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INSTITUTE FOR PUBLIC POLICY

Rail at Any Cost

Options that Could Provide Better Service than Dulles Rail At a Third of the Cost

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Thomas Jefferson Institute for Public Policy

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Foreword

Traffic Congestion in Northern Virginia is among the worst in the nation. Anyone who visits here simply shakes their head and wonder "how do you do it each and every day?"

One of the most talked about and sought after transportation projects in Northern Virginia is the much heralded Rail to Dulles. It has almost become the Holy Grail of any transportation plan that those in positions of power talk about.

Clearly, the transportation corridor between the end of the current Metro Rail at West Falls Church and Dulles International Airport is a key to reducing congestion in this part of Northern Virginia. But, according to this study by two transportation experts, the Dulles Rail Project will provide poor service compared to Bus Rapid Transit, offer relatively limited capacity, and is far too expensive.

And within the past year, Congress waived its financial oversight by agreeing that the cost-effectiveness guidelines that other new transit systems must meet do not apply to this particular project!

If a transportation network can be developed that moves more riders than rail, cost substantially less than rail, offers more convenient service, more timely trips, and provides commuting options sooner than rail, then why isn't this alternative acknowledged by our leaders as something that should be seriously considered in a fair and open manner?

If the first phase of rail to Dulles is not "too far down the road" to stop, then Bus Rapid Transit should be considered as an alternative transportation mode for the Dulles Corridor since it would provide, according to this study, better service, attract more passengers and cost must less than the rail system. At a minimum, Bus Rapid Transit should be considered as an alternative for the second phase of the Dulles Rail Project. And Bus Rapid Transit should be considered in other areas of Virginia where the commuter ridership would make it a viable addition to the transportation strategy such as part of the High Occupancy Toll lanes under active consideration in Northern Virginia and elsewhere.

When billions of dollars are at stake, it seems only proper that a full, open and accurate analysis be presented to the citizens and commuters who have to foot the financial bill and live with the final product. Such an analysis is particularly important given that some recent rail projects, such as the extension of San Francisco's BART system to San Francisco International Airport, have fallen far short of expectations.

As this paper shows, there seem to be serious unanswered questions about the planning for rail in the Dulles Corridor: If heavy rail did not work for San Francisco's airport, why will it work for Dulles? If a Bus Rapid Transit system can be up-and-running years earlier than rail, why isn't it a serious alternative? If the alternative Bus Rapid Transit system outlined in this study can provide better service, then why isn't it a serious alternative? If vast amounts of limited resources can be saved through Bus Rapid Transit, then why isn't it a serious alternative?

The Thomas Jefferson Institute offers this study in order to continue its efforts to bring creative alternatives to the public debate. This foundation has championed more efficient government and Dulles Rail does not seem to be the most efficient way to solve the Dulles Corridor needs of Northern Virginia – at least this paper would suggest that is the case.

This paper and its conclusions do not necessarily represent the views of the Thomas Jefferson Institute for Public Policy nor its Board of Directors. Nothing in this paper is meant to influence legislation that is pending at the federal, state or local level. The paper is presented to add to the public debate and we hope it will do just that.

Michael W. Thompson, Chairman and President
Thomas Jefferson Institute for Public Policy
December 2005

Executive Summary

This paper compares the effectiveness of alternative transit modes to serve the Dulles Corridor, a suburban corridor west of Washington DC that includes Tyson's Corner and Dulles International Airport. It describes the current plan to build a 23-mile extension of the Washington Metrorail system and shows that it is possible to equal or exceed the performance of the proposed rail system at a significantly lower cost. This is important, because extending rail to Dulles is the most expensive project in the Washington region's long range transportation plan and one of the most expensive transportation projects in Virginia history.

Two alternatives to rail were examined: (1) a dedicated busway used to provide bus rapid transit (BRT) service, and (2) a toll-managed facility that would be available for buses at no charge and open to other vehicles on a fee-paying basis. Under both options, new lanes would be constructed in the median of the Dulles Airport Access Road (DAAR) and a median busway would be constructed in Tyson's Corner.

As summarized in the table below, the current rail plan is roughly three times more expensive per new transit trip generated than either alternative we examined. This is significant, because it suggests that for the same budget as rail, a high quality transit system could be built in the Dulles corridor *and* in several other corridors in Northern Virginia. This would attract many more people to transit, serve many more communities, and do more to relieve Northern Virginia's notorious traffic congestion.

Moreover, our results suggest that funds currently earmarked for rail are not being invested in a cost-effective manner. Congress appears to recognize this, because it enacted a special-interest exemption for Dulles Rail from the Federal Transit Administration (FTA) cost-effectiveness standard. The most viable explanation for this exemption is an awareness that Dulles Rail would have flunked the existing standard.

Cost Per New Transit Trip Generated			
Dulles Rail Phase I	Dulles Rail Phase I and II	Busway/BRT Option	Express Toll Lane (ETL) Option
$26.41	$33.91	$8.75-$12.19	$8.56-$11.93

We reached this conclusion by: (1) calculating annualized capital and annual operating costs using Federal Transit Administration criteria, and (2) dividing these costs by the estimated number of new regional transit trips generated by each of the systems compared. We used a methodology sanctioned by the FTA and data that was developed for the Dulles Corridor during the planning process for rail.

The current rail plan also has other serious implications that have not been properly assessed. For example, to make room for the Dulles trains, roughly half of existing Orange Line trains will be taken out of service, reducing capacity on the already overcrowded Orange Line. To help remedy this, $625 million is proposed for new rail cars, many of which would be used to create longer trains on the Orange line. Yet, even with these new rail cars (which are NOT included in the budget for Dulles Rail), Metro's CEO projects that crowding on the Orange Line will become "unmanageable" in 2012, just six years from now.

Similarly, rail's serious overcrowding requires that many passengers stand toe-to-toe throughout their trip. This can be particularly uncomfortable for passengers who must travel long distances on rail, such as those traveling from the Dulles Corridor to downtown DC.

By contrast, a BRT system can provide the same capacity as the current rail plan, yet do so in a manner that provides all passengers with a seat. Unlike rail, BRT vehicles also can skip stops and provide express service, thus dramatically reducing travel time. BRT vehicles also can provide more frequent service than rail vehicles, reducing the amount of time passengers must wait in stations. In fact, the current rail operating plan reduces Dulles line service from 10 trains per hour, as originally conceived, to 8-9 trains per hours. BRT service can be provided much more frequently, such as every 30 or 60 seconds during peak hours.

Our alternatives show that it is possible to attract new transit riders in the Dulles Corridor for significantly lower cost than the current rail plan and without adding to the overcrowding problems of the existing Metrorail system. In fact, a BRT alternative could be designed to complement the existing Metrorail system, helping to relieve chronic overcrowding while serving areas not served by rail.

Finding innovative, cost-effective solutions ought to be a significant component of any strategy to address chronic traffic congestion in Virginia. Our analysis, as well as the recent Congressional cost-effectiveness exemption, clearly shows that extending Metorail into the Dulles Corridor is not a cost-effective way to address congestion in Northern Virginia. If Governor-elect Kaine is serious about addressing transportation issues, he should seek an examination of alternatives that can perform better for far less cost.

