Analysis of Potential Traffic and Revenue Impacts of Two-Way Tolling at the Verrazano-Narrows Bridge

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ABSTRACT

This report presents an analysis of the potential traffic and revenue effects of restoring two-way tolling at the Verrazano-Narrows Bridge (VNB). The analysis considered changes in traffic patterns at the VNB as well as at key regional bridges and tunnels. A detailed traffic analysis was performed at four critical study locations that may potentially experience traffic impacts at: the Canal Street corridor and Lower Manhattan; the Gowanus Expressway between the Prospect Expressway and the Brooklyn-Queens Expressway; the Gowanus Expressway at 92nd Street; and the Staten Island Expressway at Mosel Avenue.

If two-way tolling were implemented, the current traffic imbalance of 7,000 more vehicles using the VNB daily eastbound than westbound would be largely eliminated. Eastbound traffic volumes would decrease while westbound traffic volumes would increase at the VNB.

Eastbound, about 3,225 daily vehicles would divert from the VNB to the Port Authority Trans-Hudson crossings which would be distributed to the George Washington Bridge (49 percent), Lincoln Tunnel (20 percent), and Holland Tunnel (31 percent). Westbound, about 3,361 daily vehicles would be attracted to the VNB from the George Washington Bridge (45 percent), Lincoln Tunnel (17 percent), and the Holland Tunnel (38 percent). Much of the traffic diversion is projected to occur during the late evening/nighttime and midday periods when traffic congestion is lower and alternate routes become more attractive.

Along Canal Street, traffic volumes under two-way tolling would increase by less than 50 vehicles eastbound and decrease by less than 50 vehicles westbound during the AM, Midday and PM peak hours. Speeds, which change inversely to changes in traffic volumes would be slightly lower eastbound and slightly higher westbound. Intersection delays would increase for some movements and decrease for other movements, with more movements experiencing a decrease in delays. Overall intersection performance along Canal Street and Lower Manhattan would remain about the same.

Along the Gowanus Expressway and the Staten Island Expressway, changes in traffic volumes would vary by direction and time of day, with relatively small increases in traffic westbound and small decreases in traffic eastbound. The highest changes in traffic volumes would occur during the off-peak periods when congestion is lower along the alternate routes. Speeds may increase eastbound or decrease westbound up to about 0.1 mph during any hour of the day, with most hours experiencing no change in speed.

Overall Triborough Bridge and Tunnel Authority toll revenues would be expected to increase by approximately $12.3 million annually under two-way tolling at the VNB.
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I. Introduction

A. Background

The Verrazano-Narrows Bridge (VNB), owned and operated by the Triborough Bridge and Tunnel Authority (TBTA)\(^1\), crosses the Narrows and connects with the Gowanus Expressway (I-278) and the Belt Parkway to the east in Brooklyn, and the Staten Island Expressway (I-278) to the west in Staten Island. **Figure 1** presents the key crossings and highways in the study area. The VNB establishes a critical link in the local and regional highway system, providing access to John F. Kennedy International Airport and Newark Liberty International Airport. The VNB is also an important truck route and is one of only two facilities in New York City capable of accommodating tractor-trailer vehicles traveling to and from points in New Jersey and beyond.

**Figure 1: Study Area Crossings and Highways**

\(^1\) TBTA is the legal entity known as MTA Bridges and Tunnels
The VNB originally operated as a two-way tolled facility from its opening in 1964. However, since 1986, when one-way tolling was implemented, tolls in the eastbound direction were eliminated and tolls in the westbound direction were doubled, in accordance with federal law. The stated purpose of the change to one-way tolling was to reduce queuing and delays at the eastbound toll plaza in Staten Island. The one-way tolling policy was made permanent in 1998 by an act of Congress and the toll booths in the eastbound direction were subsequently removed.

B. Effect of Current One-Way Tolling

Although the change in toll collection from two-way to one-way did not alter the overall cost of round-trip travel across the bridge, the removal of the eastbound toll attracted additional drivers traveling in the eastbound (Brooklyn-bound) direction. Conversely, some drivers traveling in the westbound (New Jersey-bound) direction diverted to alternate toll-free routes through Manhattan to avoid the double tolls at the VNB in that direction. As a result, traffic increased in the eastbound direction along the Staten Island Expressway (SIE) and on the VNB, and traffic decreased in the westbound direction on the VNB and SIE. The change to one-way toll collection at the VNB also affected travel patterns on regional highways in New York and New Jersey, TBTA’s other tolled facilities, New York City Department of Transportation (NYCDOT) toll-free East River bridges, and on the Port Authority of New York and New Jersey (PANYNJ) Trans-Hudson and Staten Island crossings.

