





## Evaluation of Alternatives

### What's in Chapter 5?

This chapter compares the alternatives and their uses in addressing capacity issues in an urban corridor. Analysis of each alternative is based on a detailed review of its operational performance, environmental impacts, cost effectiveness, implementation level, and advantages and disadvantages. A comparison section, including a table and graphic, allows for an at-a-glance comparison of all the alternatives. The chapter concludes with a recommendation of alternatives retained for further study in the FEIS that will best address congestion in the 14<sup>th</sup> Street Bridge Corridor with minimal or no impacts to the environment while meeting the Purpose and Need of the project.

### 5.1 Introduction

A wide range of alternatives that reduced vehicular trips and provided low-cost/high-benefit type improvements that met the purpose and need of this project were analyzed. During the alternative development process, attention was given not only to highway improvements that will improve safety and reduce congestion, but also to multi-modal alternatives that will improve mobility. Attention was also given to demand management alternatives that will reduce or redistribute trips and to system management alternatives that allow existing capacity to better accommodate traffic.

The purpose of this chapter is to select an operationally efficient and economically feasible alternative (or alternatives) to be retained for further study in the FEIS that improve safety, mobility, and congestion in the Corridor, with minimal impacts to the environment. This includes an evaluation of the combined effects of each performance measure listed below on the nine action alternatives and eight management alternatives.

- Operational Performance
- Level of Environmental Impacts
- Cost Effectiveness
- Implemental Level

It continues with a discussion of the advantages and disadvantages of each alternative, including the application of sustainability, and livability principles followed by the recommendation of the

alternatives(s) retained for further study in the FEIS. It concludes with a discussion of funding availability and opportunities.

**Table 5.1** includes a summary of evaluation results for action and management alternatives. **Figures 5.1** and **5.2** provide a graphical comparison of results. It highlights the most preferred, moderately preferred, and least preferred alternatives based on evaluation results. A discussion of these results is included in the next few pages.

### 5.2 Operational Performance

A total of nine system and local level measures of effectiveness were identified to analyze traffic operations for highway and transit action alternatives as part of the Level 3 screening process described in Chapter 3. Since there are a limited number of opportunities to see a significant improvement in performance by way of increasing capacity in the Corridor, opportunities to increase person throughput and vehicle miles traveled (VMT) were analyzed. Consequently, the VMT and person throughput will be the focus of an evaluation on operational performance. The VMT was selected to compare impacts of action and management alternatives. As one might expect, the demand management alternatives that involve reducing travel demand result in a reduction of VMT, while the action alternatives result in an increase of VMT. The system management alternatives result in no change to VMT. Person throughput was selected to see the benefits of adding transit alternatives. The total system delay measure will be the focus of an evaluation on costs and benefits to be discussed later in this chapter.

#### 1) Total VMT

Aggregate measure of the total miles traveled throughout the study area roadway network measured for the duration of the simulation run.

#### 2) Estimated Screenline Person Throughput

The total throughput measure on the 14<sup>th</sup> Street Bridges measured for the duration of the simulation run.

#### 3) Total System Delay (Hours)

Aggregate measure of the total hours vehicles are delayed throughout the study area roadway network measured for the duration of the simulation run.

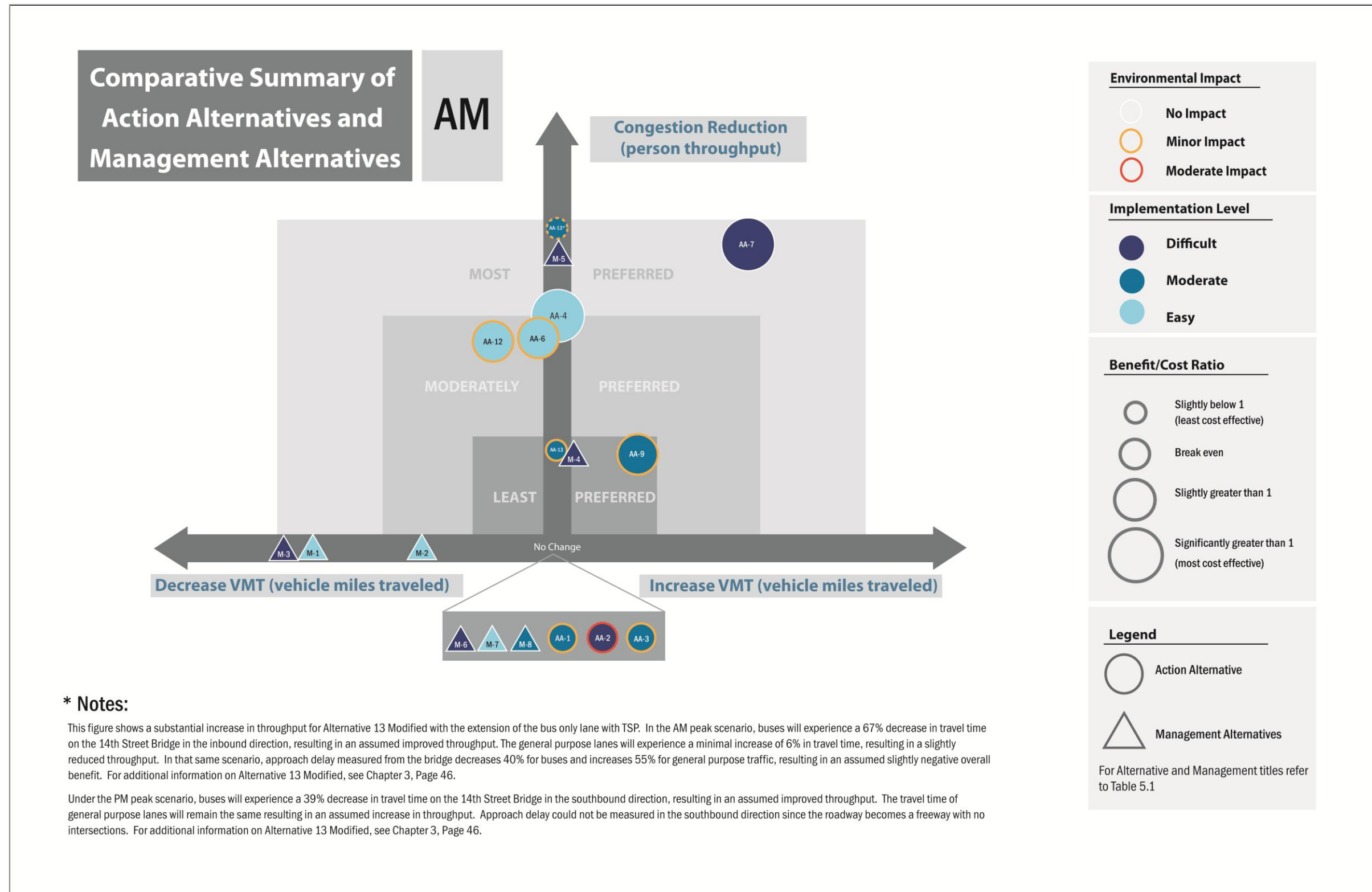
### Bicycle/Pedestrian Alternatives Carried Forward After Level 3 Screening

The VMT and person throughput values were selected from VISSIM output. Bicycle/Pedestrian Action Alternatives 1, 2, and 3 were not included in the VISSIM analysis since they were not part of the existing or proposed roadway network. They are, however, part of a large bicycle and pedestrian network in the study area, so the alternatives in this study address their mobility by including proposed improvements that connect missing gaps in the network where facilities do not exist. Therefore, it was assumed for this evaluation that vehicle throughput and VMT will not change.

