Section 4
Evaluation of Alternative Alignments

Description of Viable Alternatives

This study evaluated three viable alternatives, which are shown in Figure 4-1. These alternatives are generalized alignments. In the next stage of project development, which would be environmental documentation in conformance with the National Environmental Policy Act, these alignments and possibly others would be defined in more detail. The viable alternative alignments described, however, provided a sound basis for preliminary analysis and project planning.

All of the alternatives include the physical removal of the CSX freight railroad between the point where passenger rail diverges near 2nd Street SW and the District-Maryland border near Kenilworth Avenue. This study assumed that a railroad spur between 2nd Street SW and the Capitol Power Plant would be maintained.

All of the alternatives include a new aboveground or underground crossing of the Potomac River. The details of these crossings, including required clearances and structure types, should be analyzed and designed in future project efforts.

DC Tunnel

This alternative would connect the RF&P Subdivision on the west with the Alexandria Extension east of the District. The alignment would follow the existing RF&P Subdivision to Potomac Yard in South Arlington, where it would go into a nine-mile long twin-bore tunnel beneath the District. It would emerge around the District-Maryland border and connect with the existing route for CSX south-northeast freight traffic. The construction and operation of the tunnel would include security features.

The tunnel would accommodate a double-track, double-stack railroad. This alignment would require upgrading approximately four miles of the existing Alexandria Extension to double track. Depending on its exact alignment, the tunnel would pass beneath or near Reagan National Airport, the Potomac and Anacostia Rivers, the underground Metrorail Green Line, and a future utility tunnel designed to control combined-sewer overflows.

In this alternative, freight railroad traffic would be removed from the existing railroad between the area near Four Mile Run and Potomac Yard in Arlington and just south of Jessup, Maryland.

Indian Head

This alignment would follow the existing RF&P Subdivision to the Arkendale, Virginia area just south of Marine Corps Base, Quantico and cross the Potomac River on a double-track 2.5-mile-long railroad bridge. On the east side of the river, a new double-track railroad would run northeast to connect with the Indian Head Branch. The route would connect with the Pope's Creek Branch and travel north where it would parallel the Amtrak Northeast Corridor to around Odenton, Maryland. A new double-track railroad would be built somewhere between the Patuxent River and MD Route 32 to join the Amtrak Northeast Corridor and the CSX Capital Subdivision. As shown in Table 4-1 and Figure 4-2, this route would include approximately 35 miles of existing railroad right-of-way, 14 miles of government property, and 17 miles of privately owned land.

This alternative would require expansion of the Indian Head Branch and the Pope's Creek Branch to double-track railroads. The Pope's Creek Branch portion of the alignment could include noise walls, security fencing, and the grade-separation of major roadways where appropriate. This study assumed construction of a new line that would generally leave the Pope's Creek Branch near Collington, bridge the Amtrak Northeast Corridor north of Bowie, and follow an alignment near MD Route 32 to connect with the CSX Capital Subdivision near the south end of Jessup Yard. Much of the land between Bowie and Jessup is federally owned, and more detailed analysis and coordination would be required to identify the exact alignment of this connection.

Evaluation of Alternative Alignments

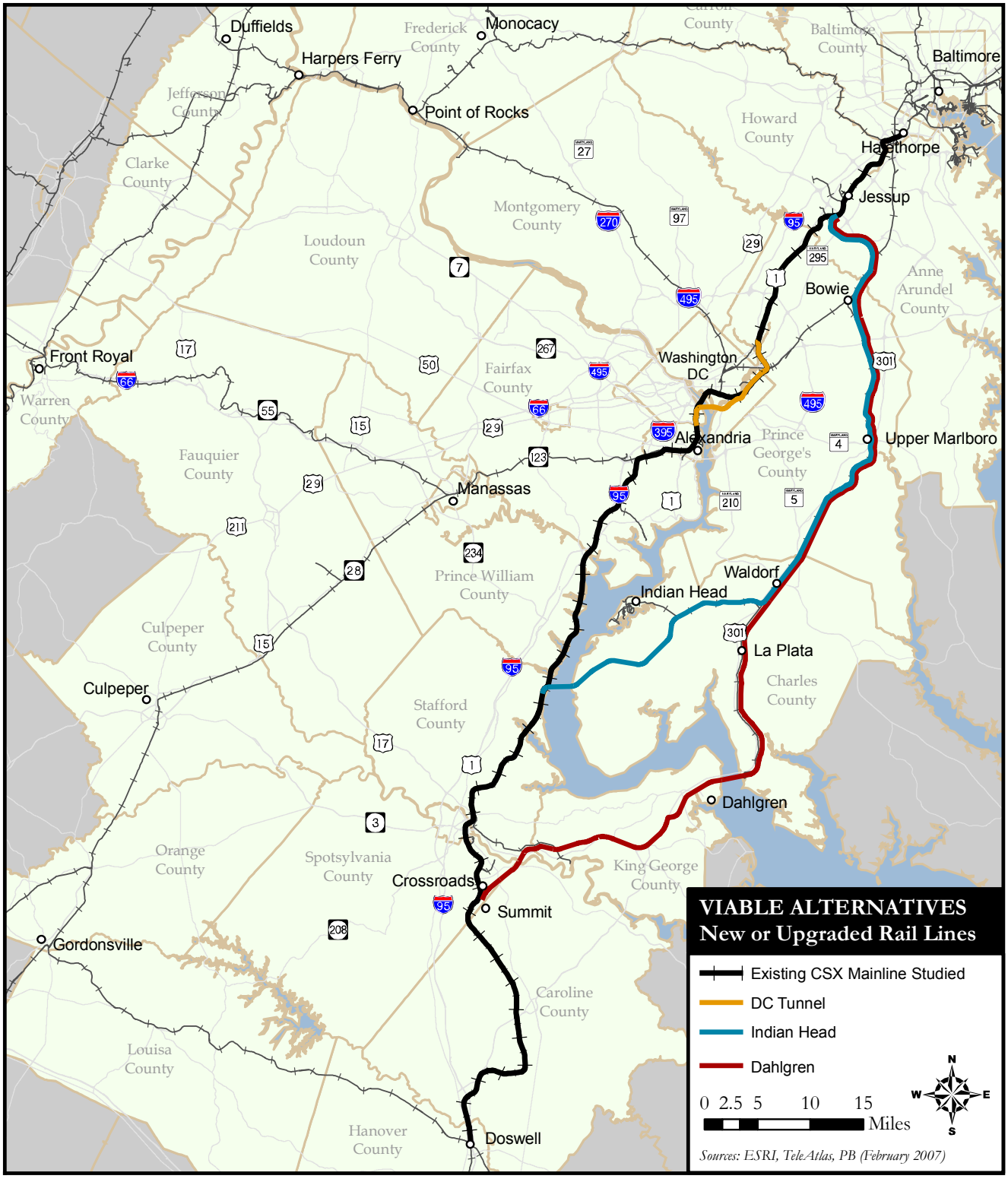

Figure 4-1. Viable Alternatives

Evaluation of Alternative Alignments

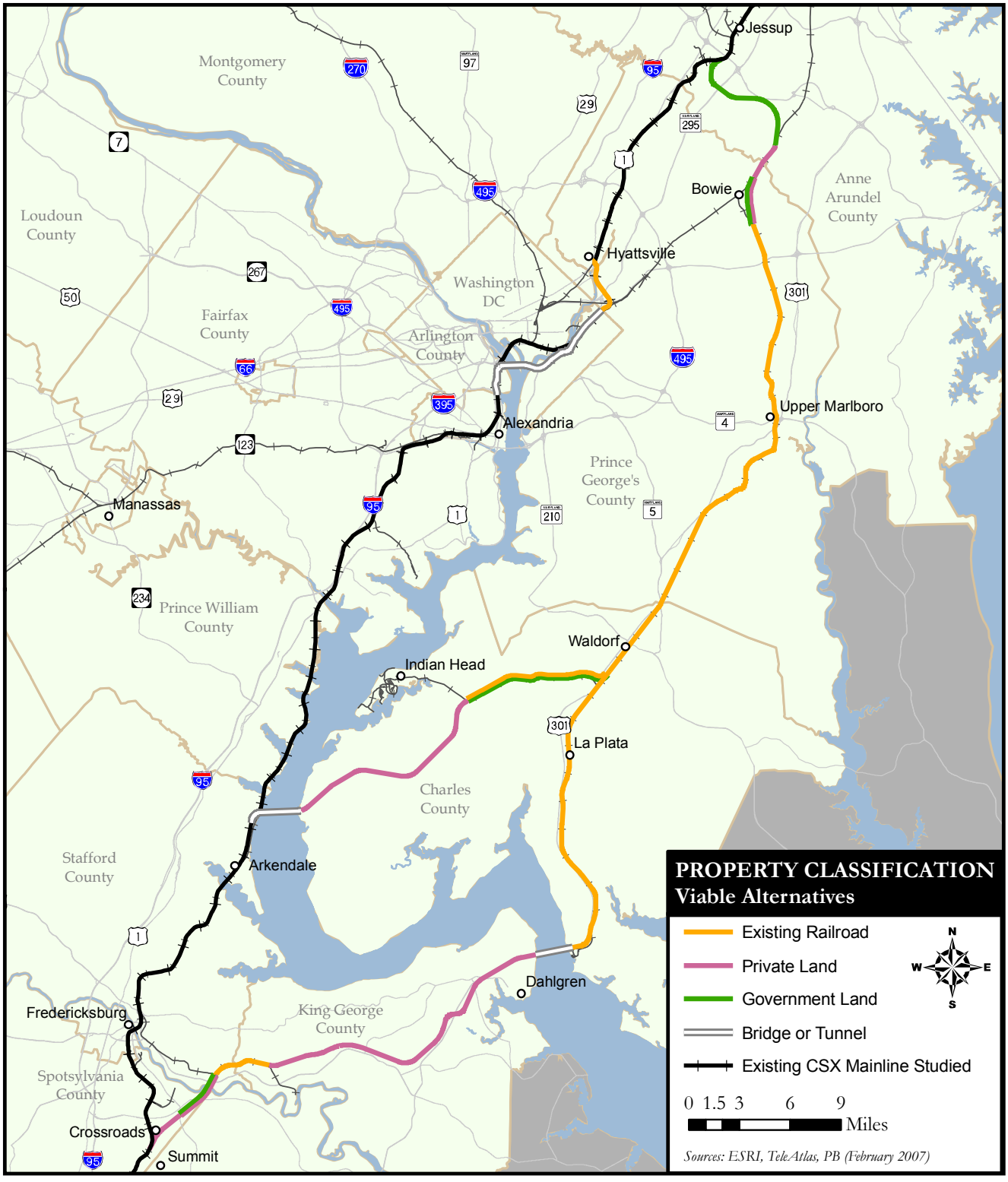

Figure 4-2. Right-of-Way Classification of Viable Alternatives

Evaluation of Alternative Alignments

In this alternative, north-south freight railroad traffic would be removed from the existing railroad between the Arkendale, Virginia area and just south of Jessup, Maryland.