Figure 2 illustrates the effect of VNB one-way tolling on regional travel patterns.

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2 The implementation of one-way tolling at the VNB was mandated by federal law after the approval by Congress of the Appropriations Bill which contained a rider sponsored by Representative Guy V. Molinari, Staten Island, requiring that tolls on the VNB be collected only from vehicles exiting the bridge in Staten Island.
Currently, under one-way tolling, the VNB carries approximately 217,000 vehicles on an average weekday, approximately 112,000 eastbound and 105,000 westbound. There is about a 7,000-vehicle imbalance between eastbound and westbound traffic volumes due to the one-way toll collection. Weekend traffic volumes at the VNB are nearly as high as on weekdays with traffic volumes of about 215,000 vehicles on Saturday, and about 203,000 vehicles on Sundays. The...
Saturday directional imbalance is about 7,000 vehicles, which is about the same as the weekday imbalance. The Sunday directional imbalance is higher at about 10,000 vehicles daily, most likely due to less congestion on the alternate routes and more flexibility on the part of motorists.

In the westbound direction, traffic volumes along Canal Street and the Holland Tunnel are higher due to no tolls collected at the PANYNJ crossings in that direction, combined with double tolls collected at the VNB in the westbound direction.

The TBTA is reviewing the possibility of restoring two-way tolling at the VNB in light of new technology that eliminates delays associated with toll collection. The TBTA implemented cashless, Open Road Tolling (ORT) at the VNB in July 2017 with tolls collected only in the westbound direction, as required by federal law. If two-way tolling is implemented at the VNB, TBTA would employ the same ORT technology in the eastbound direction to avoid the toll collection delays that prompted the decision to implement one-way tolling in 1986.

C. Objectives of the Review
The comprehensive review of two-way tolling at the VNB examines potential changes in regional travel patterns between New York and New Jersey, the potential changes in bridge and tunnel crossing volumes at TBTA’s facilities, PANYNJ’s Trans-Hudson crossings and Staten Island Bridges, and the East River toll-free bridges. The analysis was intended to answer the following four questions related to the possibility of restoring two-way toll collection at the VNB.

   1. Will a VNB two-way toll encourage Long Island/Brooklyn drivers to travel westbound to New Jersey (NJ) over the VNB and Staten Island Expressway (SIE) instead of through Lower Manhattan streets/PANYNJ tunnels?
   2. Will a two-way toll at the VNB discourage eastbound drivers in NJ from entering New York City over the VNB via the SIE/VNB/Gowanus Expressway?
   3. What net traffic impact will a VNB two-way toll have on these corridors (including traffic in Staten Island, South Brooklyn, and Manhattan)?
   4. Would a VNB two-way tolling structure impact MTA revenue?

II. Study Area and Methodology
Because the VNB is a regional facility serving both local and interstate travel, the general study area includes the entire northeast. The primary study area includes New Jersey, New York City, Westchester, and Long Island.

An extensive data collection program was implemented to support WSP’s review of restoring two-way tolling at the VNB. As a key means of documenting existing conditions, traffic counts were conducted in various locations in lower Manhattan, focused along Canal Street, near the Holland Tunnel; in New Jersey along the Holland Tunnel entrance and exit; in Brooklyn along the Gowanus Expressway at 92nd Street and at the weaving section from the merge of the Gowanus Expressway and Prospect Expressway to the diverge at the Brooklyn-Queens Expressway and
Hugh L. Carey Tunnel. In Staten Island, the SIE was analyzed in the eastbound and westbound directions at Mosel Avenue. The traffic count locations are shown on Figure 3.

The data collection plan included transaction counts at toll facilities, video counts, vehicle classification counts, intersection turning movement counts, commercially purchased GPS-based data on vehicle origin-destination patterns and traffic travel time and delay information.

