	-48	-1,096	-469	-1,683	-644	-1,045	-802
2019	-1,832	-48	-981	-462	-1,613	-644	-1,010	-802
2020	-1,774	-48	-874	-468	-1,547	-649	-977	-801
2021	-1,724	-48	-763	-461	-1,477	-643	-947	-800
2022	-1,665	-48	-661	-460	-1,417	-650	-920	-798
2023	-1,615	-48	-559	-470	-1,430	-659	-896	-796
2024	-1,625	-48	-488	-480	-1,442	-661	-879	-805
2025	-1,645	-48	-503	-490	-1,450	-661	-893	-815
2026	-1,656	-48	-505	-493	-1,459	-665	-903	-820

A review of Table 38 illustrates the following:

- The results of Scenario 2 are not much different from the results of Scenario 1. In almost every instance, the net revenue loss under AET is greater than the net revenue loss under the alternative improvement. This is especially true at Dover and at Hampton Side, where the net revenue loss under AET is **at least** $800k per year greater than the net revenue loss associated with the alternative improvement.
- In general, the loss in net revenue associated with AET declines over time, while the loss associated with ORT holds steady. This suggests that the financial feasibility of AET is closely related to high and growing levels of E-ZPass usage.
- As E-ZPass usage grows, the gap between AET and the alternative improvement shrinks. For example, look at the results for **2026** at **Dover**:
    - In Scenario 1, the AET alternative had a net revenue loss of $1.9 million, compared to a loss of roughly $0.7 million under ORT. The "gap" between AET and ORT was therefore about $1.2 million.
    - However, in Scenario 2, the net revenue loss in 2026 under AET ($1.5M) was closer to the net revenue loss under ORT ($0.7M).
    - Therefore, the Dover "gap" between AET and ORT in 2026 was $0.8M under Scenario 2, compared to $1.2M under Scenario 1.

In short, Scenario 2 illustrates that, as E-ZPass usage grows, the net revenue gap between AET and ORT narrows. However, with the exception of the Bedford Mainline plaza, the gap doesn't shrink to the point that AET performs consistently better from a financial perspective.

Table 39 compares the change in net revenue associated with Scenario 3, which assumes a high frequency of travel and low levels of E-ZPass growth. Keep in mind that the "high frequency" assumption is a true upper limit of trip frequency derived from the on-line survey (see Section 4.3). HNTB believes these results overstate the actual trip frequency, given that surveys tend to appeal to more frequent travelers. However, the results are useful for putting boundaries on the potential outcomes.

Table 39 – Change in Net Revenue (AET vs. Alternative), Scenario 3 – High Frequency, Low E-ZPass Growth

	Expected Annual Change in Net Revenue (in $thousands)							
	Hampton Side		Bedford		Dover		Rochester	
Year	*AET*	*Rehab*	*AET*	*ORT*	*AET*	*ORT*	*AET*	*ORT*
2014	-1,388	-48	-547	-472	-1,244	-647	-718	-798
2015	-1,340	-48	-480	-466	-1,185	-648	-708	-797
2016	-1,308	-48	-432	-471	-1,143	-648	-691	-796
2017	-1,286	-48	-390	-468	-1,153	-650	-684	-795
2018	-1,276	-48	-358	-468	-1,147	-644	-680	-794
2019	-1,261	-48	-324	-473	-1,147	-649	-676	-793
2020	-1,269	-48	-293	-475	-1,158	-653	-673	-791
2021	-1,283	-48	-255	-473	-1,170	-658	-670	-789
2022	-1,295	-48	-241	-478	-1,181	-661	-667	-787
2023	-1,307	-48	-247	-488	-1,192	-665	-665	-786
2024	-1,317	-48	-246	-486	-1,199	-665	-663	-791
2025	-1,325	-48	-251	-493	-1,202	-661	-663	-794
2026	-1,329	-48	-252	-493	-1,203	-660	-666	-793

Two key observations may be drawn from Table 39:

- The net revenue picture for Hampton Side and Dover is the same as for the other scenarios: The alternative (non-AET) improvement is consistently better from a financial perspective.
- At Rochester, the change in net revenue for AET is consistently about $100k better (i.e. less negative) under AET as compared to ORT. What the change in net revenue under ORT is roughly -$800k, the change in net revenue under AET is in the vicinity of -$700k.
- At Bedford, AET's change in net revenue is significantly *better* than the change projected for ORT. On the surface, it appears that AET would be the best option at Bedford under Scenario 3. Keep in mind, however, that this assumes that the Bedford Mainline toll plaza could be relocated under AET; the new location would yield a 13% increase in traffic volumes compared to the existing location. [20] If this relocation were not permitted, then it is likely that ORT would still be the better option. [21]

In short, even with a low rate of E-ZPass growth, we find that AET becomes feasible (compared to the alternative improvement) at two locations if video customers truly demonstrate a high frequency of travel. The big question is: How reliable are the frequency-related results from the on-line survey?

[20] Please see the discussion in Section 6.1 regarding the difficulties associated relocating the Bedford Mainline plaza.

[21] A separate analysis by HNTB indicated that, if the AET plaza at Bedford were to be kept at the same location as the existing plaza (rather than being relocated to the south of the interchange), then the expected change in net revenue would be approximately $1.5 million per year *lower* than projected in this report.

The last scenario evaluated by HNTB was Scenario 4, which assumed both a high frequency of travel and high rates of E-ZPass growth. The results from a net revenue perspective are summarized in Table 40.

Table 40 – Change in Net Revenue (AET vs. Alternative), Scenario 4 – High Frequency, High E-ZPass Growth

	Expected Annual Change in Net Revenue (in $thousands)							
	Hampton Side		Bedford		Dover		Rochester	
Year	*AET*	*Rehab*	*AET*	*ORT*	*AET*	*ORT*	*AET*	*ORT*
2014	-1,399	-48	-535	-472	-1,245	-647	-714	-802
2015	-1,355	-48	-446	-466	-1,179	-648	-698	-804
2016	-1,318	-48	-364	-471	-1,122	-648	-673	-805
2017	-1,282	-48	-276	-464	-1,109	-645	-654	-806
2018	-1,247	-48	-195	-469	-1,076	-644	-637	-802
2019	-1,207	-48	-109	-462	-1,036	-644	-620	-802
2020	-1,174	-48	-30	-468	-998	-649	-605	-801
2021	-1,147	-48	54	-461	-955	-643	-591	-800
2022	-1,111	-48	131	-460	-920	-650	-579	-798
2023	-1,082	-48	208	-470	-931	-659	-568	-796
2024	-1,092	-48	264	-480	-939	-661	-558	-805
2025	-1,107	-48	260	-490	-944	-661	-570	-815
2026	-1,114	-48	270	-493	-950	-665	-578	-820

The results for Scenario 4 are similar to the results for Scenario 3. If we assume a high frequency of travel and a high rate of E-ZPass growth, then the net revenue comparison reveals the following:

- **Hampton Side** – The rehab option performs much better than AET
- **Bedford Mainline** – The AET option yields positive net revenue for most of the years, which is much better than the net revenue performance under ORT
- **Dover** – ORT performs slightly better than AET
- **Rochester** – The net revenue loss under AET is slightly less than the net revenue loss under ORT.

8.5.4 Summary of AET Feasibility Calculations

This section has presented numerous tables that address various aspects of AET financial feasibility. The key conclusions that may be drawn from this analysis are summarized below:

- Section 8.5.1 provided a comprehensive "revenue neutrality" assessment for AET. This assessment evaluated the impact of a particular improvement on net *operating* revenue, excluding capital costs. This study defined net operating revenue as gross revenue less the costs associated with all aspects of revenue collection. An alternative is considered to have achieved "revenue neutrality" if the net operating revenue of the proposed improvement is greater than or equal to the net operating revenue under existing conditions.

- Scenario 1, which assumed a low frequency of travel and a low rate of E-ZPass growth, was the most conservative scenario from a financial perspective. Under this scenario, all four toll plazas—Hampton Side, Bedford Mainline, Dover, and Rochester—were shown to *not* achieve revenue neutrality under AET at any point between 2014 and 2026. Rochester showed the least decline in net operating revenue under AET, while Hampton Side showed the greatest decline.
- Scenario 2 assumed a low frequency of travel and a high rate of E-ZPass growth. The revenue neutrality assessment for this scenario showed that as E-ZPass usage grows, the forecasted decline in net operating revenue diminishes. However, under the assumption of a low frequency of travel, *E-ZPass growth alone is not sufficient to make AET financially feasible*.
- Scenarios 3 and 4 both assumed a high frequency of travel. Scenario 3 assumed a low rate of E-ZPass growth, while Scenario 4 assumed a high rate of E-ZPass growth. In both scenarios, the Bedford Mainline toll plaza achieved revenue neutrality. The other three toll plazas, even in the most optimistic model runs, all predicted a loss in net operating revenue under AET.

- Section 8.5.2 provided a comprehensive "revenue neutrality" assessment for ORT. At all toll plazas, during all of the years (2014-2026), the conversion to ORT achieved revenue neutrality. The modest jump in E-ZPass usage following the conversion to ORT is sufficient to lower operating costs and thereby provide a slight bump in net operating revenue.

- A comparison of Sections 8.5.1 and 8.5.2 suggests that ORT is a preferred option from a revenue neutrality perspective. While AET is expected to yield a loss in net operating revenue in all but the most optimistic scenarios, ORT is expected to yield a slight increase in net operating revenue. This is consistent with NHDOT's experience in implementing ORT at both the Hampton Mainline and the Hooksett Mainline toll plazas.

- Section 8.5.3 provided a "net revenue" comparison of AET versus an alternative improvement. For the Hampton Side toll plaza, the alternative improvement was a rehabilitation of the existing toll plaza. For the other three toll facilities, the alternative improvement was ORT at the existing location. This comparison looked at net operating revenue (less rehabilitation costs) under existing conditions and compared it to net operating revenue (less capital costs) under the "improvement" alternative. The primary purpose of this analysis was to evaluate whether the lower capital costs under AET would offset the losses in net operating revenue in order to make AET more attractive compared to ORT.
  - Under Scenarios 1 and 2, both of which assumed a low frequency of travel, the change in net revenue under ORT was significantly better than the change in net revenue under AET. This was true at all toll plazas throughout the study period (2014-2026).
  - Under Scenarios 3 and 4, both of which assumed a *high* frequency of travel, the results were mixed. Hampton Side and Dover benefited more from the alternative improvement, while Bedford Mainline and Rochester performed similarly (from a net revenue perspective) under both AET and ORT.