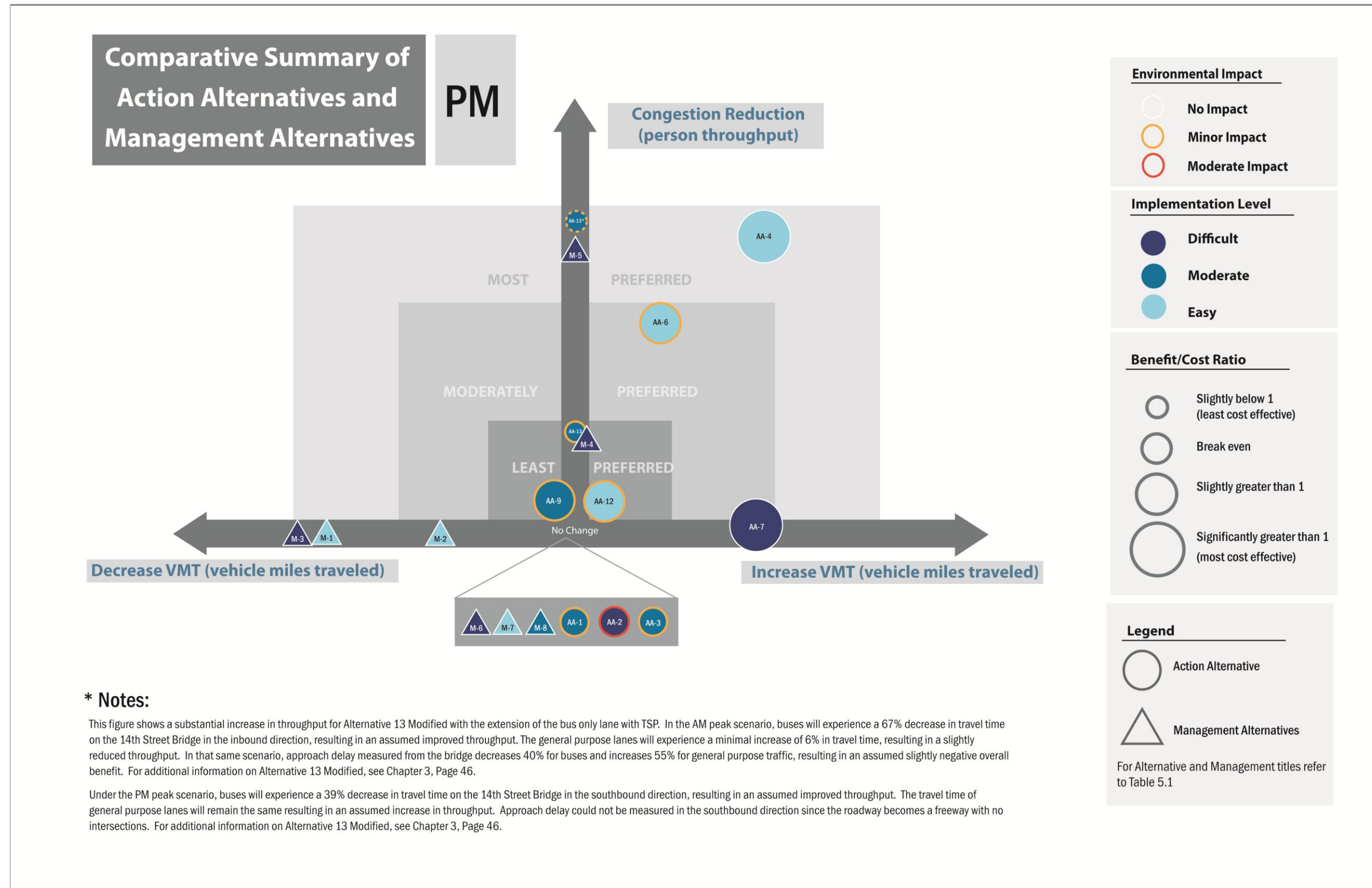
**Table 5.1 Summary of Evaluation Results for Action and Management Alternatives**

Action Alternatives	Mainline Congestion (Level of Improvement)		Environmental Impacts	Benefit / Cost Ratio	Implementation	Management Alternatives	Mainline Congestion (Level of Improvement)		Environmental Impacts	Benefit / Cost Ratio	Implementation
	*VMT Difference AM/PM	*Person Throughput Difference (Critical Direction) AM/PM					**Natural	***B/C Ratio			
<b>Bicycle / Pedestrian Alternatives</b>											
<b>Alternative 1</b> Improve bicycle/pedestrian access to the Mason Bridge	None	None	Minimal	0 (No congestion reduction benefits)	NPS, DDOT, DC HPO, VDHR, USACE	<b>Management Alternative 1</b> Expand, Formalize and Increase Incentives for Telecommuting	Substantial -168,000	No Change	None	N/A	MWCOG Federal Agencies, Local Government and Private Sector Employers
<b>Alternative 2</b> Construct bicycle/pedestrian crossing Potomac River	None	None	Moderate	0 (No congestion reduction benefits)	NPS, DDOT, Arlington Co, DC HPO, VDHR, USFWS, NMFS, USACE	<b>Management Alternative 2</b> Increase Flexible Work Hours/Compressed Work Hour Programs	Substantial -16,000	No Change	None	N/A	MWCOG Federal Agencies, Local Government and Private Sector Employers
<b>Alternative 3</b> Create integrated bicycle system	None	None	Minimal	0 (No congestion reduction benefits)	NPS, Arlington Co, , DDOT, VDOT, DoD, DC HPO, VDHR	<b>Management Alternative 3</b> Implement Parking Management Strategies	Substantial -674,000	No Change	None	N/A	MWCOG Federal Agencies, Local Government and Private Sector Employers
<b>Highway Alternatives</b>	<b>VMT Difference AM/PM</b>	<b>Person Throughput Difference (Critical Direction) AM/PM</b>	<b>Natural</b>	<b>B/C Ratio</b>	<b>Agencies Requiring Coordination</b>	<b>Management Alternative 4</b> Integrate Incident Management System	None	Minimal	None	N/A	MWCOG, MATOC DDOT, VDOT, NPS, FHWA, DC HPO, VDHR
<b>Alternative 4</b> Construct improvements at I-395 & 9th St.	None/ Moderate -209 AM/ 5,361 PM	Moderate/ Substantial 2,168 AM/ 3,045 PM	None	>>1 (Most cost effective)	DDOT, FHWA	<b>Management Alternative 5</b> Establish a Corridor Manager	None	Minimal	None	N/A	MWCOG, MATOC DDOT, VDOT, NPS, FHWA
<b>Alternative 6</b> Reduce I-395 access points at Boundary Channel Drive	None/ Minimal 549 AM/ 2,346 PM	Moderate/ Moderate 2,837 AM/ 2,059 PM	Minimal	>1 (Somewhat cost effective)	VDOT, NPS, Arlington County, DC HPO, VDHR, USACE	<b>Management Alternative 6</b> Provide Real Time Travel Information	None	Minimal	None	N/A	MWCOG, MATOC DDOT, VDOT, NPS, FHWA, DC HPO, VDHR
<b>Alternative 7</b> Eliminate turn movements at 14th St and C St intersection	Moderate/ Moderate 8,894 AM/ 7,472 PM	Substantial/ None 10,770 AM/ 125 PM	None	>>1 (Most cost effective)	DDOT, Holocaust Museum, Bureau of Engraving and Printing USDA	<b>Management Alternative 7</b> Develop Driver Education Program	None	None	None	N/A	MWCOG Local Government and Private Sector Employers
<b>Alternative 9</b> Convert shoulders on Rochambeau Bridge to general purpose lanes with additional to NB I-	Minimal/ None 1,506 AM/ 297 PM	Minimal/ None 1,195 AM/ 65 PM	Minimal	>1 (Somewhat cost effective)	DDOT, NPS, DC HPO, VDHR, USACE	<b>Management Alternative 8</b> Implement Signing Modification	None	None	None	N/A	VDOT, DDOT, NPS, DC HPO, VDHR
<b>Alternative 12</b> Construct reversible general purpose lanes in median on Rochambeau Bridge	Minimal (negative)/ Minimal -1,089 AM/ 1,128 PM	Moderate/ Minimal 2,120 AM/ 326 PM	Minimal	>1 (Somewhat cost effective)	DDOT, VDOT NPS, DC HPO, VDHR						
<b>Transit Alternatives</b>	<b>VMT Difference AM/PM</b>	<b>Person Throughput Difference (Critical Direction) AM/PM</b>	<b>Natural</b>	<b>B/C Ratio</b>	<b>Agencies Requiring Coordination</b>						
<b>Alternative 13</b> Construct bus only lanes on inside shoulders of Rochambeau Bridge	None/ None -331 AM/ 196 PM	Minimal/ Minimal 802 AM/ 370 PM	Minimal	< 1 (Least Cost Effective)	DDOT, VDOT, Arlington County, Transit Agencies, NPS, DoD, DC HPO, VDHR, USACE						