Introduction

Rail in the Dulles Corridor is one of the most expensive transportation projects in the history of the Commonwealth. At over 4 billion dollars, it will consume most of the available funding for new transit projects in Northern Virginia for a generation. It already has taken at least $100 million and more than a decade to study, and it will be at least another decade before it is completed. Indeed, concerns over skyrocketing costs raise questions about whether it will be completed at all.

Although the Virginia Department of Rail and Public Transportation has generated an extensive paper trail to support rail, a number of fundamentally basic questions have never been addressed. For example:

- What transit options other than rail can serve Tyson's Corner? The only alternative studied so far was heavy rail (the BRT options previously studied by-passed Tyson's Corner).
- What else does $4 billion buy? None of the studies established a budget and assessed options against that budget.
- What performance are we trying to achieve? None of the studies established a target, such as attracting 25,000 new transit riders, and assessed the best way to achieve that target.

This paper begins to address some of these questions by comparing the cost and effectiveness of alternative transit modes to serve the Dulles Corridor. Two scenarios are considered: (1) a busway / bus rapid transit (BRT) option, and (2) an Express Toll Lane (ETL) option that includes express bus and/or BRT service operating on the ETL's.

In conducting this analysis, we used data that was generated by the alternatives analysis prepared for Dulles Rail, as well as other publicly available data. We also used a cost-effectiveness methodology sanctioned by the Federal Transit Administration (FTA), including FTA's annualization factors and cost element categories.

We focused on BRT alternatives because it is well documented by the National Academies of Science and others that BRT generally performs better than rail and costs significantly less. Our analysis, though preliminary in nature, is consistent with this conclusion because it shows that both the busway/BRT option and the ETL option cost roughly one-third as much as rail without sacrificing performance.

I. Project Area and Background

As shown in Figure 1, the Dulles Corridor is a 23-mile suburban area in the Washington DC region that stretches from the existing West Falls Church Metrorail Station to the Loudoun County Parkway (Route 772). The development pattern is typical of other suburban centers designed for automobile traffic, including ample free parking, strip malls, and poor or non-existent pedestrian facilities.

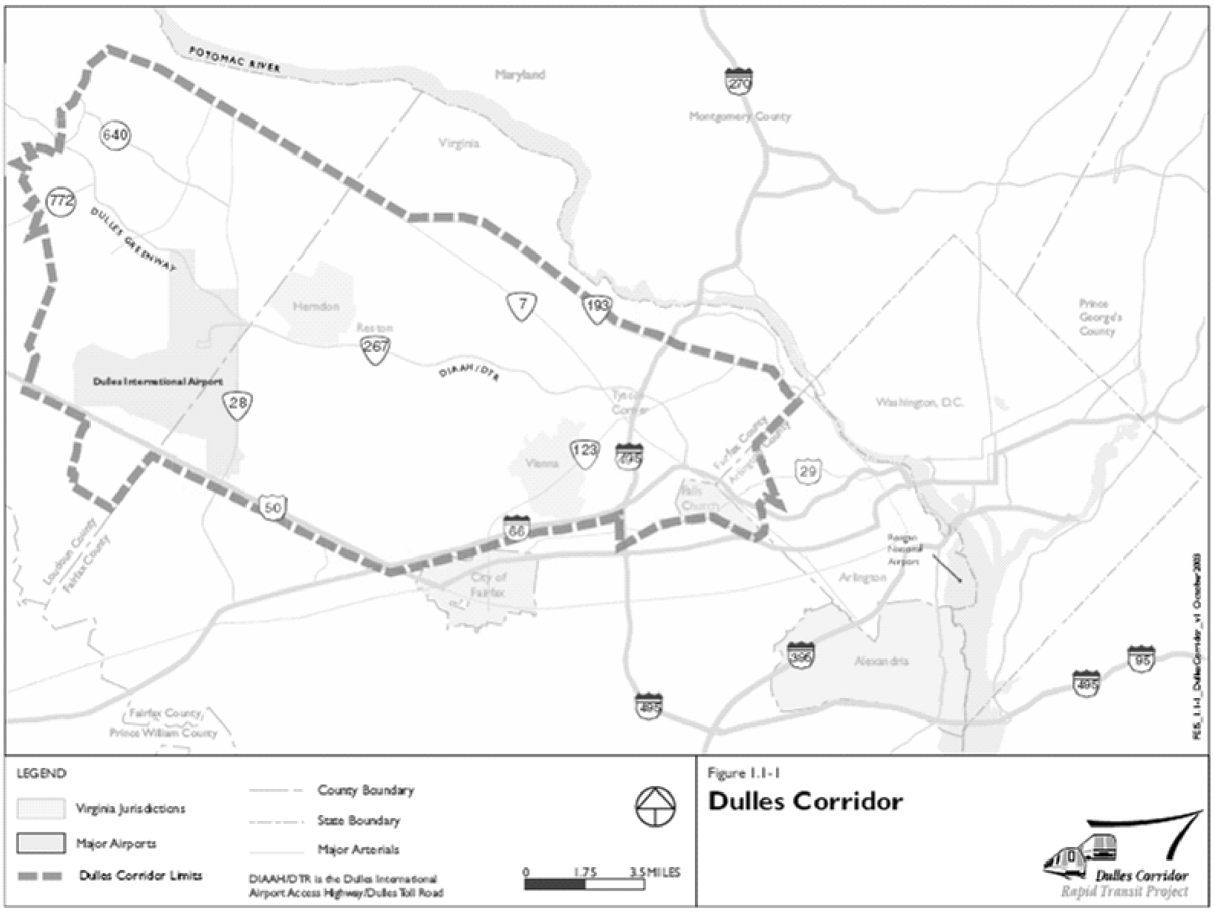

Figure 1: The Dulles Corridor[1]

The most significant activity center in the Dulles Corridor is Tyson's Corner, which is projected to contain 124,000 jobs and 30,000 residents by 2025.[2] Other major activity centers include the towns of Reston and Herndon, both of which are typical suburban towns with relatively low densities and a strong orientation to the automobile. The most significant transportation facility is Dulles International Airport (IAD).

The concept of rail in the Dulles Corridor was initially explored in the 1950's as part of the planning for IAD.[3] A four-lane highway was constructed to provide exclusive access to IAD, and the median of that highway was reserved for a future transit link.[4]

In 1997, the *Dulles Corridor Transportation Study* recommended extending rail to route 772 in Loudoun County. The estimated cost of this extension was $1.45 billion, with a total of 114,500 daily estimated trips.[5] In 1999, the *Supplement to the Dulles Corridor Transportation Study* recommended beginning with enhanced express bus services, followed by bus rapid transit (BRT) and ultimately rail.