A Toll Policy Model (TPM) developed by WSP was used to replicate current facility choices and to project the change in travel patterns at each facility by time of day, direction of travel, and vehicle type for each origin-destination pair in the study area. The TPM produced estimates of changes in facility volumes and diversions to alternate routes which was used to analyze potential traffic impacts.

Existing traffic conditions with one-way tolling and future traffic conditions with two-way tolling were analyzed using industry accepted traffic modeling tools and software. These included Synchro 9 to model intersection level traffic performance and HCS 7.3 to analyze highway traffic flow conditions.

Measures of potential traffic impacts included changes in traffic volumes, speeds, intersection performance, queueing delays, and traffic density (vehicles/lane/mile) along highways.
Figure 3: Traffic Count Locations

Turning Movement Counts (TMCs)
Automatic Traffic Recorders (ATRs)
Miovision Camera
Vehicle Classification Counts (VCCs)
Tolled Direction*
Toll-Free Direction**

*Data based on tolled transaction counts
**Data based on ATRs
III. Potential Traffic Impacts

A. Regional Diversions

Implementation of two-way tolling on the VNB would alter traffic patterns within the region, mostly affecting vehicular travel between New Jersey and New York City. Traffic diversions between the key crossings may occur because reducing the VNB westbound toll by 50 percent would be a toll-based incentive to utilize the westbound VNB and I-278 corridor, while adding the equivalent toll to the eastbound direction would be a disincentive to use the eastbound VNB and I-278 corridor. Effects of a VNB two-way toll are discussed in terms of regional origin-destination based diversions between the VNB and alternate routes as analyzed by the Toll Policy Model as well as potential traffic impacts at key locations tied to the regional crossings such as Canal Street and congested highway segments in Brooklyn and Staten Island.

Based on the model, diversions to and from the VNB are projected to vary temporally by time of day as shown in Figure 4. Most of the eastbound diversions from the VNB to the Trans-Hudson facilities would occur during the evening/late night (7:00 p.m. - 6:00 a.m.) and the midday off-peak (10:00 a.m. - 3:00 p.m.) periods, accounting for about 75 percent of the daily diversions. Similarly, westbound diversions from the Trans-Hudson crossings to the VNB would occur mostly during the evening/late night and the midday off-peak periods, accounting for about 69 percent of the daily diversions. The AM peak period (6:00 a.m. - 10:00 a.m.) and PM peak period (3:00 p.m. - 7:00 p.m.) diversions are projected to be much lower, accounting for 25 percent of the daily eastbound diversions and 31 percent of the daily westbound diversions. Diversions are less likely to happen during the AM and PM peak periods in part because the VNB primarily serves as a local bridge between Brooklyn and Staten Island and because congestion along alternate routes is greater during these periods, resulting in lower anticipated diversions.

Figure 4: VNB Diversion Percentages by Time Periods – Weekday
1. Westbound Diversions

Generally, drivers diverting to the VNB westbound due to the lower toll in that direction would cause westbound trips across the Hudson and East River to decrease, and trips westbound via Staten Island to New Jersey to increase. The analysis of two-way versus one-way tolling on the VNB projects that under two-way tolling, on an average weekday, the westbound lanes of the VNB would gain approximately 4,361 trips (+4.1 percent) of which about 157 vehicles would be medium trucks (2-3 axles) and about 332 vehicles would be heavy trucks (3+ axles). This indicates that, with the lowering of the westbound toll (halving the current double tolls), an increased number of drivers would choose to travel across the VNB in the westbound direction, diverting away from lower Manhattan Streets and the Holland Tunnel, Lincoln Tunnel and George Washington Bridge. Figure 5 illustrates the anticipated weekday hourly westbound diversions from the Trans-Hudson facilities to the VNB and the breakdown of diversions from each facility.

Figure 5: Weekday Westbound Trans-Hudson Crossings Hourly Diversions
Figure 6 shows the westbound diversions broken out by major origins and destinations. Westbound diversions from the Trans-Hudson crossings to the VNB would originate from Brooklyn (37 percent), Manhattan (25 percent), Queens (17 percent), and Long Island (16 percent). The primary westbound destination for diverting traffic would be New Jersey (82 percent). Staten Island would account for about 10 percent of the westbound diversions.