\* See Chapter 3 for methodology used to determine Mainline Congestion (Level of Improvement) \* See Chapter 4 for methodology used to determine Environmental Impacts \*\*\* See Table 6.4 for methodology used to determine B/C Ratio



**FIGURE 5.1 – COMPARATIVE SUMMARY OF ACTION ALTERNATIVES AND MANAGEMENT ALTERNATIVES – AM**



**FIGURE 5.2 – COMPARATIVE SUMMARY OF ACTION ALTERNATIVES AND MANAGEMENT ALTERNATIVES – PM**

### Highway Alternatives Carried Forward After Level 3 Screening

Figures 5.1 and 5.2 depict a graphical relationship between VMT and person throughput for each of the highway alternatives for AM and PM periods. Since the Level 3 screening results in the elimination of highway alternatives that perform poorly, none of the alternatives result in overall negative person throughput. Alternative 7 shows the highest overall increases in VMT and person throughput on the 14<sup>th</sup> Street Bridge, particularly in the inbound direction during the AM peak period. Other alternatives showing moderate increases in person throughput and little to no change in VMT during the AM peak period were Action Alternatives 4 and 6. Moderate to maximum increases in throughput were experienced in the outbound direction during the PM peak period with minimal to moderate increases in VMT. In the outbound direction, however, a minimal decrease throughout was experienced during the AM peak period due to the complexity of diverge areas approaching 14<sup>th</sup> Street Bridge. The remaining highway alternatives (Action Alternatives 9, 12) show no to minimal increases in VMT and no to moderate improvements in person throughput. Although they add capacity to the 14<sup>th</sup> Street (Rochambeau Bridge), the lanes must terminate in the heavily traveled 14<sup>th</sup> Street Corridor.

### Transit Alternatives Carried Forward After Level 3 Screening

For the transit alternative (Action Alternative 13: Bus Only Lane), a slight decrease in VMT is shown for the combination of bus lanes and adjacent general purpose lanes. This is a result of the proposed configuration of the bus only lane which merges with general purpose traffic as it approaches 14<sup>th</sup> Street in the northbound direction. Again, although it adds capacity to the 14<sup>th</sup> Street (Rochambeau Bridge), the bus only lane must terminate in the heavily traveled 14<sup>th</sup> Street Corridor.

In an effort to improve the results the bus only lane was modified to include an extension of the bus only lane on 14<sup>th</sup> Street north of the bridge with transit signal priority (TSP) treatments at signalized intersections. Figure 5.1 shows a substantial increase in throughput for Action Alternative 13 Modified in the AM peak. In the AM peak scenario, buses will experience a 67 percent decrease in travel time on the 14<sup>th</sup> Street Bridges in the inbound direction, resulting in an assumed improved throughput. The general purpose lanes will experience a minimal increase of six percent in travel time, resulting in a slightly reduced throughput. In that same scenario, approach delay measured from the bridge decreases 40 percent for buses and increases 55 percent for general purpose traffic, resulting in an assumed slightly negative overall benefit.

Under the PM peak scenario for Alternative 13 Modified, buses will experience a 39 percent decrease in travel time on the 14<sup>th</sup> Street Bridge in the southbound direction, resulting in an assumed improved throughput. The travel time of general purpose lanes will remain the same resulting in an assumed overall increase in throughput. Approach delay could not be measured in the southbound direction since the roadway becomes a freeway with no intersections.

A dedicated bus lane is expected to increase the ridership of buses based on studies of service elasticity. *Service elasticity* refers to transit ridership increases or decreases in response to an increase or reduction in

transit vehicle-mileage, vehicle-hours, or frequency. Factors that affect service elasticities include transit dependent populations, population and employment density, and bus speed, all of which exist within the study area. Research shows that transit ridership could increase by 0.5 percent to 0.7 percent with a one percent improvement in transit service (measured in vehicle miles or vehicle hours). The addition of an exclusive bus only lane on the 14<sup>th</sup> Street Bridges will have a positive effect on bus ridership in the Corridor. Additional study is needed of this alternative to verify assumptions for ridership increases. For additional information on Action Alternative 13 Modified, see Chapter 3, Page 46.

### Management Alternatives Carried Forward After Level 3 Screening

Management alternatives that involve the reduction of trips are telecommuting, flexible work hours, and parking management options (Management Alternatives 1, 2, and 3). They result in substantial decreases in VMT in ranges from 16,000 to 674,000 as shown in Table 5.2. Person throughput will decrease with these management alternatives according to average daily vehicle trip reductions reflected in the Table 5.2 below.

**Table 5.2  
Management Strategy Reduction Summary**

Management Strategy	Average Daily Vehicle Trips Reduction	Average Daily Vehicle Miles Reduction
Telecommuting	8,900	168,000
Flexible Work Hours	850	16,000
Parking Management	35,600	674,000

In the case of management alternatives that address incident management strategies (Management Alternatives 4 and 5), minimal increases in throughput were assumed as a result of proposed improvements that could reduce the response time for removal of an incident.

Some of the management alternatives involve improvements to traveler information and signing (Management Alternatives 6, 7, and 8). These alternatives improve mobility in the Corridor but are not expected to increase throughput across the bridge.

