

## CHAPTER V – EVALUATION AND COMPARISON OF ALTERNATIVES

This Design Report concentrated on the geometric, operational and safety issues in the project area and the operational problems related to the SB MDE off-ramp to E. 138<sup>th</sup> Street (Exit 3). As discussed in Section III.C, the alternatives initially identified to address the project's goals and objectives included:

- (1) the **No-Build/Maintenance Alternative (No-Build)**, which would provide for continued highway maintenance, but with increasing amounts of maintenance time and money needed to keep the facility open to traffic and no improvements in the highway's operations or safety;
- (2) the **Rehabilitation Alternative**, which would include the following upgrade elements:
  - Providing standard width travel lanes, left and right shoulders and median;
  - Lengthening the southbound acceleration lane and northbound deceleration lane of the Macombs Dam Bridge/E. 153<sup>rd</sup> Street on- and off-ramps;
  - Providing a northbound auxiliary lane between the entrance from E. 138<sup>th</sup> Street and the exit to E. 149<sup>th</sup> Street; and
  - Minor widening of portions of the MDE Viaduct to allow sufficient space to maintain peak-period traffic capacity during construction and minor improvements to shoulder and lane widths, as noted above.

The Rehabilitation Alternative would avoid the need for property acquisition but would not address the most critical problem in this highway segment – the operational and safety problems associated with the Southbound off-ramp to E. 138<sup>th</sup> Street; and

- (3) **Alternatives with Improved E. 138<sup>th</sup> Street SB Off-Ramp**. These three additional alternatives would include all of the elements provided under the Rehabilitation Alternative, but also would also include various levels of improvement to the E. 138<sup>th</sup> Street southbound off-ramp; i.e.:
  - **Alternative #1**, which would replace the existing ramps with a new one-lane off-ramp on the west side of Exterior Street, extending upstream to E. 149<sup>th</sup> Street.
  - **Alternative #2**: This alternative is similar to Alternative 1, but with a southbound auxiliary lane connecting the on-ramp acceleration lane from the Macombs Dam Bridge/E. 153<sup>rd</sup> Street to the deceleration lane for the new off-ramp to E. 138<sup>th</sup> Street. The off-ramp would be widened to two lanes downstream of the ramp gore, and then merge with Exterior Street on the west side of the street, and continue as a three-lane section to the E. 138<sup>th</sup> Street intersection.
  - **Alternative #3**: This alternative would be the same as Alternative #2 with one exception – it would provide a two-lane exit from the highway to better address the weave/merge problems of vehicles exiting at this location.

The assessment of these alternatives supports the following conclusions:

- The No-Action/Maintenance Alternative would address none of the identified needs and is not considered a viable option for NYSDOT.

- The Rehabilitation Alternative would deal with many of the identified problems of the highway’s condition and design while maintaining traffic, but it would not address the key operational and safety problems within the project limits and the effects of the spillback from the southbound E. 138<sup>th</sup> Street off-ramp onto the mainline.
- Alternative #3 is considered to be the preferred design alternative for the E. 138<sup>th</sup> Street off-ramp to supplement the other rehabilitation and operational improvements to the MDE. It would be the most effective in meeting the project’s identified goals and objectives.
- None of the alternatives would correct the capacity limitations of the Exterior Street/E. 138<sup>th</sup> Street intersection that causes this spillback problem. However, Alternative #3’s design of two highway lanes led to a two-lane off-ramp would most effectively deal with the impact of this intersection’s limitation on the ramp and highway operations.

Table V-1 provides a comparison assessment of these various alternatives under the key engineering and environmental impact areas presented in Chapters III and IV. Alternative #2 is not included in this table or analyzed in the Benefit-Cost section below because the projected capital costs of Alternatives #2 and #3 are effectively the same, but Alternative #3’s two-lane exit design would provide additional operational benefits over Alternative #2.

#### Benefit-Cost Analysis

Of the alternatives reviewed in the previous section, only three were considered in the Benefit/Cost (“B/C”) analysis: The Rehabilitation Alternative and two of the Improved E. 138<sup>th</sup> Street Off-Ramp alternatives -- Alternatives #1 and #3, as defined above.