Dahlgren

Similar to the Indian Head alignment, this alternative would connect the RF&P Subdivision to the Pope's Creek Branch. The new alignment would diverge from the RF&P just south of Fredericksburg where a new double-track railroad would traverse King George County. Following an existing utility corridor right-of-way, the new railroad would cross the Rappahannock River and connect with the abandoned Dahlgren Railroad, which would be restored to a functioning double-track railroad. The railroad would then parallel the recently completed Dahlgren Railroad Heritage Trail for a short distance before establishing new right-of-way that would partially follow U.S. 301 to the Potomac River.

At the Potomac River, a new two-mile-long railroad drawbridge would be constructed near the existing U.S. Route 301 bridge, which would connect the new railroad in King George County with the southern terminus of Pope's Creek Branch. From this point north, the alternative would follow the same route as the Indian Head alignment. Similar to the Indian Head alignment, this alternative would require the upgrade and enhancement of the Pope's Creek Branch.

In this alternative, north-south freight railroad traffic would be removed from the existing railroad between Crossroads, Virginia and just south of Jessup, Maryland.

Table 4-1. Right-of-Way Breakdown of Viable Alternatives

Property Classification (route-miles*)		DC Tunnel	Indian Head	Dahlgren
Existing Railroad	DC	-	-	-
	MD	4	35	49
	VA	-	-	4
	TOTAL	**4**	**35**	**53**
Government Land	DC	-	-	-
	MD	-	14	9
	VA	-	-	2
	TOTAL	**-**	**14**	**11**
Private Land	DC	-	-	-
	MD	-	17	3
	VA	-	-	24
	TOTAL	**-**	**17**	**27**
Bridge/Tunnel	**TOTAL**	**9**	**3**	**2**
TOTAL		**13**	**69**	**93**

*Note: Route-miles listed are rough estimates based on conceptual alternative alignments and field observations

Benefit-Cost Analysis

The benefit-cost analysis measured the potential benefits accruing to various public- and private-sector beneficiaries over a 40-year period and compared them with the investment costs associated with the railroad realignment alternatives. The 40-year period is typical of benefit-cost analyses of rail investments and reflects the approximate average live cycle of railroad infrastructure. After 40 years, most assets would be fully depreciated. Extending the analysis to a longer period would add increasingly smaller increments to the present value of benefits because of the compounding effects of the discount rate.

The benefit-cost results, while important, are not the exclusive or necessarily the most important decision criterion. Other factors were also considered in the overall project evaluation.

Benefit-Cost Analysis Methodology

The benefit-cost analysis includes only those benefits that can be accurately and reliably expressed in monetary terms. Accordingly, two major categories of benefits were estimated for each alternative alignment: 1) transportation-related benefits (for example, increased efficiencies for shippers and highway savings due to diversion of freight from trucks to rail), and 2) real estate benefits. The total benefits in the formal benefit-cost analysis are the sum of these two categories. Impacts that cannot be expressed monetarily with reasonable reliability, such as security, were addressed separately in the study.

Security benefits are not included in the benefit-cost analysis even though they are the primary objective of railroad realignment because estimates of the monetary value of security benefits are unreliable. Assumptions about the types and probabilities of security-related events are hypothetical suppositions not based on empirical evidence, experience, or data. Moreover, there is disagreement among economists regarding the economic cost of loss of life. Other security-related costs, such as the political, psychological, and long-term economic costs associated with the disruption of the federal government and damage or destruction of iconic structures of national significance are essentially unknown, although they are undoubtedly highly significant. These economic impacts were clearly demonstrated after the 9/11 attacks on the World Trade Center and would undoubtedly be repeated. Including security benefits in the overall equation would likely increase the benefit-cost ratios of all alternatives substantially.

Benefit-Cost Scenarios

The rail line in this study is one segment in the much larger north-south freight railroad network extending through the eastern United States from New England to the Southeast. Removing other bottlenecks in this network in addition to those in the Washington, DC region would provide greater benefits than Washington, DC region realignment only, especially by allowing the operation of double-stack intermodal trains. Because of this, two scenarios were analyzed, one reflecting only the transportation benefits to be achieved from railroad realignment in the Washington, DC region and a second reflecting the larger benefits that could be realized if additional bottlenecks were removed over a broader area, such as the Howard Street tunnel in Baltimore. Accordingly, transportation-related benefits were estimated for two basic scenarios and the benefit-cost analysis was done for each scenario:

- **Railroad realignment in the Washington, DC region only**: The resulting benefits are only those that could be realized as a result of the railroad realignment in the Washington, DC region. This scenario would produce limited transportation-related benefits because other railroad bottlenecks on the mid-Atlantic corridor would continue to constrain railroad operations. However, some improvements could be achieved.
- **Railroad improvements throughout the mid-Atlantic corridor**: Benefits are expanded to include the effects in the Washington, DC region of railroad realignment in the region plus major improvements elsewhere on the north-south freight rail corridor. In general, these

Evaluation of Alternative Alignments

other corridor improvements were identified in the Mid-Atlantic Railroad Operations Study (MAROPS). MAROPS defined a wide range of needed improvements throughout the mid-Atlantic corridor that would eliminate freight rail bottlenecks resulting from bridge and tunnel clearance restrictions, lack of mainline capacity, and service restrictions resulting from shared rights-of-way with passenger trains. Estimated benefits in this scenario were approximated where necessary to include only the share of total corridor-wide benefits that would be realized within the Washington, DC region. This approximation was accomplished by apportioning the total corridor benefits to the Washington, DC region based on the share of freight travel occurring on the Washington, DC segment of the entire corridor analyzed in MAROPS.

The estimated real estate benefits were the same in both scenarios. The costs were also the same in both scenarios and included only the costs of the railroad

Table 4-2. Benefit Categories Applied to Alternatives

Benefit Category	Washington, DC Region Realignment Only			With Other Mid-Atlantic Corridor Improvements		
	DC Tunnel	Indian Head	Dahlgren	DC Tunnel	Indian Head	Dahlgren
Freight shipper savings Rail operator savings, shipper cost savings and benefits of improved competitive access	No	No	No	Yes	Yes	Yes
Highway user savings Travel time and VOC savings from truck diversion	No	No	No	Yes: auto and truck	Yes: auto and truck	Yes: auto and truck
Highway system benefits Improved safety, emissions, and highway maintenance reductions from truck diversion; highway construction cost savings from rail realignment	Minimal	Minimal	Minimal	Yes	Yes	Yes
Rail user benefits VRE passenger time savings and reliability benefits; Amtrak passenger time savings	No	Yes: travel time and reliability	Yes: travel time and reliability	No	Yes: travel time and reliability	Yes: travel time and reliability
New real estate development East of the River development only	Yes	Yes	Yes	Yes	Yes	Yes
Value increase due to removal of rail line Reflects price gradient increases around Metro stations.	Yes	Yes	Yes	Yes	Yes	Yes
User value of improved access to waterfront parkland "Imputed" value per park visit; does not include "option" value of non-users	Yes, but minimal	Yes, but minimal	Yes, but minimal	Yes, but minimal	Yes, but minimal	Yes, but minimal

realignment in the Washington, DC region. This definition of benefits and costs provided a consistent basis for the analysis in both scenarios.

Table 4-2 summarizes the economic benefits considered in this study organized by benefit categories. Some economic benefits do not apply in some cases because of an alternative's physical and operational characteristics. For example, the "Rail user benefits" category does not apply to the DC Tunnel alignment because that alternative would not separate freight and passenger rail service south of the District.

Benefit-Cost Analysis Assumptions

Project Schedule

The assumed schedule for project development, implementation, and use is in Figure 4-3. This schedule defined the years in which costs would be incurred and benefits realized. Assumptions related to the schedule were:

- The project development process—planning, environmental analysis, engineering design, and construction—could be completed in approximately 10 years, which is aggressive for a project of such magnitude and complexity, but not unrealistic. The realigned railroad was assumed to enter service in 2017.
- The discounted present value analysis extended through the year 2057. This represents 40 years of operating experience and a 40-year benefit stream as well.
- Construction costs were assumed to be expended at a level rate over a five-year period beginning in 2012. For discounting purposes, 2012 was thus assumed to represent Year 1. Costs would be incurred over a five-year period before any project benefits would be assumed to begin. Deferral of project benefits for five years results in a substantial discounting of benefits.