To summarize the results by toll plaza:

- At **Hampton Side**, the results are clear. From a financial feasibility perspective, the option of rehabilitating the existing toll plaza is superior to converting to AET. The construction costs are lower and the revenue leakage is also lower. There is no scenario in which AET appears to be preferable. Depending on the year and on the assumptions used, a net operating revenue loss of between $0.5 million and $2.0 million per year would be expected.
- At **Bedford Mainline**, the results are more ambiguous. If video customers at this location exhibit a low frequency of travel, then AET is clearly not feasible. But if video customers demonstrate a high frequency of travel, then its financial performance is comparable to ORT. However, these results are contingent on the ability of NHDOT to place an AET structure south of the existing interchange—a location that would immediately boost overall traffic volumes by over 12%. If NHDOT is unable to relocate the Bedford Mainline plaza under AET—and current guidance from FHWA suggests that such a relocation is unlikely—then it would not achieve financial feasibility in any scenario.
- At **Dover**, the results also clearly suggest that ORT is the preferred option. Even under the most optimistic scenario, net operating revenue under AET is expected to decline by $0.5 to $1.0 million.
- At **Rochester**, as at the Bedford Mainline toll plaza, the results are somewhat ambiguous. In terms of the net revenue test, ORT is better than AET in the scenarios that assume a low frequency of travel. However, the results are comparable in the scenarios that assume a high frequency of travel.

In sum, from a financial perspective, it appears clear that if the Bureau of Turnpikes wishes to modernize its toll plazas, it should move forward with ORT at Dover and with rehabilitation at Hampton Side. As for the other two toll plazas at Bedford and Rochester, ORT is a fairly risk-free proposition financially. But if the Bureau wishes to advance with AET at these locations, it should perform more detailed studies regarding the frequency of travel of today's cash customers. Only if these customers are truly frequent travelers (making about 6 round trips per month on average) will AET be financially feasible.

Section 9. Rank Order and Assessment

Based on the detailed financial analysis detailed in Section 8, HNTB developed a rank order of the toll facilities in terms of their feasibility for conversion to AET. The ordering, along with a brief explanation of the rating, is summarized in Table 41.

Table 41 – Rank Order Summary for AET Feasibility

Rank	Plaza	Rating	Rationale
1	Rochester	Caution	• Performs slightly better than ORT in the "high frequency" scenarios • Has the least cash revenue at risk. Possible annual net revenue losses are $1M or less in the most pessimistic scenarios.
2	Bedford Mainline	Caution	• Yields positive net revenue and out-performs ORT financially under two conditions: (a) if the plaza is relocated south of the existing interchange, and (b) if video customers demonstrate a high frequency of travel. • If these conditions do not prevail, net revenue loss would likely exceed $1M annually
3	Dover	Poor	• Yields an annual loss of net operating revenue of $600k to $1.8M, depending on the scenario and on the year. • ORT performs much better financially than AET in all years, in all scenarios.
4	Hampton Side	Poor	• Yields the greatest loss of net revenue of all four toll plazas. • This plaza provides no opportunity to save on capital costs. The alternative improvement (plaza rehabilitation) is far less expensive than installing AET.

This rank ordering is similar to the preliminary ranking presented in Section 7.7. As in the preliminary ranking, Rochester ranks ahead of Dover, which in term ranks ahead of Hampton Side. The only outlier is Bedford Mainline, which rose from a preliminary ranking of 4 to a final ranking of 2. The reason for the change is that the Bedford Mainline assessment accounted for a proposed change in toll plaza location. The change in location increased traffic volumes by over 12% in the AET alternative; as a result, its performance improved relative to existing conditions with lower traffic volumes. But as noted earlier in the report, there appears to be little probability of obtaining approval from FHWA to relocate the Bedford plaza just south of the Manchester Airport Access Rd.

Section 10. Qualitative Assessment of AET

The previous section focused on providing a quantitative assessment of the feasibility of implementing AET at selected toll plazas on the New Hampshire Turnpike. However, there are other considerations related to AET that are not as easily quantified but are nonetheless important. This section will review some of these more qualitative considerations. The discussion will be general in nature. A separate, more detailed analysis would be required to assess how these various qualitative considerations apply specifically to each of the four selected toll plazas. In some cases the ability to communicate and quantify these types of factors has been a key consideration for other agency AET conversions where toll rate or fee increases were required to balance the projects financially.

10.1 Congestion Relief

For some toll agencies, a compelling reason to implement AET is to relieve traffic congestion. If a particular toll barrier routinely exceeds its capacity and experiences lengthy queues during peak periods and the plaza cannot be physically or cost effectively converted to ORT, then AET can effectively completely remove the toll plaza as a source of congestion.

HNTB performed an initial review of traffic data and toll plaza capacity at each of the four selected locations. This review indicated the following:

- **Hampton Side** – The toll plaza currently operates with 4 lanes in each direction. This is sufficient for virtually all time periods. The only exception is Friday afternoon, in the exiting direction during the summer months (July and August). During these times an additional cash lane would be helpful to reduce congestion, although the Bureau of Turnpikes does not indicate that there is any significant congestion at this location. Moreover, as E-ZPass usage grows, the need for an additional cash lane diminishes each year.
- **Bedford Mainline** – The toll plaza typically operates with 6 lanes in each direction. A preliminary traffic analysis indicates that 5 lanes in each direction would be sufficient to meet the peak-period demand for the next 12 years. So this toll plaza would not likely benefit from congestion relief in the form of AET.
- **Dover** – Like the Hampton Side, this plaza currently operates with 4 lanes in each direction. And again like the Hampton Side, this toll plaza experiences some small windows of time in which it could potentially benefit from an additional cash lane. Those time periods are summer Friday afternoons in the NB direction and summer Sundays (during the mid-day hours) in the SB direction. However, peak-hour cash volumes continue to decline over time due to the growth in E-ZPass market share. So this briefly-felt need for an additional lane will not last for long. As at the Hampton Side, the Bureau of Turnpikes does not indicate that summer congestion is a significant problem at Dover.
- **Rochester** – This toll plaza currently operates with 3 lanes in each direction. A preliminary traffic analysis indicates that this is adequate to handle peak period traffic for the next 12 years. So, like the Bedford Mainline, this toll plaza would likely not benefit from congestion relief in the form of AET.

In short, AET could potentially provide some congestion relief during fairly narrow windows of time (on summer weekends) at two of the toll plazas (Hampton Side and Dover). The big question is: Would this improvement *alone* be worth the financial risk? Given the likelihood that congestion will actually diminish over time at these toll plazas, the answer is most likely "no." But congestion relief would be a corollary benefit if AET were selected at these locations for other, more compelling reasons.

10.2 Environmental Considerations

The implementation of AET brings a host of environmental considerations that should be considered by the Bureau of Turnpikes when determining how best to modernize. This section will identify some of these considerations and discuss them in general terms.

10.2.1 Vehicle Emissions

Vehicles have four fundamental emissions as they travel down the road and through a toll plaza: exhaust, noise, fluids, and dust. These emissions are discussed in detail below.

Exhaust. Vehicles powered by internal combustion engines emit various chemical compounds. The degree to which each is harmful, and the areas of the environment each affects, continues to be studied by the scientific community.

The amount of each chemical compound emitted varies widely among the many variables associated with behaviors such as accelerating, moving through stop-and-go traffic, idling, and operating at "constant speed." The amount of each chemical compound emitted also varies widely between the different vehicle types. A detailed study of each tolling point would be required to somewhat quantify vehicle emissions during different day parts and seasons.

At New Hampshire Turnpike facilities today, customers paying cash must practically stop each time they approach a tolling point. When queues develop, cash-paying vehicles often idle and move toward the tolling point in stop-and-go traffic. After toll processing is completed, these vehicles then accelerate back to the speed of the ramp or adjoining roadway. When these cash queues get long enough, all (cash and non-cash) vehicles have to proceed through stop-and-go traffic and then accelerate after the tolling point.

In general, the negative environmental impact of vehicle exhaust from stopping, queuing up due to cash payment, and then accelerating would be reduced when vehicles pay a toll via an AET facility.

Noise. Vehicles produce noise at various frequencies and volumes under different conditions. These attributes also vary with vehicle type. The degree to which specific noises impact the quality of life and the degree to which they are harmful have been studied extensively.

Vehicles completely stopping and idling or queuing up in stop-and-go traffic to pay cash produce certain frequencies and volumes of noise. The noise from these vehicles is generally reduced when vehicles pay toll on an AET facility.

Leaking Fluids. Vehicles leak fluids that are harmful to the environment and include (but are not limited to) fuel, motor oil, transmission fluid, anti-freeze, brake fluid and gear oil. At New Hampshire Turnpike facilities today, customers paying cash must practically stop each time they approach a tolling point. When queues develop, cash-paying vehicles idle and move toward the tolling point through stop-and-go traffic. In general, this significantly concentrates leaking fluids in the toll plaza area, and it also increases the total volume of leaked fluid.

Any additional vehicle collisions occurring due to toll collection layout and traffic will further increase the volume and concentration of leaked fluids in this area. In this way, safety and fluid emissions are related.

Leaking fluids impact groundwater and storm water runoff (detailed further in Section 10.2.4 below). With even moderate accumulations, they can negatively impact safety by markedly reducing the stopping and turning capabilities of all vehicles traversing the leaked fluid. Leaked fluids can reach a concentration level where the pavement beneath them is considered toxic waste, greatly increasing the cost of maintaining and refurbishing the tolling point.

Converting to an AET facility would reduce the concentration and total volume of those fluids. In general, the amount of these fluids would be approximately the same as that of the remainder of the facility where free-flow traffic exists.

Brake and clutch particulates / "dust." Vehicles emit "brake dust." Vehicles equipped with certain types of transmissions (e.g. manual transmissions) additionally emit "clutch dust". This dust formerly consisted mostly of asbestos. Newer materials have replaced asbestos in most vehicles, but particulates of these new materials are still released as dust during stopping and, for certain vehicles, acceleration.

