PARSONS BRINCKERHOFF

Final Report

Richmond Rail Transit Feasibility Study

Richmond, VA

submitted to

Virginia Department of Transportation

Richmond Area Metropolitan Planning Organization

submitted by

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1.0 Executive Summary

The Richmond Rail Transit Feasibility Study is a preliminary study of potential rail transit corridors in the Richmond region. The study identified feasibility issues related to ten preliminary alternatives and four screened alternatives. The rail transit projects identified in the 2023 Long Range Transportation Plan for the region formed the basis of the study. Although a large number of alternatives were initially reviewed, the scope of the project was specific to two types of rail transit systems, commuter rail and light rail transit. The interim results of the study were coordinated with the Regional Light Rail Development Program Committee established by the Richmond Area Metropolitan Planning Organization (MPO). The draft recommendations from the study are listed below.

Recommendations:

- Clearly identify the major transportation problems in each potential transit corridor to develop a purpose and need statement for transit improvements.
- Formulate goals and objectives for the potential transit corridors that support the purpose and need statement.
- Prioritize the potential transit corridors based on the above process.
- Focus on one transportation corridor to conduct the next phase of study, an Alternatives Analysis (AA) of potential transit solutions for the corridor's transportation problems.
- Measure the region's public support for investment in rail transit projects.
- Seek funding support from state and federal elected officials in Richmond and in Washington.

Study Process:

The feasibility study began with the proposed rail transit projects identified in the 2023 Richmond Area Long Range Transportation Plan. The first meeting of the working committee was used to refine these potential segments into preliminary alternatives for analysis. Emphasis was placed on identifying unique alternatives with realistic termini. All transit alternatives provided service at or near Main Street Station in downtown Richmond, except for the Boulevard LRT alternative which connected Maymont Park to the Lewis Ginter Botanical Gardens. The ten preliminary alternatives included the following:

Commuter Rail:

- Ashland
- Hanover
- Midlothian
- Petersburg
- Providence Forge

Light Rail:

- Boulevard
- Broad Street to South Boulevard
- Midlothian Light Rail Transit
- Richmond International Airport
- Short Pump

The first technical task completed for the project included the development of preliminary ridership analysis for the ten candidate alternatives identified by the working committee. The ridership analysis used a nationally recognized spreadsheet model with inputs from existing and readily available socioeconomic data for the alternatives. A general conclusion of the ridership analysis was that light rail transit would likely attract higher ridership than commuter rail transit in the Richmond region. This is at least partly due to the type and frequency of service provided by light rail compared to commuter rail's emphasis on peak hour commuting.

The project team collected other available data from the region to perform a preliminary screening of alternatives. Data collected included projected congestion levels on the region's highways, socio-economic data, and projected household growth over a twenty year period. Capital costs were calculated for each preliminary alternative based on unit costs of other proposed projects in the U.S. Evaluation criteria were then identified to compare the preliminary alternatives based upon the collected data, ridership results and preliminary capital costs. A weighting system was introduced to the evaluation criteria to allow for a greater emphasis on capital cost and ridership.

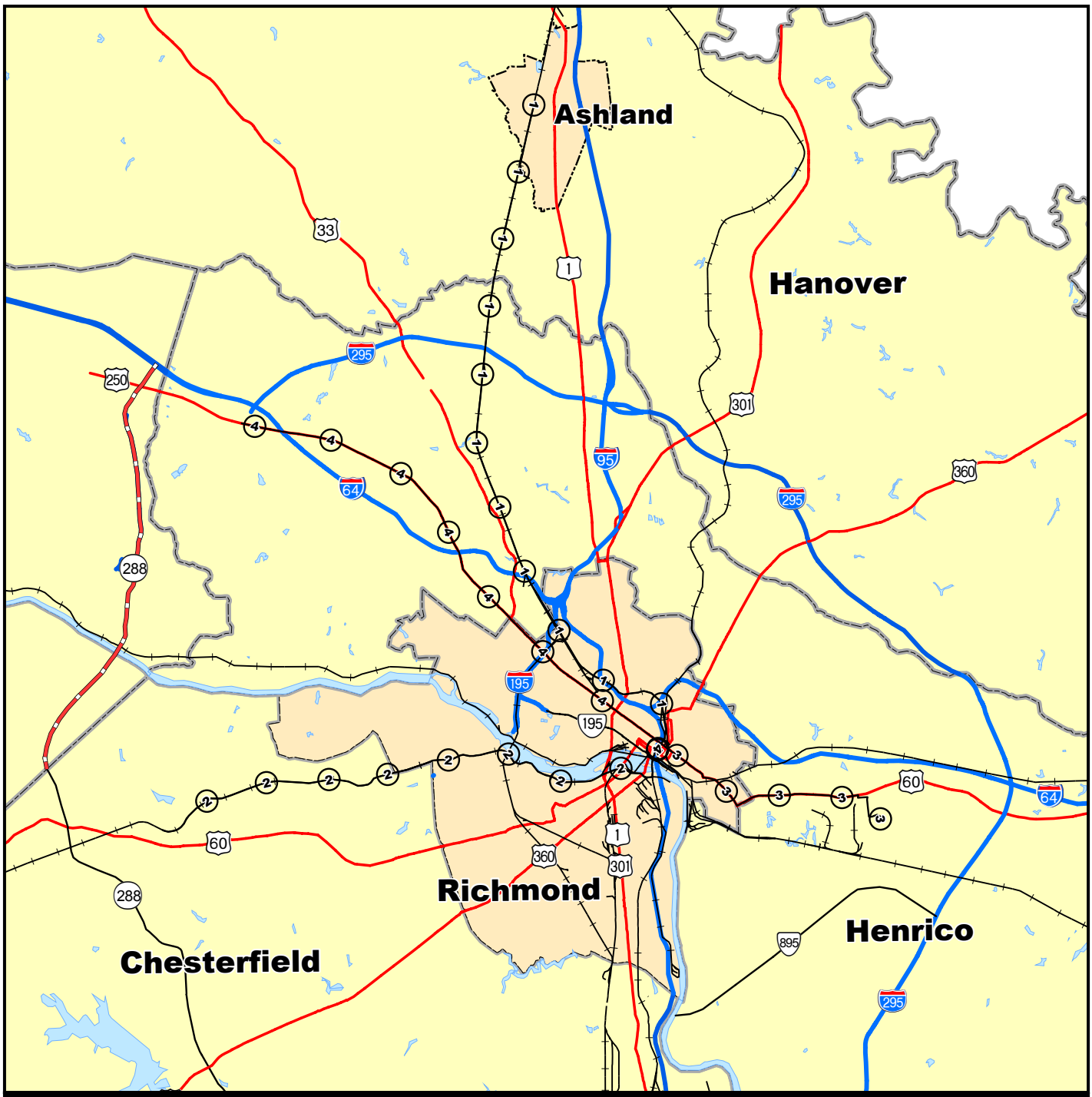
The working committee held two meetings to discuss the recommended alternatives for further analysis. Four screened alternatives, two light rail and two commuter rail, resulted from these meetings and are depicted in Figure 1-1 .

The four screened alternatives were then more closely reviewed to determine potential alignment options, and identify feasibility issues. Operating concepts were identified for each proposed alternative, including hours of service, vehicle requirements, travel times, and operating speeds. Preliminary operations and maintenance costs were prepared for each alternative.

The two light rail alternatives (Short Pump and Richmond International Airport) were identified operating along existing roadway corridors because there is no available or abandoned right-of-way within their general alignment. Several potential alignment options were identified for each light rail corridor. Each light rail alignment considered would require extensive new infrastructure facilities, including stations, parking facilities, overhead power distribution systems, vehicle maintenance and layover facilities, as well as separate passenger facilities at Main Street Station. Additionally, any new light rail segments operating in mixed traffic on-street would likely require an extensive traffic study to determine necessary changes to traffic and circulation.

The two commuter rail alternatives were identified along railroad lines with existing operations. There would be significant capital improvements required to support either of the two potential commuter rail lines, due to the need for station platforms, parking facilities, and equipment maintenance and layover facilities. Additionally, integrating commuter rail service into existing freight service would require extensive coordination with the affected railroads that own the right-of-way.

A summary of the characteristics of each of the four screened alternatives is presented in Table 1-1 .



Screened Alternatives Figure: 1-1

- Main St. Station to Ashland (Commuter Rail)
- Main St. Station to Midlothian (Commuter Rail)
- Main St. Station to Airport (Light Rail)
- Main St. Station to Short Pump (Light Rail)

N

2 1 0 2 Miles

Table 1-1 Summary Characteristics of Screened Alternatives

Alternative	Length (miles)	Capital Cost Estimate ($ Millions)	Weekday Boardings	Estimated Annual Operating Costs ($ Millions)	Estimated Annual Farebox Revenue ($ Millions)	Estimated Annual Subsidy ($ Millions)
Ashland Commuter Rail	17.9	$103	1,800	$2.47	$0.82	$1.65
Midlothian Commuter Rail	14.1	$81	1,700	$1.6	$0.58	$1.01
Richmond International Airport Light Rail[1]	6.4 – 7.2	$374 - $420	19,100	$7.0	$3.23	$3.77
Short Pump Light Rail[1]	13.6 - 13.9	$791 - $812	33,700	$11.7	$5.64	$6.06

[1] More than one potential alignment, therefore lengths and capital costs expressed in ranges.

The next major step for a potential rail transit project in the Richmond region would be completion of an Alternatives Analysis, to evaluate a range of possible alternatives for a candidate corridor. During the Alternatives Analysis phase coordination with Federal Transit Administration is essential to develop a project that is likely to gain acceptance in to the New Starts process. The study identified the major project phases involved in the New Starts process for candidate new transit projects. The process is used by the FTA to select which projects to fund with federal transportation dollars. The program is a highly-competitive source of funding, and as such the evaluation criteria used by the FTA are extremely selective.

2.0 Preliminary Alternatives

The study considered two rail modes: light rail transit (LRT) and commuter rail. Each mode has particular characteristics regarding technology, type of service, capacity, cost and appropriateness in various settings. Basic attributes of the two modes are described below, and Section 3.0, "Demand Analysis", explored many of these distinctions in greater depth.

2.1 *Transit Modes Considered*

2.1.1 Light Rail

Light rail describes a category of steel-wheeled transit that can operate in mixed traffic with automobiles, in an exclusive right-of-way with at-grade crossings, or in a completely exclusive right-of-way. Light rail also can operate in single- or multiple-car consists. For example, Figure 2-1 and Figure 2-2 show a single-car train operating in exclusive right-of-way and a multiple-car train operating on a city street, respectively. Light rail trains are electrically powered via overhead trolley wire or pantograph, and service typically is provided at frequent intervals, all day.

Figure 2-1 Light Rail in Exclusive Right-of-way (Photo from Denver, The Ride)

Figure 2-2 Light Rail in Mixed Traffic (Photo from Baltimore, Central Light Rail)

Light rail can provide much higher capacity and quality of service than a common bus route, without the major capital investments typically associated with fully grade-separated subway or elevated systems. The mode's versatility makes it suitable for a wide variety of settings. Some portions of light rail systems make frequent stops like a local bus route while other sections can have long station spacing to accommodate regional travel. Light rail has been viewed as a relatively affordable way to significantly improve service quality as compared to local bus services.

The fixed nature of LRT facilities, coupled with attractive urban design features and high passenger volumes, grant light rail the potential to shape development. Older light rail systems, built in the 1890s and early 1900s, heralded the "streetcar suburbs" that today define many of the more attractive urban neighborhoods in this country. Recently, light rail has experienced a renaissance. Many new LRT systems have been constructed recently in numerous medium-sized cities, with much fanfare and success – including new and/or expanding systems in Portland (Oregon), Salt Lake City, San Diego, St. Louis, Baltimore, Jersey City, and Houston, to name a few. Businesses view LRT access, for employees and customers, as a great amenity, and light rail systems successfully have helped

define and redefine “central places”, attracting new, moderately dense development and helping to shape growth in a way that local communities have viewed as more livable.

Table 2-1 displays a few examples of U.S. light rail systems in terms of basic characteristics such as ridership, exclusivity of right-of-way (number of crossings), stations and mileage. Note the great variation among these systems, reflecting the versatility of the mode.