This aggressive schedule assumes that tow critical aspects of a project could be quickly defined. One is the responsibility for project implementation. Some entity or entities must have powers necessary

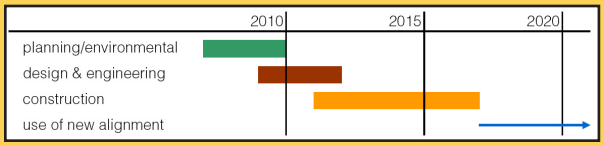

Figure 4-3. Project Development Schedule

Table 4-3. Alternative Alignment Time Differences

	Run Time	
	General Merchandise	Premium Intermodal
Existing	3' 30"	2' 55"
DC Tunnel	2' 50"	2' 50"
Indian Head	2' 59"	2' 59"
Dahlgren	3' 07"	3' 07"

The DC Tunnel alignment would reduce freight railroad travel times through the Washington, DC region and thus would result in modest time and cost savings for rail carriers. The eastern alignments would produce slightly longer routes but higher travel speeds for general merchandise trains resulting from the separation of freight and passenger rail.

to carry out the steps in project development as well as the ability to involve the appropriate stakeholders, both public- and private-sector. This authority must be clearly defined early in project development to avoid delays. The other aspect is funding. Adequate resources must be assured on a timely basis to support project costs.

The project development schedule is important because the security risks created by the present alignment would persist for a long time. Security risks would not be fully reduced until a railroad realignment project is completed and in operation. This fact underscores the urgency of beginning and completing a project as quickly as possible.

Discount Rates

Discount rates were assumed as follows:

- Transportation-related benefits were discounted at a real discount rate of 3.25 percent. This represents a consensus discount rate utilized in recent transportation benefit-cost studies and project evaluation guidelines. The current US Office of Management and Budget guideline for federally funded projects is a 3.0 percent real discount rate (OMB Circular No. 94 -Appendix C, 2006; the current AASHTO guideline is 3.5 percent (A Manual of User Benefit Analysis for Highways, 2nd ed.)
- Real estate benefits were discounted at 5 percent—a higher discount rate than transportation-related benefits—to reflect the higher risk associated with real estate investment and the typically higher hurdle rates that real estate developers seek in the market. Because of the substantial public component to the benefits associate with redevelopment in the city, the rate is not as high as a full private-sector developer hurdle rate.

Transportation-Related Benefits

Several types of measurable transportation-related benefits would be generated by the various railroad realignment alternatives, including travel time savings for freight rail, passenger rail riders, and highway users. Other benefits are explained below, including the methodology and assumptions used to estimate each benefit category. The methodologies and assumptions used for the transportation-related benefits were adapted from recent rail benefit studies in the mid-Atlantic region. These studies include the *Mid-Atlantic Rail Operations Study: Interim Benefits Assessment*, developed for the I-95 Corridor Coalition (2004), the *Guide to Quantifying the Economic Impacts of Federal Investments in Large-Scale Freight Transportation Projects*, developed for the U.S. DOT (2006), and the *Baltimore Freight Rail Bypass Study*, developed for the Maryland DOT (2005).

Travel time impacts for existing freight rail

Each of the three alternatives would affect freight railroad travel time. Travel time impacts for existing freight rail were estimated using: 1) a rail network simulation model, 2) federal Surface Transportation Board carload waybill sample data for the Washington, DC rail corridor, and 3) estimates of average carload costs per hour for intermodal and all other freight rail merchandise. The waybill data was used to estimate the number of intermodal and general merchandise carloads traveling through the Washington, DC rail corridor. The total volume of carloads in 2005 was 368,489 with 32 percent intermodal rail. Based on the MAROPS,[1] the projected annual average growth rate is 3 percent for intermodal rail volumes and 1.1 percent for general merchandise. Based on data provided by CSX, hourly carload costs were estimated to be $23.81 for intermodal and $15.96 for general merchandise.

The DC Tunnel alignment would reduce freight railroad travel times through the Washington, DC

1 It is worth noting that MAROPS was sponsored by CSX Transportation, Norfolk Southern, and Amtrak, and all three rail operators participated in the data and assumptions used in the benefits analysis.

region, creating modest time and costs savings for rail carriers. The Indian Head and Dahlgren alignments would produce slightly longer routes but higher travel speeds for general merchandise trains resulting from the separation of freight and passenger rail. Because the Indian Head and Dahlgren alignments would allow for trains to run without delay, this analysis assumed the same travel time for general merchandise and premium or intermodal trains. As a result, premium intermodal traffic would have a small increase in cost due to the longer route. This would be largely offset, however, by the large time savings general merchandise freight would have shifting from an existing run time of 3 hours 30 minutes to a shorter run time of 2 hours 59 minutes for Indian Head or 3 hours 7 minutes for Dahlgren.

Shipper cost savings of freight rail

Improving the performance and capacity of the rail system can lead to higher volumes of freight moving by rail rather than trucks. Because shipping by rail is less expensive on a cents-per-ton-mile basis than shipping by truck, shippers and receivers of freight benefit through lower costs. This benefit would accrue only in the scenarios with other mid-Atlantic corridor railroad improvements, as other improvements would be needed to allow long-distance shipment of double-stack containers.

The methodology to estimate this effect used the ratio of carloads passing through the Washington, DC rail corridor compared to total carloads examined in MAROPS (8 percent), which allowed the derivation of estimates of both tons diverted to rail and reductions in truck VMT. Based on the shipping pattern (origins and destinations and average distance) of rail from the waybill sample, the resulting increase in ton miles shipped via rail (compared to a scenario without other mid-Atlantic railroad improvements) can be estimated. Applying the MAROPS differential in cost per ton mile shipped by rail ($0.045) versus truck ($0.08) to the increase in freight rail shipments resulted in an estimate of shipper cost savings.

Shipper cost savings would benefit all three alignments equally. The cumulative savings to freight shippers over the 40-year analysis period from 2017 to 2057 was estimated to be $618,199,988.

Reduced supply chain and logistics costs

The ultimate beneficiaries of reduced shipping costs would be the businesses that ship and receive goods by rail. Recent research by the U.S. DOT and FHWA documents how companies can leverage "1st order" direct transportation-related benefits into additional cost savings and market share by restructuring their distribution and supply chain processes to produce, ship, and receive goods.

The recently published U.S. DOT freight economic impact guidebook describes the benefits of reduced transportation costs as: 1) greater supply network reach, 2) reduction in the number of plants or distribution centers to serve a market, and 3) a reduction in inventory from the use of smaller shipment sizes for the same price. Parameters estimated from a large sample of empirical, quantitative business case studies show that a ten percent reduction in freight transportation costs can lead to a four to seven percent additional supply chain benefit. The actual benefit amount varies based on the industry mix and supply chains affected. This methodology was applied in the Baltimore freight rail bypass case study as part of the U.S. DOT freight economics guidebook and resulted in additional supply chain benefits that equaled 63.25 percent of the 1st-order shipper cost savings. Since the industry mix and supply chain logistics of freight shippers and receivers using the Washington, DC rail corridor is similar to those in Baltimore, that estimate was applied to the rail transportation cost impacts estimated for each alternative in this study.

Supply chain benefits are based directly on the freight rail operator's savings. Therefore, the supply chain savings are in direct proportion to the savings the freight rail operators would receive.

Highway benefits from reduced truck volumes

Increasing freight capacity provides the opportunity for freight to be transported via railroad instead of

truck. To the extent that the Washington, DC rail realignment led to higher volumes of freight moving by rail instead of by truck in the future, truck vehicle miles of travel (VMT) would be reduced. These benefits would accrue only in the scenarios with other mid-Atlantic corridor railroad improvements, which provide additional premium intermodal capacity by allowing for long-distance shipment of double-stack containers.

For this analysis, highway-related benefits stem entirely from the estimation of increased freight rail volumes and thus lower truck VMT on the highway system (primarily in the mid-Atlantic region). Based on the number of additional carloads, truck VMT was estimated to decrease by 128.1 million by 2025. The reduction in future truck VMT would have two measurable impacts.

First, it would relieve future traffic congestion and improve travel performance for the trucks and autos that remain on the highway system. These benefits were quantified using a ratio of truck VMT reduction compared to the full MAROPS program of benefits. The resulting reductions in travel time and delay were further segmented and monetized into trucks, on-the-clock business auto trips, and non-business auto trips. The original MAROPS estimated these benefits by simulating a reduction in truck VMT through FHWA's Highway Economic Requirements System (HERS) model to quantify the highway efficiency benefits to remaining highway travelers. The cumulative highway benefits would accrue equally to the three alignment alternatives, providing $1,341,716,594 to auto and truck highway users between 2017 and 2057.

The second impact category is a number of secondary effects related to reduced truck miles traveled such as reduced polluting air emissions, reduced wear and tear on highway facilities and consequently reduced future pavement maintenance costs, and safety increases with fewer trucks resulting in fewer accidents. Based on a combination of data from the FHWA and the Baltimore Freight Rail Bypass Study, the following parameters were used to estimate these secondary effects:

- Air pollution emissions: $0.045 per truck VMT
- Highway maintenance savings: $0.20 per truck VMT
- Safety savings: $0.115 per truck VMT

Overall highway system benefits would also accrue equally to the three alignment alternatives, providing $1,635,961,051 between 2017 and 2057.

Improved passenger rail travel times and reliability

For the Indian Head and Dahlgren alignment alternatives, separating freight and passenger rail services traveling through Virginia and into downtown Washington, DC would lead to improved Virginia Railway Express and Amtrak performance. Improved performance would be realized through both reduced average travel times and improved on-time performance providing benefits to commuter and other passenger rail riders.