Figure 6: Expected VNB Westbound Daily Diversion Origins & Destinations

Figure 7 illustrates the expected pattern for westbound diversions under two-way tolling. Most of these diversions are anticipated to occur outside of the peak travel periods, due to increased flexibility, and better traffic flow conditions. The overall impact of these diversions on traffic patterns is discussed in Section IV B, Net Effect on Traffic.
Figure 7: Expected Westbound Diversion Travel Pattern
2. Eastbound Diversions

Drivers diverting from the VNB eastbound would choose one of the Trans-Hudson crossings and then one of the East River crossings to Brooklyn, Queens, and Long Island, resulting in a decrease in trips from New Jersey to Staten Island. The analysis of two-way versus one-way tolling on the VNB projects that under two-way tolling, on an average weekday, the eastbound lanes of the VNB would lose approximately 4,325 vehicle trips (-3.9 percent) of which about 72 vehicles would be medium trucks (2-3 axles) and about 182 vehicles would be heavy trucks (3+ axles). As a result, fewer drivers from New Jersey would enter New York City via the SIE/Gowanus Expressway. Figure 8 illustrates the anticipated weekday hourly eastbound diversions from the VNB to the Trans-Hudson crossings and the breakdown of diversions from each facility.

Figure 8: Weekday Eastbound Trans-Hudson Crossings Hourly Diversions

![Eastbound Diversions Chart](source: WSP Toll Policy Model)
As shown in

**Figure 9**, most eastbound diversions would originate from New Jersey (81 percent). The main destinations for eastbound diversions are Brooklyn (35 percent) and Manhattan (34 percent), accounting for 69 percent of the daily diversions.

**Figure 9: Expected VNB Eastbound Daily Diversion Origins & Destinations**

![Origin and Destination Pie Charts](Image)

**Figure 10** illustrates the expected change in travel patterns for eastbound diversions. Like westbound diversions, it is anticipated that the majority of the eastbound diversions would occur outside of the peak travel periods, due to increased flexibility, and better traffic flow conditions.
The overall impact of these diversions on traffic patterns is discussed in Section B IV, *Net Effect on Traffic*.

**Figure 10: Expected Eastbound Diversion Travel Pattern**
B. Net Effect on Traffic

It is expected that under two-way tolling the current imbalance at the VNB between eastbound and westbound traffic would be substantially reduced.

Table 1 summarizes the changes in daily traffic volumes at key crossings that would arise from two-way tolling at the VNB. In general, the net changes in traffic, eastbound plus westbound, are small, ranging between 0.0 to 0.2 percent net change at key cordon crossings.

<table>
<thead>
<tr>
<th>Facility</th>
<th>Direction</th>
<th>One-Way Tolling</th>
<th>Two-Way Tolling</th>
<th>Net Change</th>
<th>% Net Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>VNB</td>
<td>Eastbound</td>
<td>111,847</td>
<td>107,522</td>
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<td>-3.9%</td>
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<tr>
<td></td>
<td>Westbound</td>
<td>105,143</td>
<td>109,504</td>
<td>4,361</td>
<td>4.1%</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>216,990</td>
<td>217,026</td>
<td>36</td>
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<tr>
<td>Trans-Hudson Crossings</td>
<td>Eastbound</td>
<td>238,482</td>
<td>242,807</td>
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<td>1.8%</td>
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<tr>
<td></td>
<td>Westbound</td>
<td>261,266</td>
<td>256,905</td>
<td>-4,361</td>
<td>-1.7%</td>
</tr>
<tr>
<td></td>
<td>Total</td>
<td>499,747</td>
<td>499,711</td>
<td>-36</td>
<td>0.0%</td>
</tr>
<tr>
<td>Staten Island Crossings</td>
<td>Eastbound</td>
<td>93,949</td>
<td>89,781</td>
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<td>-4.4%</td>
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<tr>
<td></td>
<td>Westbound</td>
<td>80,273</td>
<td>84,805</td>
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<tr>
<td></td>
<td>Total</td>
<td>174,223</td>
<td>174,586</td>
<td>363</td>
<td>0.2%</td>
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<tr>
<td>East River Crossings</td>
<td>Eastbound</td>
<td>244,919</td>
<td>246,558</td>
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<tr>
<td></td>
<td>Westbound</td>
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<td>248,154</td>
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</tr>
<tr>
<td></td>
<td>Total</td>
<td>495,203</td>
<td>494,713</td>
<td>-490</td>
<td>-0.1%</td>
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<tr>
<td>Gowanus/Prospect Expwy</td>
<td>Eastbound</td>
<td>89,087</td>
<td>87,945</td>
<td>-1,142</td>
<td>-1.3%</td>
</tr>
<tr>
<td>Expwy Interchange</td>
<td>Westbound</td>
<td>101,552</td>
<td>102,839</td>
<td>1,288</td>
<td>1.3%</td>
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<tr>
<td></td>
<td>Total</td>
<td>190,638</td>
<td>190,784</td>
<td>146</td>
<td>0.1%</td>
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<tr>
<td>Gowanus Expwy at 92nd St</td>
<td>Eastbound</td>
<td>58,112</td>
<td>55,865</td>
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<td>-3.9%</td>
</tr>
<tr>
<td></td>
<td>Westbound</td>
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<td>56,170</td>
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<tr>
<td></td>
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<td>112,035</td>
<td>-10</td>
<td>0.0%</td>
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<tr>
<td>Staten Island Expwy</td>
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<td>73,849</td>
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<td>-5.3%</td>
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<td>Westbound</td>
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<td></td>
<td>Total</td>
<td>148,183</td>
<td>148,217</td>
<td>34</td>
<td>0.0%</td>
</tr>
</tbody>
</table>