Table 2-1 Selected U.S. Light Rail Examples

Transit Agency / City	Ridership	Crossings	Stations	Mileage
Maryland Mass Transit Administration (MTA) Baltimore, MD	28,500	52	32	57.6
Tri-County Metropolitan District Portland, OR	77,500	111	47	64.9
Bi-State Development Agency St. Louis, MO	38,600	12	18	34
San Diego Trolley San Diego, CA	71,100	96	49	96.6
Regional Transportation District Denver, CO	28,000	34	20	28

2.1.2 Commuter Rail

Commuter rail describes regional, downtown-oriented passenger train service, operating between a central city and adjacent suburbs. Commuter rail can operate as an electric or diesel propelled railway, and can have locomotive-hauled or self-propelled railroad passenger cars. The great majority of commuter rail passengers tend to use the service to access employment in the central business district and therefore ride during peak periods. As a result of the mode’s high peaking characteristic, service on some systems operates only during peak periods or provides very limited off-peak service. To provide the high speeds necessary to facilitate regional travel, stations tend to be spaced far apart, usually a mile or more, and trains operate in exclusive rights of way with only limited grade crossings. Line lengths also tend to be long, approaching 100 miles in some cases. Access to commuter rail tends to be by foot and predominantly via park-and-ride. In this manner, a commuter rail line can serve a fairly wide catchment area.

Figure 2-3 Commuter Rail: Electric Push-Pull Train, Low-Floor Platform (Philadelphia, SEPTA)

Figure 2-3, Figure 2-4 and Figure 2-5 show a variety of commuter rail technologies and service characteristics, including electric- and diesel-powered, push-pull and locomotive-pulled

coaches, single- and double-deck passenger seating areas, and low- and high-floor station platforms.

Figure 2-4 Commuter Rail: Diesel Double-deck, Low-Platform Station (San Diego, Coaster; Locomotive Not Shown)

Figure 2-5 Commuter Rail: Diesel Locomotive, Single-Deck Passenger Cars, High-Platform Station (Boston, MBTA)

Commuter rail services originally took advantage of existing freight railways and rights of way, in some cases with freight and passengers sharing the same train. For this reason, older commuter rail systems generally follow routes of the inter-state freight railway network as they converge on large cities. Interestingly, not much has changed over the years: the most affordable and common method to implement commuter rail is via existing freight rights of way, tracks, or active railways.

Commuter rail provides a cost-feasible method to provide long-distance transit service. Its operating costs per passenger trip and per vehicle-mile tend to be far higher than for other modes, but the mode is relatively much better suited to provide the type of service it does. If other modes were to provide such service, they would be incredibly cost inefficient. Likewise, commuter rail could not provide the capacity or service quality generally required for urban rapid transit.

Table 2-2 displays some examples of U.S. commuter rail systems. As compared to light rail, note the much longer average station spacing, lower number of crossings per mile, and lower ridership and boardings per mile.

Table 2-2 Selected U.S. Commuter Rail Examples

Transit Agency / City	Ridership	Stations	Crossings	Route Mileage
Virginia Railway Express Washington, DC	11,700	18	23	177.5
MARC Baltimore / Washington	21,700	40	40	373.4
Tri-Rail Miami, FL	8,800	19	72	142.2
Massachusetts Bay Transportation Authority Boston, MA	144,300	120	NA	710.2
NCTDB San Diego, CA	4,900	8	34	82.2

2.2 *Richmond Long Range Transportation Plan (LRTP)*

The Richmond Area Metropolitan Planning Organization (MPO) identified several long-range public transportation improvement projects for the Richmond region in the 2023 Long Range Transportation Plan. These twelve rail transit projects are summarized in Table 2-3 below and were the basis for developing preliminary corridors.

Table 2-3 2023 LRTP Transit Project List

Commuter Rail Projects	**Length (Miles)**	**Cost (Million $)**	**Phasing**
Main Street Station to Richmond International Airport	7.6	1.98	5-10 Years
Richmond International Airport to Providence Forge	16	5.94	5-10 Years
Stratford to Acca Yard	3.8	1.32	Vision
Main Street Station to Strawberry Hill	4.1	1.32	Vision
Main Street Station to Midlothian	13.2	4.84	Vision
Main Street Station to Ashland	17.5	5.94	Vision
Main Street Station to Petersburg	19.5	7.92	Vision
Light Rail Transit Projects	**Length (Miles)**	**Cost (Million $)**	**Phasing**
Broad St: Main Street Station to Science Museum	2.7	60.5	10-15 Years
Broad St: Main Street Station to Church Hill	1.2	27.397	10-15 Years
Broad St: Main Street Station to Parham Road	6.3	264	Vision
Main Street Station to Midlothian Town Center	2.1	101.2	Vision
Main Street Station to Cloverleaf Mall	5.9	58.3	Vision

Richmond 2023 Long Range Transportation Plan

Commuter Rail

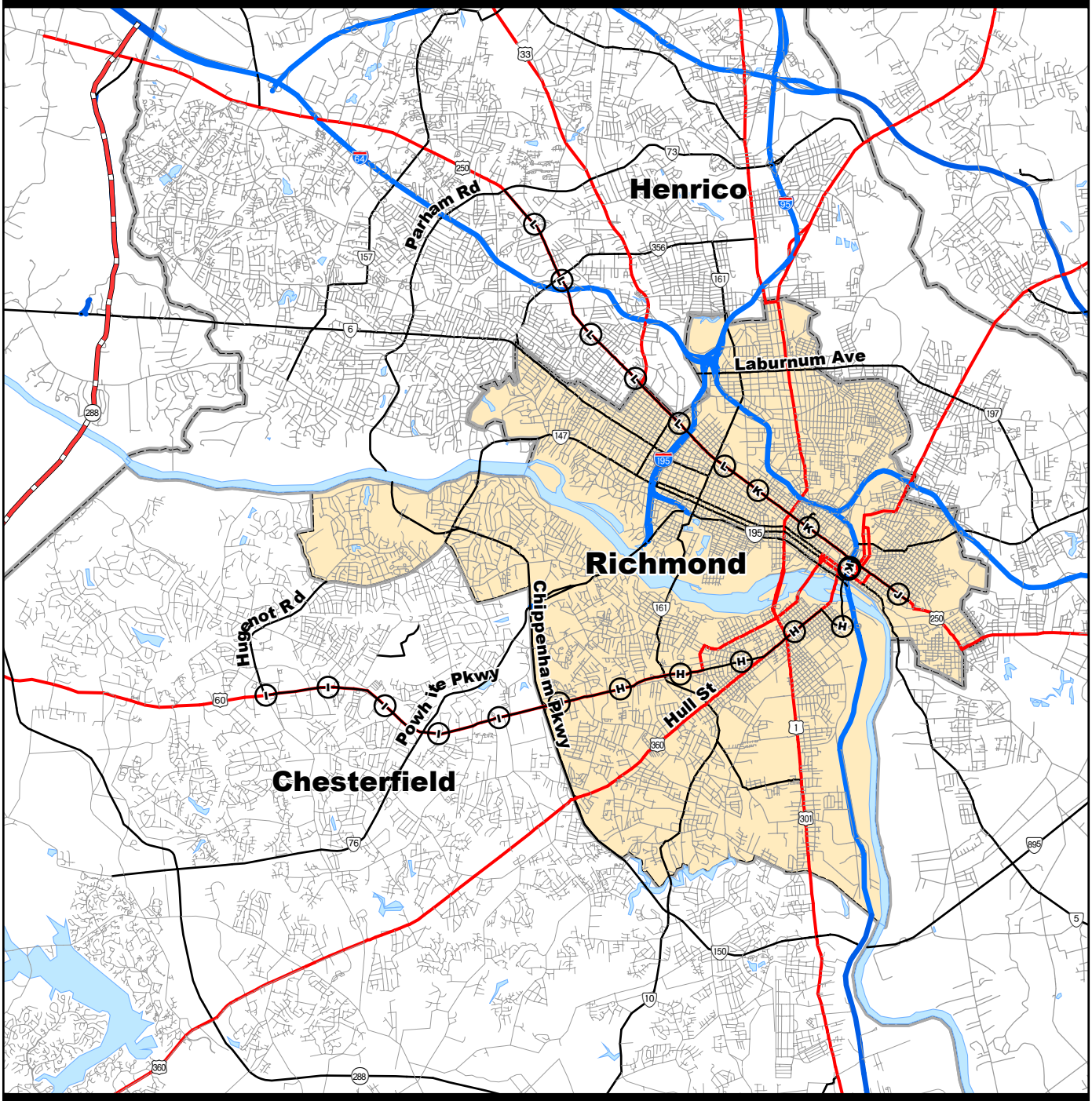
Figure: 2-6

- A-A-A Main St. Station to Ashland
- B-B-B Main St. Station to Petersburg
- C-C-C Main St. Station to Midlothian
- D-D-D Main St. Station to Airport
- E-E-E Main St. Station to Stawberry Hill
- F-F-F Acca Yard to Stratford
- G-G-G Airport to Providence Forge

N

5 2.5 0 5 Miles

2023 Long Range Transportation Plan



Light Rail Figure: 2-7

- H-H-H Main St. Station to Cloverleaf Mall
- I-I-I Cloverleaf Mall to Chesterfield Town Center Mall
- J-J-J Main St. Station to Church Hill
- K-K-K Main St. Station to Science Museum
- L-L-L Main St. Station to Parham Rd

N

2 1 0 2 Miles

2.3 *Preliminary Corridors*

The twelve rail transit projects listed in the Long Range Transportation Plan (LRTP) were used as a starting point to identify preliminary rail transit corridors for analysis in the study. During the October 7, 2002 meeting with the Study's Rail Development Committee, the project team suggested eight preliminary corridors for preliminary analysis and screening. The eight corridors were identified by combining several of the LRTP segments, and deleting one commuter rail segment from further consideration (see Table 2-4):

- "Main Street to Richmond International Airport" and "Richmond International Airport to Providence Forge" were combined into a single commuter rail corridor from Main Street Station to Providence Forge.
- "Stratford to Acca Yard", was dropped from further consideration because it did not terminate in downtown and lacked support among committee members.
- "Main Street Station to Strawberry Hill" commuter rail segment was extended to Hanover.
- "Broad Street to Science Museum" and "Broad Street to Parham Road" were combined into a single light rail transit corridor. Rather than stop at Parham Road, committee members suggested extending the corridor west to Short Pump to determine ridership demand. Additionally, the "Main Street Station to Church Hill" corridor was extended to Richmond International Airport, and then combined with the Short Pump light rail alternative. This created a single light rail alternative from Short Pump to Richmond International Airport.[1]
- "Main Street Station to Cloverleaf Mall" and "Cloverleaf Mall to Midlothian Town Center" were combined into a single light rail corridor, "Main Street Station to Midlothian Town Center".
- Committee members also identified a new light rail corridor from Maymont Park to Ginter Botanical Gardens along the Boulevard. The new corridor was added to the others corridors for preliminary demand analysis.

[1] During the demand analysis phase, this single LRT corridor was divided into two separate corridors: "Short Pump to Main Street Station" and "Main Street Station to Richmond International Airport"

Table 2-4 Comparison of LRTP Projects to Preliminary Alternatives

Long Range Transportation Plan	Proposed at October 2002 Rail Development Committee Meeting
Commuter Rail Transit Projects	
1) Main Street Station to Richmond International Airport	1) Main Street Station to Providence Forge
2) Richmond International Airport to Providence Forge	
3) Stratford to Acca Yard	(Removed from consideration)
4) Main Street Station to Strawberry Hill	2) Main Street Station to Hanover
5) Main Street Station to Midlothian	3) Main Street Station to Midlothian
6) Main Street Station to Ashland	4) Main Street Station to Ashland
7) Main Street Station to Petersburg	5) Main Street Station to Petersburg
Light Rail Transit Projects	
1) Broad St: Main Street Station to Science Museum	1) Short Pump to Richmond International Airport
2) Broad St: Main Street Station to Parham Road	
3) Broad St: Main Street Station to Church Hill	
4) Main Street Station to Midlothian Town Center	2) Main Street to Midlothian Town Center
5) Main Street Station to Cloverleaf Mall	
(Not in LRTP)	3) Boulevard: Maymont Park to Ginter Botanical Gardens

After the October 2002 Rail Development Committee Meeting, the study team identified potential station locations along each corridor, conducted Geographic Information Systems (GIS) analysis along each corridor, and performed a preliminary field review of each corridor. The information obtained from these three activities was used in conjunction with the ridership demand analysis to screen the preliminary alternatives.

Preliminary station locations were determined as an input to the ridership demand analysis. Station locations were selected based upon proximity to developed areas and access to the existing roadway transportation network. Locations near intersections within short distances (one mile or less) of surrounding developments were given higher priority than locations near intersections with no nearby development. Although the presence of development was important to station location selection, the character and mix of development was not considered.