In April 2000, a process was initiated to obtain federal funding through the federal New Starts program,[6] which is administered by the FTA. Four options were included in a Draft Environmental Impact Statement (DEIS): Metrorail, BRT, a combined BRT/Metrorail system, and a phased implementation beginning with BRT and resulting in Metrorail.[7]

The BRT and Metrorail options were very different, making an "apples to apples" comparison impossible and clearly slanting the analysis to favor Metrorail. For example:

- none of the BRT options included service in Tyson's Corner while the rail options had multiple stations in Tyson's Corner (with four Tyson's stations ultimately selected). In fact, the BRT options had between 1 and 5 total stations while the Metrorail options had between 10 and 13 total stations. A more credible study would have examined alternatives on a level playing field, such as by studying similar alignments and numbers of stations for both alternatives, or by establishing a project budget and comparing alternatives and performance based upon that budget.

- None of the BRT options included a dedicated right of way for BRT vehicles, thus ensuring that they would get stuck in traffic. All of the Metrorail options, however, included dedicated rights of way for the trains.

- The BRT options operated less frequently than the rail options. A more credible study would have established frequency of service to meet demand and to more accurately reflect how BRT service is delivered. Often, BRT vehicles arrive and depart more frequently than rail vehicles, not less frequently, as assumed by the Dulles study.

The DEIS concluded that rail would attract 86,900 total daily trips, a significant reduction from the 114,500 estimate in the 1997 study.[8] The cost estimate for the Metrorail option was $3.246 billion, more than double the amount cited in the 1997 study.[9]

Moreover, the DEIS noted that to accommodate Dulles trains, half of the existing Orange line trains would need to be cut.[10] This is because Dulles trains must share a single track with Blue and Orange trains after the Rosslyn Station, and the DEIS determined that a limit of 30 trains per hour would achieve acceptable reliability.

The project team recommended Metrorail to Virginia's Commonwealth Transportation Board, the organization responsible for selecting the locally preferred alternative (LPA). Metrorail was recommended because, among other things, it would "directly serve Tyson's Corner," even though no other options were considered for service into Tyson's Corner.[12]

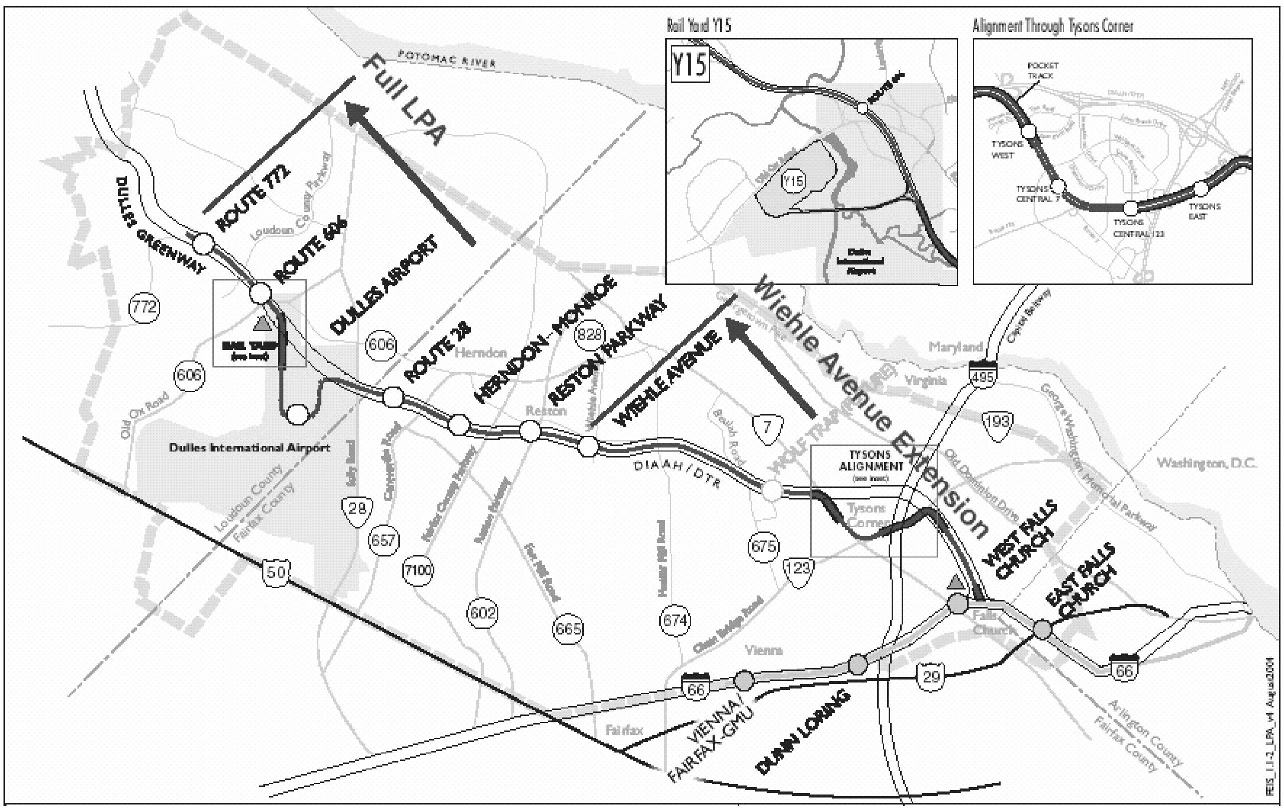

Figure 2: Alignment of the Locally Preferred Alternative[11]

The Commonwealth Transportation Board selected rail as the locally preferred alternative in December 2002. The alignment, shown in Figure 2, included four stations in Tyson's Corner, six stations in the median of the Dulles Access Road and the Dulles Greenway, and one station at Dulles International Airport.

As shown in Figure 3, the stations in the highway median would be a substantial distance from local activity centers. This reduces the attractiveness of transit as a travel option, because a transfer is required to get from the station to the activity center. Moreover, the location in the highway median makes transit-oriented development extremely difficult around the station.

Figure 3: Rail Alignment West of Tyson's Corner[13]

Due to the exceptionally high costs, the FTA demanded that the project be broken into two phases. Phase I would extend rail to Wiehle Avenue and is planned to enter revenue service in 2011. Phase II would continue from Wiehle Avenue to Loudoun County and is planned to enter revenue service in 2015.

FTA approved Phase I for preliminary engineering in June 2004. It was estimated that the cost for Phase I would be $1.5 billion and that the federal New Starts share would be 50%.

The Final Environmental Impact Statement (FEIS) was issued in 2004. The reduction in Orange Line service to accommodate Dulles trains was addressed, in part, by recommending that roughly half of the Blue Line trains be diverted away from the Rosslyn Station, thus freeing up track space to restore a portion of the cut Orange Line Service. It also was recommended that service frequency be cut from 10 trains per hour to 8-9 trains per hour.

At the same time, the Washington Metropolitan Area Transit Authority (WMATA), which operates Metrorail, is seeking $1.5 billion through its Metro Matters program to enhance transit capacity. This program includes $625 million for rail cars, which will enable the Orange Line and other lines to operate longer trains. However, according to WMATA General manager Richard White, the Orange line crowding will become "unmanageable" in 2012, even if the Metro Matters program is funded.[14] Without Metro Matters, the Orange line is predicted to become "unmanageable" in 2008.