Cash-paying customers increase the volume and concentration of "brake dust" and "clutch dust" particulates at the tolling point and surrounding areas. While the long-term negative health effects of asbestos appear to be well understood, the long-term environmental effects of these new types of "brake dust" and "clutch dust" particulates are unknown. The amount of vehicle braking and acceleration caused by cash collection, and the associated volumes and concentration of brake and clutch dust particulates, would likely be reduced by converting to AET.

10.2.2 Consumption of Fossil Fuels

Practically all vehicles now using the New Hampshire Turnpike are powered, directly or indirectly, by fossil fuels. Variations in fuel consumption result from the same causes that alter a vehicle's emissions, as detailed in Section 10.2.1 above. A detailed study of each tolling point would be required to somewhat quantify the fuel consumption of each tolling configuration during different parts of the day and seasons.

In general, fuel consumption of a vehicle stopping and queuing up to pay cash is believed to be higher than that of vehicles paying tolls in an AET configuration. Therefore, it is assumed that vehicles paying tolls in an AET environment would maintain their speed of around 70 mph resulting in greater fuel efficiency.

10.2.3 Work Environment

Workers involved in cash toll collection at the existing Bureau of Turnpikes toll plazas have safety training and procedures as well as significant infrastructure elements at the toll plazas to promote their safety. While these elements exist, these workers are still faced with a greater exposure to potential risks than the equivalent staff functioning in an AET operation collecting tolls as part of offsite customer service operation. For these reasons, AET is viewed as benefit to reducing risks in the work environment, even in the case of state-of-the-practice cash collection operations with reasonable safety records.

10.2.4 Toll Plaza Footprint

The conversion from conventional toll collection to AET can have a significant impact on the physical layout of the toll facility. Some of the implications of this layout change are discussed below.

Physical space requirements. With its lane throughput higher than that of cash collection, AET requires fewer travel lanes to sustain the same traffic service levels. Simply put, AET toll points require significantly less space and land impact that ORT or traditional cash plazas. This reduction will result in

lanes that will no longer be necessary for traffic throughput. The Bureau of Turnpikes may decide to leave the pavement in place on the toll plaza building side to ensure that authorized personnel still have access to the facility. The remaining canopy structure that spans the roadway can be:

1. De-commissioned and left in place and new gantry structures constructed to attach toll equipment.
2. Modified and utilized to attach new toll equipment necessary for AET
3. De-commissioned and demolished with gantry structures put in their place

With the second and third options the toll plaza size would be greatly reduced.

Energy consumption. Energy consumed by an AET toll collection *system* is typically comparable to that consumed by a toll collection system processing cash transactions. However, there would be substantial energy consumption reduction associated with the facilities required to *support* staff for cash toll collection, such as electricity, heating and cooling for toll booths and staff support areas such as offices, break rooms and rest rooms. By removing the toll booths and not requiring toll collection staff in the plaza building, the utility consumption will be reduced. Even if the toll plaza building remains to support AET, the facility will require far less utility service.

Storm water. Toll facilities utilizing AET operate with fewer lanes than cash collection (due to higher per lane throughput) require no additional paved roadway areas leading up to and immediately after the tolling point. This reduction in use of paved roadway area can occur immediately after AET is put into operation. Alternatively, it can occur over time (as part of the maintenance program for toll plaza roadway pavement) to reduce negative impacts to storm water quality. Because vehicles are no longer stopping on paved areas, fewer impacts due to leaking fluids or similar emissions would be expected. Furthermore, the area of pavement where any water quality impacts from customer vehicles is reduced, resulting in fewer single points for pollution. Smaller utilized pavement areas will also require less snow and ice control. So where applicable, the use of sand, salt or chemical solutions will be reduced also. The run-off reduction under AET assumes that the unused pavement from the cash plaza will be removed and restored in some way to reduce run-off (such as re-vegetation of the site).

AET also typically requires less floor space and less associated parking than the plaza administration buildings and parking lots that currently support many toll plazas collecting cash. Eventually reducing the size of, or eliminating, the floor space and parking at each tolling point could further reduce storm water runoff.

Visual clutter. With higher per-lane throughput, AET can provide the same traffic service levels with no toll plaza lanes, reducing visual clutter wherever construction of additional toll lanes can be avoided and wherever demolition of surplus toll lanes is practical.

Light pollution. In general, AET can be deployed and operated to produce far less light pollution than alternatives that maintain cash fare collection.

10.3 Legislative Considerations

This section discusses the legislative considerations associated with AET. It is intended to provide a broad framework and starting point for understanding of legislative issues, options and requirements under AET. Based on an initial layman's (non-legal) review of Title XX-Transportation, Chapter 237-Turnpike System of the New Hampshire state statutes and applying what is already in place with the Bureau of Turnpikes for violation enforcement, the following key considerations have been identified.

- **Legislative approval.** In the above referenced New Hampshire state statute Section 237-7 (I-a) states "The department shall not proceed with the installation of all electronic tolling without prior legislative approval."

- **Process and other state entity impacts.** Currently, the Bureau of Turnpikes obtains vehicle owner information data from Motor Vehicle Departments (DMV) in eight states (New Hampshire, Maine, Massachusetts, Vermont, Connecticut, Rhode Island, New York, and New Jersey) in order to send toll violation notices. Because of the increase in the volume of requests that would follow AET implementation, it may be advantageous to coordinate with the appropriate motor vehicle departments in any proposed AET legislation.

- **Current reciprocity with other states.** Currently New Hampshire has reciprocity agreements with Maine and Massachusetts for enforcement of toll violations. In those agreements, the states agree to share registered owner information of vehicles that pass through a tolling point without paying, as described in Section 4.2. Moreover, New Hampshire State Law (RSA 237:16-c) grants broad authority to the Commission of the New Hampshire DOT to enter into reciprocal agreements with other states. The statute explicitly states: "The departments of transportation and safety may release driver's and owner's information to other jurisdictions relative to enforcement or collection of tolls and may take such other action as is necessary to effectuate the reciprocal enforcement agreements." Thus, current statutes appear to be sufficiently broad to support the exchange of information needed to collect outstanding tolls. It is not necessary for a driver to be considered a "violator" before registration information can be exchanged.

- **Coordination with existing law enforcement.** Currently law enforcement and public safety services on the New Hampshire Turnpike system are provided by the Department of Safety, Division of the State Police. Coordination between the Bureau of Turnpikes and the state police will need to occur for enforcement of toll violations. If state police today can issue a toll violation if they witness a vehicle pass through a tolling point without paying, then that process will need to change. Under AET they may be utilized to only monitor for habitual violators.

- **Privacy considerations.** The current statute addresses confidentiality of registered owner information. This may be an area that will need to be addressed because now there will be limitations on the ability of a toll customer to remain anonymous. This has proven to be an area of concern in other parts of the country where AET has been implemented.

The Bureau of Turnpikes has been proactive in the development of products that can allow customers to drive on the New Hampshire Turnpike near-anonymously, neither using a transponder nor paying at the tollbooth. Two of these products are described below:[22]

- *Prepaid video*. Drivers who do not have an E-ZPass can make payment in advance of the trip. The driver must go on-line and establish a "Prepay" account. This account, which must have a minimum initial balance of $1.00 that is tied to a method of payment (i.e. debit or credit card), will be linked to one or more license plates registered by the owner. The prepaid balance will be reduced as the driver's license plate is observed going through the plaza.
- *Postpaid video*. This product is for drivers who have passed through a New Hampshire toll plaza without an E-ZPass and without paying cash. These drivers have a 7-day period to go on-line and submit payment to cover the tolls, without being required to pay an administrative fee. The driver must simply identify the plaza that was used, the approximate time at which it was used, and the license plate number of the vehicle that was driven. Again, payment must be tied to a debit or credit card. Once paid, a record of the transaction is deleted within 30 days, thus helping preserve anonymity.

10.4 Bond Resolution Considerations

A toll authority's ability to reliably repay loans from its bond holders, and pay interest on those loans, will determine the amount of risk in the toll authority's bonds (i.e. debt). This risk level, in turn, practically determines what interest rate the borrower (i.e. the toll authority) must pay in order for the bond holders (i.e. the lenders) to put their money at risk by funding the toll authority.

Under AET, a vehicle without a pre-paid tolling account incurs charges when it travels through the tolling point. The toll authority effectively extends credit to the vehicle registrant, without any guarantee or security, until those charges are paid. Vehicle registrants that do not pay after a specified period of time are deemed toll violators and collection is pursued through violations enforcement practices. Charges that are not collected through the violations enforcement practices are eventually written off as bad debt.

The cash flow under AET is very different from traditional cash lane operations and pre-paid or similarly secured E-ZPass accounts. There is typically a 30-90 delay in collecting payment on toll transactions that have been invoiced under AET. This delay can be shorter or longer depending on the effectiveness of the agency's invoicing/collection process. Over the course of time the cash flow stream will stabilize and become more predictable. Even after cash flow, stabilizes overall revenue collection will likely be decreased due to revenue leakage.

These cash flow changes will show up on the toll authority's income, cash flow and balance sheet statements with the transition to AET. The change in financial position will need to be explained and thoroughly discussed with rating agencies and investors in advance to assure them that the agency recognizes and has addressed this additional risk. If the bond rating agencies are not sufficiently satisfied

[22] A complete description is provided on-line at http://www.ezpassnh.com/en/prepay/prepay.shtml.

that the risk has been mitigated, it is possible that agency's bond ratings could be lowered. This in turn would constrain the agency's ability to issue new debt or to refinance debt at reasonable rates.

When toll agencies issue debt, they enter into an agreement with bondholders that they will be fiscally prudent to ensure that the bondholder is repaid as promised. Those bond agreements (resolutions) typically place restrictions or provide parameters within which the toll agency must operate. It is advised that the Authority's bond counsel review and advise the Bureau of Turnpikes on the specifics of their bond resolution. The following sections describe some things that should be evaluated when reviewing the bond resolution to make the conversion the AET.

10.4.1 Payment of Bonds

The "Debt Service Coverage Ratio" is commonly calculated and used to prove the toll agency's ability to meet its financial obligations both operationally and to bond holders. In simple terms, the ratio is calculated by first subtracting operating expenses from operating revenue, and then dividing the result by the debt service payment that is due during that fiscal year. Typically the covenant requires that the coverage ratio be some percentage greater than 1x the debt service amount (i.e. 120% is greater than the required 100%).