GIS analysis was performed along each preliminary corridor using data from the 2000 US Census and 2023 forecast data from the RRPDC. Data was analyzed along a buffer extending ½ mile from either side of each preliminary corridor. Data analyzed included the number of existing and future residents (population and households), median household income, and automobiles per household. Additionally, total employment data (from all economic sectors) was

determined along each corridor. Additional GIS analysis was performed at the proposed station areas as an input to the ridership demand analysis. At each station location, an area with a radius of ½ mile was analyzed for the same data as described above.

A preliminary field review of each corridor was conducted over several days between October and December. For light rail corridors, which are designated along streets, the study team drove the corridor and photographed station locations. The character and intensity of land uses were noted. For commuter rail corridors, all preliminary field reviews were conducted from public streets outside the railroad right-of-way or from highway grade crossings (including bridge overpasses). Photographs were taken of the rail corridors and the land uses surrounding the proposed station locations. During the field review the study team noted the large amount of freight train traffic on and through the rail network surrounding Richmond.

Descriptions of the preliminary corridors are provided below:

2.3.1 Commuter Rail Corridors

All of the commuter rail corridors assume that commuter rail service would be operated along existing railroad right-of-way. For this preliminary analysis, it was assumed that commuter rail operations would be non-disruptive to existing and future freight service operations. This would most likely result in the requirement of some new tracks and switches to be built adjacent to existing tracks to increase capacity on the respective routes. Several other improvements would be necessary, such as: maintenance facilities and storage yards for passenger rail equipment; new or improved signal and communication systems; and improved grade crossings (potentially including grade-separations).

Ashland Commuter Rail

Length:

18 miles from Main Street Station to proposed station site in Ashland

Current Use:

- Owned by CSX; currently in use for freight service and Amtrak service between Richmond and Washington, D.C..
- Future High Speed Rail improvements from Washington to Richmond will bring further enhancements to this right-of-way
- Future Southeastern High Speed Rail (SEHSR) trains would operate on this corridor

Preliminary Station Locations

The following preliminary station locations were identified for the Richmond to Ashland commuter rail corridor. Station spacing averaged 1.8 miles along the corridor.

Miles from Main Street Station	Station Location	Jurisdiction
0	Main Street Station	Richmond
2.1	Chamberlayne Avenue near Belvidere Street	Richmond
3.6	Leigh Street near Hermitage Road	Richmond
7.5	Staples Mill Road (Amtrak station)	Henrico County
8.6	Oakview Avenue near Parham Road	Henrico County
9.4	Hungary Road near Oakview Avenue	Henrico County
11.0	Mountain Road near Old Washington Highway	Henrico County
12.8	Greenwood Road near Mill Road	Henrico County
14.4	Elmont Road near Cobbs Road	Henrico County
17.9	Ashland (Amtrak Station)	Ashland

CORRIDOR DEMOGRAPHICS:

	2000
Population	37,300
Households	14,300
Median Household Income (1999$)	$30,300
Total Employment (jobs) Outside Richmond CBD	66,334

Hanover Commuter Rail

Length:

18 miles from Main Street Station to proposed terminal station site near Hanover

Current Use:

- Owned by CSX; currently in use for freight service

Preliminary Station Locations

The following preliminary station locations were identified for the Richmond to Hanover commuter rail corridor. Station spacing averaged 2.25 miles along the corridor.

Miles from Main Street Station	Station Location	Jurisdiction
0	Main Street Station	City of Richmond
2.2	Magnolia Street near Rady Street	City of Richmond
3.9	Laburnum Avenue near State Fairgrounds	Henrico County
6.4	Industrial Road near Meadowbridge Road (near Ellerson Industrial Park)	Hanover County
9.0	Chamberlayne Road near Atlee Station Industrial Park	Hanover County
12.4	New Ashcake Road near Marboro Road & Station Place	Hanover County
14.8	Peaks Road near Colefield Drive	Hanover County
18.0	Depot Road near Bumpy Hollow Lane	Hanover County

Corridor Demographics:

	2000
Population	26,800
Households	9,000
Median Household Income (1999$)	$35,100
Total Employment (jobs)	12,100

Midlothian Commuter Rail

Length:

13.7 miles from Main Street Station to proposed station site at Salisbury Drive near Midlothian

Current Use:

- Owned by Norfolk Southern; currently in limited use for freight service.

Preliminary Station Locations

The following preliminary station locations were identified for the Richmond to Midlothian commuter rail corridor. Station spacing averaged 1.7 miles along the corridor.

Miles from Main Street Station	Station Location	Jurisdiction
0	Main Street Station	Richmond
1.6	Near Riverview Drive / Manchester Bridge	Richmond
3.0	Near Riverview Drive / 28th Street	Richmond
5.5	Near Powhite Parkway / Forest Hill Avenue	Richmond
6.6	Near Chippenham Parkway	Richmond / Chesterfield County
8.3	Buford Road near Rockaway Road	Chesterfield County
11.4	Robius Road near Huguenot Road	Chesterfield County
13.7	Salisbury Drive near Headwaters Road	Chesterfield County

Corridor Demographics:

	2000
Population	26,700
Households	11,500
Median Household Income ($1999)	$46,500
Total Employment (jobs) Outside CBD	20,700

Petersburg Commuter Rail

Length:

25.0 miles from Main Street Station to proposed station site at Halifax Road near Petersburg

Current Use:

- Owned by CSX; currently in use for freight service. Also Amtrak uses a portion of this route south of a junction near Walmsley Boulevard and the Richmond City Limits
- Future High Speed Rail improvements from Washington to Richmond will bring further enhancements to this right-of-way
- Future South Eastern High Speed Rail (SEHSR) trains would operate on this corridor

Preliminary Station Locations

The following preliminary station locations were identified for the Richmond to Petersburg commuter rail corridor. Station spacing averaged 1.8 miles along the corridor.

Miles from Main Street Station	Station Location	Jurisdiction
0	Main Street Station	Richmond
1.3	4th Street near Gordon Ave	Richmond
3.1	Commerce Road near Bellemeade Road	Richmond
4.5	Bells Road near Meridian Ave – Phillip Morris Facilities	Richmond
5.3	Walmsley Boulevard – near Trenton Avenue and Jefferson Davis Highway	Richmond
6.5	Chippenham Parkway – near Jefferson Davis Highway & I95 / 895 interchange	Chesterfield County
8.7	Jefferson Davis Highway near Bellwood Drive and US Defense General Supply Center	Chesterfield County
11.3	Centralia Road near Chester Road	Chesterfield County
13.1	Hundred Road near Chester Road	Chesterfield County
17.4	Woods Edge Road near Jefferson Davis Highway and Exit 58 of Interstate 95	Chesterfield County
20.2	Taswell Avenue near Boulevard (Colonial Square Shopping Center)	Colonial Heights
22.4	Ettrick (Amtrak station) near Laurel Road	Chesterfield County
23.8	Washington Street near McKinney Street in Petersburg	Petersburg
25.0	Halifax Road near Vaughn Road	Petersburg

Corridor Demographics:

	2000
Population	36,200
Households	14,400
Median Household Income ($1999)	$31,200
Total Employment (jobs) Outside CBD	32,100

Providence Forge Commuter Rail

Length:

23.3 miles from Main Street Station to Providence Forge terminal station

Current Use:

- Owned by CSX; currently in use for freight service and passenger service
- Amtrak operations between Newport News and Richmond follow this route
- If implemented, potential rail improvements identified in the I-64 Corridor Major Investment Study may increase passenger rail operating speeds, improve track conditions, and increase the number of Amtrak trains per day operating on corridor.

Preliminary Station Locations

The following preliminary station locations were identified for the Richmond to Providence Forge commuter rail corridor. Station spacing averaged 4.6 miles along the corridor.

Miles from Main Street Station	Station Location	Jurisdiction
0	Main Street Station	Richmond
3.8	Darbytown Road	Henrico County
6.4	Charles City Road near Monahan Road (near Richmond International Terminal)	Henrico County
13.5	Elko Road near White Oak Technology Park	Henrico County
23.3	Providence Forge: near intersection of US 60	New Kent County

Corridor Demographics:

	2000
Population	10,800
Households	4,600
Median Household Income ($1999)	$19,600
Total Employment (jobs) Outside CBD	19,200

2.3.2 Light Rail Transit Corridors

The light rail corridors identified for preliminary analysis were located along existing streets and highways. One of the benefits of light rail transit is its adaptability to different types of settings. It may operate in mixed traffic on streets, in exclusive lanes within a street, or in an exclusive right-of-way (such as former railroad corridor, elevated structure, tunnel, or utility line right-of-way). The street and highway corridors selected for consideration in the Richmond region include urban arterials downtown and commercial highway corridors in the suburbs. For the preliminary analysis no specific track alignments were selected, however impacts to the existing street network will be anticipated if light rail is implemented in these corridors. In urban settings this may include a reduction of on-street parking spaces, restricted movements at intersections, or the reduction of street capacity by removing travel lanes. In suburban settings, the same issues are usually encountered; however other issues emerge due to the automobile-oriented development characteristic of suburban settings. Consideration must be given to maintaining vehicular access to existing developments such as shopping centers, residential subdivisions, office parks, and industrial parks.

Boulevard Light Rail

Length:

5.5 miles from Ginter Botanical Garden to Maymont Park

Current Use:

- Lakeside Avenue, Hermitage Road, Boulevard

Preliminary Station Locations

The following preliminary station locations were identified for Boulevard light rail corridor. Station spacing averages 0.4 miles along the corridor.

Miles from Ginter Botanical Garden	Station Location	Jurisdiction
0	Lakeside Avenue at Hilliard Road	Henrico County
0.4	Lakeside Avenue at Spruce Street	Henrico County
0.9	Lakeside Avenue at Dumbarton Street	Henrico County
1.8	Hermitage Road at Bellevue Avenue	Richmond
2.3	Hermitage Road at Laburnum Avenue	Richmond
2.7	Hermitage Road at Westwood Ave / Brookland Pkwy	Richmond
3.6	Boulevard at Leigh Street	Richmond
4.0	Boulevard at West Broad Street	Richmond
4.3	Boulevard at Kensington Avenue	Richmond
4.5	Boulevard at Grove Avenue	Richmond
4.8	Boulevard at Cary Street	Richmond
5.2	Boulevard at Lakeview Avenue	Richmond
5.5	Boulevard at Rugby Road	Richmond

Corridor Demographics:

	2000
Population	37,300
Households	12,500
Median Household Income ($1999)	$35,200
Total Employment (jobs) Outside CBD	25,800

Midlothian Light Rail

Length:

11.3 miles from Main Street Station to Chesterfield Town Center

Current Use:

- Hull Street, Midlothian Turnpike

Preliminary Station Locations

The following preliminary station locations were identified for the Midlothian light rail corridor. Station spacing averages 0.6 miles along the corridor.

Miles from Main Street Station	Station Location	Jurisdiction
0	Main Street Station	Richmond
0.3	14th Street at Dock Street	Richmond
1.0	Hull Street at 4th Street	Richmond
1.2	Hull Street at Commerce Road	Richmond
1.4	Hull Street at 12th Street	Richmond
1.7	Hull Street at Jefferson Davis Highway	Richmond
2.3	Hull Street at Midlothian Turnpike / Clopton Street	Richmond
2.7	Midlothian Turnpike at Broad Rock Road	Richmond
3.3	Midlothian Turnpike at Roanoke Street	Richmond
4.3	Midlothian Turnpike at Covington Road	Richmond
5	Midlothian Turnpike at German School Road	Richmond
5.5	Midlothian Turnpike at Old Warwick Road	Richmond
6.4	Midlothian Turnpike at Cloverleaf / Beaufont Malls	Chesterfield County
7.4	Midlothian Turnpike at Providence Road South	Chesterfield County
8.6	Midlothian Turnpike at Pinetta Drive	Chesterfield County
9.2	Midlothian Turnpike at Moorefield Park Drive	Chesterfield County
9.9	Midlothian Turnpike at Sturbridge Drive	Chesterfield County
10.5	Midlothian Turnpike at Southlake Boulevard	Chesterfield County
11.3	Midlothian Turnpike at Chesterfield Town Center Mall	

Corridor Demographics:

	2000
Population	26,900
Households	11,300
Median Household Income ($1999)	$31,200
Total Employment (jobs) Outside CBD	43,000

Richmond International Airport Light Rail

Length:

6.4 miles from Main Street Station to Richmond International Airport (RIC)

Current Use:

- E. Broad Street, Government Road, Williamsburg Road, Airport Drive

Preliminary Station Locations

The following preliminary station locations were identified for the Richmond International Airport light rail corridor. Station spacing averages 0.4 miles along the corridor.