A record of decision, which completes the alternatives analysis process, was issued in March 2005. Three months later, in June 2005, the project team estimated that the costs for Phase I could be as high as $2.4 billion, a $900 million increase, unless substantial cuts are made to the project scope. After a significant public outcry over these increases, significant cuts were made, bringing the current total for Phase I to roughly $1.8 billion.

In August 2005, the federal SAFETEA-LU bill exempted Phase I from cost-effectiveness standards set forth by the FTA.[15] This Congressional exemption is a clear indication that the project is not considered cost-effective.

As the rail project unfolded, a number of proposals were received that would provide the Commonwealth with transportation funding in exchange for the right to collect tolls on the Dulles Toll Road (DTR). As explained in our toll road scenario below, it is possible to use toll roads as supporting infrastructure for a BRT system that would perform as well or better than the current proposed rail system. Moreover, consistent with the Fluor-Transurban proposal to build HOT lanes on Interstate 395/95, it is likely that the private sector would be willing to pay some of the capital and operating costs of this BRT system.

II. Issues

The capacity of the full LPA is projected in 2025 to be 8,642 passengers per hour in the peak direction, which requires 126 passengers per car.[16] A critical issue is whether this capacity can be achieved through alternative technologies at a lower cost. This issue was not addressed in the alternatives analysis. As documented by a recent National Academies of Sciences report,[17] and discussed below, experience around the world clearly shows that alternative technologies could in fact achieve equal or greater capacity at a much lower cost.

A second issue is whether alternative technologies could produce increased benefits to passengers that would make transit more attractive to them. This issue also was not addressed in the alternatives analysis process. Rather, it was assumed that, among other things, BRT vehicles would depart less frequently than rail vehicles. It also was assumed that all BRT passengers would be forced to transfer to Metrorail's West Falls Church station, instead of proceeding directly to downtown Washington, the Pentagon, or some other destination.

III. Alternatives Considered

To begin thinking about these issues, we looked at two alternatives to link the western Dulles Corridor with Tyson's Corner and downtown Washington:

- A busway for the exclusive use of transit vehicles operating in bus rapid transit (BRT) mode, and
- An Express Toll Lane (ETL) facility that to be used by transit free of charge and by other vehicles on payment of a toll, the toll rate being varied to ensure congestion-free travel at all times.

In both scenarios, we assumed that a two lane facility would be constructed in the median of the DAAR. This is the same location proposed for Dulles Rail. Unlike rail, however, transit stations would not be located in the median. Rather, ramps would enable vehicles to serve stations located at key activity centers, such as Reston and Herndon. This reduces travel time and creates more opportunities for transit-oriented development.

The busway would be open to all transit service providers and possibly to other designated vehicles, such as vanpools and HOV-3 vehicles. The ETL's would be open to transit vehicles, such as buses and vanpools, at no charge, and to other vehicles upon payment of a toll. Toll rates would be adjusted to keep the lanes free of congestion at all times. Variable toll lanes are in operation or under study in a number of cities around the country, including Southern California HOT lanes that began operating in 1995, and Minneapolis HOT lanes which opened in 2005.[18] Their application to the Washington DC area were described by noted transportation experts Robert Poole and Ken Orski, who envisioned a High Occupancy Toll (HOT) Network in the National Capital region that would include a network of express bus services.[19]

Both of our alternative scenarios include service to Tyson's Corner, the key activity center in the corridor. Currently, the rail plan envisions an alignment along Routes 123 and 7 with 4 stations. We assume a similar alignment that, instead of elevated tracks and a tunnel, would consist of a busway to be constructed in the median of Routes 123 and 7. Both of these roads are of sufficient width to accommodate a busway as well as travel lanes for cars. The busway would be exclusive for buses and would include stops near key activity centers, such as the Tyson's Corner shopping malls. This would enable the busway to serve as a focal point for development similar to what currently is planned for rail. Figure 4 shows a median busway proposed for K Street in Washington.[20]

Figure 4: Median Busway Proposed for K Street in Washington, DC

To access the busway from Route 267 (the Dulles Access Road), a bus-only ramp could be built at the intersection of Routes 7 and 267, enabling buses to serve Tyson's Corner without conflicts with general traffic. Buses also could access Tyson's Corner at the intersection of Route 267 and Spring Hill Road.

Figure 5 provides one concept for how service could be provided from these access points, as well as for how service could be provided both on and off the median busway. To help vehicles move through intersections, we also assumed that both scenarios would include signal priority, which is included in our cost estimate.

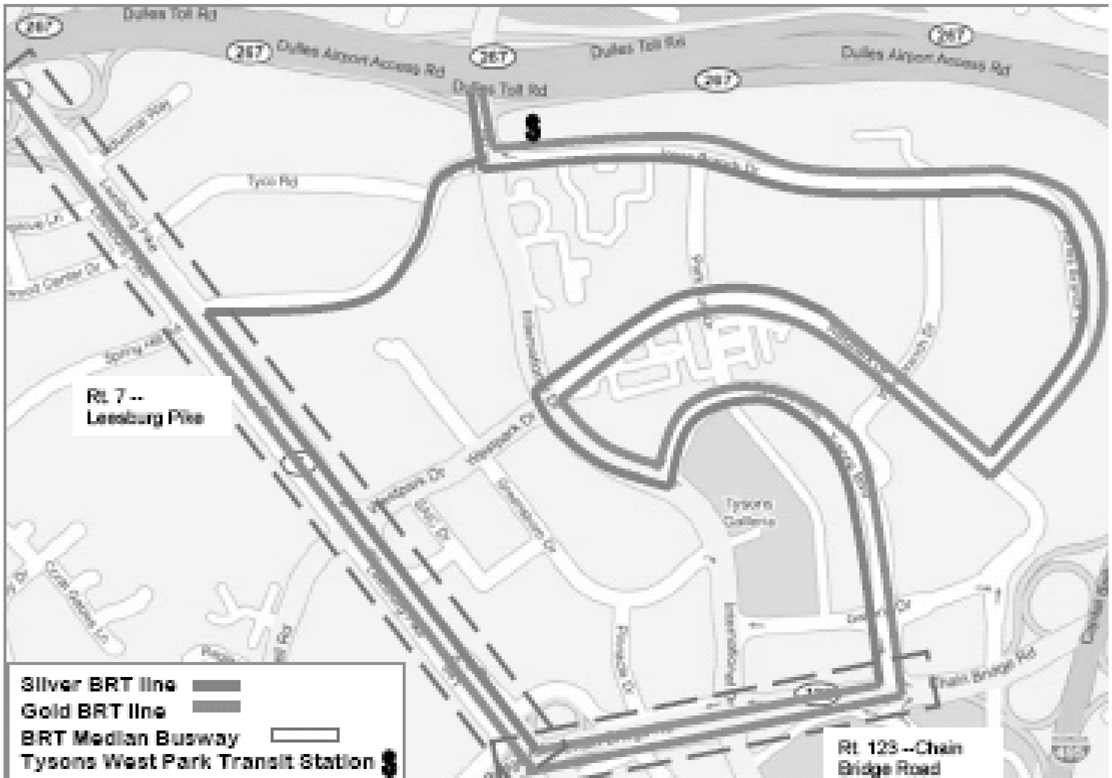

Figure 5: Potential Operating Concept

IV. The Busway/BRT and ETL Scenarios Outperform the Current Rail Plan

Our analysis shows that either the busway/BRT or the Express Toll Lane (ETL) scenario can outperform the current rail plan by a substantial margin. Specifically, the current rail plan costs between $26.41 and $33.91 per new transit trip generated. By contrast, the busway/BRT and ETL options cost between $8.56 and $12.19 per new transit trip generated.