### Summary

Action Alternatives 4 and 7 operate at a higher level of operational efficiency when compared with other highway and transit alternatives since they achieve the greatest increases in VMT and person throughput on the bridge. Although these alternatives increase VMT, there are no impacts to air quality. There is an opportunity to show significant improvement in operational efficiency in the Corridor with the selection of Action Alternative 13 Modified, however, more study is required.

Management Alternatives 1, 2, and 3 will result in the most substantial decrease in VMT.

### 5.3 Level of Environmental Impacts

Several of the resources within the study area will not be impacted by any of the alternatives (Table 5.3). None of the alternatives will impact land use, wetlands, air quality, noise, greenhouse gas emissions, environmental justice areas, archaeological resources, hazardous waste sites, or aesthetics and viewsheds within the study area. In addition, there will be no residential, business, or community facility displacements. Though there are impacts to right-of-way, socioeconomic, cultural, and natural resources, none of them are considered significant.

#### Bicycle/Pedestrian Alternatives

Bicycle/Pedestrian Action Alternatives 1 and 2 result in impacts on adjacent right-of-way, Section 4(f), parklands, historic properties, streams, floodplains, rare, threatened or endangered (RTE) species, and trees (Table 5.3). Action Alternative 2, the Bicycle/Pedestrian Bridge, has the greatest number of impacts of all the action alternatives. Resources that are impacted include Section 4(f) properties (4), historic properties (2), streams (4.45 acres), parklands (2.60 acres), floodplains (2.42 acres), RTE's (1), and trees (32). Impacts were experienced on similar resources identified in Action Alternative 2, but to a lesser extent for Action Alternatives 1.

#### Highway and Transit Alternatives

There are no environmental impacts associated with Action Alternatives 4 and 7. Minor impacts on adjacent right-of-way, Section 4(f), historic properties, parklands, and floodplains are associated with Action Alternatives 6, 9, and 12 as shown in Table 5.3.

Similarly, minor impacts are associated with transit alternative, Action Alternative 13. They were identified as adjacent right-of-way (1.41 acres), Section 4(f) resources (2), parklands (0.79), floodplains (0.22), and trees (9) as shown in Table 5.3.

#### Management Alternatives

The management alternatives will have minimal to no impact on study area resources. There is, however, the potential to experience significant VMT and travel time reductions with telecommuting and parking management alternatives.

#### Summary

It is apparent that highway alternatives, Action Alternatives 4 and 7 offer the greatest benefit by avoiding impacts to environmental resources while increasing person throughput. Other highway alternatives (Action Alternatives 6, 9, and 12) and the transit alternative (Action Alternative 13) experience minor impacts to socioeconomic, cultural, and natural resources.

Bicycle/pedestrian action alternatives impact more resources than highway and transit action alternatives, yet there is no assumed increase in person throughput. In the cases of right-of-way, stream, and floodplain impacts, the bicycle/pedestrian bridge (Alternative 2), experiences more impacts than highway and transit impacts combined.

**Table 5.3  
Summary of Environmental Impacts**

Resource	No-Action	AA-1	AA-2	AA-3	AA-4	AA-6	AA-7	AA-9	AA-12	AA-13
Total Limit of Disturbance (Acres)	0	0.72	9.81	0	0	5.08	0	1.29	0.77	1.41
<b>Socioeconomic/Cultural Impacts</b>										
Section 4(f) Use (No.)	0	4	4	0	0	2	0	2	2	2
Adversely Affected National Register of Historic Places (NRHP) Properties (No.)	0	2	2	0	0	1	0	1	1	1
<b>Natural Environmental Resources</b>										
Parklands (Acres)	0	0.72	2.60	0	0	2.44*	0	0.61	0.18	0.79
Streams (Acres)	0	0	4.45	0	0	0	0	0	0	0
Floodplains (Acres)	0	0.31	2.42	0	0	0.02	0	0.12	0	0.22
Rare, Threatened, and Endangered Species (No.)	0	0	1	0	0	0	0	0	0	0
Trees (No.)	0	9	32	0	0	21	0	13	0	9

\*With Action Alternative 6, approximately 0.65 acre that is currently transportation use will be converted back into parkland.

Action Alternatives:

AA-1: Improve bicycle and pedestrian access to the Mason Bridge by making improvements at each end of the bridge

AA-2: Construct separated bicycle/pedestrian crossing of the Potomac River and add a grade-separated bicycle crossing of GWMP as proposed by Arlington County

AA-3: Create integrated (DC-VA-NPS) bicycle system, including signing for commuters and other destination bikers

AA-4: Construct geometric improvements at I-395 & 9<sup>th</sup> St

AA-6: Reduce I-395 access points at Boundary Channel Drive

AA-7: Eliminate turn movements at 14<sup>th</sup> Street and C Street intersection

AA-9: Convert shoulders on Rochambeau Bridge to general purpose lanes with additional lane to NB I-395

AA-12: Construct reversible general purpose lanes in median on Rochambeau Bridge (include potential moveable barrier or overhead markings)

AA-13: Construct bus lanes between Pentagon Transit Center and 14<sup>th</sup> St at Independence Ave using inside shoulders on Rochambeau Bridge

### 5.4 Cost Effectiveness

Table 5.4 summarizes the cost analysis for highway and transit action alternatives. Total VMT, person throughput, and system delay changes were used to calculate the following critical measures for each alternative.

- Value of time saved per day system-wide
- Cost per hour of delay reduction
- Cost per unit of VMT change
- Value of time saved per person per day
- Daily delay reduction per person
- Benefit Cost Ratio – Value of time saved per dollar of cost

### Bicycle/Pedestrian Alternatives

The total costs were computed for bicycle/pedestrian Action Alternatives 1, 2, and 3; however, no critical measures can be calculated. As previously discussed in operational performance, the bicycle/pedestrian action alternatives were not included in the VISSIM analysis since they are not part of the existing or proposed roadway network. A future study should be performed that determines the operational efficiency and cost effectiveness of the proposed bicycle and pedestrian improvements. In addition it is recommended that the future study determine what percent of travelers might shift from automobiles to bicycle and pedestrian modes if the network included the proposed bicycle and pedestrian improvements.

### Highway and Transit Alternatives

The value of time saved per day range from \$3,298/day to \$34,187/day measured over the entire system (**Table 5.4**, Column G). Higher values are projected for Action Alternatives 4 and 7. When comparing Action Alternatives 9 and 12, which involve the addition of a general purpose lane in the median of the 14<sup>th</sup> Street Bridge, Action Alternative 9 generates greater value of time savings than Action Alternative 12, although it costs more to construct. This is because capacity added in the median of the bridge in both directions reduces delay. Action Alternative 12 adds capacity in the median but only in the peak direction during the peak period yielding less reduction. Action Alternative 13 actually increases delays experienced when the bus only lane merges with general purpose traffic.

The project cost per hour saved ranged from about \$0.02 to almost \$6.00 (**Table 5.4**, Column H). These savings can be compared to the value of one hour of commuting saved which has been estimated to be \$17 per hour. Action Alternatives 4 and 7 have the lowest cost per hour saved of \$0.02. This means they only need a small financial investment to achieve a high reduction in system delay. Comparing Action Alternatives 9 and 12, there is only a \$1.50 difference between them with the higher cost per hour of delay reduced for Action Alternative 12, although this is the lower cost alternative. Action Alternative 13 yields a negative benefit, when factoring in the effects of the impacts to general purpose traffic that are adjacent to bus only lanes.