In reviewing the bond resolution for the Bureau of Turnpikes initially approved November 9, 1987 (and most recently amended August 12, 1992), the "Net Revenue Requirement" defines the required coverage ratio. The "Net Revenue Requirement" for each Fiscal Year (or other period) is an amount equal to the greater of: (a) 120% of Debt Service; or (b) 100% of Debt Service plus the total amount of principal and interest on all general obligation or other bonds, notes or other evidences of indebtedness payable from Revenues during the Fiscal Year or other period and the additional amount, if any, required to be paid from the General Reserve Account to satisfy the Renewal and Replacement for the Fiscal Year or other period.

10.4.2 Revenue Neutrality

Bond agreements typically require a toll authority to maintain their current coverage ratio by requiring "Revenue Neutrality" in its operation. In some cases the bond resolution requires that if toll revenues will be negatively impacted by a certain percentage, then an independent study must be performed to prove that the toll agency will continue to meet the minimum DSCR now and in the future. At a very high level, revenue neutrality constraints typically require that:

- Any overall cost increase be accompanied by an increase in toll revenues or other revenues, and
- Any shortfall in revenue must be remedied by a toll increase, other means of generating revenues and/or reducing operating costs.

Other agencies who have deployed AET have established sufficient proof to satisfy both ratings agencies and lenders that the toll authority will maintain a coverage ratio that is acceptable and revenue neutral. These other toll agencies achieved this by establishing a prudent and comprehensive risk mitigation strategy, often in the form of an acceptable revenue assurance plan, to maintain an acceptable coverage ratio in all reasonable scenarios.

Explicit constraints regarding the revenue neutrality were not found in a cursory, layman's review of the existing bond agreement for the Bureau of Turnpikes.

10.4.3 No Free Passage

Bond agreements sometimes prohibit the toll authority from granting free passage to anyone. In some cases there is specific guidance to the Authority allowing vehicles associated with specific agencies or procedures with which the governing body of the agency must follow to authorize free passage. Some have interpreted to mean that billing someone for tolls after the fact is equivalent to authorizing "free passage."

Specific language was found in a cursory, layman's review of existing bond agreement (section 4.10) for the Bureau of Turnpikes. It appears that free passage is authorized to vehicles as defined by state law and policies of the Department of Transportation, at the time the resolution was approved. In addition, it requires any delinquent account be dealt with using all remedies permitted by law.

10.4.4 Extension of Credit

Prior to AET, toll agencies could operate without extending credit to their users by accepting toll payments in cash, via a pre-paid account or via a secured post-paid account. Implementation of AET, from a practical standpoint, results in many unsecured post-paid accounts.

Explicit constraints regarding the Extension of Credit were not found in a cursory, layman's review of New Hampshire Turnpike's existing bond agreement.

10.5 Privacy Considerations

The Bureau of Turnpikes will need to consider the *privacy protection* that will be afforded to video customers. For example, how would the BOT respond if a newspaper were to submit a Freedom of Information Act request for all license plates that were recorded at the Dover toll plaza between 3:30pm and 4:30pm on a particular day? Would video customers' privacy be protected in this instance?

The issue is clouded somewhat by the change in the way "violator" is defined when converting to AET. While customers that are in good standing have an expectation of privacy, violators typically do not have such an expectation.

- In the existing situation, violators are identified immediately. If a vehicle passes through the tolling point without paying a toll, then that vehicle is considered to be a violator.
- Under AET, however, all vehicles are considered "customers." A person does not become a violator until he has failed to respond to payment notices distributed in the mail.

Thus, under AET, it takes time—perhaps as long as 2-3 months—for an individual to be classified as a violator. This lag in time could have implications for privacy rights.

The State of New Hampshire has a history of defending the privacy rights of the traveling public. This is encoded in state law under RSA 237:16-e, which is reproduced below:

> **237:16-e: Confidentiality of Records. –** Notwithstanding RSA 91-A or any other provision of law, all information received by the department that could serve to identify vehicles, vehicle owners, vehicle occupants, or account holders in any electronic toll collection system in use in this state shall be for the exclusive use of the department for the sole purpose of administering the electronic toll collection system, and shall not be open to any other organization or person, nor be used in any court in any action or proceeding, unless the action or proceeding relates to the imposition of or indemnification for liability pursuant to this subdivision. The department may make such information available to another organization or person in the course of its administrative duties, only on the condition that the organization or person receiving such information is subject to the limitations set forth in this section. For the purposes of this section, administration or administrative duties shall not include marketing, soliciting existing account holders to participate in additional services, taking polls, or engaging in other similar activities for any purpose.

In other words, the State of New Hampshire has made it clear that all records pertaining to electronic toll collection shall be exclusively used for purposes of collecting toll revenue. This same principle could be applied to video images if the Bureau of Turnpikes were to initiate video tolling.

MTA Bridges and Tunnels encountered this issue as well during their planning of an AET pilot on the Henry Hudson Bridge in New York. They made the decision that they would protect the privacy of license plate photos for video tolls. Their justification rested on the agency's interpretation of NY Public Authorities Law §2985(14), quoted below:

> 14. Notwithstanding any other provision of law, all photographs, microphotographs, videotape or other recorded images prepared pursuant to this section shall be for the exclusive use of a public authority in the discharge of its duties under this section and shall not be open to the public nor be used in any court in any action or proceeding pending therein unless such action or proceeding relates to the imposition of or indemnification for liability pursuant to this section. The public authority shall not sell, distribute or make available in any way, the names and addresses of electronic toll collection system account holders, without such account holders' consent to any entity that will use such information for any commercial purpose provided that the foregoing restriction shall not be deemed to preclude the exchange of such information between any entities with jurisdiction over and or operating a toll highway bridge and/or tunnel facility.

10.6 Industry Trends

There has been a general trend among certain agencies toward All Electronic Tolling over the past 6 years. The states of Florida and Texas have included many of the earlier adoptions, but since then other states now have experience with AET as well. Below is a list of some of the facilities that have implemented AET since 2008:

- E-470 Public Highway Authority, Colorado (2008)
- Northwest Parkway Public Highway Authority, Colorado (2008)
- North Texas Tollway Authority (selected facilities, starting in 2009)
- Tampa Hillsborough Expressway Authority (Selmon Expressway, 2010)
- Miami-Date Expressway Authority (Gratigny Parkway, Don Shula Expressway, and Snapper Creek Expressway, 2010)

- Cameron County Regional Mobility Authority (State Highway 550, 2011)
- Florida's Turnpike Enterprise (Homestead Extension, 2011)
- Maryland Transportation Authority (Intercounty Connector, 2011)
- North Carolina Turnpike Authority (Triangle Expressway, 2011-2012)
- MTA Bridges & Tunnels (Henry Hudson Bridge, 2012)
- Golden Gate Bridge Highway and Transportation Authority (Golden Gate Bridge, 2013)
- Transportation Corridor Agencies (All corridors, 2014)
- Massachusetts Port Authority (Tobin Bridge, 2014)

The facilities above are open to all customers. Those with a transponder pay automatically. Those without a transponder are typically sent a bill based on a trace of their license plate. However, in some cases (e.g. the TCA in California), travelers are required to contact the Agency to either pre-register their license plate or to post-pay for their trip.

Some facilities in Texas (such as Harris County Toll Road Authority) have employed another form of all electronic tolling. It could best be described as "transponder only" tolling. This tolling paradigm requires all users of the facility to have a transponder. Any vehicle not having a transponder is traced through its license plate and is subsequently treated as a violator, with its associated fees and fines.

While new toll facilities as AET and conversions to AET have been very common in recent years, conversions to ORT have been ramping down. In the late 1990's and early 2000's, ORT facilities began to emerge in places such as Oklahoma and Colorado. In the mid-2000's, the New Jersey Turnpike and Illinois State Toll Highway Authority both delivered major programs to convert large numbers of conventional plazas to ORT. However, in recent years, the number of conversions has tapered off, with the majority of opportunities to convert leveraged. Some of the more recent conversions include:

- Woodbury Mainline Toll Plaza, I-87 (NY State Thruway Authority, 2010)
- Hampton Mainline Toll Plaza, I-95, Hampton, New Hampshire (New Hampshire Bureau of Turnpikes, 2010)
- Downtown Expressway Toll Plaza, Richmond, Virginia (Richmond Metropolitan Authority, 2012)
- New Gloucester Mainline Toll Plaza, I-95, New Gloucester, Maine, (Maine Turnpike Authority, 2013)
- Hooksett Mainline Toll Plaza, I-93, Hooksett, New Hampshire, (New Hampshire Bureau of Turnpikes, 2013)

Some of the reasons for the relative decline in the frequency of conversions include the following:

- *Geometric constraints*. There are many places where ORT simply is not suited to a particular facility's geometry. As Figure 9 illustrates, an ORT facility needs 1-2 linear miles in order to facilitate the transitions between highway-speed toll collection and conventional toll collection. As a result, it cannot be implemented in areas (such as the Hampton Side) where less room is available. AET facilities do not have such stringent geometric requirements.
- *Geographic constraints*. In some cases (such as occurred at Hampton and Hooksett), a conversion to ORT requires a broader footprint for the toll plaza. Right-of-way constraints or other

physical site limitations may prohibit the cost effective expansion of a particular toll facility in order to accommodate the conversion to ORT.

- *Capital costs*. As Section 6 illustrated, AET facilities are often considerably less expensive than ORT facilities. For aging facilities that are in need of replacement, converting to AET is an opportunity to reduce capital costs.
- *Traffic Conditions and Customer Demographics*. Some agencies with remaining traditional mainline barrier plazas that may not have the site constraints listed also do not have the compelling traffic congestion or significant enough transponder customer base to justify ORT conversion.

In short, the majority of readily available conversions to ORT have been completed and more recent conversion activities have trended around AET. However, each toll facility is unique. Any modernization solution must be tailored to the specific financial, customer demographic, geometric, and geographic constraints and needs of the toll facility in question.

Section 11. AET Industry Survey – Invoicing

This study assumes that, if the Bureau of Turnpikes implements AET at one or more of its facilities, it will maintain the same three-tiered invoicing system that it currently uses to handle violations. This system was described in detail in Section 5. The purpose of Section 11 is to review how other agencies have chosen to implement AET from an invoicing perspective.