East River Crossings includes: Brooklyn, Manhattan, Williamsburg & Queensboro Bridges

With respect to local roads, directional changes in traffic volumes during the AM, Midday, PM, and Evening/Late Night hours along Canal Street, the Gowanus Expressway, and the Staten Island Expressway would be relatively small, and within normal daily fluctuation of traffic. Based on the
results of the Toll Policy Model, the changes in traffic volumes are expected to occur mostly during the Midday and Evening/Late Night periods when congestion is lower. Potential traffic impacts at these key locations are summarized below. It should be noted that for each of the intersections described below, projected changes in traffic volume, vehicle speed, and delays would be minimal during all hours of the day, and these changes would be well within normal daily fluctuation ranges.

1. VNB and PA Trans-Hudson Facilities
Under the current one-way tolling, a total of 217,000 vehicles on an average weekday utilize the VNB, approximately 112,000 eastbound and 105,000 westbound. Under two-way tolling, the total weekday traffic volume at the VNB is expected to remain about the same, with approximately 107,500 vehicles eastbound and 109,500 vehicles westbound. It is anticipated that the current imbalance of 7,000 vehicles daily would be reduced and traffic volumes would be nearly balanced with an imbalance of about 2,000 vehicles daily. The projected imbalance under two-way tolling would be less than 1 percent of the total traffic.

Westbound traffic at the Trans-Hudson PA facilities is expected to be reduced, while eastbound volumes would likely increase. The GWB would comprise 45 percent of diversions westbound and would receive 49 percent of diversions eastbound. The HT would comprise 38 percent of diversions westbound and would receive 31 of diversions eastbound. The LT would comprise 17 percent of diversions westbound and would receive 20 percent of diversions eastbound.

Changes in traffic volumes at the VNB, HT, LT and GWB would vary by time of day. The highest changes in traffic volumes would occur during the off-peak periods when congestion is lower and when the VNB operates more like a regional bridge and less like a local bridge, as it does during the AM and PM peak periods.

2. Canal Street
Traffic volume changes along Canal Street would vary by direction and time of day, with small increases in eastbound traffic and small decreases in westbound traffic. The highest changes in traffic volumes would occur during the off-peak periods when congestion is lower. Canal Street and Varick Street are likely to see the highest net reduction of traffic, about 50 vehicles, during the peak Midday hour. Total volumes are expected to change by less than 1 percent during all periods along the Canal Street corridor.

Speeds along Canal Street would decrease up to 0.3 mph, from 4.6 mph to 4.3 mph, in the eastbound direction and increase up to 0.3 mph, from 5.8 mph to 6.1 mph, in the westbound direction during the off-peak periods, 10 a.m. to 3 p.m. and 7 p.m. to 6 a.m. The potential speed impacts during the peak periods would be smaller. The overall speed changes, increases in the westbound direction and decreases in the eastbound direction, would be relatively small and would not be noticeable to motorists during any hour of the day because it would generally represent less than 2 percent of the total traffic volumes for each intersection.
3. Gowanus Expressway Weave - between the Prospect Expressway and the Brooklyn-Queens Expressway
Traffic volume changes along the Gowanus Expressway Weave would vary by direction and time of day, with relatively small increases in traffic westbound and small decreases in traffic eastbound. The highest changes in traffic volumes would occur during the off-peak periods when congestion is lower.