The cost per change in VMT ranges from a fraction of a cent to almost \$8.00 (**Table 5.4**, Column I). Again, Action Alternatives 4 and 7 require the lowest financial investment to produce the highest benefit for each alternative. Action Alternative 12 has a significantly higher cost per VMT change than Action Alternative 9 due to a lesser VMT change for Action Alternative 12. Action Alternative 13 experiences a

negative cost per VMT change since the overall change in VMT is negative, again noting that a negative change is experienced because of the merge of the bus only lane with general purpose traffic.

An important measure is the value of a commuters time saved (**Table 5.4**, Column J). When dividing the value of time saved by the total person throughput in the system, Action Alternatives 4 and 7 result almost equal returns of \$0.40 and \$0.38 per person, respectively. Action Alternative 12 yields a low return of \$0.05 per person. Action Alternative 13 results in a near zero savings. Results for the daily delay reduction per person are consistent with above values. While Action Alternatives 4 and 7 show higher reductions of 1.41 minutes and 1.36 minutes respectively, Action Alternative 12 yields a low rate of 0.16 minutes saved and Action Alternative 13 yields a no reduction in delay.

The benefit-cost ratio shows the value of time saved for each dollar of project cost. It ranges from -0.56 to 843 (**Table 5.4**, Column K). Higher ratios of \$843 and \$826 are demonstrated by Action Alternatives 4 and 7, while low ratios are shown by Action Alternatives 9 and 12. Action Alternative 13 generates a negative ratio, which is the project cost exceeds the value of time savings.

When analyzed, Action Alternative 6 fell between higher ranking Action Alternatives 4 and 7 and lower ranking Action Alternatives 9 and 12 for each category of measures. It experienced minimal cost per hour saved (\$1.41) and cost per VMT change (\$0.19), but it did not make the top three for value of time saved (\$0.08) and daily delay reduction per user (0.30). The Benefit-Cost Ratio ranked third after Action Alternatives 4 and 7 but much lower at twelfth.

### Management Alternatives

Management alternatives were not analyzed for their cost-effectiveness since information needed on their capital and annual costs specific to the 14<sup>th</sup> Street Bridge Corridor is not available. Additional study is needed to determine these costs for each of the management alternatives. In some cases the program will have to apply to areas beyond the study corridor and the cost-effectiveness will be evaluated on a larger geographic area than the study corridor.

For this study it is assumed that the management alternatives are not being analyzed for comparison with action alternatives, but they could be implemented with any of the alternatives retained for further study in the FEIS to maximize congestion reduction in the study area.

### Summary

Action Alternatives 4 and 7 are more cost effective when compared with other action alternatives. In each case the investment of \$1 in project cost yields over \$800 in benefits to persons using the Corridor. By contrast, Action Alternatives 6, 9, and 12 yield \$12, \$4, and \$3 of benefit for each dollar of project cost. Action Alternative 13 losses \$0.56 for each dollar of project cost making this alternative least cost effective of the build alternatives.

**Table 5.4  
Summary Cost Analysis**

Column	A	B	C	D	E	F	G	H	I	J	K	L
Cost Measures												
Cost Measures	Period	Total Construction Costs	System Delay Reduction per day (Hours)	Change in VMT	Total Throughput (persons) <sup>(3)</sup>	Daily Cost	Value of Time Saved per Day	Daily Cost per Hour of Delay Reduction	Daily Cost per unit of VMT Change	Value of Time saved per day per person	Daily Delay Reduction per Person (Minutes)	Benefit/ Cost from Delay Reduction
Formulas						$B / 5000^{(1)}$	assumes savings of \$17 <sup>(2)</sup> per hour * C	F / C	F / D	G / E	C *60 / E	G / F
AA-4	AM		714	(209)	35,059							
	PM	\$ 185,055	1085	5361	41,687	\$37.01	\$30,583.00	\$0.021	\$0.0072	\$0.40	1.41	826
AA-6	AM		131	549	37,750							
	PM	\$ 2,701,981	251	2346	38,859	\$540.40	\$6,494.00	\$1.42	\$0.1867	\$0.08	0.30	12
AA-7	AM		1095	8894	43,803							
	PM	\$ 202,800	916	7472	45,087	\$40.56	\$34,187.00	\$0.020	\$0.0025	\$0.38	1.36	843
AA-9	AM		274	1506	34,606							
	PM	\$ 12,583,735	299	297	37,365	\$2,516.75	\$9,741.00	\$4.39	\$1.3959	\$0.14	0.48	4
AA-12	AM		44	(47)	35,461							
	PM	\$ 5,711,828	150	196	36,966	\$1,142.37	\$3,298.00	\$5.89	\$7.6669	\$0.05	0.16	3
AA-13	AM		(45)	(331)	34,201							
	PM	\$ 5,300,000	10	196	36,930	\$1,060.00	(\$595.00)	(\$30.29)	(\$7.8519)	(\$0.01)	(0.03)	(0.56)

All information in 2010 Dollars

Parentheses denotes negative

 Highlights top three values

1. The cost per day is calculated for a duration of 20 years. The total number of days is the product of 20 years by 250 work days. Work days reflect 50 work weeks at 5 work days per week.
2. Value of time saved per day is estimated by assuming a savings of \$17, 1/2 of the average hourly wage earned by workers in the region, for every hour saved while traveling during the peak periods.
3. Total throughput measured on the 14<sup>th</sup> Street Bridge.

Action Alternatives:

AA-4: Construct geometric improvements at I-395 & 9<sup>th</sup> St

AA-6: Reduce I-395 access points at Boundary Channel Drive

AA-7: Eliminate turn movements at 14th Street and C Street intersection

AA-9: Convert shoulders on Rochambeau Bridge to general purpose lanes with additional lane to NB I-395

AA-12: Construct reversible general purpose lanes in median on Rochambeau Bridge (include potential moveable barrier or overhead markings)

AA-13: Construct bus lanes between Pentagon Transit Center and 14<sup>th</sup> St at Independence Ave using inside shoulders on Rochambeau Bridge

In another option, Action Alternative 13 Modified, the merge was removed by extending the bus only lane with TSP treatments which is anticipated to highly improve performance of the bus only lanes. Although a direct comparison of cost savings cannot be performed with other build alternatives at this time due to limited data, it is assumed that the benefits outweigh the cost, resulting in benefit cost ratio of one or greater. It is recommended that a future cost savings analysis be performed to account for substantial reductions in travel time for buses and the potential for significant increases to overall person throughput.

### 5.5 Implementation

Implementation refers to the level of complexity required for coordination of activities to advance the alternative to design, build, and implementation stages. It is measured by the number of participating and coordination agencies involved; the greater number, the more difficult implementation is likely to be.

#### Bicycle/Pedestrian Alternatives

Each of the three Bicycle/Pedestrian Action Alternatives identifies the National Park Service (NPS) as the lead agency since each alternative lies in park property. The number of coordination agencies varies among the three alternatives. Action Alternative 2, construct separated bicycle/pedestrian crossing of the Potomac River, involves a greater necessity for coordination between agencies and results in higher degree of difficulty for implementation.