Several agencies around the country have already converted to AET or are in the process of making the conversion. In performing a survey of toll agencies that have made the conversion it is clear that there are as many ways to invoice for tolls in an AET environment as there are agencies using AET. The common theme in all cases is that each agency has focused on invoicing processes that are easy for customers to understand, yield the highest collection rates possible, and are cost effective to the agency. In addition, these agencies are using a combination of toll differentials (higher tolls rates for video) and escalating fees as the unpaid tolls age.

11.1 North Carolina Turnpike Authority (NCTA)

The NCTA currently operates one toll road in North Carolina, the Triangle Expressway. This is an all-electronic toll road that connects N.C. 540 between N.C. 55 and N.C. 54 in Wake and Durham Counties. When using the road, customers can pay with their NC Quick Pass (transponder) account or pay-by-mail (video tolling). As of December 31, 2013, approximately 58% of the transactions were paid using a transponder. For customers that drive on the facility without a transponder, their toll rate will be approximately 50% higher than that of NC Quick Pass. Once customers receive a pay-by-mail invoice, they are given 30 days to pay the amount due. If the bill invoice is not paid, additional fees and/or civil penalties will be added to the amount due. In addition, the account may be referred to a collection agency or the DMV may be asked to place a hold on the vehicle registration until the account is paid.

11.2 Florida Turnpike Enterprise (FTE)

The FTE operates 460 miles of tolled roads throughout central and southern Florida. In 2011 they converted the southern 47 miles of the Florida Turnpike in Miami-Dade County to AET. FTE customers driving on the 47 miles that have been converted to AET either pay their toll using their SunPass (transponder) account or they are sent a Toll-By-Plate (video tolling) invoice. As of the fiscal year ended June 30, 2013 the Florida Turnpike had a SunPass penetration rate of 80.9%; these customers pay approximately $0.25 per transaction less than Toll-By-Plate customers.

Customers will receive a Toll-By-Plate invoice approximately 30 days after their initial toll transactions. The invoice will contain all of the transactions incurred during that 30 day period. The amount due on the invoice will include all outstanding tolls in addition to a $2.50 per-invoice administrative fee. Customers are given 30 days to pay the amount due on the initial invoice. If the invoice remains unpaid after the due date, a second invoice will be sent which will include the previous balance due from the first invoice plus any new tolls incurred, along with an additional $2.50 administrative fee.

11.3 North Texas Tollway Authority (NTTA)

The NTTA System includes approximately 125 miles of tolled highway on five facilities, two bridges and one tunnel in North Texas. In 2009 NTTA completed the conversion to AET on the President George Bush Turnpike. In 2010, three additional facilities—the Dallas North Tollway, the Addison Airport Toll Tunnel, and the Mountain Creek Lake Bridge—were also converted. The remainder of the NTTA system was converted to AET in 2013.

Customers can use their TollTag (NTTA transponder), TxTag (TxDOT transponder), or EZ Tag (Harris County Toll Road Authority or HCTRA transponder) account to pay their tolls. If they do not have one of those accounts, they will receive a ZipCash bill (video toll). As of December 31, 2013, 79% of transactions on the NTTA System were paid using a transponder. Customers that do not sign up for a transponder account will charged approximately 50% more per transaction than a customer who uses a transponder.

ZipCash uses a series of four (4) notices that are generally sent on a 30 day cycle to collect unpaid tolls. Notices could be sent in less than 30 days if the notice contains greater than thirty (30) transactions.

- **ZipCash Bill** – 30 days to pay ZipCash tolls only, no additional fees assessed if paid.
- **1st Notice of Nonpayment** – 30 days to pay ZipCash tolls and an additional $10 administrative fee per notice.
- **2nd Notice of Nonpayment** – 30 days to pay ZipCash tolls and an additional $10 and $25 administrative fee per notice.
- **Collection/3rd Notice of Nonpayment** – 30 days to pay ZipCash tolls and previous fees charged and an additional $29 collection service fee.
- **Legal Action** – All ZipCash tolls and fees previously assessed plus any additional court costs and fines as provided by law.

NTTA has the legal authority to list a customer as a "Habitual Violator" for failure to pay ZipCash bills. Under that authority, there are enforcement remedies that include fees and fines, blocked vehicle registration, a vehicle ban from NTTA roads with up to a $500 fine, and/or vehicle impoundment.

11.4 E-470 Public Highway Authority

E-470 is a 47 mile toll highway that runs along the eastern perimeter of the Denver metropolitan area in Colorado. The road extends from its southern point at State Highway C-470 and Interstate 25 (I-25) in Douglas County to its northern point at I-25 and 160th Avenue in Thornton. On January 1, 2009, E-470 introduced License Plate Tolling (LPT) as an option for paying tolls via video tolling along with cash collection and EXpressToll, their transponder program. Six months later—on July 4, 2009—the Authority removed cash collection entirely and only offered LPT and EXpressToll as payment options.

As of December 31, 2013, the EXpressToll penetration rate was approximately 71%. Customers that have an EXpressToll account pay 20% less than LPT customers per transaction. Since making the conversion, E-470 has made many changes to both its billing process and its fee and fine structure. The result is a monthly statement process with fees and fines that escalate the longer that tolls remain unpaid. The billing process unfolds in the following manner:

- **Month 1** – LPT statement issued with 30 days of tolls.
- **Month 2** – LPT statement reissued with new tolls and previous unpaid tolls, a one-time $5 late fee is included.
- **Month 3** – LPT statement reissued with new toll and previous unpaid tolls and late fee. No additional fees added.
- **Month 4** – Account referred to third-party collection firm. A collection letter is included with the LPT statement. A one-time $20 collection fee is included with all previous unpaid tolls.
- **Months 5-7** – Account receives a monthly statement and collection letter with all tolls due at that point in time, no additional fees charged.
- **Month 8 on** – Account remains in collection status and continues to receive monthly statements but is now eligible to receive Notices of Civil Penalty, adjudication fees and non-renewal of vehicle registration.

11.5 Transportation Corridor Agency (TCA)

TCA operates a system that includes 51 miles of toll highways in Southern California. The highways that make up the TCA system are The San Joaquin Hills (SR 73), Foothill (SR 241) and Eastern (State Routes 241/261/133). On January 1, 2014 the agency began to allow customers to register and use ExpressAccount (their new license plate tolling program) while still accepting cash. Five months later—on May 1, 2014—TCA discontinued cash collection, leaving only ExpressAccount and FasTrak.

Approximately 83% of customer transactions on TCA facilities are associated with a FasTrak account, the transponder program available throughout California. The remaining 17% of customer transactions can be paid using the One-Time-Toll (video tolling) program or one of the three ExpressAccount options.

- **One-Time-Toll** allows a customer that is not registered with a FasTrak account or ExpressAccount 48 hours from the time of the transaction to pay the toll. If payment is not received in that time frame the customer will receive a toll violation.
- The three ExpressAccount options all require users to go on-line and pre-register their vehicle's license plate with the TCA. Once the plate is registered, the user can select one of the following options:
    - **Prepaid ExpressAccount** allows a customer to prepay for their tolls with a credit card, cash or check. Statements can be emailed or mailed at the customers' request. The account only works on TCA toll roads
    - **Charge ExpressAccount** allows customers to be charged for tolls as they use them. No prepayment is necessary but a credit card is required so that it can be charged when tolls are incurred. Statements can be emailed or mailed at the customers' request. The account only works on TCA toll roads.
    - **Invoice ExpressAccount** allows a customer to be invoiced for the tolls incurred on the account. No payment method is required to be associated with the account. Invoices can be paid with a credit card, cash or check. Invoices can be emailed or mailed; all invoices are charged a $2 fee. The account only works on TCA toll roads.

Toll rates are 10-40% higher (compared to the FasTrak rates) when using One-Time-Toll or any of the ExpressAccount types. Tolls that are incurred against any ExpressAccount are required to be paid by their due date or a toll violation will be issued for each unpaid transaction. In addition to higher toll rates for using the video products, certain locations are charged a higher toll rate across all types of toll transaction during peak periods.

11.6 Golden Gate Bridge Highway & Transportation District

The Golden Gate Bridge Highway & Transportation District operates the Golden Gate Bridge as well as two public transit systems—Golden Gate Transit Buses and Golden Gate Ferry. Customers using the Golden Gate Bridge can pay tolls using their FasTrak account or with the Pay-By-Plate option. Since their conversion to AET in March of 2013, the Bridge has seen its FasTrak market share increase from about 70% to approximately 85%. Customers that cross the bridge without a FasTrak account are charged a toll 20% higher than those with a FasTrak account. There are three ways that customers not using a FasTrak account can pay their tolls.

- A **License Plate Account** allows customers to register their license plate and then pay as they go. If a credit card is associated to the account, then prepayment is not required; the card will be charged each time that the vehicle crosses the bridge. If cash/credit/money order is used, then prepayment equivalent to a single toll is required; when the vehicle crosses the bridge, the toll will be charged against the prepaid balance. There are no toll discounts when using a license plate account.
- A **One-Time Payment** option is provided for customers that do not use the bridge frequently. The One-Time Payment can be made up to 30 days in advance or up to 48 hours after using the bridge. Payments can be made using a credit card online, by phone, or by cash/check/money order in person at designated locations. There are no toll discounts when using the One-Time Payment option.