In reaching these conclusions, we made a number of key assumptions. First, we assumed that BRT would attract ridership equivalent to the ridership estimated for rail. Our alternatives can provide better service than rail, including more seating capacity, more frequent service, and the ability to skip stops. Moreover, our options are more robust than the previously studied BRT options, including the addition of a dedicated right-of-way, service to Tyson's Corner, and 4,000 park and ride spaces.

The previous study showed that even an improperly designed, 3-station BRT alternative with no service to Tyson's Corner would attract 13,600 average daily new riders in 2020.[21] By contrast, the Phase I of rail, which will have five stations and provides service to Tyson's Corner, is forecast to attract just 15,100 daily new riders in 2025.[22] It is reasonable to assume that our enhanced BRT system would, at a minimum, bridge the gap between rail and the scaled down BRT previously studied.

Second, we did not include other potential benefits, such as transit-oriented land use. Fairfax County currently is considering substantial land use changes in anticipation of rail. There is no reason why these same land use changes could not be considered in conjunction with another mode. In fact, according to a recent National Academies of Sciences report, full-featured BRT has land use benefits similar to rail investments.[23]

Third, we did not include benefits associated with the ability to implement either the busway/BRT or the ETL option sooner than rail. In some cities, initial service has been provided within two years. By contrast, rail is taking decades. The benefits of providing service sooner are substantial.

Fourth, we made no adjustment for the far higher risk associated with rail. Rail requires a significantly greater capital investment than BRT. If it fails, there is no other conceivable use for the project. This risk of failure was recently highlighted by the extension of San Francisco's BART system to San Francisco International Airport, which has attracted less than half of the projected ridership and faces severe service cuts.[24] A similar situation could occur in the Dulles Corridor, particularly when Phase II connects with Dulles International Airport.

A. Dulles Rail

1. Phase I.

Phase I of rail originally was estimated to cost $1.521 billion. In June 2005, a $900 million cost increase was announced, bringing the total costs to $2.421 billion. Although $600 million in savings were found, bringing the total for Phase I to $1.8 billion, we used $2.4 billion as our cost estimate. This is because the ridership projections for rail were based upon the $2.4 billion project design and did not include the changes in scope that were necessary to reduce the cost to $1.8 billion. Moreover, as shown below, the difference in cost between rail and our alternatives is so great that using the $1.8 billion number would not change the conclusion.

To account for the cost increase, we allocated the $900 million proportionally among the cost categories identified in the FEIS and we applied the FTA's useful life and annualization factors to derive annualized costs.[25] Table 1 shows the results of our capital cost calculations. The "Element" column shows the standard capital cost elements used by the FTA. The "Total Cost" column contains three sub-columns. The "FEIS Costs" sub-column contains costs set forth in the FEIS. The "Cost Increase" sub-column contains the proportional amount of the $900 million cost increase for each category. The "Adjusted Values" sub-column shows the adjusted total.

To the right of the "Total Cost" column is the "FTA Annualization Factor" column, which shows the annualization rate used by the FTA in cost-effectiveness calculations.[26] The "Annualized Costs" column shows the product of the "Adjusted Values" column and the FTA "Annualization Factor" column. The total annualized capital costs are $195.13 million, as shown in the lower right.

Table 1: Capital Cost Allocations Phase I Rail

Element	**Total Cost (Millions)**			**FTA Annualization Factor**	**Annualized Costs (Millions)**
	FEIS Costs	Cost Increase	Adjusted Values		
Busway and Track Elements	$362.8	$214.6	$577.40	.081	$46.76
Yards and Shops	57.2	33.83	91.03	.081	7.37
System elements	172.7	102.15	274.85	.081	22.26
Stations	268.7	158.94	427.64	.081	34.63
Vehicles	189.5	112.09	301.59	.086	25.9
Sitework and Special Conditions	51.0	30.16	81.16	.070	5.68
Right of Way, Land, Existing Improvements	88.7	52.46	141.16	.070	9.88
Soft Costs*	265.1	156.81	421.91	.081	34.17
Contingency	65.8	38.92	104.72	.081	8.48
Total	$1,521.5	$900	$2,421.5	n/a	$195.13

*"Soft Costs" include administrative expenses, certain study expenses, office space, computers, training, etc.

The FEIS projects that annual operating and maintenance costs will be $67.64 million in 2025.[27] To simplify the calculation, we assumed that operating costs are constant over the 30 year period. We then added the annual operations and maintenance costs to the total annualized capital costs, yielding a total annual cost of $262.77 million ($67.64 million plus $195.13 million).

The FEIS estimates that Phase I rail would attract 34,300 daily regional new trips. Assuming 290 weekdays per year,[28] we estimate roughly 9,947,000 new transit trips per year. Dividing the total annual cost by the annual number of new trips, we arrive at a cost of $26.41 per new transit trip generated.

2. Phase I and II – the "Locally Preferred Alternative"

Next, we looked at the locally preferred alternative, which is Phase I supplemented by Phase II. We used the same methodology and table as used for the Phase I analysis.

The FEIS estimated capital costs at $3.46 billion for the completed locally preferred alternative. Again, we added in the recent $900 million cost increase and apportioned those costs to each of the project elements, raising the total capital costs to $4.36 billion. Multiplying the "Adjusted Values" sub-column and the "FTA Annualization Factor" column, we arrived at annualized costs for each of the capital elements. As shown in the lower right of Table 2, the sum of these annualized capital costs is $352.21 million.

Operating costs are forecast to be $117.88 million in 2025.[29] We added these annual operating costs to the annualized capital costs for a total annual cost of $470.09 million ($117.88 million plus $352.21 million).

The FEIS estimates that the completed rail project would attract 47,800 new daily regional new trips. Assuming 290 weekdays per year, we estimate roughly 13,862,000 new transit trips per year. Dividing the total annual cost ($470.09 million) by the annual number of new trips, we arrive at a cost of $33.91 per new transit trip generated.

Table 2: Capital Cost Allocations Full LPA

Element	Total Cost (Millions)			FTA Annualization Factor	Annualized Costs (Millions)
	FEIS Costs	Cost Increase	Adjusted Values		
Busway and Track Elements	$805.4	$209.49	$1,014.89	.081	$82.20
Yards and Shops	186.4	48.48	234.88	.081	19.03
System elements	431.1	112.13	543.23	.081	44.00
Stations	610.9	158.9	769.8	.081	62.35
Vehicles	393.3	102.3	495.6	.086	42.62
Sitework and Special Conditions	130.0	33.81	163.81	.070	11.46
Right of Way, Land, Existing Improvements	117.3	30.51	147.81	.070	10.35
Soft Costs	631.2	164.18	795.38	.081	64.43
Contingency	154.5	40.19	194.69	.081	15.77
Total	$3460.1	$900	$4360.1	n/a	$352.21

B. Busway/BRT and HOT Lane Alternatives

Under these scenarios, we assume a 2-lane facility operating in the median of the DAAR from Route 772 to Spring Hill Road, a distance of roughly 15 miles, for a total of 30 lane miles.[30] We also assume a median busway operating in Tyson's Corner. Both scenarios are described in more detail below.