Miles from Main Street Station	Station Location	Jurisdiction
0	Main Street Station	Richmond
0.3	E. Broad Street at 19th Street	Richmond
0.6	E. Broad Street at 23rd Street	Richmond
0.8	E. Broad Street at 27th Street	Richmond
1.1	E. Broad Street at 31st Street	Richmond
1.3	E. Broad Street at 35th Street	Richmond
2.0	Government Road at Admiral Gravely Boulevard	Richmond
2.6	Government Road at Williamsburg Road	Richmond
2.9	Williamsburg Road at Randall Avenue	Richmond
3.5	Williamsburg Road at Brittles Lane	Henrico County
4.2	Williamsburg Road at Millers Lane	Henrico County
5.1	Williamsburg Road at Laburnum Avenue South	Henrico County
5.6	Williamsburg Road at Lewis Road	Henrico County
6.0	Airport Drive South at Clarkson Road	Henrico County
6.4	Airport Drive at Terminal Drive	Henrico County

Corridor Demographics:

	2000
Population	19,000
Households	8,000
Median Household Income ($1999)	$22,800
Total Employment (jobs) Outside CBD	11,000

Short Pump Light Rail

Length:

13.6 miles from Main Street Station to Short Pump Plaza

Current Use:

- West Broad Street

Preliminary Station Locations

The following preliminary station locations were identified for the Short Pump light rail corridor. Station spacing averages 0.6 mile along the corridor.

Miles from Main Street Station	Station Location	Jurisdiction
0	Main Street Station	Richmond
0.4	Broad Street at Governor Street	Richmond
0.6	Broad Street at 8th Street	Richmond
0.8	Broad Street at 5th Street	Richmond
1.1	Broad Street at 1st Street	Richmond
1.3	Broad Street at Jefferson Street	Richmond
1.5	Broad Street at Belvidere Street	Richmond
1.9	Broad Street at Harrison Street	Richmond
2.3	Broad Street at Allen Avenue	Richmond
2.7	Broad Street at DMV	Richmond
3.1	Broad Street at Boulevard	Richmond
4.1	Broad Street at Westwood Avenue	Richmond
4.9	Broad Street at Staples Mill Road	Richmond
5.7	Broad Street at Libbie Avenue	Henrico County
6.3	Broad Street at Falmouth Street	Henrico County
6.8	Broad Street at Forest Avenue	Henrico County
7.3	Broad Street at Glenside Drive	Henrico County
8.1	Broad Street at Wistar Road	Henrico County
8.8	Broad Street at Fountain Square Shopping Center	Henrico County
9.8	Broad Street at West End Drive	Henrico County
10.6	Broad Street at Pemberton Road	Henrico County
11.1	Broad Street at Gaskins Road	Henrico County
12.0	Broad Street at Cox Road	Henrico County
13.6	Broad Street at Short Pump Plaza	Henrico County

Corridor Demographics:

	2000
Population	48,100
Households	23,300
Median Household Income ($1999)	$32,600
Total Employment (jobs) Outside CBD	60,900

3.0 Demand Analysis

Demand analysis, as conducted for ten alternatives, were studied, including five commuter rail options and five light rail options, each on its own distinct corridor. These ten alternatives included the eight alternatives identified by the Rail Development Committee in October 2002. One alternative was split into two segments and an additional alternative was studied for comparison to the "Boulevard" LRT alignment. All but one light rail alternative would terminate at the refurbished Main Street Station in downtown Richmond. Commuter rail options would extend 14 to 25 miles from the Central Business District (CBD) with stations spaced every 1.5 to 6 miles on average, while light rail options would extend 4.5 to 13.5 miles from the CBD, with stations spaced about every 0.3 to 0.7 miles on average. The options studied are described in Table 3-1, and depicted in Figure 3-1.

Table 3-1 Commuter Rail and Light Rail Alternatives

Alternative	Mode	General Alignment	Length (mi.)
Ashland	Commuter Rail	Existing Rail to Ashland	17.9
Hanover	Commuter Rail	Existing Rail to Depot Road in Hanover	18.0
Midlothian	Commuter Rail	Existing Rail to Midlothian Town Center	13.7
Petersburg	Commuter Rail	Existing Rail to Petersburg	25.0
Providence Forge	Commuter Rail	Existing Rail to Providence Forge	23.3
Boulevard[2]	Light Rail	Lakeside Avenue/Hermitage Road/Boulevard from Hillard Road to Botanical Garden to William Byrd Park	5.5
Broad to Blvd. South[2]	Light Rail	Broad Street/Boulevard from Downtown to William Byrd Park	4.6
Midlothian	Light Rail	Midlothian Turnpike to Huguenot Road	11.3
RIC[3]	Light Rail	Broad Street and Route 60 to RIC Airport	6.4
Short Pump[3]	Light Rail	Broad Street to Short Pump Road	13.5

[2] The Boulevard alternative does not enter the Richmond CBD; and therefore did not directly apply to the demand analysis methodology. "Broad to S. Boulevard" alternative was created to serve part of the Boulevard corridor and provide service to the CBD.

[3] The "Short Pump to RIC" LRT alternative was divided into these two corridors for demand analysis and further screening.

Alternatives Figure: 3-1

Commuter Rail

- 1-1-1 Main St. Station to Ashland
- 2-2-2 Main St. Station to Hanover Courthouse
- 3-3-3 Main St. Station to Midlothian
- 4-4-4 Main St. Station to Petersburg
- 5-5-5 Main St. Station to Providence Forge

Light Rail

- 6-6-6 Boulevard
- 7-7-7 Broad to South Boulevard
- 8-8-8 Midlothian
- 9-9-9 Main St. Station to Airport
- 10-10-10 Main St. Station to Short Pump

N

0 2.5 5 10 Miles

3.1 *Background*

The choice of whether to construct commuter or light rail for particular corridors depends to a great extent on the characteristics and geographic attributes of the region. Transit systems have been constructed and evaluated in enough cities to draw reliable conclusions about what conditions and types of cities are most suitable for light rail or commuter rail systems.

Generally, commuter rail's operating characteristics are most compatible with geographically expansive metropolitan regions with very large downtowns. Commuter rail's exclusive or semi-exclusive right-of-way facilitates high speeds that can support regional mobility provided that stations are spaced far enough apart. Typically, commuter rail lines operate on routes longer than 10 miles. Longer routes tend to produce higher ridership. Such long distances are most compatible with work trips, which tend to be longer than other types of trips and are primarily oriented to a common destination, such as the CBD. The high-speed regional service also justifies charging higher fares that can offset some of the mode's higher per-train-hour operating costs as compared to light rail. However, over such long distances, the intensity of trip-making tends to be relatively light, and as a result, commuter rail typically operates at headways as long as 30 to 60 minutes during peak periods and commonly operates at 60-minute headways or not at all during off-peak periods.

Light rail's operating characteristics, in contrast, match most compatibly with densely populated residential areas and medium or large downtowns. The operational advantage of light rail is the mode's ability to provide high capacity service while operating in mixed traffic or in semi-exclusive right-of-way. However, the average operating speed for LRT is much slower than commuter rail and therefore serves trips of shorter distances; the mode's stations are typically spaced about a half mile or so apart. Light rail also serves a relatively larger proportion of non-work trips than commuter rail, since the mode serves a larger number and variety of origins and destinations within walking distance of its route. Also, the dense urban settings in which light rail typically operates tend to generate higher intensities of trip-making, which translates into higher travel demand. These factors work together to justify headways that are typically as short as four to 12 minutes during peak periods and 10 to 20 minutes during off-peak periods.

Table 3-2 summarizes and compares some of these characteristics that differentiate commuter rail and light rail systems and the types of regions they most commonly serve. In summary, commuter rail is most compatible with very large downtowns that serve expansive metropolitan regions, while light rail is most compatible with densely populated urban areas whose downtowns can be medium-sized.

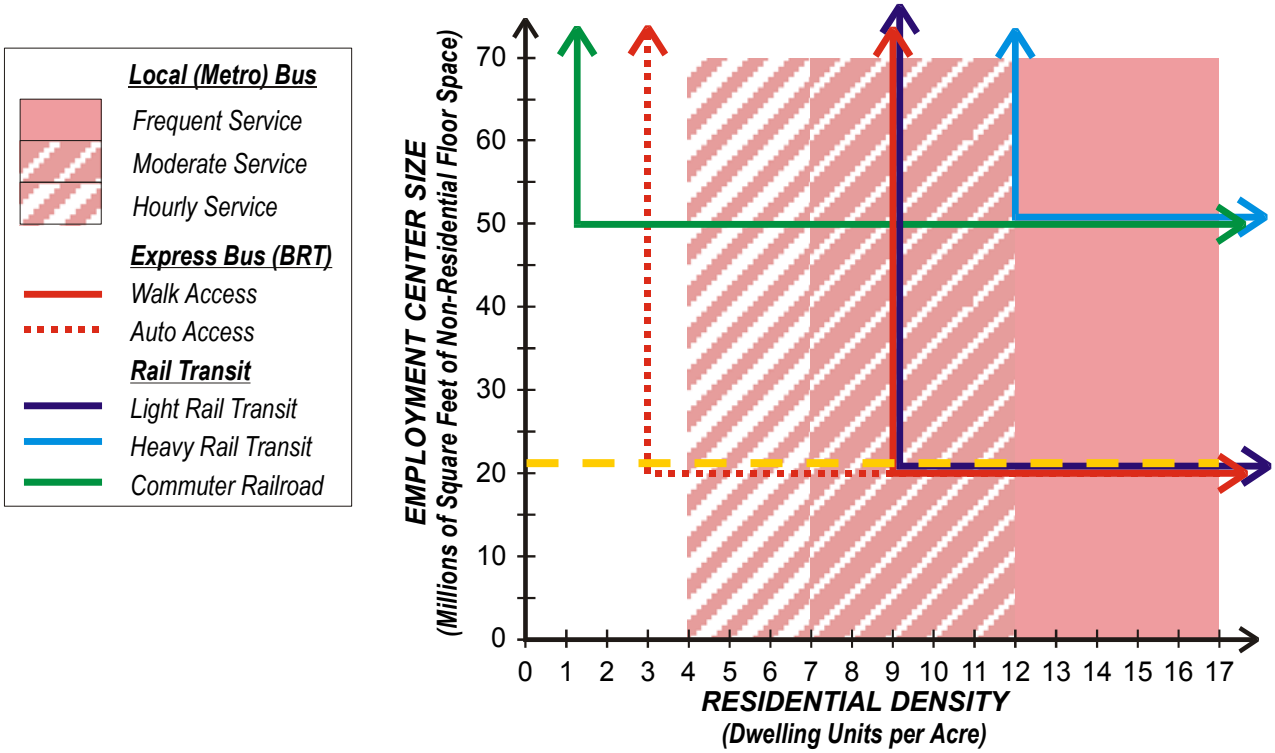
Table 3-2 Typical Characteristics of Commuter and Light Rail Systems and Regions They Serve

	Commuter Rail	Light Rail
Characteristic of the Region		
Downtown Size	Very Large	Medium or Large
Geographic Size of Metro Area	Very Large	Small, Medium or Large
Station-Area Residential Density	Typically Low	Medium or High
Good Local Bus Systems	Unimportant	Very Important
Characteristic of the Rail System		
Parking Availability	Very Important	Moderately Important
Station Spacing	Long	Short
Service Frequency	Low	High
Trip-Making Intensity	Low	High

Research since the 1970s indicates that downtowns that have more than 50 million square feet of non-residential floor space – or more than about 200,000 jobs – are best suited to support commuter rail service (see Figure 3-2). These downtowns are large enough to draw significant travel demand from a large area. Since most access to commuter rail stations is via park-and-ride, residential densities can be as low as one dwelling unit per acre (large-lot single-family homes), as long as residential development is sustained along a corridor of at least 30 miles for cities with the very largest downtowns, or at least 50 miles for other cities.

Light rail typically can perform well with a downtown as small as 20 million square feet of non-residential floor space, or about 80,000 jobs, though residential densities normally have to be higher than about nine dwelling units per acre (garden apartments or denser) and must be sustained along a corridor about 10 miles or longer. More densely developed residential areas can support light rail systems that serve smaller downtowns or that operate on shorter routes.