The No-Build/Maintenance Alternative was not considered a viable alternative for B/C analysis in this instance, as it would provide none of the required operational and safety improvements and would not substantially extend the useful life of the highway. Alternative #2 was not considered for the reason mentioned above.

The B/C analysis was developed to further assess the relative value of implementing the more extensive Alternative #3 instead of Alternative #1. These two alternatives were then compared against the Rehabilitation Alternative to assess the merits of the additional improvements associated with Alternatives #1 and #3.

The analyses, which are discussed further in Appendix Y, were completed in accordance with NYSDOT’s Highway User Cost Accounting (HUCA) system and the associated safety benefit procedures in NYSDOT’s Highway Safety Improvement Program Procedures and Techniques. These analyses balance the project’s capital costs against a monetary estimate of the value of two project-related benefits:

- (1) Improvements in traffic operation that lower the total vehicle hours of travel (i.e., travel time savings); and
- (2) Accident reductions related to improvements to roadway geometry, pavement conditions, drainage, signage and appurtenances, etc.

Table V-2 summarizes the results of this assessment.

TABLE V-1 COMPARISON OF IMPACTS OF PROJECT ALTERNATIVES – MDE PROJECT			
Alternatives for Southbound Off-Ramp to E. 138 <sup>th</sup> Street [3]			
	Rehabilitation Alternative	Alternative #1	Alternative #3
<b>Impacts/Benefits [2]</b>	<b>No-Build/Maintenance Alternative</b>		
<b>Description of Work</b>	Continue on-going maintenance / inspection programs of MDE viaduct structure to flag repairs. Rehabilitate mainline viaduct structure and provide structural widening required for staged construction. Replace mainline deck. Improve / eliminate mainline and ramp geometric deficiencies sufficiently to attain the minimum required design standards with the exception of the tie-in point located in the vicinity of the E. 138 <sup>th</sup> Street at the southern terminus. Lengthen SB acceleration and NB deceleration lanes of Macombs Dam Bridge/E. 153rd Street on- and off-ramps Provide approximately 700 ft NB auxiliary lane between E. 138th Street/Gerard Ave. entrance E. 149th Street exit lanes.	All improvements shown under Rehabilitation Alternative would also be included under Alt. #1. Construct new one-lane off-ramp on the west side of Exterior Street and close existing ramp. Extend length of two-lane segment of NB ramp to E. 149 <sup>th</sup> Street to improve ramp storage.	All improvements shown under Rehabilitation Alternative would also be included under Alt. #2. Construct new two-lane off-ramp on the west side of Exterior Street and close existing ramp. Provide new southbound auxiliary lane between entrance from Macombs Dam Bridge/E. 157 <sup>th</sup> Street to new exit to E. 138 <sup>th</sup> Street. Alternative #3 would be the same as Alternative #1, except it would provide a two-lane exit ramp to E. 138 <sup>th</sup> Street and two exit lanes from the SB MDE to the E. 138 <sup>th</sup> Street off-ramp.
<b>Estimated Construction Cost</b>	Not Applicable	\$326 Million <sup>(1)</sup>	\$343 Million <sup>(1)</sup>
<b>Estimated Construction Duration</b>	Not Applicable	40 months	42 months
<b>Impacts During Construction</b>	Partial closures of traffic lanes on MDE and Exterior Street to perform repairs.	All six lanes of traffic on the MDE will be maintained during construction. No detours to local streets. Limited construction performed during Yankee home game days.	All six lanes of traffic on the MDE will be maintained during construction. No detours to local streets. Limited construction performed during Yankee home game days.