#### Highway and Transit Alternatives

Action Alternative 4 requires the least number of coordination agencies since it lies entirely within the District of Columbia. The lead agency is DDOT and it involves mainly striping, signing, and pavement marking within the District of Columbia. However, the Federal Highway Administration (FHWA) will also be involved since improvements to I-395 are proposed.

Action Alternative 7 is also entirely within the District of Columbia. However, adjacent properties are owned by the Federal government. Coordination for the proposed improvement involving the removal of the left turn lanes on 14<sup>th</sup> Street at C Street includes the US Holocaust Memorial Museum (USHMM) and the U.S. Bureau of Engraving and Printing. The proposed improvement will require that vehicles exiting the USHMM parking lot, planning to travel north, will turn right followed by another right onto a section of road owned by the US Bureau of Engraving, and continue left or right on 15<sup>th</sup> street. FHWA has requested permission from the Bureau for a limited number of vehicles from the USHMM daycare facility to make these movements. Since this situation requires rights for vehicular access from a Federal agency, it is considered a difficult implementation.

Agencies that require coordination for remaining highway and transit alternatives are summarized in **Table 5.1**.

### Management Alternatives

The majority of management alternatives identify MWCOG as the lead agency and DDOT, VDOT, NPS, and FHWA as coordinating agencies. In the case of the parking management system, Management Alternative 3, Federal and local government agencies, as well as private sector employers will participate as coordinating agencies. This alternative is difficult to implement since the Federal government will need to enact new policies to make this happen.

Agencies that require coordination for remaining management alternatives are summarized in **Table 5.1**.

### 5.6 Advantages and Disadvantages

Advantages and disadvantages of each alternative, in terms of operational efficiency, environmental impact, cost effectiveness, and implementation, are shown in **Tables 5.5** through **5.8**, below.

**Table 5.5  
Bicycle/Pedestrian Alternatives Advantages and Disadvantages**

<b>Action Alternative 1: Improve bicycle and pedestrian access to the Mason Bridge by making improvements at each end of the bridge</b>		
<b>Measures</b>	<b>ADVANTAGES</b>	<b>DISADVANTAGES</b>
Operational Efficiency	Improves bicycle accessibility	Does not improve operational efficiency of roadway system
Environmental Impact		Minor impacts to parklands
Cost Effectiveness	Low cost	
Implementation		Moderate implementation
<b>Action Alternatives 2: Construct separated bicycle/pedestrian crossing of the Potomac River; add a grade-separated bicycle crossing of GWMP as proposed by Arlington County</b>		
<b>Measures</b>	<b>ADVANTAGES</b>	<b>DISADVANTAGES</b>
Operational Efficiency	Improves bicycle connectivity	Does not improve operational efficiency of roadway system
Environmental Impact		Moderate impacts to parklands and environmental resources
Cost Effectiveness		Not very cost effective
Implementation		Multiple agency coordination needed to implement.
<b>Action Alternatives 3: Create integrated (DC-VA-NPS) bicycle system, including signing for commuters and other destination bikers</b>		
<b>Measures</b>	<b>ADVANTAGES</b>	<b>DISADVANTAGES</b>
Operational Efficiency	Improves bicycle efficiency	Does not improve operational efficiency of roadway system
Environmental Impact	No environmental impacts	
Cost Effectiveness	Low costs	
Implementation		Multiple agency coordination needed to implement.

**Table 5.6  
Highway Alternatives Advantages and Disadvantages**

<b>Action Alternatives 4: Construct geometric improvements at I-395 &amp; 9th St</b>		
<b>Measures</b>	<b>ADVANTAGES</b>	<b>DISADVANTAGES</b>
Operational Efficiency	Improves person throughput and VMT; Reduces system delay	Increases traffic on local street network
Environmental Impact	No environmental impacts	
Cost Effectiveness	Very cost effective	
Implementation	Easy to implement	
<b>Action Alternatives 6: Reduce I-395 access points at Boundary Channel Drive</b>		
<b>Measures</b>	<b>ADVANTAGES</b>	<b>DISADVANTAGES</b>
Operational Efficiency	Improves person throughput and VMT	Minimally reduces system delay
Environmental Impact		Minor impacts to parklands
Cost Effectiveness	Cost effective	
Implementation	Easy to implement	
<b>Action Alternatives 7: Eliminate turn movements at 14th Street and C Street intersection</b>		
<b>Measures</b>	<b>ADVANTAGES</b>	<b>DISADVANTAGES</b>
Operational Efficiency	Improves person throughput and VMT; Reduces system delay	Eliminates lefts turns for USHMM
Environmental Impact	No environmental impacts	
Cost Effectiveness	Very cost effective	
Implementation		Difficult to implement as it requires vehicular access from federal agency
<b>Action Alternatives 9: Convert shoulders on Rochambeau Bridge to general purpose lanes with additional lane to NB I-395</b>		
<b>Measures</b>	<b>ADVANTAGES</b>	<b>DISADVANTAGES</b>
Operational Efficiency	Reduces system delay	Minimally improves person throughput and VMT; converts shoulders into general purpose lanes
Environmental Impact		Minor impacts to parklands
Cost Effectiveness		Not cost effective
Implementation	Easy to implement	
<b>Action Alternatives 12: Construct reversible general purpose lanes in median on Rochambeau Bridge (include potential moveable barrier or overhead markings)</b>		
<b>Measures</b>	<b>ADVANTAGES</b>	<b>DISADVANTAGES</b>
Operational Efficiency	Improves inbound person throughput in AM and outbound person throughput in PM	Minimally improves VMT and system delay; requires operation of movable barrier system
Environmental Impact		Minor impacts to parklands
Cost Effectiveness		Not cost effective
Implementation	Easy to implement	

**Table 5.7  
Transit Alternatives Advantages and Disadvantages**

<b>Action Alternatives 13: Construct bus lanes between Pentagon Transit Center and 14th St at Independence Ave using inside shoulders on Rochambeau Bridge</b>		
<b>Measures</b>	<b>ADVANTAGES</b>	<b>DISADVANTAGES</b>
Operational Efficiency	Improves person throughput and travel time of buses	Minimally improves VMT and system delay as a result of impacts to general purpose traffic
Environmental Impact		Minor impacts to parklands
Cost Effectiveness		Not cost effective
Implementation		Difficult to implement

**Table 5.8  
Management Alternatives Advantages and Disadvantages**

<b>Management Alternative 1: Expand, Formalize and Increase Incentives for Telecommuting</b>		
<b>Measures</b>	<b>ADVANTAGES</b>	<b>DISADVANTAGES</b>
Operations		Hard to document benefits specific to corridor.
Environmental	Minor to no impacts on the environment.	
Implementation	Existing program in place; Government agencies already participating; Federal law in place requires Federal agencies to have a telecommuting program.	Reluctance of private firms to participate.
<b>Management Alternative 2: Increase Participation in Flexible Work Hours Program</b>		
<b>Measures</b>	<b>ADVANTAGES</b>	<b>DISADVANTAGES</b>
Operations	Reduces traffic congesting by spreading the traffic throughout the day	Hard to document benefits specific to corridor; Lack of more flexible and reliable bus schedule and routes.
Environmental	Minor to no impact on the environment.	
Implementation	Existing program in place; Government agencies already participating	Reluctance of private firms to participate
<b>Management Alternative 3: Implement Parking Management Strategies/Increase Parking Price/Decrease Supply</b>		
<b>Measures</b>	<b>ADVANTAGES</b>	<b>DISADVANTAGES</b>
Operations	Reduces automobile trips by eliminating parking; encourages carpooling	Hard to document benefits specific to corridor; Lack of more flexible and reliable bus schedule and routes.
Environmental	Minor to no impact on the environment.	
Implementation	Existing program in place; Government agencies already participating	Reluctance of government agencies to participate