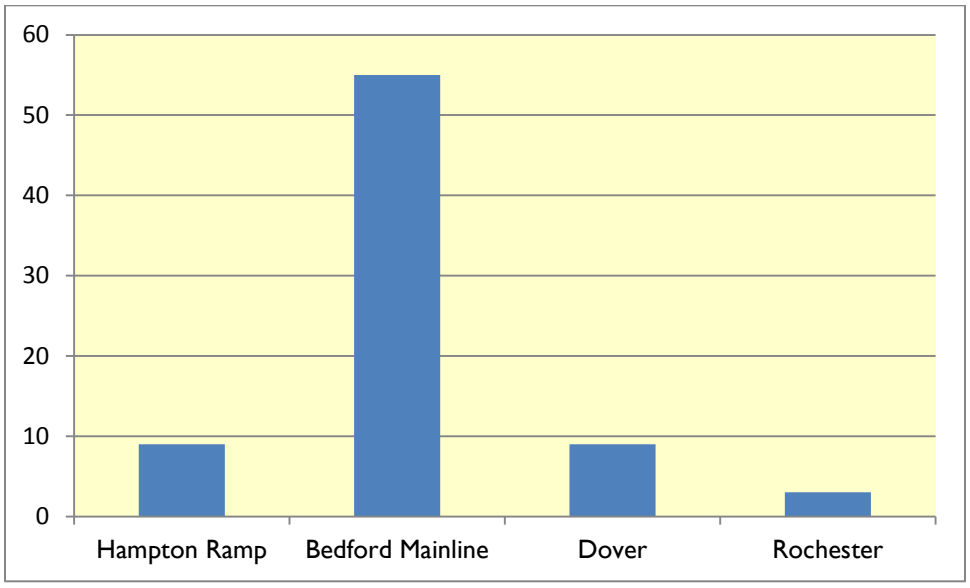
- A **Toll Invoice** will be sent to the registered owner of the vehicle within 4-5 days of travel on the bridge and every 30 days thereafter if there is additional usage. The Toll Invoice is only for the toll amount due. Customers have 30 days to pay the balance of the invoice. Any unpaid Toll Invoice or unpaid portion of a Toll Invoice will lead directly to a Toll Violation Notice which attaches a $25 penalty for each unpaid toll transaction. If the first Toll Violation Notice remains unpaid, a second Toll Violation Notice will be sent with increase penalties. If the second Toll Violation Notice is unpaid, the amount due is referred to the DMV who will hold the vehicle registration until all penalties are paid. Out-of-state vehicles are referred to a collections agency.

Section 12. Safety Assessment

One potential benefit of modernizing the toll plazas to either ORT or AET is accident reduction. By reducing the stopping, starting, and weaving that typically occur in the vicinity of a conventional toll plaza, both ORT and AET have the potential to reduce collisions and improve safety.

Figure 15 summarizes the total number of accidents observed at the four selected toll plazas.

Figure 15 – Total Accidents Recorded at Selected Toll Plazas, 2011-2013 [23]

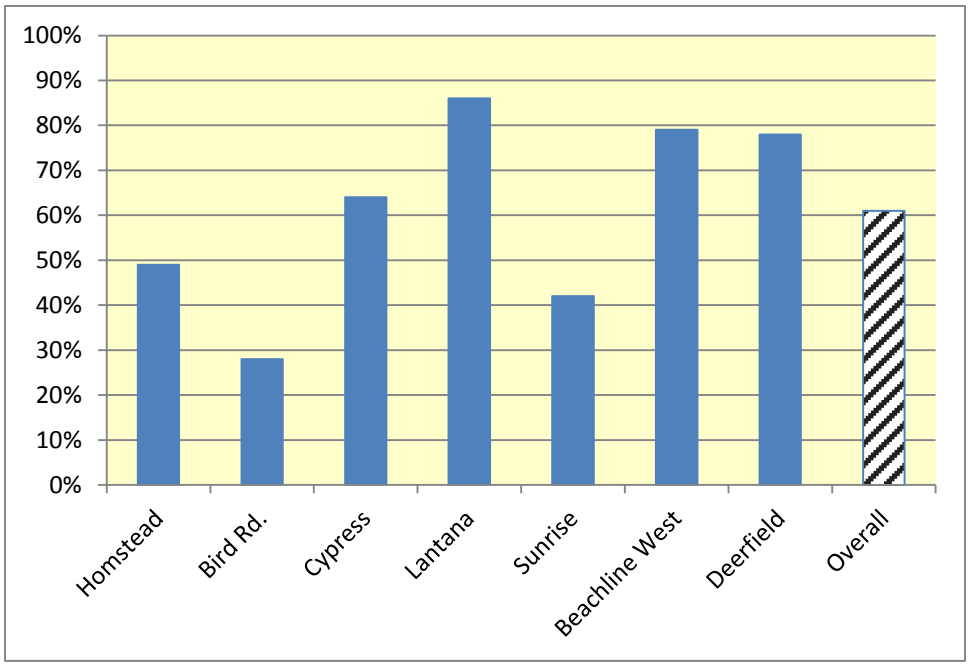


As Figure 15 illustrates, the Bedford Mainline toll plaza clearly has the greatest number of accidents. As a result, it would stand to benefit the most from the safety improvements that could accompany a conversion to ORT or AET.

[23] Data provided by Bureau of Turnpikes. The crashes reported in the table were all recorded within the following distances: (a) Hampton Side, 650' either side of the toll plaza; (b) Bedford Mainline, 0.5 miles either side of the toll plaza; and (c) Rochester and Dover, 0.3 miles either side of the toll plaza.

Very little data is readily available concerning the safety benefits of AET. However, some research on ORT facilities has been completed. Figure 16 summarizes the accident reductions associated with the implementation of ORT at various facilities on the Florida Turnpike. [24]

Figure 16 – Reported Reduction in All Crash Types at ORT Facilities on Florida Turnpike



The data from Florida suggests that ORT can reduce crashes by about 60%. This data has been reinforced by the Bureau of Turnpike's experience at the Hampton Toll Plaza, which converted to ORT in May 2010. Table 42 summarizes the crash reduction trends that have been observed at this toll plaza.

Table 42 – Crash Trends at Hampton Toll Plaza, 2007-2012 [25]

Year	Crashes	VMT	Crashes per 100 Million VMT
2007	55	39,957,485	137.6
2008	79	38,574,329	204.8
2009	52	38,279,250	135.8
2010	50	38,352,252	130.4
2011	13	38,194,097	34.0
2012	7	37,827,455	18.5

In 2007 and 2008 (before construction on the ORT conversion began), the Hampton Mainline toll plaza averaged about 171 crashes per hundred-million vehicle-miles traveled (VMT). In 2011 and 2012—the

[24] Data was drawn from ITS America, *New Data Show that "Open Road Tolling" Improves Safety at Toll Plazas*, May 2011.

[25] Data provided by NH Bureau of Turnpikes. The influence area evaluated by this analysis ranged from 0.75 miles south of the toll plaza to approximately 0.95 miles north of the toll plaza.

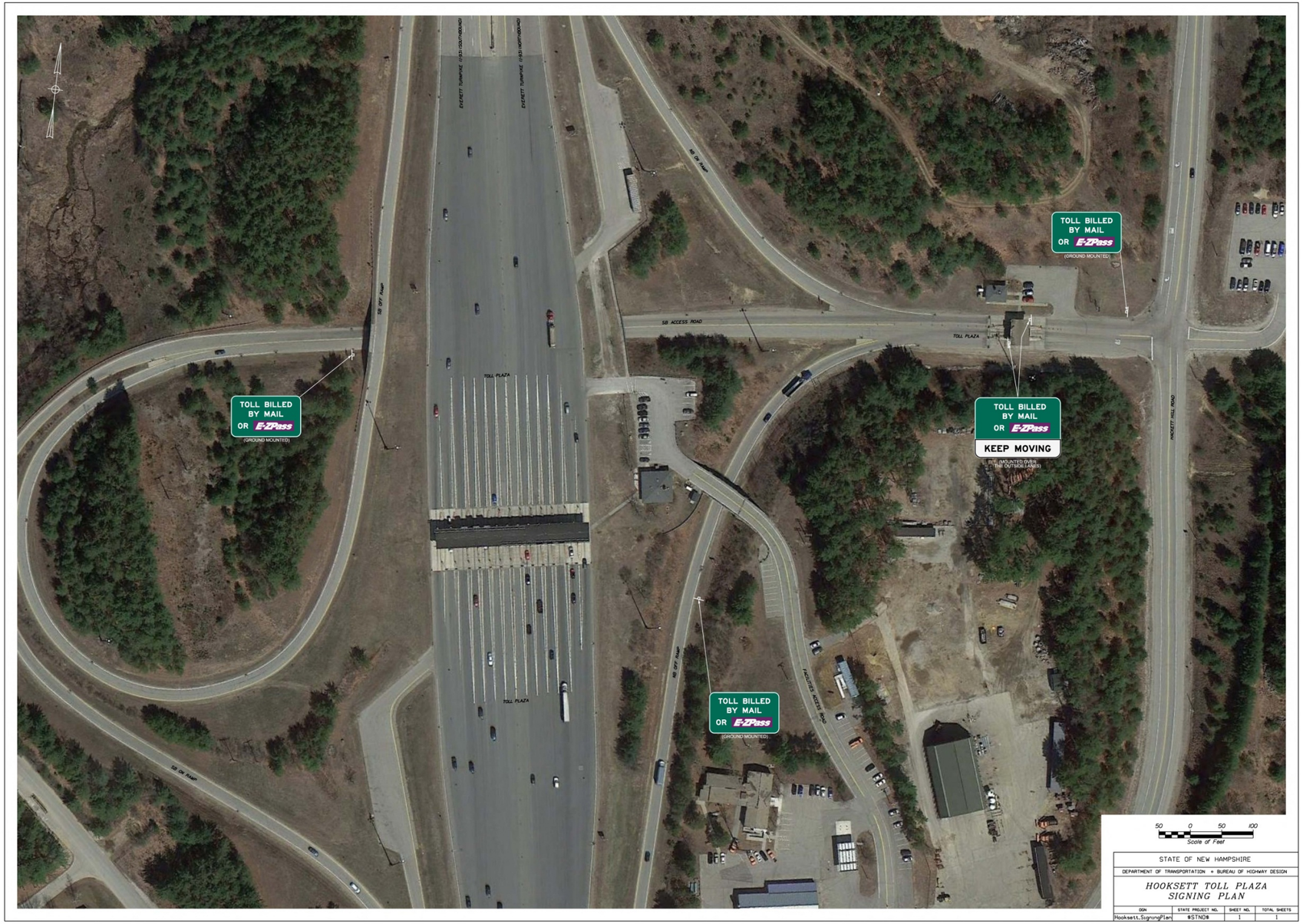
two complete years following the conversion to ORT—the crash rate was reduced to an average of about 26 crashes per hundred-million VMT. This represents a reduction in the crash rate of roughly **85%**.

In short, a review of available data reveals fairly convincing evidence that ORT reduces crash rates compared to conventional toll plazas. However, little data is available that evaluates the potential safety benefits of AET. Therefore, we cannot yet conclude that one modernization strategy is superior to the other with respect to crash reduction.