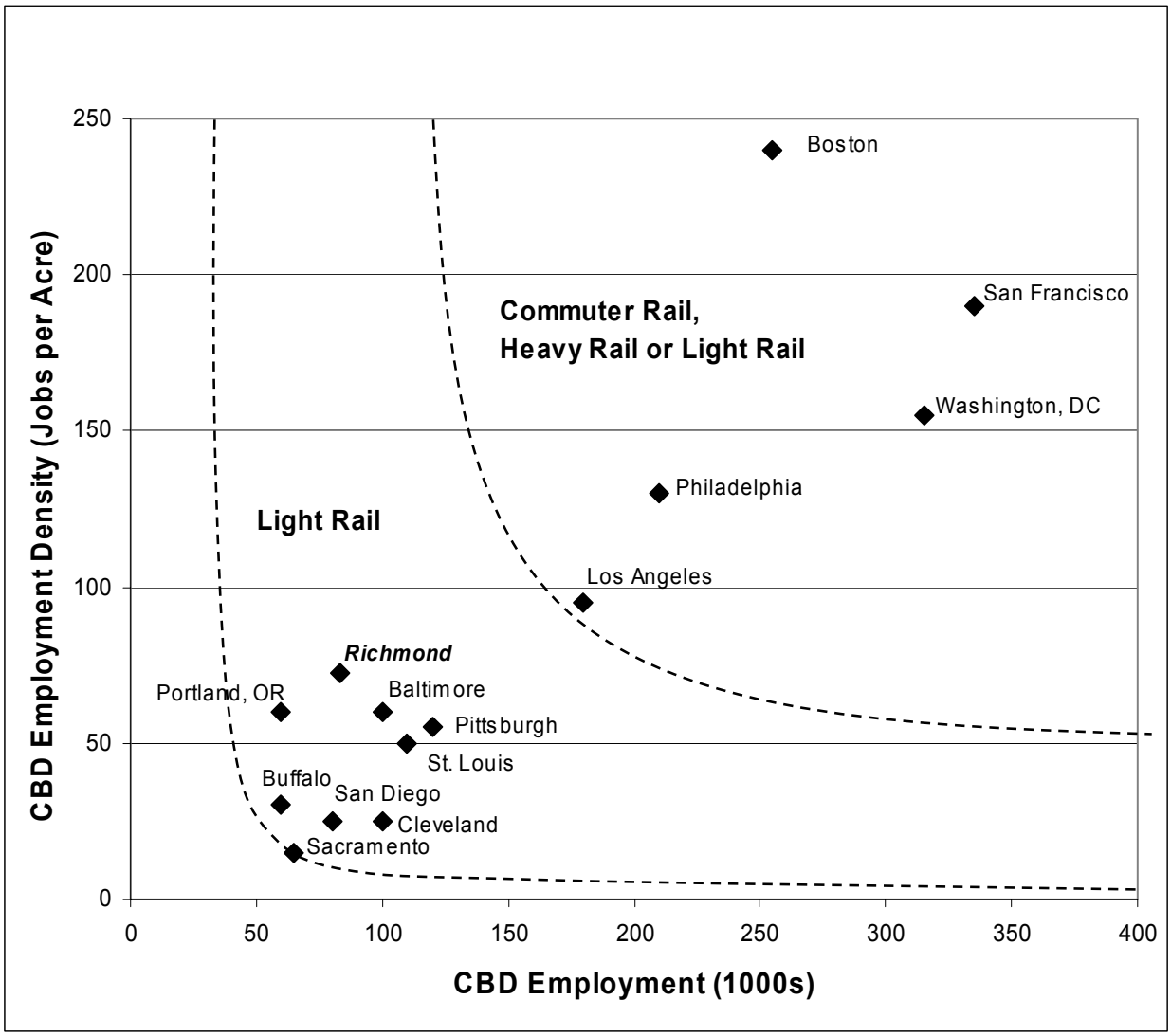
Figure 3-2 Transit Warrants



In comparison, Richmond's downtown presently has about 87,400 jobs and is projected to have about 83,200 in 20 years. This corresponds to slightly greater than 20 million square feet of non-residential floor space. Residential densities of one unit per acre or greater are sustained only up to 12 miles from downtown. On the other hand, Richmond's denser neighborhoods, to the west of downtown, are developed at densities of nine to 19 units per acre up to five miles from downtown. Based on these criteria, the Richmond area is potentially well suited for light rail but seems poorly suited to support commuter rail.

Figure 3-3 compares the downtown sizes of the U.S. cities with rail transit systems to which the travel demand model was calibrated. Generally, downtown density increases linearly with downtown size. Interestingly, all downtowns containing over 175,000 jobs at a density higher than 95 jobs per acre also are served by commuter rail systems. A larger cluster of medium-sized downtowns, more similar to downtown Richmond, all have light rail systems. In a couple of cases, namely San Diego and Baltimore on this chart, some medium-sized downtowns are served by commuter rail systems as well. The dashed curves on the chart very generally delineate the thresholds for downtown size that are typically associated with commuter and light rail systems.

Figure 3-3 Downtown Size of Various U.S. Cities with Rail Transit Systems



3.2 *Methodology*

Consistent with the study's pre-feasibility phase of planning, the estimation of ridership relied on off-the-shelf "sketch" level planning models that required a moderate amount of effort, but not the intensive effort normally necessary to run a traditional four-step travel demand model. The sketch planning model chosen for this analysis was taken from the Transit Cooperative Research Program's Report 16, "Transit and Urban Form," which developed models to estimate ridership for commuter and light rail systems, specifically for pre-feasibility studies like this one. The model was estimated using a sample of 261 light rail and 526 commuter rail stations around the U.S. The accompanying report was published in two volumes by the Transportation Research Board and the National Academy Press in 1996. Parsons Brinckerhoff was the primary author of this report.

The ridership model accepts as inputs some basic information about station-area demographics, local transit system connections, and downtown employment. Numerous variables were tested to estimate the model, and determine the combination of variables that provided the best fit for matching projected to actual demand. Table 3-3 outlines the specific variables used by the model that best correlated with observed demand on the studied commuter rail and light rail systems. The model predicts ridership at any particular, non-CBD light rail or commuter rail station.

Table 3-3 Variables Used to Estimate Travel Demand for Commuter and Light Rail

Variable	Commuter Rail Model	Light Rail Model
Terminal Station (yes/no)		X
Parking Present (yes/no)	X	X
Feeder Bus Access (yes/no)	X	X
Miles to Nearest Station		X
Miles to the CBD	X	X
Residential Density	X	X
1000s of Employees in CBD	X	X
Employment Density in CBD	X	
Average Household Income	X	

For commuter rail, the number of downtown employees is most important in the model, followed by the station's distance from downtown. For light rail, whether the station is the terminal station affects ridership most, though among non-terminal stations, residential density, distance to the next light rail station, and downtown size are the most important variables.

The model is appropriate to apply to estimate ridership on transit alternatives that are generally similar to the systems that were used to create the model. For example, the model probably would not be an appropriate tool to test a light rail line running through very rural areas, nor would it provide reliable results when applied to an extremely dense urban setting such as New York City. These types of cases were not included in the set of transit systems used to create the model and therefore would not be appropriate test cases for applying the model. For the same reason, the model is only applicable in U.S. settings.

A comparison of the Richmond-area alternatives to the criteria used to create the model confirms that all alternatives other than the Boulevard alternative would be appropriate cases to use the model for demand forecasting. Unlike every system used to estimate the demand model, the Boulevard option, which would run between the Botanical Garden and William Byrd Park, would not serve any downtown. The alternative is likely to attract very little ridership, since it does not serve any major activity center. Because downtown size is so important to the model, the absence of a downtown in this alternative means that it would not be a suitable case to use the model for demand forecasting. Therefore, the projections for this alternative were adjusted downward to reflect more realistic volumes. As a substitute, a light rail alternative was created that would serve William Byrd Park and the Boulevard and turn east onto Broad Street to serve downtown Richmond.

3.3 *Demand Analysis Assumptions*

The sketch planning demand model inputs utilized the most current socioeconomic data available to the Richmond Area MPO at the time of the study. This data included population/housing data from the Year 2000 US Census and 1998 Employment data and projections. A future analysis year of 2023 was used as the buildout year for the study. This data was organized into Transportation Analysis Zones (TAZs) as established by the Richmond Area MPO, compiled into a GIS database and analyzed using GIS query tools for the study corridors.

Station locations for demand analysis were estimated by identifying the potential rail corridors and identifying major roadway intersections and land use locations on the corridor. A formal site assessment and evaluation was not conducted. It can be anticipated that in future studies, the station locations would be refined based on formal studies of the physical characteristics of each site.

Population, housing and employment data were evaluated for a half-mile study area on either side of the proposed rail transit line. This data was organized to approximate the population densities surrounding the proposed rail transit line. Employment densities (per square mile and per acre) were calculated for the Central Business District (CBD). As described previously, these socioeconomic factors were input into the ridership model and compared to other cities with rail transit systems to develop travel demand estimates. The assumed future land use conditions for each corridor are outlined in Table 3-4.

Table 3-4 Land Use Data

Alternative	Mode	Line Length	Stations	2023 Population	2023 Employment
Ashland	Commuter Rail	17.9	10	49,800	95,700
Hanover	Commuter Rail	18.0	8	31,600	50,600
Midlothian	Commuter Rail	13.7	10	29,600	61,300
Petersburg	Commuter Rail	25.0	14	41,300	68,400
Providence Forge	Commuter Rail	23.3	5	17,800	44,200
Boulevard	Light Rail	5.5	13	22,800	27,400
Broad to Blvd. S	Light Rail	4.6	16	32,900	100,200
Midlothian	Light Rail	11.3	19	30.100	92,300
RIC	Light Rail	6.4	15	23,700	54,500
Short Pump	Light Rail	13.6	24	60,900	150,800

3.4 *Projections*

Using the sketch planning demand model, the land use data, and physical assumptions for each corridor, ridership projections were developed. The travel demand model yielded the results shown in Table 3-5. All projections are rounded.

Table 3-5 Ridership Results

Alternative	Mode	Line Length	Stations	Daily Boardings	Boardings per Mile	Boardings per Station
Ashland	Commuter Rail	17.9	10	1,800	100	180
Hanover	Commuter Rail	18.0	8	1,400	80	180
Midlothian	Commuter Rail	13.7	10	1,700	120	170
Petersburg	Commuter Rail	25.0	14	2,700	110	200
Providence Forge	Commuter Rail	23.3	5	700	30	140
Boulevard	Light Rail	5.5	13	6,000[1]	1,100[1]	460[1]
Broad to Blvd. S	Light Rail	4.6	16	20,200	4,400	1,260
Midlothian	Light Rail	11.3	19	20,200	1,800	1,070
RIC	Light Rail	6.4	15	19,100	3,000	1,280
Short Pump	Light Rail	13.6	24	33,700	2,500	1,400

[1] For reference, this table includes an adjusted model estimate for ridership for the Boulevard Line. According to the model, this line performs least productively and attracts the least ridership among the light rail alternatives. The model estimates were revised downward, however, since the model is not suited well to examine this type of line.

Overall, the light rail alternatives would attract considerably more ridership than the commuter rail alternatives. Among the light rail options, the line to Short Pump would attract the highest ridership, followed by the other three options to Midlothian, the Richmond Airport, and the new "Broad to Boulevard South" option. However, as the alternatives have considerably different distances and number of stations, the total ridership numbers should be directly compared. Generally, the longer a line is, the more ridership it will attract, all other things equal. Thus, examining the ridership results on a per-mile or per-station basis is important. Lines with higher productivity generally are most cost effective as well, since costs are correlated closely with length of line. On a per-mile basis, the "Broad to Boulevard South" line would be the most productive service, and the Boulevard is the least productive service.

Among the commuter rail alternatives, the line to Petersburg would attract the most ridership, and the line to Providence Forge would attract the least ridership. The other three services all would attract about the same number of daily boardings. In terms of productivity, the Midlothian Line performs best, and the Petersburg Line also performs well.

Although the light rail systems perform better in terms of ridership than the commuter rail alternative, much of the variation has to do with inherent differences between the modes. In any setting, an infrequent, higher-fare commuter rail service will attract less ridership than a

frequent, lower-fare light rail service. A more telling evaluation would compare the alternatives to the performance of other commuter and light rail systems around the country.

Figure 3-4 through Figure 3-7 compare the ridership and productivity of these alternatives to other commuter and light rail systems nationwide. Figure 3-4 and Figure 3-5 show that by either demand measure – ridership or boardings per mile– all five commuter rail alternatives compare quite poorly to other systems around the country. The alternatives would generate among the lowest ridership and fewest boardings per mile.