<b>Traffic</b>	MDE mainline & ramp operation expected to worsen with increase traffic volumes anticipated in the area.	Under this alternative, ramp storage is projected to be exceeded during peak periods by approximately 2025, after which it would operate similar to existing conditions with substantial spillbacks onto the SB MDE mainline.	Under this alternative, ramp storage, with queues extending onto the auxiliary lane, is projected to be exceeded during peak periods by approximately 2030. Impacts on highway operations from queues would be less than under Alt. #1 due to more storage on the 2-lane ramp and the auxiliary lane and with somewhat reduced weave/merge activity by existing vehicles due to two available exit lanes from the highway.
<b>Safety</b>	No significant changes	By correcting / improving non-standard and non-conforming features on MDE mainline and ramps, traffic safety is anticipated to improve. This alternative will provide moderate safety improvements to the extent that it reduced queuing on the SB mainline from E. 138 <sup>th</sup> St.	By correcting / improving non-standard and non-conforming features on MDE mainline and ramps, traffic safety is anticipated to improve. This alternative will provide more substantial safety improvements relative to Alt. #1 due to wider exit ramp to E. 138 <sup>th</sup> St., provision of SB auxiliary lane and 2-lane exit to new ramp, which will facilitate merging and provide more queuing space for ramp traffic.
<b>Structural Rating</b>	4 - 5 (poor)	7 (like new)	7 (like new)
<b>Right-of Way</b>	Not Applicable	Impacts eight properties (i.e., building, lot and/or access) situated along the west side of Exterior Street between E. 138 <sup>th</sup> Street and E. 150 <sup>th</sup> Street due to reconfiguration of off-ramp and Exterior Street.	Slight increase in impacts to same eight properties impacted under Alternative #1 -- i.e., those situated along the west side of Exterior Street between E. 138 <sup>th</sup> Street and E. 150 <sup>th</sup> Street.
<b>Socio-Economics</b>	No significant impact	Several small businesses may require relocation under this alternative.	Same business relocation as under Alternative #1.
<b>Cultural Resources</b>	Not Applicable	The MDE is in Final List of Nationally and Exceptionally Significant Features of the Federal Interstate Highway System. Required analyses in consultation with SHPO confirm this alternative would have no significant impact on historic elements of MDE.	The MDE is in Final List of Nationally and Exceptionally Significant Features of the Federal Interstate Highway System. Required analyses in consultation with SHPO confirm this alternative would have no significant impact on historic elements of MDE.
<ol style="list-style-type: none"> <li>The construction cost includes improvements described under Rehabilitation Alternatives plus costs of proposed new southbound E. 138<sup>th</sup> Street off-ramp and (under #3) southbound auxiliary lane. Costs are inflated to mid-year of construction and include inspection and ROW costs.</li> <li>No significant impacts under any alternative are projected on air, noise or water quality, visual resources or pedestrian or bicycling networks.</li> <li>Alternative #2 was not included in these analyses because the projected capital costs of Alternatives #2 and #3 were effectively the same, but Alternative #3's two-lane exit design would provide additional operational benefits over Alternative #2.</li> </ol>			