Travel-time savings and on-time performance improvements were estimated using a rail simulation model, which provided general estimates of running times. The travel time for a passenger rail trip from Fredericksburg to the District was estimated to achieve an 11 percent reduction in journey time from the present 90 minute schedule. Three elements make up this schedule reduction. Fewer freight trains open up the possibility of operating some skip stop or express train service instead of all trains making all stops. Second, there is limited opportunity for increased speeds—80 mph instead of 70 mph. Finally, the biggest savings comes with the confidence of trimming the schedules' recovery time or make-up time because the freight trains are somewhere else for all or part of the trip.

On-time performance was estimated to be improved from 80 percent to 95 percent. This is almost entirely the result of reducing or eliminating freight trains. The improvement in on-time performance led to the estimate of a reduction of delay of six minutes per trip. To estimate aggregate time savings, average daily ridership on VRE (7,750 in FY2006) was multiplied

Evaluation of Alternative Alignments

by the time savings and converted to annual estimates based on the number of work days per year and the portion of the route a rider used. The aggregate time savings for all riders over the course during a year add up to a significant amount of time. These travel time savings were converted into monetary terms using values of time used by the Virginia DRPT for business and personal travel ($37.55 and $16.97 calculated in 2005 dollars, respectively). To be conservative, most of the travel was assumed to be for personal, in most cases commute, trip purposes with 20 percent for on-the-clock business trips. VRE passenger rail benefits were estimated to grow with VRE ridership projections of 3.3 percent average annual growth on the Fredericksburg and Manassas lines.

Amtrak trains should also experience improvements in travel time and on-time performance. A similar methodology to the VRE benefits was applied to Amtrak, with a few key differences: 1) average daily ridership on affected Amtrak service is lower (4,965 in 2006), 2) the average value of time was reduced to reflect the primarily personal nature of travel ($18.00 per hour), and 3) Amtrak's estimate of annual average ridership growth of 4.8 percent on the Richmond-to-Washington, DC service was applied to grow benefits over time.

Another important benefit of improved travel time, reliability, and capacity is the ability of commuter rail to absorb a greater share of commute trips in the VRE corridors, especially on the Fredericksburg Line. While this induced demand effect was not measured for this study, the resulting improvement in VRE service from the Indian Head and Dahlgren alignments has the potential to attract commuters at a faster rate than highway travel.

Cumulative savings to the Indian Head and Dahlgren alignments would be equal, resulting in $188,951,468 in travel time saving and $1,240,682,041 in reliability savings between 2017 and 2057.

Table 4-4. Summary of Benefits* (2017-2057) $2006

	DC Tunnel	Indian Head	Dahlgren
With Other Corridor Mid-Atlantic Improvements	$4,284,465,657	$7,288,362,602	$7,176,596,767
Without Other Corridor Mid-Atlantic Improvements	$297,576,531	$3,330,147,3476	$ 3,189,707,641

* Benefits in Table 4-4 are not discounted.

All three rail realignment alternatives would produce significant transportation-related benefits for the region and the nation. Ultimately, Indian Head would be likely to produce slightly greater transportation-related benefits.

Transportation-Related Benefits Summary

All three rail realignment alternatives would produce significant transportation-related benefits for the region and the nation. The Indian Head alternative would generate the most transportation-related benefits, followed closely by the Dahlgren alternative. Both alignments fared well in the transportation-related benefits analysis, largely because of the travel time and reliability savings they would provide passenger rail service. Ultimately, the Indian Head alignment would be likely to produce slightly greater transportation-related benefits than the Dahlgren alignment because it would be shorter in distance and therefore has a shorter run time.

Geographic Distribution of Transportation-Related Benefits

The benefits to shippers and receivers would be geographically distributed. The benefit-cost analysis identified this geographic distribution from two perspectives:

- Regional benefits: Washington, DC, Maryland, and Virginia
- National benefits: summation of regional benefits and rest of the U.S.

The assumption is that benefits accrue at the origin and destination of trips, not simply the location of transportation improvements. Estimates of the origin-destination pattern of freight and passenger trips affected by alternative alignments were used to allocate benefits to the regional and rest-of-the-U.S. geographies using a simplified 50-50 split between origins and destinations. Except for the passenger rail benefits, all other benefit concepts were allocated to regions based on analysis of the origin-destination pattern of rail shipments in the waybill data sample. The data reveals that 25 percent of the freight shipments are directly related to origins and destinations within the DC-MD-VA region, while 75 percent accrue to other parts of the United States. Given the long-distance nature of most freight rail shipments, this result is not unexpected. Of the 25 percent of the regional benefits, the District of Columbia would receive 1 percent of the regional

Table 4-5. Public/Private/Geographic Breakdown of Benefits* $2006

With Other Mid-Atlantic Corridor Improvements

Public Benefit	DC Tunnel	Indian Head	Dahlgren
DC, MD, VA	$667,519,015	$3,023,849,876	$3,023,849,876
DC	$8,345,877	$8,345,877	$8,345,877
MD	$261,612,277	$261,612,277	$261,612,277
VA	$397,560,861	$2,685,260,727	$2,685,260,727
Rest of USA	$2,002,577,044	$2,775,859,691	$2,775,859,691

Private Benefits	DC Tunnel	Indian Head	Dahlgren
DC, MD, VA	$356,787,932	$346,465,818	$337,290,606
DC	$4,460,859	$4,331,803	$4,217,087
MD	$139,831,377	$135,785,962	$132,190,037
VA	$212,495,696	$206,348,053	$200,883,482
Rest of USA	$1,257,601,666	$1,142,187,216	$1,039,596,594

TOTAL	**$4,284,465,657**	**$7,288,362,602**	**$7,176,596,767**

Without Other Mid-Atlantic Corridor Improvements

Public Benefits	DC Tunnel	Indian Head	Dahlgren
DC, MD, VA	$-	$2,356,330,862	$2,356,330,862
DC	$-	$-	$-
MD	$-	$-	$-
VA	$-	$2,356,330,862	$2,356,330,862
Rest of USA	$-	$773,302,647	$773,302,647

Private Benefits	DC Tunnel	Indian Head	Dahlgren
DC, MD, VA	$27,584,666	$17,262,551	$8,087,339
DC	$344,886	$215,831	$101,115
MD	$10,810,909	$6,765,493	$3,169,568
VA	$16,428,870	$10,281,227	$4,816,656
Rest of USA	$269,991,866	$154,577,416	$51,986,794

TOTAL	**$297,576,531**	**$3,301,473,476**	**$3,189,707,642**

* Benefits in Table 4-5 are not discounted.

benefits, Maryland would receive 39 percent, and Virginia would receive 60 percent. The District would reap very little of the transportation-related benefits because most of the rail traffic is passing through, not originating or terminating. Benefit concepts such as highway congestion relief and reduced accidents and pavement costs can be fittingly attributed to the geographies based on freight shipment patterns since these benefits occur due to reductions in truck VMT that would not have occurred throughout the broader mid-Atlantic region without rail improvements. Passenger rail benefits, which are largely commuter trips on VRE are primarily allocated to the region, and even more specifically, Virginia.

Public and Private Benefits

- Benefits would also be distributed to both public and private recipients. Understanding this distribution is particularly important for freight transportation projects for at least two reasons: 1) freight activity by its nature directly affects the costs and efficiency of business-related travel and trade and 2) freight transportation facilities, such as rail lines, are often at least partially owned and maintained by private-sector transportation firms and providers. Consequently, the benefits analysis identified separate estimates of public and private benefits. For purposes of this analysis, private benefits are those that most directly relate to private rail carriers and the shippers and receivers of goods:
- Freight rail travel time impacts
- Freight rail shipper cost savings
- Truck and on-the-clock auto highway travel efficiency benefits (reduced delay)
- Public benefits accrue to either personal, non-business travel (across a large number of people) or society in general (e.g., air emissions) and include:
- Passenger rail travel time savings (VRE and Amtrak)
- Non-business auto travel efficiency benefits
- Highway system benefits—safety, emissions, and pavement maintenance

Transportation-Related Benefit Results

The results of the transportation-related benefit analysis reveal several important conclusions:

- The private sector benefits most when other corridor improvements are made.
- The public benefits most from the Indian Head and Dahlgren alternative alignments because of passenger rail savings.
- Of the regional public benefits, the majority accrue to Virginia.
- Of the regional private benefits, the breakdown is 1 percent to the District of Columbia, 39 percent to Maryland, and 60 percent to Virginia.

DC Tunnel with Washington, DC region realignment only

This alternative would produce the least cumulative transportation-related benefits, resulting in an estimated $297,576,531 between 2017 and 2057. All the benefits would accrue to the private sector; the public sector would receive no benefit. The private benefits would be a result of reduced freight travel times, benefiting the rail service providers and shippers. Of the private benefits, the majority, 91 percent, would be allocated to the rest of the United States.

DC Tunnel with other mid-Atlantic corridor railroad improvements

When additional corridor improvements are added to the DC Tunnel alternative the transportation-related benefits would drastically increase. The private benefits would increase from $297,576,531 to $1,614,389,598, with the majority, 90 percent, still being allocated to the rest of the United States. The public benefits would total $2,670,076,059 and would all be due to reduced truck VMT.

Indian Head with Washington, DC region realignment only

In this alternative, the public benefits of $3,129,633,509 would be nearly 18 times greater than the private benefits of $171,839,967. All of the public benefits would be due to passenger rail savings, which would be allocated either to the rest of the United States or to Virginia. Maryland and the District of

Evaluation of Alternative Alignments

Columbia would receive no public benefit from this alternative. The private benefits would be a result of higher train speeds and ultimately a total travel time savings.