Section 13. Preliminary AET Signing Plan

HNTB was tasked with assembling a preliminary AET signing plan for the proposed AET pilot at the Hooksett Ramp toll plaza. This preliminary plan is presented in Figure 17.

Figure 17 – Preliminary AET Signing Plan for Hooksett Ramp Toll Plaza



The proposed signing plan is fairly simple. There are basically two types of signs. On the ramps that precede the plaza, there are roadside, post-mounted signs that inform drivers of the two types of toll collection that will be employed for customers at the ramp toll plaza—"Toll Billed by Mail" and "E-ZPass."[26] And at the plaza itself, signs will be mounted on the existing canopy reinforcing the toll collection methods and informing the drivers to keep moving.

No new signs are proposed for the mainline. We do not want to potentially confuse drivers who may think that the "Toll Billed by Mail or E-ZPass" sign refers to the Hooksett *Mainline* toll plaza. Because the Hooksett Mainline toll plaza uses a different method of toll collection (ORT), and because the vast majority of drivers approaching this interchange will pass through the mainline toll plaza, it is essential that we not create a situation that could lead drivers to think that the "Toll Billed by Mail" designation applied to the mainline plaza.

Moreover, no new signs are proposed for the local roads. These roads already have signs alerting drivers to the location of the interchange. Drivers on the local roads do not necessarily require advance information about the change in the method of cash toll collection.

Section 14. Preliminary Outreach Plan

This section will provide information that can be used for both current and future customers using the New Hampshire Turnpike. The plan will begin well in advance of implementation and will continue after implementation based on feedback from customers using the facility. Ultimately customers want to know how the change will impact them as it relates to paying tolls on the facility without an E-ZPass account.

14.1 Pre-transition outreach

It will take some time to implement AET, so it is best to take as much time as possible to begin to explain to customers, public officials and employees what the impact will be to them.

14.1.1 Customers

Customers will be affected by the conversion to AET not only during the transition, but also once AET is operational in the selected areas. Regardless of the customer type before or after conversion, keys to success will include the following overarching themes:

- Prompt service to customers in how billings are delivered and processed
- Positive opportunities to convert to E-ZPass, the preferred method of payment
- Multiple channels for making payments for all products

The impacts are considered relative to the three major types of current users under the existing system—E-ZPass customers, violators, and cash customers.

[26] Some agencies have developed propriety nicknames for video toll collection, such as "ZipCash" or "Pay by Plate." If the Bureau of Turnpikes were to develop such a nickname, it could be placed on these signs in lieu of "Toll Billed by Mail."

14.1.1.1 Existing E-ZPass Customers

The experience for the existing E-ZPass user is largely unchanged, since these users will continue to enjoy the use of non-stop tolling lanes during travel. Moreover, customer service for payments and account maintenance will be largely unchanged. Coordination with these customers specific to changes in their experience will likely be much less intensive than that required for the cash users. Existing E-ZPass discount programs and non-revenue transponder based accounts would translate easily into AET, also requiring limited coordination with respect to those aspects.

14.1.1.2 Existing Violators

The conversion to AET comes with a fundamental change in how violators that go through toll plazas are categorized. Under an AET scenario, they are no longer considered violators, but rather a video customer that will receive a bill in the mail requesting payment along with (potentially) additional charges to recover the costs. Similar to the current system, these "customers" have images taken of their license plate. And via interfaces with the DMV or third party sources, these customers would be sent a bill based on the registered owner linked to the image. Systems and processes would need to be reviewed in order to support such functionality although the change in tone alone (e.g. "customer" instead of "violator") would be met more favorably.

Note that a violation and collections process would remain in place for those video customers who do not respond to the bills sent. AET shifts this process further downstream, providing these customers with an additional payment option prior to becoming a violator.

14.1.1.3 Existing Cash Customers and Other Manual Activities

With the elimination of cash collection in the lanes, cash customers will have two account options: a prepaid E-ZPass transponder account or a post-paid video account driven by the vehicle license plate. As part of the public outreach process, cash customers should be encouraged to open an E-ZPass account. The Bureau of Turnpikes should emphasize the cost benefits of an E-ZPass account versus a post-paid video account by highlighting rate differentials and late fees on subsequent bills.

Former cash customers will notice improved travel times as they no longer have to stop to pay tolls. Additionally, traffic safety will be improved, which will be outlined in more detail in the next section.

14.1.2 Public Officials

Keeping the public officials informed is as important, if not more important, as keeping customers informed. These officials want to understand how their constituents are going to be affected by the change. Having on-going communications throughout the process will likely help spread the message to the customers. In many cases they may be contacted, and it will be important that they have the information and that they are relaying that information in the same manner that the Bureau of Turnpikes would.

14.1.3 Employees

Toll Collection personnel will be affected by a conversion to AET; therefore, it is important to communicate changes to staff and provide options well ahead of the AET transition. Options include:

- **Transfer to other positions.** Examine the options available under the collective bargaining agreements to shift staff into other toll collection locations or other positions within the Authority. Consider tenure and qualifications, and offer training programs ahead of the transition to enable staff to prepare for their new positions.
- **Early retirement or buyout.** Develop potential early retirement or buyout programs to present to qualified staff. Years of service and on-the-job performance could be considered when tailoring tiered packages.
- **Future Employment Assistance.** Provide staff with Human Resources support to assist in updating resumes, to provide letters of recommendation, and to help locate employment opportunities.

These measures will benefit staff and may help to prevent possible media backlash.

14.2 Post-transition outreach

Even after making the transition to AET, it is important to continue dialogue with all of the same people that were involved prior to transition. Monitoring customer response to the new way of collecting tolls will be important to make sure things are going along as planned. Actively soliciting feedback from the customers will help with the evaluation. The feedback provided in the post-transition period may be different from what was said during the pre-transition. It is possible that customer behavior will be different from what they said it would be before the transition. Now that customers have had the chance to experience the new system, some additional functionality may become apparent that would enhance the customer experience.

Continued dialogue with the staff will also provide insight into what the customers are saying about the new process. Additionally, once the system is operational, it will not take long for the staff to identify areas that could be changed to improve efficiency and provide better service to the customers. Public officials will also be a good source of information on how things are going. In some cases customers would rather reach out to a public official with feedback than contact the toll agency.

While the information is valuable that is gathered during this period it is important for the Bureau of Turnpikes to document the information and continue to monitor before deciding to make a major change. It will be important to allow the customers to have time to learn how to use the new system. Only if there is a major issue should changes be made to the system and/or process.

14.3 Description of AET and how it works

If the Bureau of Turnpikes were to move forward with AET deployment at one or more of the plazas evaluated in this report, it would be essential to provide the traveling public with a clear explanation of what AET is and how it works. The following bullets represent one way in which key points might be explained to the public.

- All Electronic Tolling is simply that—collecting tolls electronically, meaning there is no cash collected on the toll facility. The elimination of cash collection along the roadway leaves two primary ways for customers to pay their tolls. The first option is to open an account that has a transponder associated with it (E-ZPass in the case of New Hampshire). The account typically requires a prepaid balance and/or a payment method where the tolling agency can automatically replenish the balance or charge for tolls incurred over a period of time. The second option is simply to let the toll system take an image of the vehicle's license plate and wait for the invoice to come in the mail.

- If a vehicle is associated with a transponder account, and if the transponder is in the vehicle, then the antennas that are mounted overhead in the lane will detect the transponder as it passes through the tolling location. The equipment in the lane will create a transaction. That information will be sent to the back office system; the transaction will be posted to the account, and the amount of the toll will be deducted from the prepaid balance. Alternatively, the tolls will accumulate with other transactions associated with the vehicle, and the sum of those transactions will be charged to the payment method associated with the account.

- If the transponder is not in the vehicle, or if the antennas don't detect the transponder, then an image will be taken of the rear and possibly the front of the vehicle in order to capture the license plate on the vehicle. If it turns out after reviewing the image that the vehicle is actually associated with a transponder-based account, the same process for posting and collecting the funds will occur as if the transponder was detected.

- Vehicles that pass through the tolling location that are not associated with a transponder based account will have an image taken of the rear and possibly the front of the vehicle to capture the license plate. The equipment in the lane will create a transaction. All of the transaction information is sent to the back office system for processing. Once in the back office, the image associated with the transaction will be reviewed automatically by the system and/or manually. After the license plate number and issuing state have been identified, the information will be sent to the state DMV (or possibly to a 3rd party source) to obtain the registered owner information associated with the vehicle. Once the registered information is returned to the toll agency, a video account is established. Any additional transactions associated with that vehicle will be accumulated on the account and will be billed to the registered owner. If the bill is not paid by the assigned due date, additional bills with additional fees could be issued. If the tolls continue to be unpaid, then the transactions could be converted to toll violations, which could also have additional fees and fines applied.

If the Bureau of Turnpikes moves forward with AET deployment, these descriptions can be refined and details can be added. This just summarizes some of the key points that HNTB has found is valuable in the process of educating customers about AET.

14.4 Commonly Asked Questions

The following is provided as a list of commonly-asked questions that often arise in response to AET deployments. The proposed answers are preliminary; subsequent work will be required to confirm and expand upon them.

- **How does video tolling work?** Customers that drive through a tolling location in a vehicle that is not associated with a transponder account will have an image taken of their vehicle. The license plate information will be used to determine the registered owner of the vehicle and a bill will be mailed to that individual. Payment of the bill by its' due date can be made by mail, over the phone, walking in to a service center or online using cash, check, credit/debit card.

- **Do I need to register my vehicle before driving on the toll road?** It is not necessary to register the vehicle before driving on the toll road. Based on the license plate information on the vehicle the registered owner will be identified and billed.

- **Will it cost more to use the video billing system?** Yes, there will be a 30% discount given to customers who use the facility with an E-ZPass account based in New Hampshire.

- **What if I forget to pay my bill by the due date?** If you don't respond to your bill within 30 days, then you will receive a second bill. This bill will cover all unpaid tolls from the first bill, and it will also include a late fee of $1.50 per unpaid transaction. If the bills go unpaid for an additional 30 days, then a third bill for all unpaid tolls will be mailed that includes a $25 per-transaction administrative fee.