1. Busway/BRT

We based our cost estimate on the methodology and cost-elements used to analyze BRT in the DEIS.[31] To more fully account for the costs of our approach, we adjusted the cost elements where needed. All adjustments we made were *increases* to the costs set forth in the DEIS, not decreases. Thus, our analysis may actually overestimate the cost of providing BRT or express bus service in the corridor.

As shown in Table 3, we added $228 million for busway costs. This is based upon 30 lane-miles to be added in the median of the DAAR at $7.1 million per mile, for a cost of roughly $213 million. Next, we assumed roughly 1.5 miles of median busway would be needed on routes 123 and 7 in Tyson's Corner. We assumed an average cost of $10 million per mile, for a total cost of $15 million. Adding this to the $213 million for the DAAR busway brings the total cost to $228 million.

Our estimate of $7.1 million for the guideway costs in the DAAR was derived by taking an average cost of estimates for adding similar lanes.

- The Northern Virginia 2020 Transportation Plan estimated the cost for adding one lane to the Dulles Toll Road as between $2 and $5 million per mile.[32]
- A private sector proposal to add four HOT lanes to the Capital Beltway is estimated to cost $14.4 million per lane mile, which includes 7 entry/exit points and two direct ramp access points to I-66 and the Dulles Toll Road (Route 267).[33]
- In California, 40 lane-miles of HOT lanes were constructed for $134 million, or roughly $3.35 million per mile.[34]

The average of these costs is roughly $7.1 million per mile. This is similar to costs quoted by a recent National Academies of Sciences report, which found that the average cost for busways is $7.5 million per mile.[35] Thus, we used $7.1 million per lane mile as our estimate. As the government already owns the right-of- way in the DAAR, this estimate should be sufficient to cover construction, including some intermediate access points.

Our $10 million per mile estimate for a median busway in Tyson's Corner was derived by taking the average cost of median busways cited in the National Academies report ($6.6 million) and adding 50 percent to account for the high costs of construction in the Washington, DC area.

As shown in Table 3, we added $10 million to the system elements category to pay for signal priority along the median busway and at other key intersections. We also added a category called “Parking Lots.” According to WMATA, recent parking garages at New Carrollton and College Park averaged about $12,500 per new parking space.[36] Thus, our $50 million could obtain roughly 4,000 new parking spaces in parking garages.

Based upon our assumptions, the total capital costs would be $769.4 million and the annualized costs would be $69.29 million.

The operating and maintenance costs for a BRT system in the corridor were estimated in the DEIS at $51.7 million per year in 2025.[37] We added an estimated $300,000 per year for guideway maintenance, bringing the total to $52 million.[38] Again, we assumed that operating costs are constant over the 30 year period. Adding the total annualized capital costs to the annual operations and maintenance costs provides a total annual cost of $121.29 million ($69.29 million plus $52 million).

Table 3: Capital Cost Allocations Busway/BRT

Element	**Total Cost (Millions)**			**Annualization Factor**	**Annualized Costs (Millions)**
	DEIS Costs	Cost Adjustments	Adjusted Values		
Busway	$0	$228.0	$228.0	.094	$21.43
Yards and Shops	50.7	0	50.7	.081	4.11
System elements	24.6	10	34.6	.081	2.8
Stations	165.3	0	165.3	.081	13.39
Vehicles	84.4	0	84.4	.126	10.63
Parking Lots	0	50	50.0	.094	4.7
Special Conditions	29.5	0	29.5	.081	2.39
Right of Way	41.1	0	41.1	.070	2.88
Soft Costs	85.9	0	85.9	.081	6.96
Total	$481.4	$288.0	$769.4	n/a	$69.29

Next, we established a range for potential ridership. On the low end of the range, we used the same ridership assumptions as Phase I of rail, or roughly 9,947,000 new transit trips per year. Dividing the total annual cost by the annual number of new trips, we arrive at a cost of $12.19 per new transit trip generated.

We believe that our alternative would attract more than the 34,300 weekday new trips assumed for rail. This is because our alternative is a significant improvement over the BRT alternative that was analyzed in the DEIS, including the addition of a dedicated right-of-way, 4,000 parking spaces, and service to Tyson's Corner.

Moreover, our alternative is a significant improvement over Phase I of rail. Unlike rail, it would immediately provide service to the western part of the corridor, including Dulles International Airport. It also would provide travel times savings as compared with rail, in part because it would offer express and limited stop services.

For the high end of the range, we assume that our alternative could generate the same number of regional new trips as the completed locally preferred alternative, or roughly 13,862,000 new transit trips per year. Using the same calculation as above, the costs would be $8.75 per new transit trip generated.

Thus, for the BRT alternative, we believe an appropriate range for costs per new transit trip generated is $8.75 - $12.19.

2. ETL Option

As discussed above, Express Toll Lanes (ETL) are travel lanes that charge a variable toll for private cars, regardless of occupancy, but let transit buses and other designated vehicles use the lanes free of charge. They are similar to High Occupancy Toll (HOT) lanes, except that HOT lanes generally allow HOV vehicles to access free of charge.

For the ETL option, we assumed capital costs of $11.5 million per mile. HOT lanes in the median of route I-15 north of San Diego, California cost this amount, inclusive of moveable barriers, direct access ramps for buses, and other transit elements.[39] We believe the $11.5 million estimate is more appropriate here than the $7.1 million estimate for the busway, because toll lanes require infrastructure, such as toll collection equipment, that is not required on a busway.

At $11.5 million per mile, 30 lane-miles will cost roughly $345 million, including intermediate access points and bus-only ramps. We reduced this number by 80 percent on the assumption that private sector investors would be willing to pay for much of the construction costs in exchange for repayment from toll revenues. Thus, we estimated the total costs for the guideway at $69 million.

Next, as with the busway option, we included $15 million for a median busway in Tyson's Corner. This brings the total guideway costs to $84 million, as shown in Table 4.

Assuming private sector participation is consistent with the Poole and Orski study on HOT Networks,[40] which found that revenues could average $677,000 per lane mile each year, thus providing a revenue stream capable of supporting private investment. Our assumption that the ETL could attract private investment also is consistent with current private sector proposals to fund HOT lanes on Interstates 495 and 395/95 in Northern Virginia, as well as to take over and expand the Dulles Toll Road.