Indian Head with other mid-Atlantic corridor railroad improvements

When additional corridor improvements are added to the Indian Head alternative, the transportation-related benefits would increase 121 percent. The public benefit of $ 5,799,709,567 would continue to outweigh the private benefits of $1,488,653,034. However, the difference between the public and private benefits drastically decreases. The increased private benefits would be a result of greater shipper cost savings and reduced truck VMT.

Dahlgren with Washington, DC region realignment only

In this alternative, the public benefit of $3,129,633,509 would be nearly 52 times greater than the private benefit of $60,074,133. All the public benefits would be due to passenger rail savings, which are allocated either to the rest of the United States or to Virginia. Maryland and Virginia would receive no public benefit from this alternative. The private benefits would be a result of higher train speeds and ultimately a total travel time savings.

Dahlgren with other mid-Atlantic corridor railroad improvements

When additional corridor improvements are added to the Indian Head alternative, the transportation-related benefits would increase 125 percent. The public benefits of $ 5,799,709,567 would continue to outweigh the private benefits of $1,376,887,200. However, the difference between the public and private benefits would drastically decrease. The increased private benefits would be a result of greater shipper cost savings and reduced truck VMT.

Real Estate Benefits

The freight railroad realignment would allow the redevelopment of parts of the existing railroad right-of-way within the District. This redevelopment would create real estate benefits, including potential increases in property value.

The real estate analysis assumed the existing railroad right-of-way would be vacated between the divergence of the Amtrak line to Union Station and the District-Maryland line, except for a spur that would allow continued coal deliveries to the Capitol Power Plant. The removal of the rail line holds significant implications related to property value and opportunities for new land development.

Real Estate Methodology

In the locations where the rail line would be removed, two real estate dynamics would come into play. One is (re)development that will be possible on and adjacent to the vacated rail right-of-way. The other real estate-related consequence is an increase in property values in the areas adjacent to the rail right-of-way resulting from an improved physical environment—the removal of a significant barrier and improved connections, the construction of new development on and adjacent to the vacated rail right-of-way, the creation of potential new amenities such as roadways, green space, and transit. These two dynamics would create new property value within the District of Columbia that would not otherwise be generated should the rail line remain.

To understand the market dynamics shaping growth in areas adjacent to the existing alignment, a study of existing conditions was conducted. The development history, land use and building stock, property ownership, zoning, and transportation network were evaluated within each section. Demographic conditions within the Washington, DC region, within the District, and within the specific study areas were also evaluated. Finally, current activities affecting the individual study areas, including economic trends, land use and infrastructure planning efforts, and real estate development activity were evaluated. This study is in Appendix C, which is in a separate report volume.

Evaluation of Alternative Alignments

To aid in understanding of the opportunities and challenges of redevelopment in the corridor, the National Capital Planning Commission and the District Department of Transportation sponsored an Urban Land Institute Fellows Panel on December 11-13, 2006. The panel brought together four respected real estate and development experts to review conditions in the corridor and recommend development-related actions. The panel's recommendations are described in a separate report. Similar panels could be convened in the future to understand the development impacts to areas around any new alignment.

The analysis measured real estate benefits of freight railroad realignment by estimating the following impacts:

- Projected long-term (re)development in square feet of new development and associated new market value (cumulative and annual).
- Projected potential increase in property values in the areas adjacent to the vacated rail right-of-way and the new development market values.

While real estate impacts to areas where a new alignment may go need to be analyzed, it was beyond the scope of this study to assess these impacts. This type of analysis, which would include having a specific railroad alignment and adjacent property data, would

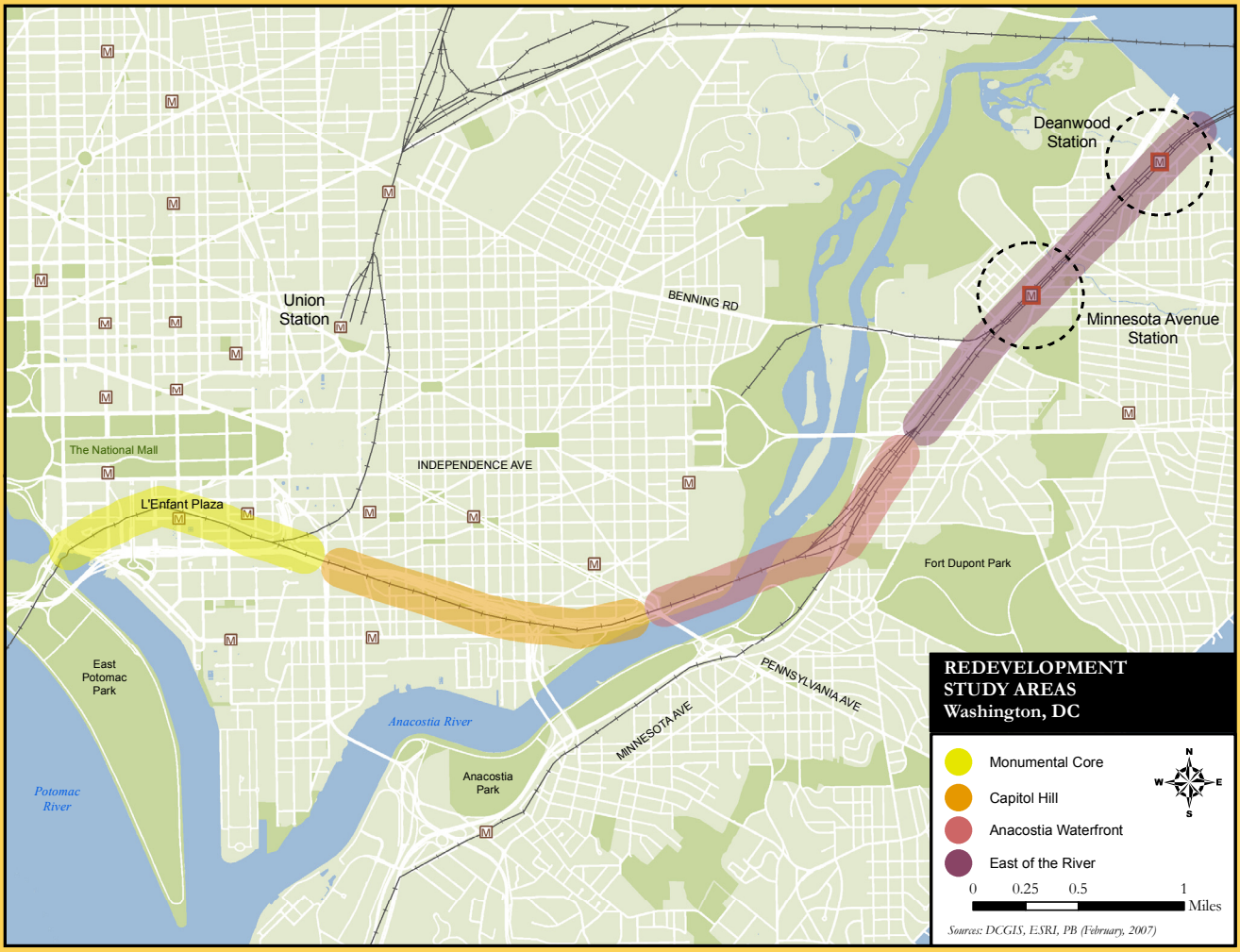

Figure 4-4. Real Estate Study Areas

be appropriate once the project becomes more defined.

Real Estate Assumptions

Several assumptions were used to calculate the benefits resulting from the real estate impacts.

Development was assumed to be generated over a 40-year period, beginning in 2017 (the year the rail line was assumed to be removed) and extending to 2057. The 40-year period is consistent with the overall benefit-cost analysis framework—the discounted present value of benefits must assume uniformity across all benefit categories to arrive at a correct benefit-cost result. The 40-year period was also regarded as a reasonable build-out period for new development.

Development was assumed to be, on average, evenly distributed over this 40-year time period. Multiple factors, including the segment's historically low market share of the District of Columbia as a whole combined with improving market conditions and approaching build-out in the city's traditional markets, do not support the creation of a detailed projected absorption trend. As a result, an average annual absorption was applied to avoid the need for assumptions about how and when absorption will occur in the East of the River segment. This absorption rate was tested to establish its reasonableness given current and anticipated real estate development trends, existing conditions in this area, and plans for growth.

The analysis includes the monetary benefits resulting from new development only in the East of the River segment. The real estate analysis addressed both the Monumental Core and East of the River segments, but development within the Monumental Core is not dependent upon railroad realignment. A proposed deck over the existing rail line in the Monumental Core would allow development independent of railroad realignment. Thus, development in the Monumental Core is not included in the benefit-cost analysis.

Table 4-6. Moderate Development Scenario

Net New Floor Area Ratio (FAR) Assumptions* Redevelopment Properties - Moderate Redevelopment Scenario			
Location	0-350 ft	350 – 800 ft	800 – 1500 ft
Vacated Rail Bed	0.5	No change	No change
Minnesota Avenue Metrorail Station	3	1.5	No change
Deanwood Avenue Metrorail Station	1	0.5	No change

*Geographic zones based on the following assumptions: redevelopment most likely to occur within 350 feet (approximately equivalent to one city block) of rail line or 0.25 mile radius (walking distance) around Metrorail stations.

Table 4-7. Land Use Mix Assumptions

Land Use Mix Assumptions East of the River			
Location	Residential	Retail	Office
Minnesota Avenue	75%	20%	5%
Minnesota Avenue Metrorail Station	65%	10%	25%
Deanwood Metrorail Station	65%	10%	25%

- Based on land use mix in proposed and planned projects in the East of the River segment

Figure 4-5. Recent Decking Over Present Railroad

Evaluation of Alternative Alignments

Both moderate and major redevelopment scenarios were developed in the study. The moderate scenario was used for the allocation of benefits in the benefit-cost analysis.