- **What happens if I receive a video toll bill and I have an E-ZPass account?** This situation can occur if the vehicle that was driven on the toll road is not registered on the E-ZPass account. If this happens please contact the customer service center to add the vehicle and get the tolls charged to the account.

- **I received a second notice or violation and I paid my bill?** If the payment was posted after the due date it is possible that the system had already generated the second notice or violation. If this occurs please contact customer service so that we can ensure that your payment was properly recorded to your account.

Section 15. Conclusions and Recommendations

Based on the analysis contained in this report, HNTB recommends the following:

- If the Bureau of Turnpikes desires a modernization alternative that carries minimal financial risk, then it should move forward with ORT at Bedford Mainline, Dover, and Rochester. All three of these plazas will yield positive net operating revenue upon conversion to ORT. This is consistent with the Bureau's experiences at the Hampton Mainline and Hooksett Mainline toll plazas. The conversion to ORT will likely be accompanied by a modest increase in E-ZPass market share, which in turn will reduce operating costs and improve financial performance.

- The primary financial consideration with respect to ORT is handling the associated capital costs, which will likely be in the vicinity of $560k to $970k per year. The savings in operating costs associated with ORT are not sufficient to cover the increase in capital costs.

- If the Bureau of Turnpikes wishes to further investigate the possibility of implementing AET, then it should focus its attention on *Bedford Mainline* and *Rochester*. This should include taking the following three steps:
    - **Step #1** – Further investigate whether FHWA would approve the relocation of the Bedford Mainline toll plaza to the south of the Airport Access Rd. interchange. If this is not politically possible, then no further consideration should be given to Bedford. At present, this does **not** appear to be possible, given the guidance from FHWA stating that "the opportunity for toll-free use of the MAAR must be maintained." [27]
    - **Step #2** – Do a detailed assessment of the frequency of travel of cash-paying customers at each plaza. [28] The feasibility of AET hinges in large part on the frequency with which cash-paying customers travel through the facilities. If the *actual* frequency is similar to the **high** frequencies indicated by the on-line survey results, then AET could make financial sense. On the other hand, if the actual frequency is closer to the **low** frequencies observed at some other AET facilities (such as the Henry Hudson Bridge), then the financial prospects of AET would suffer.
    - **Step #3** – Consider the possibility of adding surcharges to the current proposed video toll rate. This study has proceeded under the assumption that the video toll rate will be equal to today's cash rate. However, virtually all agencies that have moved forward with AET have incorporated a "video surcharge," which is also occasionally referred to as a "video toll premium." The purpose of the surcharge is to help cover the revenue leakage associated with video tolling. If the video toll rate were to incorporate a video surcharge of 30-60% (above today's cash rates), then the financial prospects of AET would improve.

- The best course of action at the Hampton Side toll plaza appears to be rehabilitating the existing plaza. This plaza will collect nearly $3 million in cash revenue this year (2014), and—as Figure 5 illustrates—up to 45% of this revenue is at risk upon conversion to AET. Thus, the rehabilitation alternative minimizes both capital costs and revenue at risk.

In short, ORT has a proven track record in New Hampshire. If the Bureau of Turnpikes can finance the capital costs, then there is very little financial risk from an operating perspective. Any conversions to AET would need to be accompanied by more detailed study concerning trip frequency and by a discussion concerning whether any financial measures (such as a video surcharge) could be a reasonable part of a strategy to render AET feasible.

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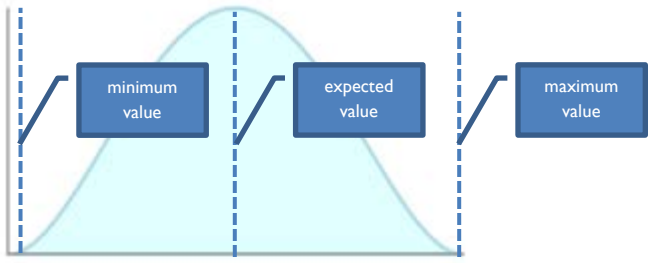
[27] See letter from Patrick A. Bauer (Division Administrator for FHWA) to the Commissioner of the New Hampshire DOT, dated April 11, 2014.

[28] This could be done by retaining the services of a vendor such as *AirSage*, which can track the frequency with which individual cell phones traverse a particular section of the roadway. The cell phones do not need to be in use in order to be tracked. For more information, go to www.airsage.com.

Appendix A. Monte Carlo Simulation

Monte Carlo simulation provides a means for quantifying the impact of uncertainty in key variables. Table 30 identified the variables whose uncertainty was described in terms of a range of possible values. Each variable in this table was modeled with a "beta-pert" distribution assumption for the likelihood of a value to occur within the range. This probability distribution takes roughly the shape of a normal distribution (sometimes referred to as the "bell-shaped curve"). The extremes of a beta-pert distribution are defined by the "low" and "high" variables, and the greatest probability is assigned to the "expected" value. The shape of a beta-pert distribution is illustrated in Figure 18.

Figure 18 – Illustrative Shape of Beta-Pert Distribution



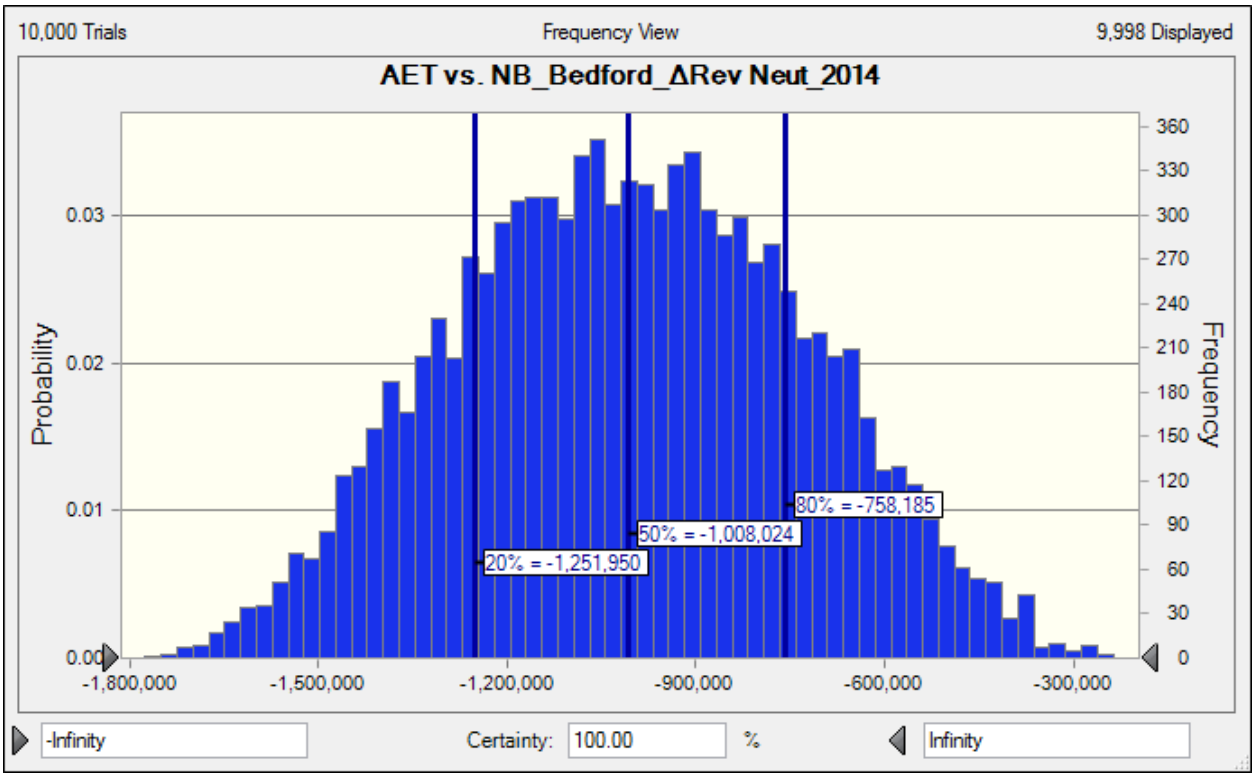
A Monte Carlo simulation involving 10,000 model runs was performed for each scenario. Each of the 10,000 model runs involved a unique combination of the above-listed variables drawn from the corresponding probability distribution. As a result, each individual model run yielded a unique value of "revenue neutrality" and "net revenue." After the 10,000 model runs were completed for a given simulation, the results were compiled and used to generate three key outputs for each facility (Bedford Mainline, Hampton Side, Dover, and Rochester) during each year (2014 through 2026). These three key outputs for both net revenue and revenue neutrality were:

- 20th percentile ("pessimistic") result
- 50th percentile ("expected") result
- 80th percentile ("optimistic") result

The "80th percentile" net revenue result is the value that was greater than or equal to 80% of the model runs. The 20th percentile result is greater than or equal to 20% of the model runs. In this study, the 80th percentile result will always be greater than the 20th percentile result. For that reason, the 80th percentile result is termed in this report as the "optimistic" result. In other words, it represents an outcome that is unlikely but certainly within the realm of possibility.

To illustrate these values, see Figure 19 below, which provides a graphical illustration of the results of one Monte Carlo simulation. In this case, the figure summarizes the 2014 revenue neutrality calculations for the Bedford Mainline toll plaza, comparing AET to existing conditions (or "no-build"). This chart corresponds to Scenario 1 (assuming low E-ZPass growth and low frequency of travel).

Figure 19 – Sample Results, Bedford Mainline: Revenue Neutrality, 2014, AET vs. No-Build



The above chart illustrates the following:

- The 20th percentile revenue neutrality calculation was -$1.25 million. In other words, this value was greater than or equal to 20% of the 10,000 model runs that comprised this simulation.
- The 80th percentile revenue neutrality calculation was higher, at -$0.76 million. This figure was greater than or equal to 80% of the results from the 10,000 model runs.
- The 50th percentile value, or the "expected" value, was -$1.01 million. It lay roughly halfway between the 20th percentile result and the 80th percentile result. Half of the model runs yielded a value that was greater than -$1.01 million, and half yielded a value that was less.

Rather than providing the full graphical output, the results in this report generally focused on providing a range of values, from the 20th percentile result to the 80th percentile result. The 50th percentile result was calculated but was only be used when comparing results with ORT in Section 8.5.3.