Table 4: Capital Cost Allocations ETL Option

Element	**Total Cost (Millions)**			**Annualization Factor**	**Annualized Costs (Millions)**
	DEIS Values	Cost Adjustments	Adjusted Values		
Busway	$0	$84	$84.0	.094	$7.90
Yards and Shops	50.7	0	50.7	.081	4.11
System elements	24.6	10	34.6	.081	2.8
Stations	165.3	0	165.3	.081	13.39
Vehicles	84.4	0	84.4	.126	10.63
Parking Lots	0	50	50.0	.094	4.7
Special Conditions	29.5	0	29.5	.081	2.39
Right of Way	41.1	0	41.1	.070	2.88
Soft Costs	85.9	0	85.9	.081	6.96
Total	481.4	$129	610.4	n/a	$55.76

As shown in Table 4, for non-busway elements, we assumed the same system capital costs as in the busway/BRT alternative. Multiplying the "Adjusted Values" and "Annualization Factor" columns yields a total annualized capital cost of $55.76 million, as shown in the lower right of Table 4.

Next, we used the operating and maintenance costs estimated in the DEIS, which were $51.7 million per year in 2025.[41] We then added $11.2 million per year for operating costs of the ETL lanes. We took this number directly from the proposal to add HOT lanes to the Capital Beltway.[42] This proposal includes over 44 lane-miles in HOT operation as opposed to our 30 lane-miles in ETL operation. Thus, our $11.2 million estimate ought to be more than sufficient.

Adding the $11.2 million to the $51.7 million in the DEIS, we assumed the total operating costs would be $62.9 million. We then added the $62.9 million to the estimated $55.76 million in annualized capital costs, for a total annual cost of $118.66 million.

It is important to note that, in the ETL option, a portion of the operation and maintenance costs of the BRT system could be paid for by toll revenues, making the $51.7 million estimate in the DEIS too high. For example, the private sector has proposed to add HOT lanes to Interstate 395/95 in Virginia and to pay for most of the capital costs for the project. In addition, the proposal included an estimated $500 million in excess toll revenues that could be used to support transit operations and maintenance.

We did not have a way to estimate the amount of excess toll revenues that might be available in the Dulles Corridor, so we did not assume that toll revenues would be available to pay for operations and maintenance costs. However, it is likely that excess toll revenues would be available to support transit operations and maintenance costs. This is because the Dulles Toll Road currently generates a surplus, some of which is being used to fund rail. There also are a number of bidders seeking to purchase the right to operate the road, suggesting the existence of profit-making potential, some of which might be available to support additional transit services.

We again established a range for estimated ridership based upon the ridership estimates for rail. At the low end of the range, we assumed roughly 9,947,000 new transit trips per year. Dividing the total annual cost by the annual number of new trips, we arrive at a cost of $11.93 per new transit trip generated. At the high end of the range, we assumed 13,862,000 annual trips, yielding a cost of $8.56 per new transit trip.

V. Advantages and Disadvantages of Busways and BRT

In addition to lower costs, BRT has many other advantages over rail transit. Some of these advantages, and their applicability to the Dulles Corridor, are described below.

First, a BRT system can provide express, limited stop, or full stop service on exclusive or bus-priority rights-of-way, as well on local streets. This enables service delivery patterns to be designed to better meet passenger needs. By contrast, Metrorail trains are confined to fixed tracks and must stop at every station along those tracks. Many passengers will be forced to sit through multiple stops before reaching their final destination, unnecessarily increasing travel times.

This point is illustrated by Route 989 of the Fairfax Connector bus service, which provides express service from the Wiehle Avenue Park and Ride lot to the Pentagon, a key employment center and transfer point to Metrorail. Service is provided every 15-20 minutes and vehicles are quite full, averaging over 35 passengers per trip.[43] Travel time during the AM peak is roughly 25 minutes.

Under the rail plan, there would be service from Wiehle Avenue to the Pentagon. However, that service would take 57 minutes,[44] *more than twice as long as the express bus,* and would require a transfer at the Rosslyn station to the Blue line.

Second, bus services can be provided on a competitive basis, which exerts downward pressure on costs and encourages services that meet passenger demand. For example, private companies can compete to operate exclusive bus services along a busway, or multiple operators can provide competing services. Indeed, some of the most successful BRT systems in the world use competition to maximize service quality at the lowest possible cost. Rail transit, on the other hand, generally is provided as a government monopoly. This reduces pressure to control costs and improve service.

Third, BRT systems can carry more passengers than the proposed rail plan, and all passengers could have a seat. As shown in the "Passenger Capacity" column of Figure 6 below, the Red line is the highest capacity train line, with a capacity of 17,760 passengers per hour in the peak direction. Many of these passengers are standing in very crowded conditions. By contrast, the Lincoln Tunnel Express Bus Lane, which connects New Jersey with Manhattan, has been observed to carry 32,600 passengers per lane in the peak hour, nearly four times the capacity forecast for Dulles rail.[45]

Metrorail Vehicle Loading at Maximum Load Points, 2005-2010

Line	Passenger Capacity	Passenger Demand	Capacity Utilization	2005	2006	2007	2008	2009	2010
Red	17,760	15,000	84%	87%	89%	91%	94%	96%	99%
Blue	6,720	5,890	88%	90%	92%	95%	98%	100%	103%
Orange	12,720	10,900	86%	88%	90%	93%	95%	98%	101%
Yellow	6,480	5,670	88%	90%	92%	95%	97%	100%	103%
Green	8,640	7,460	86%	89%	91%	94%	96%	99%	101%

Source: WMATA, Office of Business Planning and Project Development
Note: Utilization conditions above 85% are considered to be highly congested conditions. Passengers can no longer board crowded trains above 100% utilization.

Figure 6: Metrorail vehicle Loading at Maximum Load Points, 2005-2010

Fourth, a BRT system can work independently of Metrorail, complementing the existing service and, in many cases, relieving overcrowding conditions. As shown by Figure 6, all Metrorail lines currently are considered “highly congested,” and both the Orange and Blue lines will exceed capacity by 2010. The Dulles line likely will make this situation worse, because existing service must be cut to make room for the Dulles trains. A BRT system avoids this problem because it does not compete for limited track space.

Finally, a BRT system can meet the demand for transit and have significant excess lane capacity for other purposes. Typical highway lane capacity is roughly 2000 vehicles per hour. Fewer than 200 45-seat buses per hour can carry the 8,642 passengers forecast for rail (i.e., 200x45=9,000). Unlike rail, all of these passengers would have a seat *and* over 80 percent of the lane capacity is left over for other purposes, such as emergency vehicles, emergency evacuation, or toll lane operations.

Despite the many advantages of busways and BRT, there is one disadvantage that should be noted: lack of understanding. As in the Dulles Corridor, this lack of understanding leads to an unwillingness to consider BRT as a serious alternative to rail.

The reasons for this are many, including perceptions that buses are uncomfortable, prone to getting stuck in traffic, and unable to attract new riders from their cars. These perceptions often are reinforced by studies, such as the Dulles Corridor alternatives analysis, that compare buses operating in mixed traffic with rail operating on dedicated rights-of-way. Experience has shown, however, that BRT can take advantage of congestion-free rights-of-way to provide high quality rapid transit services that can attract car owners at a fraction of the cost of rail.

VI. Conclusions

Our analysis shows that, using FTA's methodology, either the busway/BRT or the ETL scenario can outperform the current rail plan by a substantial margin. Specifically, as shown in the following table, rail costs roughly three times more per new transit trip than either alternative we examined.