In contrast, Figure 3-6 and Figure 3-7 show that the performances of the light rail alternatives would be quite comparable to existing light rail systems across the country. The Short Pump Line could attract very robust ridership in comparison to other systems, and the "Broad to South Boulevard" Line would be among the more productive systems nationally. The RIC Line to the airport also would perform well in terms of productivity.

3.5 *Travel Demand Summary*

The Richmond area's medium-sized downtown, densely populated residential areas and relatively limited geographic size are most supportive of light rail and reflect the characteristics of numerous U.S. cities that have successful light rail systems. The sketch-level travel demand model confirms that the light rail alternatives perform best from a total and boarding-per-mile perspective. Overall, the light rail alternatives perform an order of magnitude better than the commuter rail alternatives in terms of ridership. The alternatives with the highest projected demand are the Short Pump Line, "Broad to Boulevard South" Line, and RIC Line, all light rail options. The alternatives that have the lowest projected demand are the Providence Forge Line and Hanover Line, both commuter rail options.

These demand estimates comprise a first look at potential ridership. Ultimately, a much more detailed and robust four-step travel demand model would be appropriate to apply as part of subsequent studies. However, this first look provides some very interesting and useful contrasts among the various modes and alignments.

Figure 3-4 Commuter Rail Daily Ridership

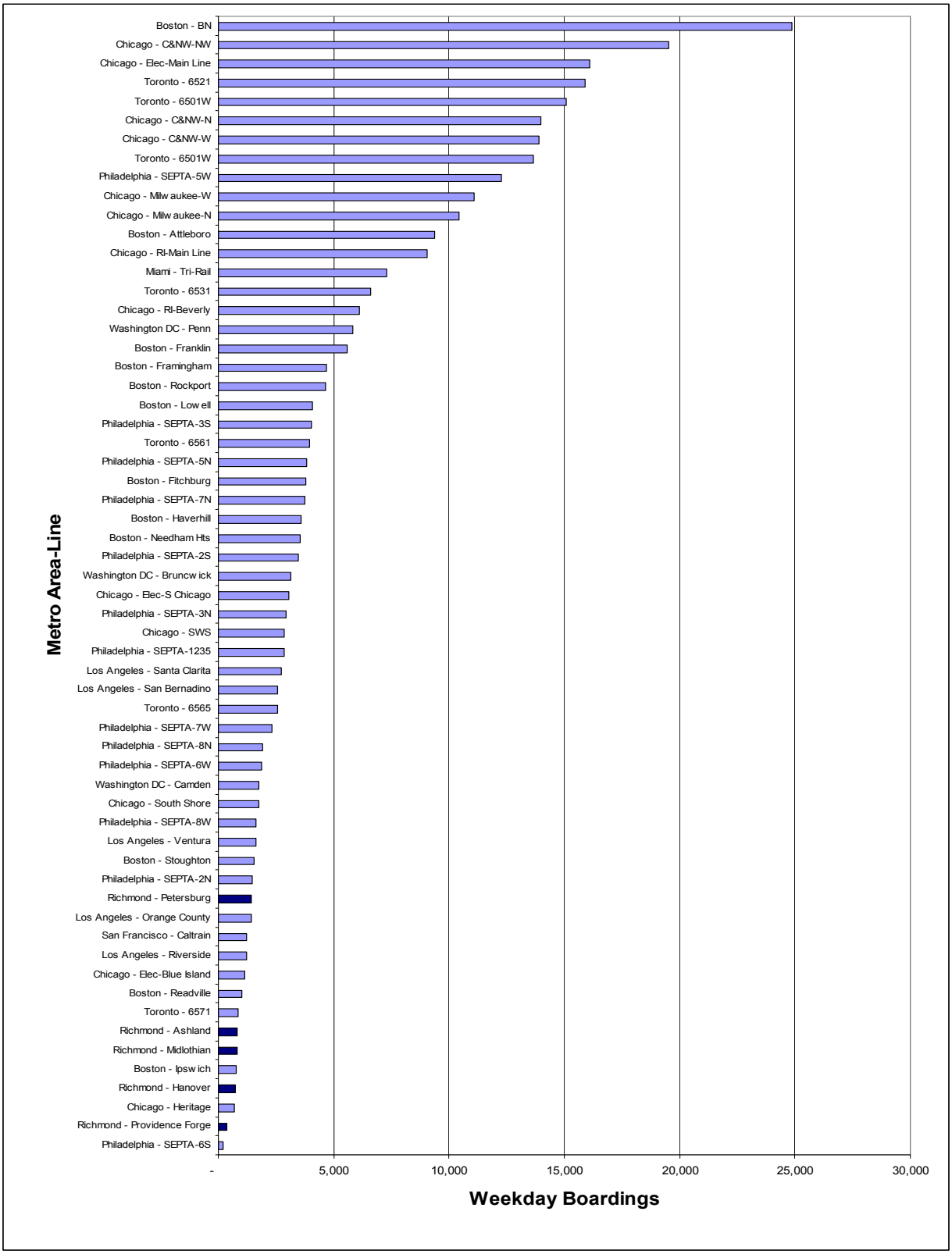


Figure 3-5 Commuter Rail Boardings per Mile

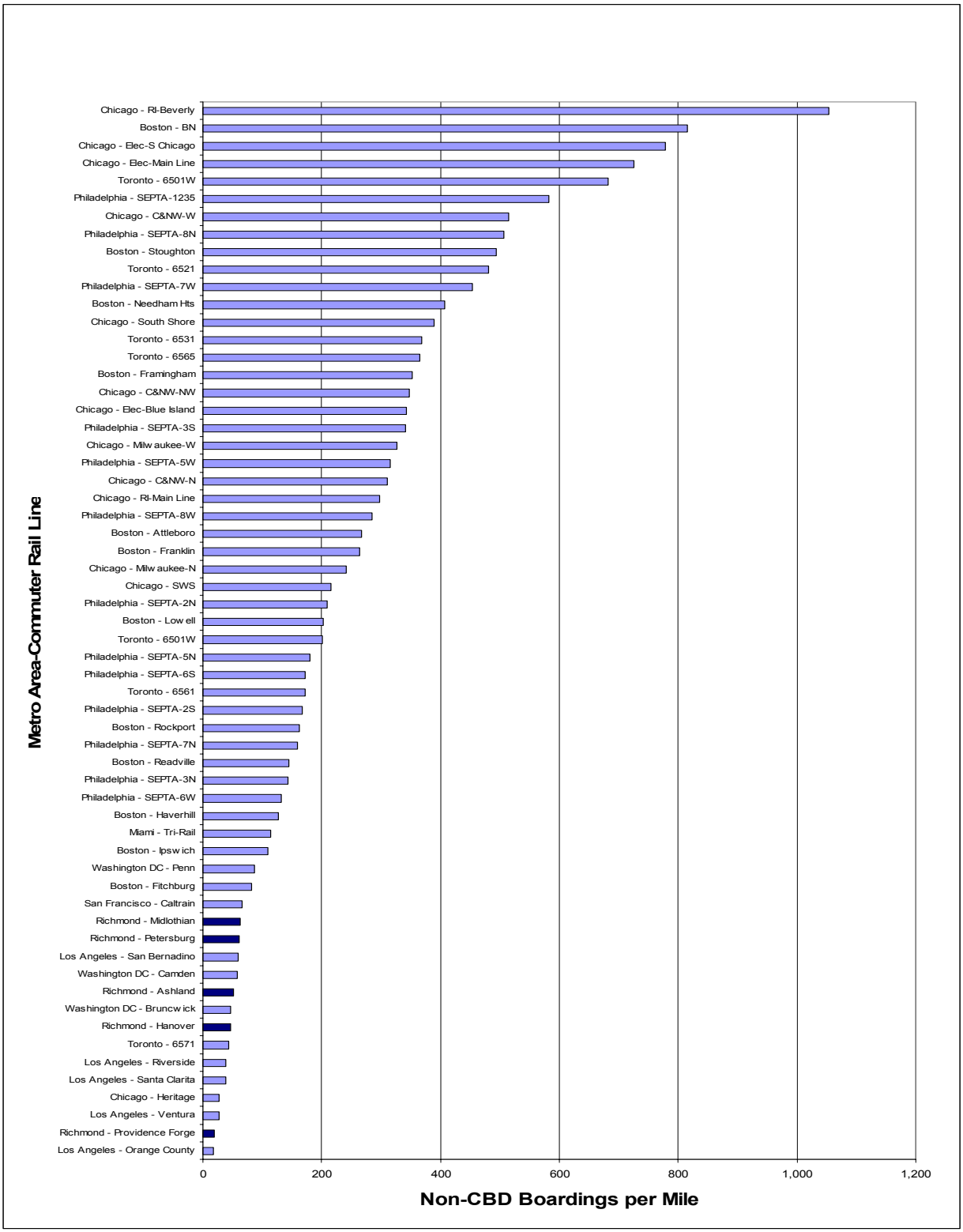


Figure 3-6 Light Rail Daily Boardings

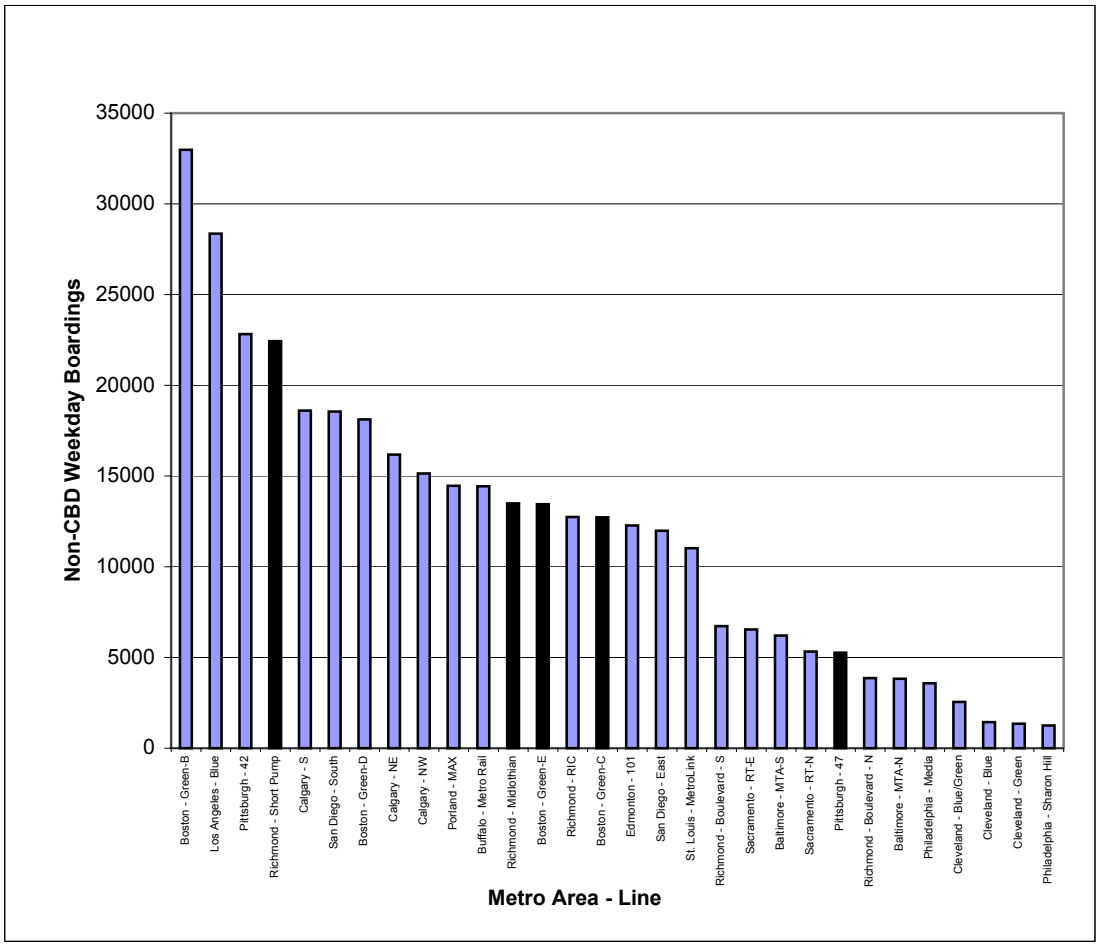
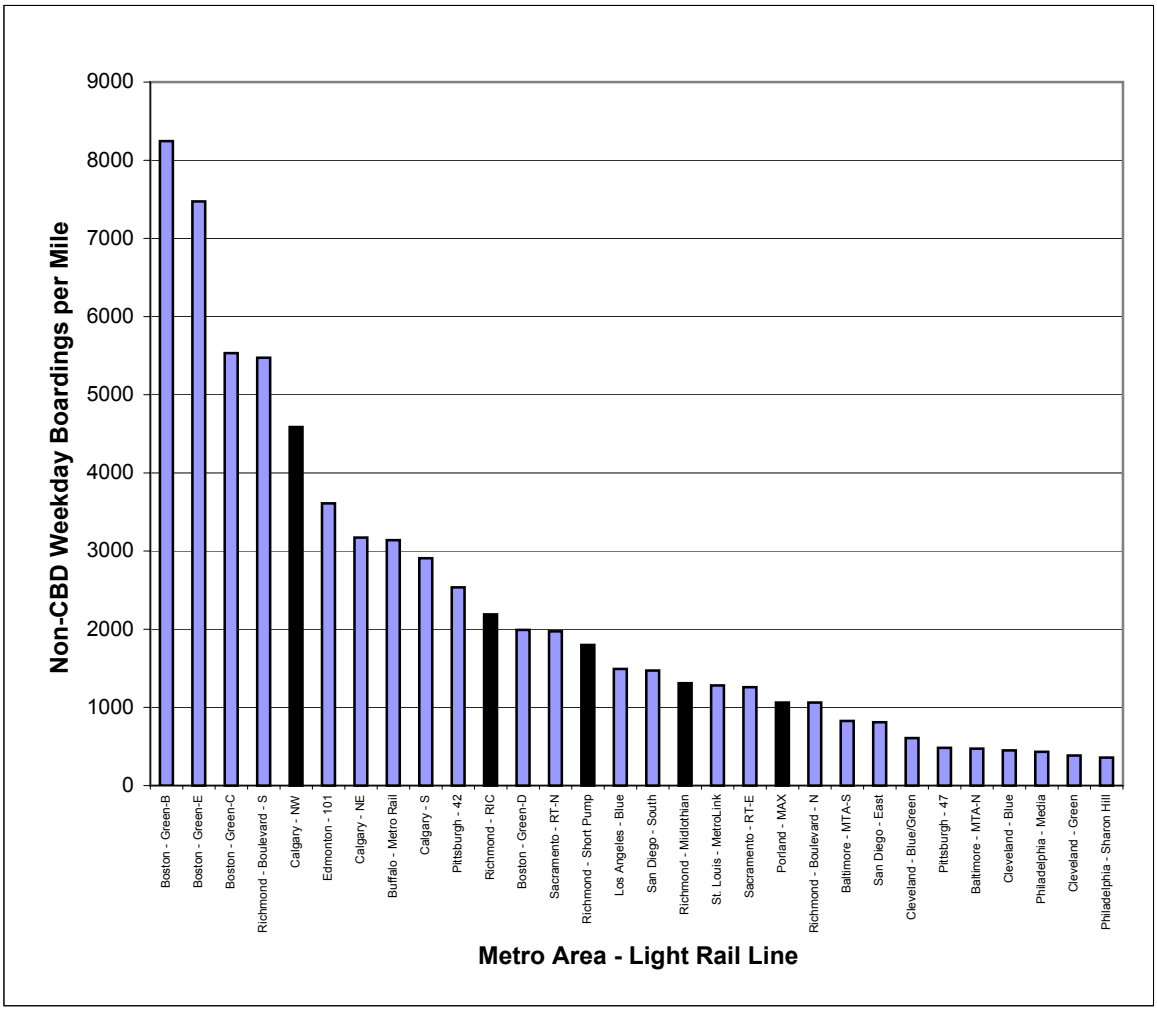


Figure 3-7 Light Rail Boardings Per Mile



4.0 Preliminary Alternatives Screening

This section of the study describes the process used to screen the study's ten preliminary rail transit corridors to four corridors for further technical analysis. The ten corridors were based on corridors identified in the 2023 Richmond Area MPO Long Range Transportation Plan. These corridors were refined during the October 7, 2002 meeting of the project's Rail Development Committee. The relined alternatives were screened using independent criteria and available data.

Although the process was effective for this preliminary transit study, this screening methodology is not sufficient to conduct a comprehensive alternatives analysis. A wider range of alternatives and a more detailed analysis process would be conducted in either an Alternative Analysis (AA) or a Draft Environmental Impact Statement (DEIS). These AA or DEIS studies are normally undertaken as a first step to pursue federal transit funding for capital expenses of a new route or services.

4.1 *Screening Process*

Five criteria were used in the screening process. These criteria include:

- Ridership (sec. 4.2)
- Capital Costs (sec. 4.3)
- Cost Effectiveness (Cost per Rider) (sec 4.4)
- Transit Dependency (sec. 4.5)
- Congestion Relief Potential (sec 4.6)

The screening process used data from the Richmond Regional Planning District Commission (RRPDC) and other sources such as the U.S. Census Bureau. The information was analyzed for each transit corridor using Geographic Information Systems (GIS). Travel demand forecasts were developed based on established "sketch planning" methods developed for pre-feasibility studies of transit corridors. Data for capital cost estimates came from other planned and constructed rail transit projects across the United States. Transit dependency forecasts were created from regional data on automobile ownership. Congestion data was taken from the Richmond Area MPO's Congestion Management System (CMS) plan. The following sections describe the screening process and results for each criterion analyzed. A summary of results is presented at the end of the document.

4.2 *Ridership Demand Analysis*

As the Richmond area initiates the preliminary phase of decision-making regarding rail transit feasibility, analyses focused on demographic indicators of the potential rail transit corridors that will be most likely to attract riders will be important. The first step of this is to identify corridors that will be most efficient overall and that will have the most likelihood of providing the initial success to develop popular support for expanded rail transit systems. The purpose of this analysis is to provide documentation of rail lines that are likely to succeed and are viable for further detailed evaluation.

The methodology and results of this process were described in section 3. A summary of the results is provided in Table 4-1.

Table 4-1 Summary of Average Daily Boardings by Corridor

Corridor	2023 Average Daily Boardings
Commuter Rail	
Ashland	1,800
Hanover	1,400
Midlothian	1,700
Petersburg	2,700
Providence Forge	700
Light Rail	
Boulevard	6,000
Broad to South Boulevard	20,200
Midlothian	20,200
Richmond Int'l Airport (RIC)	19,100
Short Pump	33,700

4.3 *Capital Costs*

4.3.1 Methodology