Speeds along the Gowanus Expressway between the Prospect Expressway and the Brooklyn-Queens Expressway would increase eastbound or decrease westbound up to about 0.1 mph during any hour of the day, with most hours showing no change in speed.

4. Gowanus Expressway at 92nd Street
Traffic volume changes along the Gowanus Expressway at 92nd Street would vary by direction and time of day, with small increases in westbound traffic and small decreases in eastbound traffic. The highest changes in traffic volumes would occur during the off-peak periods when congestion is lower.

Speeds along the Gowanus Expressway at 92nd Street would increase eastbound or decrease westbound up to about 0.1 mph during any hour of the day, with most hours showing no change in speed.

5. Staten Island Expressway
Traffic volume changes along the Staten Island Expressway at Mosel Avenue would vary by direction and time of day, with small increases in westbound traffic and small decreases in eastbound traffic. The highest changes in traffic volumes would occur during the off-peak periods when congestion is lower.

Currently, during the AM peak hour, the SIE is heavily congested and operates at a very low level of service. A relatively small decrease in traffic volumes during the AM peak hour may result in better traffic flow and thus better travel speeds. Speeds along the Staten Island Expressway at Mosel Avenue may increase eastbound or decrease westbound less than 0.1 mph during any hour of the day, with most hours showing no change in speed.

IV. Annual Vehicle Miles Traveled (VMT)
The total VMT was calculated by adding the trip length of all vehicles using the VNB and the Trans-Hudson crossings. The change in the VMT between one-way tolling and two-way tolling is a measure of system performance and an indication of potential effect on regional air quality. A decrease of VMT is considered a positive effect and an increase of VMT is considered a negative effect.
Eastbound trips are expected to normalize, with motorists no longer traveling out of the way to use the VNB in the non-tolled direction resulting in shorter travel distances and travel times during most hours of the day. Westbound trips are expected to experience slightly longer travel distances most hours of the day as motorists weigh longer distances vs. longer travel times travelling through congested Manhattan streets. During the off-peak late-night hours, both eastbound and westbound trips have slightly higher VMTs due to an increased willingness to travel further distances to save money on tolls when roadways are generally uncongested.

Under two-way tolling at the VNB, it is estimated that there would be a net daily reduction of about 45,000 VMT on an average weekday, with VMT decreasing 62,000 eastbound and increasing by 17,000 westbound. The annualized net reduction in VMT is projected to be approximately 16 million vehicle-miles. The change in VMT would be small (less than 1 percent) in both directions.

V. Revenue

Overall, it is expected that the change to two-way tolling on the VNB would increase annual TBTA toll revenue by approximately $12.3 million.\(^3\) The potential revenue effect at the other TBTA facilities would be small, with a minor revenue increase at the Queens-Midtown Tunnel (QMT) and minor revenue reductions at the Hugh L. Carey Tunnel (HCT) and the Bronx-Queens crossings. The change in revenues does not account for capital, operating, and maintenance costs that may be incurred by TBTA if two-way tolling is implemented at the VNB.

In addition to the direct impacts associated with the proposed changes to VNB tolling, potential diversions to or from the VNB would affect traffic volumes and revenues at the PANYNJ’s three Staten Island bridges and at the three Trans-Hudson crossings. Overall, PANYNJ revenues would likely increase by a small amount because some vehicles projected to divert from the VNB would also divert from the PANYNJ Staten Island Bridges which offer some customers a discounted commuter toll rate not available at the PANYNJ Trans-Hudson crossings.\(^4\)

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\(^3\) The VNB would gain about $12.4 million in annual revenues while the other TBTA facilities are projected to lose about $0.1 million in annual revenues, resulting in a net gain of about $12.3 million in annual revenues.

\(^4\) Some loss of traffic may occur due to a shift to mass transit or the elimination or consolidation of trips. This would have the effect of reducing eastbound diversions (and net revenue gains) at PANYNJ facilities slightly.