**Table 5.8 (Cont'd)**  
**Management Alternatives Advantages and Disadvantages**

<b>Management Alternative 4: Integrated Incident Management System</b>		
<b>Measures</b>	<b>ADVANTAGES</b>	<b>DISADVANTAGES</b>
Operations	Improves mobility, efficiency and safety of the corridor by reducing response and clearing times of incidents; reduces probability of secondary crashes	
Environmental	Minimal to no impact on the environment.	
Implementation	Existing program in place; Government agencies already participating	Difficult to coordinate between different jurisdictions.
<b>Management Alternative 5: Strengthen Coordination and Management in Corridor</b>		
<b>Measures</b>	<b>ADVANTAGES</b>	<b>DISADVANTAGES</b>
Operations	Improves mobility, efficiency and safety in the corridor by reducing response and clearing time of incidents; Improves decision making for travelers on routing and mode shifts prior to and during their trip.	
Environmental	Minimal to no impact on the environment.	
Implementation	Existing program in place; Government agencies already participating	Difficult to coordinate between different jurisdictions; driver notification system-will need to be devised.
<b>Management Alternative 6: Provide Real Time Travel Information</b>		
<b>Measures</b>	<b>ADVANTAGES</b>	<b>DISADVANTAGES</b>
Operations	Improves decision making for travelers on routing and mode shifts prior to and during their trip.	
Environmental	Minimal to no impact on the environment.	
Implementation	Existing program in place; Government agencies already participating	Difficult to coordinate between different jurisdictions; driver notification system-will need to be devised.

**Table 5.8 (Cont'd)**  
**Management Alternatives Advantages and Disadvantages**

<b>Management Alternative 7: Develop Driver Education Program Specific to Corridor</b>		
<b>Measures</b>	<b>ADVANTAGES</b>	<b>DISADVANTAGES</b>
Operations	Improves mobility, efficiency and safety of the corridor.	
Environmental	Minimal to no impact on the environment.	
Implementation		Difficult to coordinate between different jurisdictions
<b>Management Alternative 8: Implement Signing Modification</b>		
<b>Measures</b>	<b>ADVANTAGES</b>	<b>DISADVANTAGES</b>
Operations	Improves mobility, efficiency and safety of the corridor.	
Environmental	Minimal to no impact on the environment.	
Implementation		Difficult to coordinate between different jurisdictions

**5.7 Alternatives Not Selected**

- Action Alternative 9: Convert shoulders on Rochambeau Bridge to general purpose lanes with additional lane to NB I-395
- Action Alternative 12: Construct reversible general purpose lanes in median on Rochambeau Bridge (include potential moveable barrier or overhead markings)
- Action Alternative 13: Construct bus lanes between Pentagon Transit Center and 14<sup>th</sup> St at Independence Ave using inside shoulders on Rochambeau Bridge
- Management Alternative 4: Integrated Incident Management System
- Management Alternative 6: : Provide Real-Time Travel Information

The above alternatives were not selected in favor of those that were more operationally efficient and economically feasible. Action Alternatives 9 and 12 operated poorly as a result of merging the additional northbound general purpose lane in the median with traffic on 14<sup>th</sup> Street, lessening VMT and person throughput in the AM. During the PM, conditions are worse due to the complexity of diverge areas approaching 14<sup>th</sup> Street Bridge.

Action Alternative 13 was not selected because of conditions mentioned earlier where the impacts to general purpose traffic cause an increase in system delay and small improvements to VMT.

Management Alternatives 4 and 6 were not selected because they have already been implemented under the regions Metropolitan Area Transportation Operations Coordination (MATOC) program. The MATOC

program includes the coordination of incident management programs for DDOT, VDOT, MDOT, and WMATA. MATOC is also seeking funding to improve real-time travel information.

## 5.8 Recommendation of Alternatives Retained for Further Study in the FEIS

The 14<sup>th</sup> Street Bridge Corridor is located in an urbanized area, surrounded by buildings that house some of the nation's most important Federal agencies and cultural centers as well as prominent historic landmarks. Adding an additional lane along the 14<sup>th</sup> Street Corridor will require demolishing the buildings themselves or encroaching upon the security buffer required for all Federal buildings. However, these are not feasible options and providing an additional lane will not solve long-term problems associated with the Corridor. Additional capacity will only encourage additional vehicles and maintain the current level of congestion if not make it worse. Other options, such as creating a tunnel under existing roadways for express traffic are possible but are very costly and the construction could create additional disruption in the corridor.

Metro is one of the modes of transport for commuters coming in from the outer suburbs. However, Metro is projected to reach capacity by 2040 even with the use of eight car trains and the expansion of platforms. Other modes of transit, such as buses or surface light rail, need to be increased to accommodate those who wish to travel in modes other than personal vehicles. Additional funding is needed to improve the quality of these modes.

A range of alternatives were identified and analyzed that addressed the conditions of limited capacity of the roadway network and rail system. Results of a comprehensive evaluation of operational performance, environmental impacts, cost effectiveness, and implementation level resulted in the selection of alternatives retained for further study in the FEIS listed herein.

### Bicycle/Pedestrian Alternatives Retained for Further Study in the FEIS

- Action Alternative 1: Improve bicycle and pedestrian access to the Mason Bridge by making improvements at each end of the bridge
- Action Alternatives 2: Construct separated bicycle/pedestrian crossing of the Potomac River and add a grade-separated bicycle crossing of GWMP as proposed by Arlington County
- Action Alternatives 3: Create integrated (DC-VA-NPS) bicycle system, including signing for commuters and other destination bikers

### Highway Alternatives Retained for Further Study in the FEIS

- Action Alternative 4: Construct geometric improvements at I-395 & 9<sup>th</sup> St
- Action Alternative 6: Reduce I-395 access points at Boundary Channel Drive
- Action Alternative 7: Eliminate turn movements at 14<sup>th</sup> Street and C Street intersection

### Transit Alternative Retained for Further Study in the FEIS

- Action Alternative 13 Modified: Construct bus lanes between Pentagon Transit Center and 14<sup>th</sup> St at C Street, using inside shoulders on Rochambeau Bridge and TSP treatment

### Management Alternatives Retained for Further Study in the FEIS

- Management Alternative 1: Expand, Formalize and Increase Incentives for Telecommuting
- Management Alternative 2: Increase Participation in Flexible Work Hours Programs
- Management Alternative 3: Implement Parking Management Strategies / Increase Parking Prices and/or Decrease Supply
- Management Alternative 5: Strengthen Coordination and Management in the Corridor.
- Management Alternative 7: Develop Driver Education Program Specific to Corridor
- Management Alternative 8: Implement Signing Modification (Create World Class Corridor by Uniform look and Identity)

These alternatives retained for further study in the FEIS are the most economically feasible and offer the greatest operational benefits to the Corridor and surrounding environment. Two of the best performing highway alternatives avoid environmental impacts to the Corridor, while one generates minor impacts. The bicycle/pedestrians alternatives offer significant improvements to mobility and accessibility with minor to moderate impacts.