The capital cost estimates prepared for the alternative screening process are sketch-planning estimates that did not include engineering analysis of infrastructure components. Instead, the estimates were calculated from length-based unit costs for all currently proposed light rail and commuter rail projects in the Federal Transit Administration's New Starts program. Capital costs were also reviewed for some recently built commuter rail systems. The cost and length data for each planned project was taken from the FTA's Fiscal Year 2003 New Starts Report, which was the most current information as of December 2002. Table 4-2 and Table 4-3 list the planned light rail and commuter rail projects used to develop the unit costs.

The analysis of all currently proposed New Starts projects for each mode resulted in a wide range of individual per mile capital costs. However, by using a length-weighted average of the proposed systems, individual cost variations between projects were reduced. The resulting per-mile estimates are $58.41 million for light rail transit systems and $5.75 million for commuter rail transit systems. Depending on engineering and environmental constraints, the actual per mile cost in Richmond may be higher or lower than these figures. However, because the costs are based on other U.S. transit projects, they represent the average capital costs for other "state of the art" light rail or commuter rail transit systems currently being planned and therefore provide a good basis for estimating costs at a pre-feasibility level of planning. Operating costs are not included in these estimates.

The difference between the per mile capital costs for light rail and commuter rail underscores the fundamental difference between the two types of rail transit systems. On a per-mile basis, a typical commuter rail system requires much less new infrastructure than a light rail transit system. Light rail transit systems operate using electricity supplied via an overhead catenary system, require a separate signal and communications system, typically have more frequent station spacing, and may also include service along new exclusive-use guideway (such as freeway medians, bridge structures, or tunnels). This results in an extensive list of new infrastructure for nearly every new LRT project. Commuter rail systems, by contrast, are designated within existing railroad corridors resulting in the possibility of using or perhaps only updating existing signal, communications and even vehicle maintenance and storage facilities. However, very few commuter rail systems operate with the schedule frequency and type of service that is found on a light rail transit system.

Table 4-2 Light Rail Transit Projects in FY 2003 FTA New Starts Report [1]

Metropolitan Area	Project Name	Cost ($ Millions)	Length (miles)
Preliminary Engineering Phase			
Pittsburgh, PA	North Shore Connector	$389.9	1.6
Charlotte, NC	South Corridor	$348.2	11.2
Louisville, KY	South Central Corridor	$671.2	15
Tampa Bay, FL	Bay Regional Rail - 3 corridors	$1,455.0	20.1
Cincinnati, OH	Interstate 71 Corridor (MOS-1)	$899.9	19
Columbus, OH	North Corridor LRT	$501.8	13
Austin, TX	Rapid Transit Project MOS	$749.2	14.6
Dallas, TX	Northwest / Southeast MOS	$1,237.5	22
Denver, CO	West Corridor	$624.3	11
Phoenix, AZ	East Valley Corridor MOS	$1,181.0	20.3
Los Angeles, CA	Eastside Corridor LRT	$817.9	5.9
Los Angeles, CA	Mid-City Exposition LRT	$343.9	9.6
New Orleans, LA	Desire Corridor Streetcar	$93.5	2.9
Orange County, CA	Centerline LRT	$1,889.0	18.7
San Diego, CA	Mid Coast Corridor	$131.5	3.4
Final Design Phase			
Salt Lake City, UT	Medical Center LRT extension	$89.4	1.5
San Francisco, CA	Third Street LRT - Phase I	$557.9	5.4
Full Funding Grant Agreement (FFGA) Phase			
Baltimore, MD	Central LRT Double Track	$153.7	9.4
Dallas, TX	North Central LRT Extension	$517.2	12.5
Denver, CO	SE Corridor (T-REX)	$879.2	19.1
Minneapolis, MN	Hiawatha Corridor	$675.4	11.6
Northern NJ	Hudson Bergen LRT MOS-1	$992.1	9.6
Northern NJ	Hudson Bergen LRT MOS-2	$1,215.4	6.1
Newark, NJ	Rail Link (MOS-1)	$207.7	1
Portland, OR	Interstate MAX LRT Extension	$350.0	5.8
St. Louis, MO	Metrolink St. Clair extension	$339.2	17.4
Salt Lake City, UT	CBD to University	$118.5	2.5
Salt Lake City, UT	North / South LRT	$312.5	15
San Diego, CA	Mission Valley East LRT	$431.0	5.9
Subtotals		**$18,173**	**311.1**
Unit Cost Per Mile		**$58.41**	

[1] FTA Annual Report on New Starts, FY 2003

Table 4-3 Commuter Rail projects in FTA New Starts Program [1]

Municipality / Project Name & Description (Preliminary Engineering Phase)	Capital Cost ($ Millions)	Length (Miles)
Lowell to Nashua (New Hampshire) extension of MBTA service to Boston	$40.7	12
Minneapolis, Minnesota "Northstar Corridor"	$270.6	82
Johnson County, Kansas (I-35 Corridor)	$30.9	23
Everett-Seattle (Washington) Commuter Rail	$104.0	35
Lakewood-Tacoma (Washington) Commuter Rail	$86.0	8
Wilsonville-Beaverton (Oregon) Diesel Multiple Unit (DMU)	$82.8	15
Subtotal	$1,680.2	292
Unit Cost (Per Mile)	**$5.75 Million**	

[1] FTA Annual Report on New Starts, FY 2003

Because of the fewer number of planned commuter rail systems or extensions, the Rail Development Committee asked the study team to review the capital cost assumptions for commuter rail. Specifically, the Committee was interested if lower capital costs were possible along corridors that had lower freight train frequencies by using mostly existing railroad tracks. Table 4-4 lists recent commuter rail systems that were built using mostly existing railroad right-of-way (without the added expense of additional track). The capital costs for these projects, built between 1989 and 1996, were inflated to 2002 dollars using the Consumer Price Index.