All of the dollar amounts in Table 4-10 are presented in undiscounted, 2005 constant dollars. A three percent per year increase in real property values was applied, reflecting historic real property value increases over inflation during stable market periods. The rapid escalations in property values witnessed over the past three years were not considered in establishing the increase rate.

Real Estate Impacts

Development in the East of the River segment would likely occur on and adjacent to the vacated railroad right-of-way as well as around the two Metrorail stations located in this segment: Deanwood and Minnesota Avenue.

Using these floor-area-ratio assumptions, new square footage of development was calculated based on existing land areas and assumed floor-area ratios. Based on current and projected land use patterns, the following land use mix distributions were applied to determine total square footage by retail, residential, and office land use.[2]

Total redevelopment in gross square footage for the entire 40-year time period beginning in 2017 is depicted in Table 4-8.

Assuming average annual absorption, this development potential yields $35.2 million per year in new market value over a 40-year period.[3]

2 A complete discussion of the East of the River development potential and assumptions is in Appendix C.

3 This calculation uses 2007 constant dollars and does not include a likely 3% annual real estate real value increase beyond general price increases. Retail market values = $350/SF, residential market values - $225/SF, office market values = $300/SF and are figures utilized by the District for economic and fiscal evaluations. The appendix includes a detailed presentation of the East of the River development potential.

Table 4-8. Cumulative Development with Moderate Development

Cumulative Development in Gross Square Footage East of the River (2017-2057)	
	Moderate
Office	1,067,004
Retail	457,348
Residential	4,234,216
TOTAL	**5,758,568**

Table 4-9. Value Increase Gradient

Assumptions: Value Increased Related to Freight Rail Removal Freight Rail Estimated Real Estate Impacts	
Distance from Freight Rail Line	**Associated Value Increase***
0-500 Feet	10%
500-800 Feet	6%
800-1500 Feet	4%
1500-2500 Feet	2%

1) Based on findings of five studies that analyzed the value premium associated with amenity creation (e.g. parks, greenways, boulevards, etc.)

Evaluation of Alternative Alignments

Increases in Assessed Values

In addition to estimating total redevelopment potential, the impact of the rail realignment was evaluated by calculating the total increase in values that would result from the rail line removal. These impacts were calculated by:

1) applying a value increase gradient, diminishing as distance from the rail line increases, and
2) adjusting assessed values for estimated redevelopment potential.

The assumptions regarding value increases by distance from the with freight rail line are identified in Table 4-9.

This increase in value was projected as a one-time adjustment occurring in response to the railroad realignment.

In a No-Change scenario, real estate values were assumed to increase at three percent per year in real dollar increases (beyond general price level changes), reflecting historic real property value increases. In the Moderate Redevelopment scenario, in which the rail line is removed and a moderate level of development occurs, real estate values would increase at the three percent per year real dollar increase in addition to the following two factors:

1. a one-time premium adjustment responsive to the rail line relocation, and
2. 40-year absorption of new market value resulting from new development.

The annual difference in value between the Moderate Redevelopment scenario and the No-Change scenario is presented in Table 4-10.

Regional Development Possibilities

Though this study did not include the identification of specific development opportunities outside of the District, it did generally consider the possibility for railroad-related development in those counties that would be most affected by the viable alternatives. The key elements of these counties' comprehensive or general plans, as they relate to a proposed freight railroad alignment, are summarized. These opportunities should be studied in more detail in future project steps.

Charles County, Maryland

On the outskirts of Washington, DC, Charles County is experiencing significant residential growth pressures. The county anticipates an increase of 20,000 office jobs between 2000 and 2025. The Charles County Comprehensive Plan intends to concentrate 75 percent of all development within the northwestern portion

Table 4-10. Real Estate Benefits for Selected Years

Real Estate Benefits Net New Value of Rail Line Relocation (2017 - 2057)	2005 Observed	2010 Projected	2020 Projected	2030 Projected	2040 Projected	2050 Projected	2057 Projected
Rail Relocation with Moderate New Development (billions)	$5.065	$5.872	$8.406	$11.980	$17.018	$24.106	$30.558
No Change (billions)	$5.065	$5.872	$7.892	$10.607	$14.254	$19.157	$23.561
Net New Value (billions)	$0	$0	$0.513	$1.373	$27.640	$49.488	$6.997

(1) Assumes 2005 Constant Dollars

(2) Incorporates annual 3% real property value increase

(3) Includes one-time property value increase in 2017 (year of rail line removal)

(4) Includes 40-year straight line absorption of moderate development market value starting in 2017

of the county and the towns of Indian Head and La Plata.

The county's intention is to concentrate office development in Waldorf, White Plains, and the area adjacent to the Harry W. Nice Memorial Bridge. Though the county has determined that the majority of its waterfront areas are undevelopable, it considers the area around the Nice Bridge suitable for development. The Indian Head and Dahlgren alternative alignments pass through or close to all of these areas.

The county plan's transportation section discusses the U.S. 301 corridor, which parallels the Pope's Creek Branch. Notable transportation elements of the plan include:

- Opposition to the conversion of U.S. 301 through Waldorf into a limited-access freeway because of the physical divide it would create.
- Preservation of right-of-way for a U.S. 301 bypass around Waldorf. Both the Indian Head and Dahlgren alignments would make use of the current railroad right-of-way directly adjacent to U.S. 301 in this area.
- Light rail or bus rapid transit running along the U.S. 301 corridor between Waldorf and La Plata. The county anticipates building this transit line no earlier than 2015 and proposes the acquisition of rights-of-way in preparation.

Charles County and the project sponsors should coordinate on development possibilities associated with the Indian Head and Dahlgren alignments. The key issues of concern are coordinating any future U.S. 301 bypass with a future railroad, and coordinating the development of railroad alternatives so that they minimize impacts to the surrounding communities and maximize the benefit of new office or industrial development.

To minimize community impacts, mitigation tools such as noise walls, depressing the railroad below grade, and/or creating a railroad bypass could be used where appropriate. These elements have been included in the cost estimates for these alternatives. Accordingly, the benefit-cost analysis took explicit account of noise and other impacts.

Prince George's County, Maryland

The *Prince George's County Approved General Plan* divides the county into three regions; they are, from west to east, the Developed, Developing, and Rural Tiers. Both the Indian Head and Dahlgren alignments would pass through the Developing Tier and small portions of the Rural Tier. The county expects that the majority of all development from 2002 to 2027 will occur in the Developing Tier. In general, the county envisions a shift to become a greater employment center within the region.

The only designated development centers along the Indian Head/Dahlgren alignment are Bowie, designated a Regional Center, with residential densities greater than or equal to eight dwelling units per acre, and the area north of Waldorf at the Charles County line, which is designated a Community Center, with residential densities ranging from four to 30 dwelling units per acre.

One of Prince George's County's environmental priorities is reducing transportation-related noise volumes in residential areas to levels between 45 and 65 dBA. If a freight railroad were to be built close to homes, noise walls or other suitable mitigation measure would be included.

Anne Arundel County

The Indian Head/Dahlgren alignment would run through mostly industrially zoned areas in the county, with the exception of the medium- to high-density residential Odenton and Maryland City. Both alignments could enhance industrial development in the county.

King George County, Virginia

King George County, with 2030 population projected to be less than 30,000, is one of the most rural jurisdictions in the project study area. The Dahlgren alignment would pass near the most populated areas in King George County, Courthouse and Dahlgren. The

Evaluation of Alternative Alignments

King George Comprehensive Plan identifies the Dahlgren area as one of the only sites for redevelopment in the county; however, development intensity is limited by the Chesapeake Bay Preservation Area Overlay Zoning District. The Dahlgren alternative could enhance manufacturing or office development opportunities in and around Courthouse and Dahlgren.

Costs

Capital cost estimates for the railroad realignment alternatives are shown in Table 4-11. Because these estimates are based on conceptual alignments rather than detailed designs, they are order-of-magnitude costs and should be considered conceptual cost estimates. The estimates are sufficient to allow comparisons among the alternatives of their capital cost requirements.

High and low ranges of estimates were developed for each alternative reflecting the uncertainties in conceptual estimates. The high estimates include a higher contingency factor and assume more expensive structural solutions at waterway and roadway crossings, and higher allowances for property acquisition and noise walls. To be conservative, the benefit-cost analysis used the high cost estimate for each alternative.

The methodology used in preparing these conceptual costs estimates used accepted railroad industry techniques and is in accordance with current federal guidelines for estimating capital costs. The methodology is based on a "bottom up" estimating approach. Facility elements were grouped into major capital cost categories: guideway and track, systems, site work, and right-of-way property acquisition. The capital costs were determined in 2006 dollars.