While the action alternatives retained for further study in the FEIS offer benefits by themselves, when combined with the management alternatives retained for further study in the FEIS, the benefits increase with regard to reducing congestion in the Corridor.

Alternatives retained for further study in the FEIS were grouped in **Table 5.5** in categories of no impacts to minimal impacts and minimal impacts to moderate impacts.

### Combining Alternatives

Because of the urban nature of the 14<sup>th</sup> Street Bridge Corridor and the complexity and sensitive nature of many of the historic and cultural features within the study area, this study is focused on making existing facilities operate more efficiently. The alternatives that survived a long vetting process are quite diverse. Some have Corridor-wide impacts, while others are more effective in resolving some of the specific and localized operational deficiencies identified early in the process. However, each of the alternatives retained for further study in the FEIS meet the purpose and need of reducing congestion, enhancing safety, and improving traffic operations in the Corridor.

The operational, environmental, and cultural impacts of each of the alternatives retained for further study in the FEIS have been examined individually and the benefits were realized independently and do not rely upon the implementation of any of the other alternatives. Those impacts have been documented in this DEIS.

Because of the number of remaining potential alternatives located within several jurisdictions, an examination of multiple combinations of improvements was not feasible. Nevertheless it is clear that the alternatives retained for further study in the FEIS are not mutually exclusive. The implementation of one improvement does not prevent the implementation of a second or even a third alternative. While each of the alternatives retained for further study in the FEIS will have the identified benefits described in this document, as those improvements are made, it may become clearer over time that the benefits from implementation of any one of these alternatives may be enhanced by the implementation of one or more of the other alternatives. Implementation of the management alternatives is one example that reducing volumes in the Corridor will have benefits in particular intersections. Similarly, the benefits of constructing bus lanes (Action Alternative 13 modified) might be enhanced by eliminating turn movements at the 14<sup>th</sup> Street and C Street intersection (Action Alternative 7). There are many potential combinations of alternatives. Those combinations can occur depending upon available funding or through independent action by responsible parties in the Corridor over time.

## 5.9 Conclusion

### Addressing/Solving Future Capacity Problems

The alternatives retained for further study in the FEIS are a result of these principles. They include alternatives to single occupant vehicles like bicycle and pedestrian facilities, telecommuting, incentives to promote transit use, and carpooling. Alternatives also include strengthening the use of ITS technologies in the Corridor that will improve traveler information and incident management operations.

### Funding Availability

#### Transportation Legislation

The current transportation legislation funding projects is currently the Surface Transportation Extension Act of 2009. This act reauthorizes existing programs funded out of the Highway Trust Fund and extends the authorization of appropriations for the for the Federal-aid highway program. The Secretary of Transportation is also directed to apportion to each State the amount equal to the States apportionment for FY2009 for FY2010. While this act allows for transportation programs and projects to continue, for the immediate period, it does not provide assurance for long-term funding. This then limits what projects and programs transportation agencies are willing to fund beyond the current year. Without reauthorization of a multi-year Surface Transportation Act, programs will continue to be limited and few, if any, large construction projects will be funded.

**Table 5.9  
Environmental Summary of Alternatives**

Impact	Alternative Retained for Further Study in the FEIS
<b>No Impact to Minimal Impacts</b>	<p style="text-align: center;"><b>Action Alternatives 3</b> Create integrated (DC-VA-NPS) bicycle system, including signing for commuters &amp; other destination bikers</p> <p style="text-align: center;"><b>Action Alternative 4</b> Construct geometric improvements at I-395 &amp; 9th St</p> <p style="text-align: center;"><b>Action Alternative 7</b> Eliminate turn movements at 14th Street and C St</p> <p style="text-align: center;"><b>Action Alternative 13, Modified</b> Construct bus lanes between Pentagon Transit Center and 14<sup>th</sup> St at C Street, using inside shoulders on Rochambeau Bridge and TSP treatment</p> <p style="text-align: center;"><b>Management Alternative 1</b> Expand, Formalize &amp; Increase Incentives for Telecommuting</p> <p style="text-align: center;"><b>Management Alternative 2</b> Increase Participation in Flexible Work Hours Programs</p> <p style="text-align: center;"><b>Management Alternative 3</b> Implement Parking Management Strategies / Increase Parking Prices and/or Decrease Supply</p> <p style="text-align: center;"><b>Management Alternative 5</b> Strengthen Coordination &amp; Management in Corridor</p> <p style="text-align: center;"><b>Management Alternative 7</b> Develop Driver Education Program Specific to Corridor</p> <p style="text-align: center;"><b>Management Alternative 8</b> Implement Signing Modification (Create World Class Corridor by Uniform look and Identity)</p>
<b>Minimal to Moderate Impacts</b>	<p style="text-align: center;"><b>Action Alternative 1</b> Improve bicycle &amp; pedestrian access to Mason Bridge by making improvements at each end of the bridge</p> <p style="text-align: center;"><b>Action Alternatives 2</b> Construct separated bicycle/pedestrian crossing over Potomac River and add a grade-separated bicycle crossing over GWMP</p> <p style="text-align: center;"><b>Action Alternative 6</b> Reduce I-395 access points at Boundary Channel Dr.</p>

In June of 2009, the House of Representatives Committee on Transportation and Infrastructure presented the Surface Transportation Authorization Act of 2009: A Blueprint for Investment and Reform. This proposed Act was the Committee's proposal of what funds were needed to bring the transportation system, including roads, transit, rail, and high-speed rail, up to current standards. The American Society of Civil Engineers (ASCE) estimated it will take \$2.2 trillion over five years to bring the existing transportation infrastructure up to a state of good repair. The proposed Act recommended increasing the current funding level 38 percent from \$326 billion to \$450 billion over five years. The Committee also proposed an additional \$50 billion for high speed rail investment. Additional changes in the proposed Act included program reform and consolidation and improving livability and environmental sustainability of communities. This Act was not pushed forward and instead the existing Surface Transportation Authorization Act was extended.

### *Telework Enhancement Act of 2010*

The Telework Enhancement Act of 2010: Improving Government Operations through Workplace Flexibility was signed by President Barack Obama on December 9, 2010. This piece of legislation is the answer to President's request to find a solution that will allow the Federal government to continue to operate during situations such as inclement weather, natural disasters, or other emergencies such as the blizzards of 2010 that paralyzed the Washington, DC metropolitan area for days. Under the Telework Enhancement Act, all executive agencies are required to establish telework policies, determine which employees are eligible for telework and notify all employees of their eligibility. Telework training programs for employees and managers are required to be established and each agency must designate a Telework Managing Officer. Since the Federal government is the largest employer in the 14<sup>th</sup> Street project study area, the Telework Enhancement Act will allow for more flexible work schedules that could reduce the amount of vehicles in the corridor at peak hours.

The Federal government has the opportunity to set the bar for alternative commuting options in Corridor and it has taken the first step with the Telework Enhancement Act. Other non-traditional methods such as alternative work hours and compressed work weeks can further reduce the amount of congestion on the study area.