<b>TABLE V-2</b>			
<b>RESULTS OF THE BENEFIT/COST ANALYSIS</b>			
<b>Elements</b>	<b>Alternatives</b>		
	<b>Rehabilitation</b>	<b>Alternative # 1</b>	<b>Alternative # 3</b>
Estimated Construction Costs <sup>(1)</sup>	\$239,000,000	\$275,000,000	\$289,000,000
Annualized Costs <sup>(2)</sup>	\$22,050,312	\$25,371,698	\$26,663,348
Annual Service Benefits	\$0	\$13,062,599	\$17,644,827
Annual Safety Benefits	\$9,632,949	\$11,701,200	\$13,316,136
Total Annual Safety and Service Benefits	\$9,632,949	\$24,763,799	\$30,960,963
Benefit/ Cost Ratio	0.44	0.98	1.16

Notes:

1. Estimated Construction Costs in 2009 dollars.
2. All annualized values in 2012 dollars.

As shown, the B/C ratios for all of the alternatives are below 1.0, except Alternative #3, which indicates that the two areas of estimated benefits -- future accident reduction and reduced travel time -- translated into monetary terms, would be less than the project's capital costs in the case of the Rehabilitation Alternative and Alternative #1. However, the following factors must be considered in reviewing these results:

- The need to widen the MDE Viaduct to provide sufficient width to maintain six lanes of peak period traffic during construction increases the cost of the Rehabilitation Alternative to approximately \$239M. This action would provide some accident reductions (due to new grooved wearing surface, improved lane delineation, etc.). However, there would be no measurable reduction in recurrent peak period congestion; although, the highway's greater width and full shoulders would reduce delays associated with *incident* congestion (i.e. accidents and breakdowns).
- For the B/C analysis for a major highway project, the factor that typically provides the bulk of the benefits is travel time savings. The proposed alternatives address the effects of the delay on the mainline and ramp caused by the spillback of traffic from the SB MDE off-ramp to E. 138<sup>th</sup> Street by providing greater ramp storage space and/or auxiliary lane to separate queued and moving traffic. However, neither can address the underlying cause of the delay -- the limitation of the E. 138<sup>th</sup> Street/Exterior Street intersection.
- The results of the traffic simulation confirm that Alternative #3 (Preferred Design Alternative) would effectively shift this uncorrected ramp-related delay from the mainline to the off-ramp, increasing ramp delay and reducing highway delay. While some net travel time savings would result, major timing savings in this portion of the overall MDE network are not possible until conditions at the diamond interchange at E.138<sup>th</sup> Street (which also causes delays for exiting northbound traffic farther south) are addressed.

- The MDE Project is presently at a relatively conceptual design stage. The estimated construction costs for the three alternatives differ by only 21% from the lowest (Rehabilitation Alternative) to the highest (Alternative #3). Given the uncertainty of plus-or-minus 20% or higher normally assumed for cost estimates at this preliminary design stage, the approximate capital costs of the three alternatives are all very similar. This is particularly true for the costs of Alternatives #1 and #3, which are within 5% of each other and therefore virtually the same. However, the operational and safety benefits under the three alternatives are considerably different, especially between the Rehabilitation Alternative and Alternatives #1 and #3 (refer to Figure V-1).

Annual Costs & Benefits of MDE Alternatives (2012 dollars)

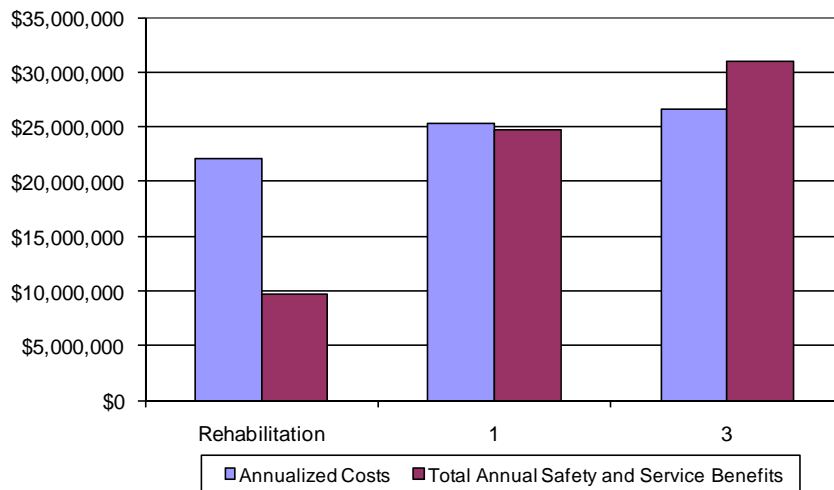


FIGURE V-1

- Given this, the decision of whether to do the minimum required Rehabilitation Alternative or either Alternative #1 or #3 is relatively straightforward.
  - o The Ratio of the difference in benefits to the difference in costs between Alternative #1 and the Rehabilitation Alternative is 4.6 (i.e., a shift from the Rehabilitation Alternative to Alternative #1 would increase benefits 4.6 times more than it would increase project costs).
  - o The added benefits of a shift from Alternative #1 to Alternative #3 would be 4.8 times more than the increase in costs.
- When the annualized costs and benefits are examined, they show very little change in costs between the alternatives. Between the Rehabilitation Alternative and Alternative #1, there is a 15% increase in annual costs but a 157% increase in annual benefits. Alternative #1 would clearly be more cost-effective than the Rehabilitation Alternative. Similarly, the very small (5%) change in cost and 25% increase in benefits support Alternative #3 over Alternative #1.

These studies further confirmed that:

- (1) Alternative #1 and #3 would provide considerable benefits for a relatively small increase in overall project costs;
- (2) The additional safety and travel time savings benefits that Alternative #3 would provide further support its selection as the preferred design alternative; and
- (3) Alternative #3 provides monetary benefits greater than the monetary costs, as indicated by the B/C ratio of 1.16 for this alternative.