Cost Per New Transit Trip Generated			
Dulles Rail Phase I	Dulles Rail Phase I and II	BRT/Busway Option	Express Toll Lane (ETL) Option
$26.41	$33.91	$8.75-$12.19	$8.56-$11.93

Our conclusion suggests that building rail as planned would be a significant misallocation of resources. It fails to maximize the number of new transit trips that can be generated, because too much is being spent to attract each new transit rider. It also takes resources away from other potential transit projects that could better serve the region. For example, for the same budget as rail, our analysis suggests that a high quality transit system could be built in the Dulles corridor *and* in several other corridors in Northern Virginia. This would attract many more people to transit, serve many more communities, and do more to relieve Northern Virginia's notorious traffic congestion.

Moreover, even though our options are more cost-effective, they can provide better service than rail, including more seats for passengers, more frequent service, and more convenient service that skips stops and reduces travel time. Our options also could be designed to help alleviate overcrowding on Metro. By contrast, the current rail plan is likely to make crowding worse.

Before making any major investment, it is prudent to carefully examine alternatives. That did not occur in the Dulles Corridor study. Our analysis suggests that the Commonwealth should now examine alternatives before it is too late.

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Footnotes

[1] Federal Transit Administration, Virginia Department of Rail and Public Transportation, *Dulles Corridor Rapid Transit Project: Final Environmental Impact Statement and (4)(f) Evaluation* ("FEIS") (2004), at 1-3.

[2] FEIS at 1-22.

[3] See FEIS at 1-2.

[4] FEIS at 1-2.

[5] Virginia Department of Rail and Public Transportation and the Federal Transit Administration, *Dulles Corridor Transportation Study, Final Report* (June 1997), at S-28.

[6] 49 USC Section 5309.

[7] Federal Transit Administration, Virginia Department of Rail and Public Transportation, *Dulles Corridor Rapid Transit Project: Draft Environmental Impact Statement and (4)(f) Evaluation* ("DEIS") (2002), at S-33.

[8] DEIS at 6-49, Table 6.3-8.

[9] DEIS at 8-3, Table 8.2-1.

[10] DEIS at 6-47.

[11] FEIS at 1-7.

[12] Virginia Department of Rail and Public Transportation, *Dulles Corridor Rapid Transit Project, Public Hearings Report Supplement: Attachment A Final Recommendations Of The Project Team* (November 2002), at A-4.

[13] Dulles Corridor Rail Association.

[14] See White, Richard, *WMATA Performance and Funding Update*, presentation to the Metropolitan Washington Council of Governments, Transportation Planning Board (September 15, 2004).

[15] Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users, Public Law Number 109-59, Section 3010 (August 10, 2005).

[16] FEIS at 6-17.

[17] Levinson, H., Zimmerman, S., et. al., *Bus Rapid Transit: Volume 1, Case Studies in Bus Rapid Transit ("TCRP-90")*, Transportation Research Board (2003)

[18] For a list of projects, see http://www.fhwa.dot.gov/policy/otps/projectlist.htm. See also Edward Sullivan, "Continuation Study to Evaluate the Impacts of the SR 91 Value-Priced Express Lanes - Final Report". Cal Poly State University, San Luis Obispo, California, December 2000.

[19] Robert W. Poole, Jr., and C. Kenneth Orski, "HOT Networks: A New Plan for Congestion Relief and Better Transit", Policy Study No. 305, Reason Public Policy Institute, Los Angeles, California, 2003. Note that the term "high occupancy toll" lane is somewhat misleading, because high occupancy vehicles generally are exempt from tolls in a HOT lane context. A more accurate description might be "high occupancy *or* toll" lanes.

[20] Newlands and Company, Inc., available at http://www.nc3d.com/gallery/KStreet

[21] Federal Transit Administration, *Annual Report on New Starts FY 2001*, Appendix A (November 1999)

[22] Federal Transit Administration, *Annual Report on New Starts FY 2006*, Appendix A (November 2004)

[23] TCRP 90 at 6.

[24] *BART to halt many rush-hour trains to SFO: Lack of Peninsula riders brings change -- system will save almost $4 million a year*, San Francisco Chronicle (July 26, 2005).

[25] www.fta.dot.gov/library/policy/ns/2001/34.html

[26] The annualization factor accounts for the useful life of the asset and a discount rate, typically 7 percent. See http://www.fta.dot.gov/grant_programs/transportation_planning/major_investment/reporting_instructions/2001/9960_10820_ENG_HTML.htm.

[27] FEIS at 8-13.

[28] 290 days was derived from WMATA's National Transit Database "profile" for the 2003 reporting year.

[29] FEIS at 8-14.

[30] This differs from the 23 miles for the full LPA for rail for several reasons, including: (1) we use an existing bus-only facility east of Tyson's Corner to connect with West Falls Church; and (2) we do not believe dedicated infrastructure is necessary to serve IAD with buses.

[31] DEIS at 8-3.

[32] See http://www.virginiadot.org/projects/nova/nv2020/techdocs/docsects/4.htm

[33] Virginia Department of Transportation, *Financial Evaluation of Fluor's Capital Beltway HOT Lane Proposal* (April 2004).

[34]US Department of Transportation, Federal Highway Administration, *A Guide for HOT Lane Development*, Chapter 7 (March 2003).

[35] TCRP 90 at 7.

[36] See *Establishment of Opening Dates for New Carrollton Yard and College Park and New Carrollton Parking Garage*s, Presentation to WMATA Board of Directors by the Planning and Development Committee (June 2, 2005), available at http://content.wmata.com/board_gm/board_docs/060205_IICEstablishmentofOpeningDates.pdf

[37] DEIS at 8-23.

[38] This was derived from VDOT's estimate of $9,000 per lane-mile multiplied by the 33 lane miles proposed in our system.

[39] *Interstate 15 Managed Lanes*, San Diego Association of Governments (January 2005), available at http://www.sandag.org/uploads/publicationid/publicationid_6_1065.pdf

[40] Robert W. Poole, Jr., and C. Kenneth Orski, "HOT Networks: A New Plan for Congestion Relief and Better Transit", Policy Study No. 305, Reason Public Policy Institute, Los Angeles, California, 2003.

[41] DEIS at 8-23.

[42] Letter to Pierce Homer, Deputy Secretary, Virginia Department of Transportation from Fluor Daniel (April 26, 2004)

[43] See Fairfax County Goverrment Web Site, http://www.co.fairfax.va.us/connector/scbp/Attachment2.htm; http://www.co.fairfax.va.us/connector/pdf/989_web.pdf

[44] FEIS at 6-12.

[45] Levinson, H.S., and K.R. St. Jacques, "Bus Lane Capacity Revisited". *Transportation Research Record 1618*, Transportation Research Board, 1998, pp. 189-199. Cited in Transportation Research Board, "Highway Capacity Manual", Exhibit 8-31, page 8-29, Washington DC, 2000.

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"… a wise and frugal government, which shall restrain men from injuring one another, shall leave them otherwise free to regulate their own pursuits of industry and improvement, and shall not take from the mouth of labor the bread it has earned. This is the sum of good government, and this is necessary to close the circle of our felicities."

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