Table 4-11. Conceptual Capital Costs of Alternatives

$s in millions	DC Tunnel		Indian Head		Dahlgren	
	Low	High	Low	High	Low	High
Bypass Alignment						
Railroad Infrastructure						
At-grade	$14	$15	$228	$221	$335	$330
Deep Retained Cut	$231	$456	$298	$829	$330	$911
Tunnel	$3,806	$3,952	$ -	$ -	$ -	$ -
Potomac River Bridge	$ -	$ -	$388	$403	$381	$395
Interlockings & Sidings	$41	$43	$145	$150	$171	$177
Subtotal	*$4,092*	$4,466	*$1,059*	*$1,604*	*$1,217*	*$1,813*
Structures	$361	$484	$1,099	$1,532	$1,275	$1,756
Civil & Utilities	$42	$44	$344	$397	$439	$456
Right-of-Way, Security, Mitigation	$52	$72	$513	$563	$387	$447
Subtotal -- Bypass Alignment*	$4,500	$5,100	$3,000	$4,100	$3,300	$4,500
Old Main Line Improvements	$150	$150	$150	$150	$150	$150
CSX Piedmont Sub Improvements	$50	$50	$50	$50	$50	$50
Capital Cost	$4,700	$5,300	$3,200	$4,300	$3,500	$4,700

* Totals are rounded

Evaluation of Alternative Alignments

The unit costs were derived from historical data from comparable railroad projects, including labor, temporary and permanent materials, equipment, and contractor's profit and overhead. The references and historical bid cost records were adjusted to comparable quantities, site conditions, and similar type of construction. Design and construction contingencies, as well as engineering and construction management allowances, are included separately as add-ons to the cost estimates. They are:

Design and Construction Contingency

A design contingency of 20 to 25 percent was included to account for unforeseen items or large quantity differences which would affect the unit prices. The lower contingency was used for the low range of the cost estimates presented. This contingency reflects the degree of risk associated with the level of engineering data available in defining the items in each category. A construction contingency of 10 percent was included to account for changes in scope and site conditions that occur during actual construction activity. A total of 30 to 35 percent allowance was applied to the construction cost estimate for each item.

Engineering and Construction Management

The engineering and management add-on includes the cost for preliminary engineering, final design, construction management and inspection services, and administrative services required to implement the selected corridor alternative. The allowance for track, structures, systems, and civil work is 20 percent. The allowance for right-of-way acquisition is 10 percent. A total of 30 percent allowance was applied to the construction cost estimate for each item. Owner's administration costs and project insurance have not been developed or applied to this estimate.

Guideway and Track

Guideway construction costs for the alternative alignments were arrived at by estimating the number of route-miles to be constructed using various standard railroad construction techniques. Per-route-mile construction costs were developed for each technique based on established unit costs of materials, labor, and equipment necessary for each. The total guideway costs of each alternative alignment are the sum of the estimated miles required of each construction technique multiplied by its respective per-mile costs. Costs for certain guideway items, such as undergrade bridges and portal transitions, which are typically installed in segments much shorter than one mile, were calculated on a per-each basis.

Systems

The systems costs of each alignment consist of three primary fixtures: interlockings, highway grade crossings, and the fiber-optic lines necessary for train control and communications. Costs for interlockings and grade crossings were calculated on a per-each basis, while the cost for fiber-optics was calculated per route-mile.

Site Work and Mitigation

Site work consists of those construction activities required to make the right-of-way suitable for the installation of new guideways, such as land clearing and demolition, erosion and sediment control, and utilities relocation. Also included are certain mitigation items, such as the construction of noise barrier walls that will lessen the impact of the finished right-of-way on sensitive neighboring land uses. The cost figures for items in the site work category were calculated on a per-mile basis, with the exception of overhead highway bridges, which were calculated on a per-each basis.

Right-of-Way Property Acquisition

Fee simple property acquisition was assumed to be required to obtain a minimum 64-foot-wide right-of-way in each alternative alignment corridor. The property area required for each alternative was calculated in acres of existing private, railroad-owned, and governmental property required. The unit cost of this item was based on assumed values of properties located within urban areas and rural areas, measured in acres.

Evaluation of Alternative Alignments

Benefit-Cost Analysis Results

All alternatives and all scenarios yield benefit-cost ratios that are well in excess of 1.0, the threshold level for economically justifiable projects. Benefit-cost ratios, shown in Table 4-12, are highest for the Indian Head alternative; the Dahlgren and DC Tunnel alternatives follow in that order. These are general benefit-cost ratios and they do not take into account the benefit of reducing the security risk of moving hazardous freight through the heart of the federal establishment. Further, they do not take into account potential benefits or costs to areas around any new rail alignment.

Real estate development-related benefits are a majority of the monetized project benefits, ranging from about two-thirds of the benefits in the scenarios that include other corridor improvements to more than 90 percent for the scenario with the Washington, DC region realignment only. The real estate and development benefits on their own justify the railroad realignment project, even when other corridor improvements are not taken into consideration, and for each of the alternatives. These benefits can be leveraged to help pay for construction of a new alignment.

While transportation-related benefits comprise a minority of the total benefits and would not in and of themselves justify any of the alternatives, it should

Table 4-12. DC Rail Benefit-Cost Analysis

	DC TUNNEL		INDIAN HEAD		DAHLGREN	
	with other Mid-Atlantic corridor improvements	without other Mid-Atlantic corridor improvements	with other Mid-Atlantic corridor improvements	without other Mid-Atlantic corridor improvements	with other Mid-Atlantic corridor improvements	without other Mid-Atlantic corridor improvements
$s in millions						
TOTAL COSTS	5,300	5,300	4,300	4,300	4,700	4,700
TOTAL COSTS (PV)	5,133	5,133	4,165	4,165	4,541	4,541
TOTAL PV: $ - MEASUREABLE BENEFITS (NOT INCLUDING SECURITY)	8,841	7,058	10,032	8,249	9,953	8,200
% CONTRIBUTION TO MEASURED BENEFITS						
RR Time and Cost Savings	0.9%	1.1%	0.5%	0.5%	0.1%	0.2%
Freight Rail Shipper Savings	3.0%	0.0%	2.7%	0.0%	2.7%	0.0%
Supply Chain/Logistics Savings	2.5%	0.7%	2.0%	0.4%	1.8%	0.2%
Highway Benefits (includes Kenilworth Ave. Savings)	15.2%	0.7%	13.4%	0.6%	13.5%	0.6%
Passenger Rail Benefits	0.0%	0.0%	12.1%	14.7%	11.9%	14.7%
Real Estate Development	77.8%	97.4%	68.5%	83.4%	69.1%	83.9%
NET PRESENT VALUE	3,707	1,925	5,867	4,084	5,412	3,659
BENEFIT-COST RATIO	**1.72**	**1.37**	**2.41**	**1.98**	**2.19**	**1.81**

be noted that the benefits to shippers and highway users (including safety and environmental benefits) have been prorated in this analysis to capture only the benefits within the Washington, D.C. metropolitan area. This means that a substantial share of the total societal benefits have been extracted from this analysis. With the other corridor improvements in place, shipper and highway-system benefits would be extensive throughout the Northeast Corridor and would greatly exceed the volume of transportation-related benefits included in this benefit-cost analysis.

Evaluation of Alternative Alignments

Comparison of Alternatives

The results of the analyses in study provide the basis for some comparisons among the alternative alignments. Comparisons were made on a relatively small number of measures that were selected to describe some of the alternatives' most important relative characteristics. These comparisons were made as a way to understand how each alternative performs under different criteria and do not imply a preferred alignment.

Capital cost was one factor. The sheer scale of a realignment project would impose large construction and facilities costs. The conceptual cost estimates generated in this study provide the basis for comparing the alternatives on this measure.

The benefit-cost analysis results provided another useful measure. The benefit-cost analysis included multiple factors including railroad time and cost savings for both freight and passenger service, freight shipper benefits, reduced supply chain and logistics costs, highway user and system benefits resulting from diversion of freight from trucks to rail, and increased property values due to the removal of the rail line. This single measure conveys a considerable amount of information.

Because not everything can be measured monetarily, other factors must also be considered. To address non-monetary factors, the comparison drew upon information generated in the screening that led to the three viable alternatives. Information in the four screening categories—security, railroad operations, engineering, and environmental considerations—was applied where it would assist the comparison.

Security characteristics were compared. All the alternatives would improve security by removing freight railroad operations from the Monumental Core and reducing its attractiveness as a target. But there would be differences among the alternatives. While the probability of an attack and the severity of its consequences cannot be predicted, the number of people who would potentially be exposed to an attack can be measured. The comparison took into account the number of people forecasted to live within 800 feet of each alternative alignment in 2030, shown in Figure 4-6. It also considered the number of jobs in 2030 within this same distance, shown in Figure 4-7.

Railroad operations factors such as time savings and reliability were already taken into account in the benefit-cost analysis, so no additional railroad operations measures were compared.

Engineering factors were also already taken into account through the conceptual cost estimates. The definition of the viable alternatives included sufficient engineering analysis to ensure they all could be built to meet railroad standards. If an alternative would require greater effort or more-complicated design solutions to achieve these standards, this effort would be reflected in higher capital costs.

Environmental considerations were compared. Detailed information on environmental impacts cannot be defined in conceptual planning, so direct environmental comparisons of alternatives must wait for a full environmental impact statement later in project development. Defining and screening the alternatives did respect environmental concerns where possible by avoiding parks, recreation sites, refuges, and the Anacostia Waterfront Initiative area, so some major concerns should have been avoided. Although the direct environmental impacts of a realigned rail line cannot yet be measured, the environmental justice implications—the proportions of the population that would be exposed to any impacts that are low-income or minority—can be measured and were compared.

Table 4-13, which also includes the existing railroad alignment, displays the comparison. The values shown for all alternatives reflect the same project length from near Crossroads, Virginia to near Jessup, Maryland, so the values can be compared.

Benefit-Cost Ratio: The Indian Head alternative would have the lowest capital cost and the best

Evaluation of Alternative Alignments

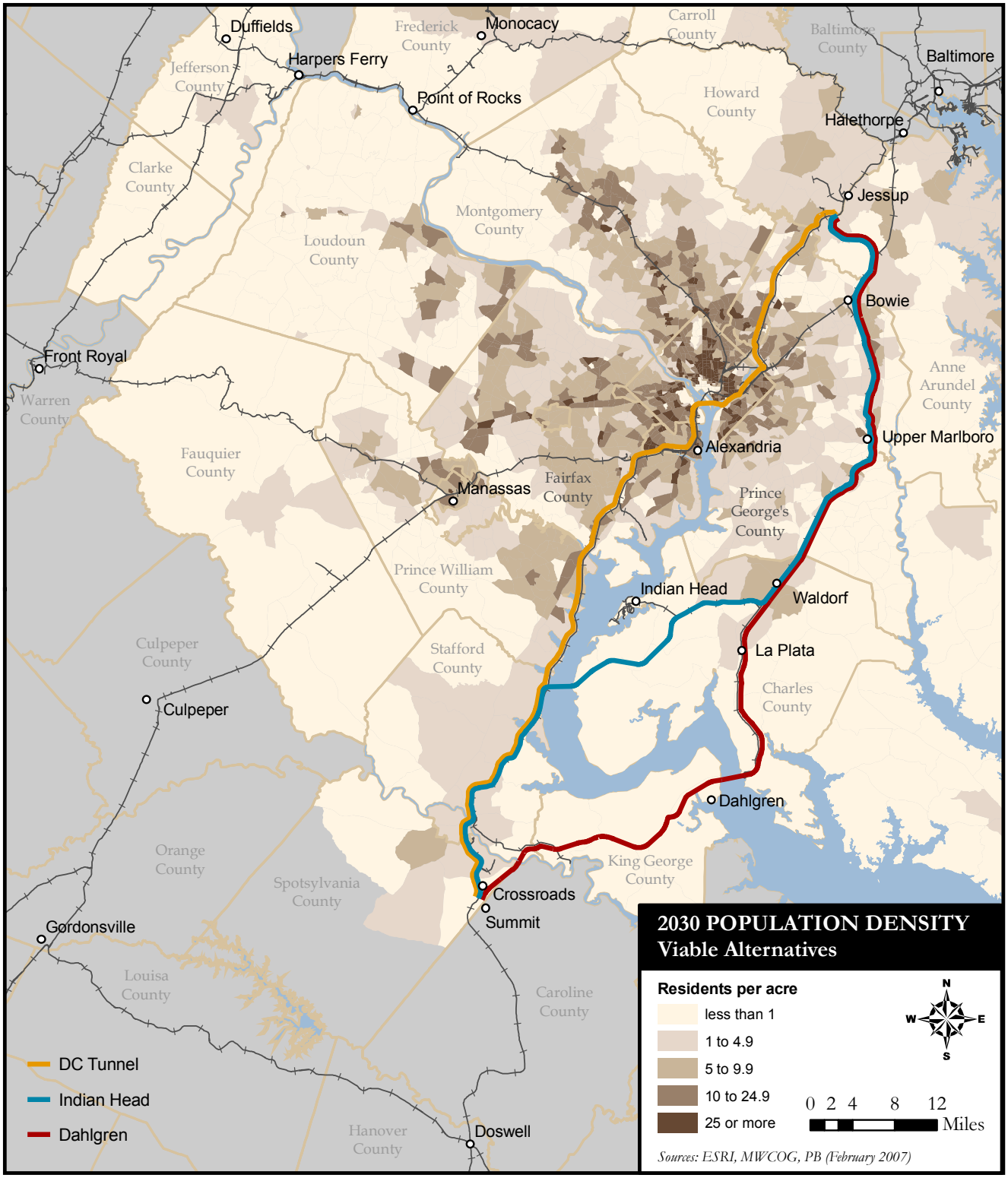

Figure 4-6. Proximity of Viable Alternatives to Future Population

Evaluation of Alternative Alignments

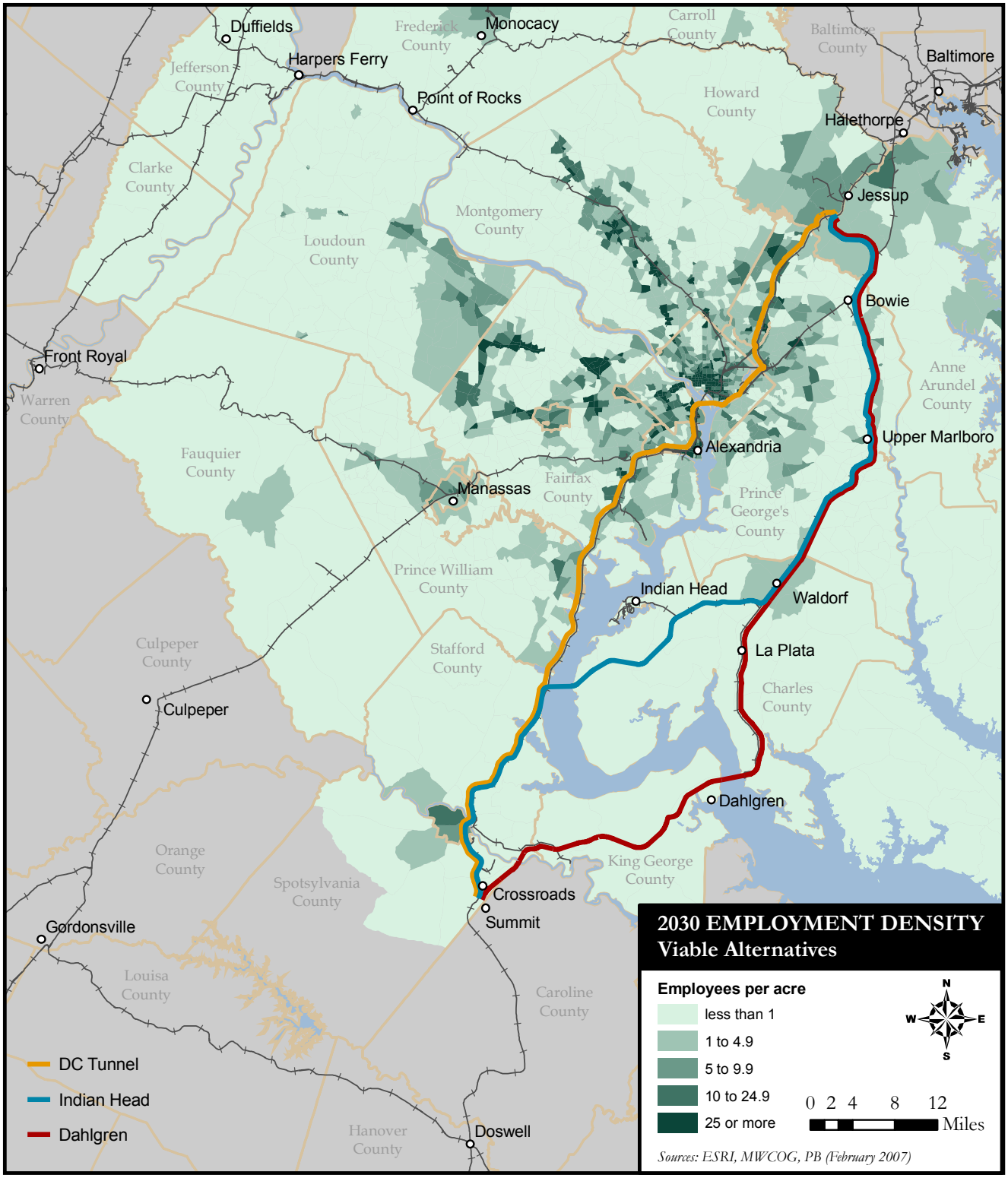

Figure 4-7. Proximity of Viable Alternatives to Future Employment

Evaluation of Alternative Alignments

Table 4-13. Comparison of Alternatives

Evaluation Factor			Outcome			
Category	Goal	Measure	DC Tunnel	Indian Head	Dahlgren	Existing
Benefit-Cost	Maximize benefits and minimize capital costs	Capital Cost ($ billion)	5.3	4.3	4.7	-
		Ranking	3	1	2	-
		Benefit / Cost *	1.72	2.41	2.19	-
		Ranking	3	1	2	-
Security	Minimize proximity to population and employment concentrations within potential plume area	Number of 2030 residential population within 800 feet of alternative rail alignment	75,368	34,146	26,061	94,741
		Ranking	3	2	1	-
		Number of 2030 employees within 800 feet of alternative rail alignment	104,697	16,963	14,873	173,831
		Ranking	3	2	1	-
Environmental	Avoid disproportionate impacts to low-income and minority populations	Percent of population below poverty level within 800 feet of alternative rail alignment	7.3	5.0	4.8	10.6
		Ranking	3	2	1	-
		Percent of population that is a minority within 800 feet of alternative rail alignment	46.9	42.1	43.4	55.1
		Ranking	3	1	2	-

* Benefit/cost ratio reflects scenario with other mid-Atlantic corridor improvements.

benefit-cost ratio; both the Indian Head and Dahlgren alternatives would perform better on these measures than the DC Tunnel alternative. In spite of their greater length of new construction, the Indian Head and Dahlgren alternatives would avoid the need for expensive tunneling and provide greater benefits to passenger railroad operations.

Security: All the alternatives would reduce the security threat to the Washington region by removing freight trains from the Monumental Core. In addition, all alternatives would improve security by reducing the number of people living close to the alignment compared to the existing rail line. The reduction for the Indian Head and Dahlgren alignments would be dramatic, dropping by fully two-thirds. The reduction in the number of nearby jobs would be even more stark—greater than 90 percent.

Environmental Considerations: The Indian Head and Dahlgren alignments would cut in half the proportion of the population near the rail alignment that is below the poverty level, a better performance than the DC Tunnel alternative. The Indian Head and Dahlgren alignments would also provide a greater reduction in the proportion of the population that is in minority groups; the DC Tunnel alternative would be similar to the existing conditions because so much of the existing line would remain in use.