Table 4-4 ITE Handbook Capital Costs for Built CR Systems

Metropolitan Area	Transit System	Length (miles)	Cost[1] ($2002 – Millions)	Year of Service
Dallas – Fort Worth, TX	Trinity Railway Express	9.9	$85	1996
Dade, Broward, Palm Beach Counties, FL	Florida Tri-Rail	66.3	$113	1989
Northern Virginia	Virginia Railway Express	81.2	$168	1992
San Diego, CA	Coaster Commuter Rail	41.5	$223	1995
Los Angeles, CA	Metrolink	412.5	$1,667	1992
Subtotal		**611.9**	**$2,256**	
Unit Cost (Per Mile)			**$3.69 Million**	

[1] 1999 ITE Transportation Planning Handbook. 2002 costs calculated using Bureau of Labor Statistics Consumer Price Index for Inflation.

The study team determined that given the preliminary nature of the study, a consistent commuter rail unit cost should be used. The higher figure ($5.75 M per mile) was more conservative, and thus was used for further analysis.

4.3.2 Capital Cost Summary

The per-mile unit costs for each mode were applied to the ten preliminary alternatives to develop the planning-level capital cost estimates. Table 4-5 summarizes the capital cost estimates for each of the ten preliminary alternatives.

Table 4-5 Summary of Capital Costs

Corridor	Length (miles)	Unit Cost ($ Millions)	Cost Estimate ($ Millions)
Commuter Rail			
Ashland	17.9	$5.75	$103
Hanover	18.0	$5.75	$104
Midlothian	14.1	$5.75	$81
Petersburg	25.0	$5.75	$144
Providence Forge	23.3	$5.75	$134
Light Rail			
Boulevard	5.5	$58.41	$321
Broad St. to S. Blvd.	4.6	$58.41	$270
Midlothian	11.3	$58.41	$658
Richmond Int'l Airport (RIC)	6.4	$58.41	$374
Short Pump	13.6	$58.41	$791

4.4 *Cost per Rider (Cost Effectiveness)*

The "Capital Cost per Boarding" criterion was used as a basic measure of each alternative's cost effectiveness. The measure indexes the ratio of total capital costs to the number of weekday boardings. Each alternative's capital cost, as shown in Table 4-5, was divided by its respective ridership estimate, as depicted in Table 4-1, to arrive at estimates for capital cost per average daily boarding. The results are listed in Table 4-6.

A smaller figure indicates less cost per boarding and therefore a more cost effective alternative. The most cost effective alternative is the "Broad Street to South Boulevard" light rail option, followed by light rail alternatives to Richmond International Airport and Short Pump. The fourth most cost effective alternative, and first among commuter rail options, is the Midlothian alternative. The least cost effective option is the Providence Forge commuter rail option.

Table 4-6 Cost Effectiveness
(Capital Cost per Average Daily Boarding)

Corridor	Cost per Boarding ($1,000s)
Commuter Rail	
Ashland	$57
Hanover	$72
Midlothian	$49
Petersburg	$53
Providence Forge	$188
Light Rail	
Boulevard	$54
Broad St to South Boulevard	$14
Midlothian	$33
Richmond Int'l Airport (RIC)	$20
Short Pump	$24

4.5 *Future (2023) Transit Dependency*

Users of public transportation can be broadly divided into two groups, “choice” riders, and “transit dependent” riders. Choice riders typically have both auto and transit options available, which usually includes a private automobile. Transit dependent riders, however, have no auto options available, and usually rely on public transportation to make their trips.

No data is collected to classify the transit dependent population along each preliminary corridor. However, the rate of automobile ownership per household is often used as a substitution for transit dependency data. It is assumed that the corridors with a lower rate of automobile ownership per household also have a higher transit dependent population. Available data from RRPDC and the Crater Planning District Commission forecasts the number of residents, households, and automobiles for the year 2023. Analysis of the data was performed using Geographic Information Systems (GIS) to determine automobile ownership rates within ½ mile of each rail transit corridor. Table 4-7 depicts this information for each corridor.

Table 4-7 2023 Forecast Automobiles per Household

Corridor	2023 # of Households	2023 # of Autos	2023 Autos / Household
Commuter Rail			
Ashland	19,300	23,000	1.19
Hanover	11,700	18,600	1.59
Midlothian	13,000	17,800	1.37
Petersburg	16,700	24,200	1.45
Providence Forge	9,000	9,600	1.06
Light Rail			
Boulevard	11,900	15,300	1.29
Broad to S. Blvd.	15,900	16,700	1.05
Midlothian LRT	12,500	18,200	1.46
Richmond Int’l Airport (RIC)	12,000	9,800	0.82
Short Pump	31,000	37,500	1.21

4.6 *Future Congestion Relief Potential*

Realizing the importance rail transit could play toward increasing transportation mobility options in the Richmond metropolitan area, this study measured congestion on nearby parallel roadways as an indication of alternatives' potential to both mitigate congestion and attract ridership.

To estimate the level of congestion on Richmond's roads, this rail feasibility study used 2023-build analyses from the Congestion Management System/Richmond Area Metropolitan Planning Organization (Richmond Regional Planning District Commission, March 8, 2001) to indicate congested conditions. The CMS Study considered the projected 2023 traffic volumes on the roadway and compared them to the calculated capacity of the specific roadway. This comparison, called the Volume-to-Capacity (V/C) ratio, indicated estimated future roadway congestion.

Although V/C ratios are provided in the CMS Study for base year and 2023 no-build conditions, the 2023 build conditions were used in this rail feasibility study to indicate future congestion relief potential. The 2023-build analysis identified roadway congestion after planned capacity improvements were made to the network and therefore represents a conservative approach to identifying future roadway congestion and congestion relief potential.

Congested conditions on the 2023 build-network were identified on a map and compared to alternative alignments of light rail and commuter rail. If a rail line appeared to parallel a congested facility, the longitudinal congestion relief distance (in miles) was estimated. These results were tabulated and compared to indicate a congestion relief potential. Table 4-8, below, lists congested segments from the CMS Study and compares these segments to applicable rail line miles that could potentially mitigate roadway congestion.

Note that this is only a measure of congestion reduction potential. Additional analysis taking into account actual transit ridership and the resulting motor vehicle traffic diversion would be required to measure actual congestion relief. Even with detailed analysis, measures of congestion relief can be difficult to measure and interpret.

Table 4-8 Future Congestion Relief Potential

CMS Study Congested Segment	Applicable Rail Line Estimated Congestion Relief Potential
I-95 – North Corporate Limits to South Corporate Limits of Ashland	2 miles possibly mitigated by both Ashland and Hanover Commuter Rail lines
I-95 - Ashland Corporate Limits to Henrico Corporate Limits	1.5 miles possibly mitigated by both Ashland and Hanover Commuter Rail lines
I-95 - Main to Bells	5 miles possibly mitigated by Petersburg Commuter Rail
I-95 - Bellwood to Rte 10	4 miles possibly mitigated by Petersburg Commuter Rail
Rte 301 - Henrico Corporate Limits to Georgetown	7.5 miles possibly mitigated by Hanover Commuter Rail
Rte 60 - Elko to New Kent Corporate Limits	2 miles possibly mitigated by Providence Forge Commuter Rail
Rte 1 - Robert E Lee Bridge	0.5 mile possibly mitigated by both Midlothian Light Rail and Commuter Rail and Petersburg Commuter Rail
Rte 360 - Rte 1 to Commerce	0.5 mile possibly mitigated by both Midlothian LRT and Commuter Rail
Rte 146 - Powhite Pkwy to Downtown Exp	0.5 mile possibly mitigated by both Midlothian LRT and Commuter Rail

4.7 *Criteria Summary*

4.7.1 Criteria Data by Corridor

Table 4-9 depicts a summary of the data used to screen each corridor. Data is provided for each of the five criteria explained in the previous text. This provided a basis for developing an estimate of ratings for each corridor.

Table 4-9 Summary of Data for Each Corridor

Criteria	Daily Boardings (Riders)	Capital Cost ($ Millions)	Cost per Boarding ($ Thousands)	Transit Dependency (Autos / HH)	Congestion Relief Potential (Miles)
Commuter Rail					
Ashland	1,800	$103	$57	1.2	3.5
Hanover	1,400	$104	$72	1.6	11
Midlothian	1,700	$81	$49	1.4	1.5
Petersburg	2,700	$144	$53	1.4	9.5
Providence Forge	700	$134	$188	1.1	2
Light Rail					
Boulevard	6,000	$321	$54	1.3	0
Broad Street to South Boulevard	20,200	$270	$14	1.05	0
Midlothian	20,200	$658	$33	1.5	2
Richmond International Airport (RIC)	19,100	$374	$20	0.8	0
Short Pump	33,700	$791	$24	1.2	0

4.7.2 Thresholds for Rating Criteria

To compare and screen the corridors, a scoring and rating system was developed and applied. A value score ranging from 1 through 5 was assigned to each criterion within each preliminary corridor. The score decreases with better performance, such that a score of "1" is "very good", while a score of "5" is "poor". Note that this system is not a ranking system representing the best corridor to the least. As a result, in some instances, the range of scores may not extend from 1 to 5 resulting in several systems having the same score in a particular category. Table 4-10 depicts the ranges used to determine the ranking thresholds for each of criteria.

Table 4-10 Thresholds for Ranking Criterion

	Daily Boardings (Riders)	Capital Cost ($ Millions)	Capital Cost per Boarding ($ Thousands)	Transit Dependency (Autos / HH)	Congestion Relief Potential (Miles)
1 = Very Good	> 24,000	< $80	< $20	< 0.5	< 25
2 = Good	< 24,000	< $120	< $35	< 1.0	< 20
3 = Average	< 16,000	< $240	< $50	< 1.2	< 15
4 = Below Average	< 8,000	< $480	< $100	< 1.6	< 5
5 = Poor	< 4,000	>$480	> $100	> 1.6	< 1

4.7.3 Rankings – Straight Average

Utilizing the rating system developed in Table 4-10, a rating was assigned to each criterion within each corridor. Assuming an equal weighting for each alternative, an average rating was developed for each corridor. Using these averages the corridors were ranked in a comparative order as shown in Table 4-11.

Using the straight averages, the three most promising corridors are the RIC Light Rail, Broad to South Boulevard Light Rail, and the Short Pump Light Rail.

Table 4-11 Criteria with Scores and Rankings: Equal Weighting

Criteria	Daily Boardings	Cost	Cost per Boarding	Transit Dependency	Congestion Relief Potential	Average Overall Score	Rank
Commuter Rail							
Ashland	5	2	4	3	4	3.6	5
Hanover	5	2	5	4	3	3.8	6
Midlothian	5	2	4	4	4	3.8	6
Petersburg	5	3	4	4	3	3.8	6
Providence Forge	5	3	5	3	4	4.0	9
Light Rail							
Boulevard	4	4	3	4	5	4.0	9
Boulevard South	2	4	1	3	5	3.0	2
Midlothian	2	5	2	4	4	3.4	4
Richmond International Airport (RIC)	2	4	1	2	5	2.8	1
Short Pump	1	5	2	3	5	3.2	3

4.7.4 Final Rankings – Weighted Average

The straight average does not reflect the actual importance of specific criterion to the analysis. For this reason, a weighting system was provided to the analysis. Specifically, three criteria were weighted double as compared the two remaining criteria. The three criteria include:

- Demand or ridership was weighted double because it serves as a measure of actual system use, is critical to actual congestion relief, and is very important if a system is to generate enough public support to be successfully implemented.
- Capital costs are critical in that they determine the actual amount of funding that a region would need to construct the project.
- Cost effectiveness, measured in cost per rider, is important because it serves as a simplification of the major Federal Transit Administration (FTA) requirements for the approval of new projects. If certain thresholds are not met, a project would not meet federal funding guidelines.

The two remaining criteria, transit dependency and congestion relief potential, were viewed as less critical at this stage because they would not serve as primary discriminators as to the ability of a project to obtain critical approvals and other requirements.

Using the weighted averages shown in Table 4-12, the three most promising corridors are the RIC Light Rail, the Broad to South Boulevard Light Rail, and the Short Pump Light Rail (as with the straight averages). Adjusting the weighting to account for Demand, Capital Costs, and Cost Effectiveness did not affect the top four alternatives.

Note that this project is only a “pre”-feasibility study to identify the corridors that would provide the highest potential of being a feasible corridor for future rail transit. By recommending alternatives for further study, however, it is recognized that it is possible that none of the chosen alternatives will be feasible. Similarly, the elimination of specific corridors from future study does not preclude the possibility that other corridors are viable. The implementation of rail transit in the Richmond region will require extensive study and re-analysis of these corridors and others as part of more formal and extensive analysis required by FTA and other state and federal agencies.

Table 4-12 Scores and Rankings for Each Corridor: Modified Weighting

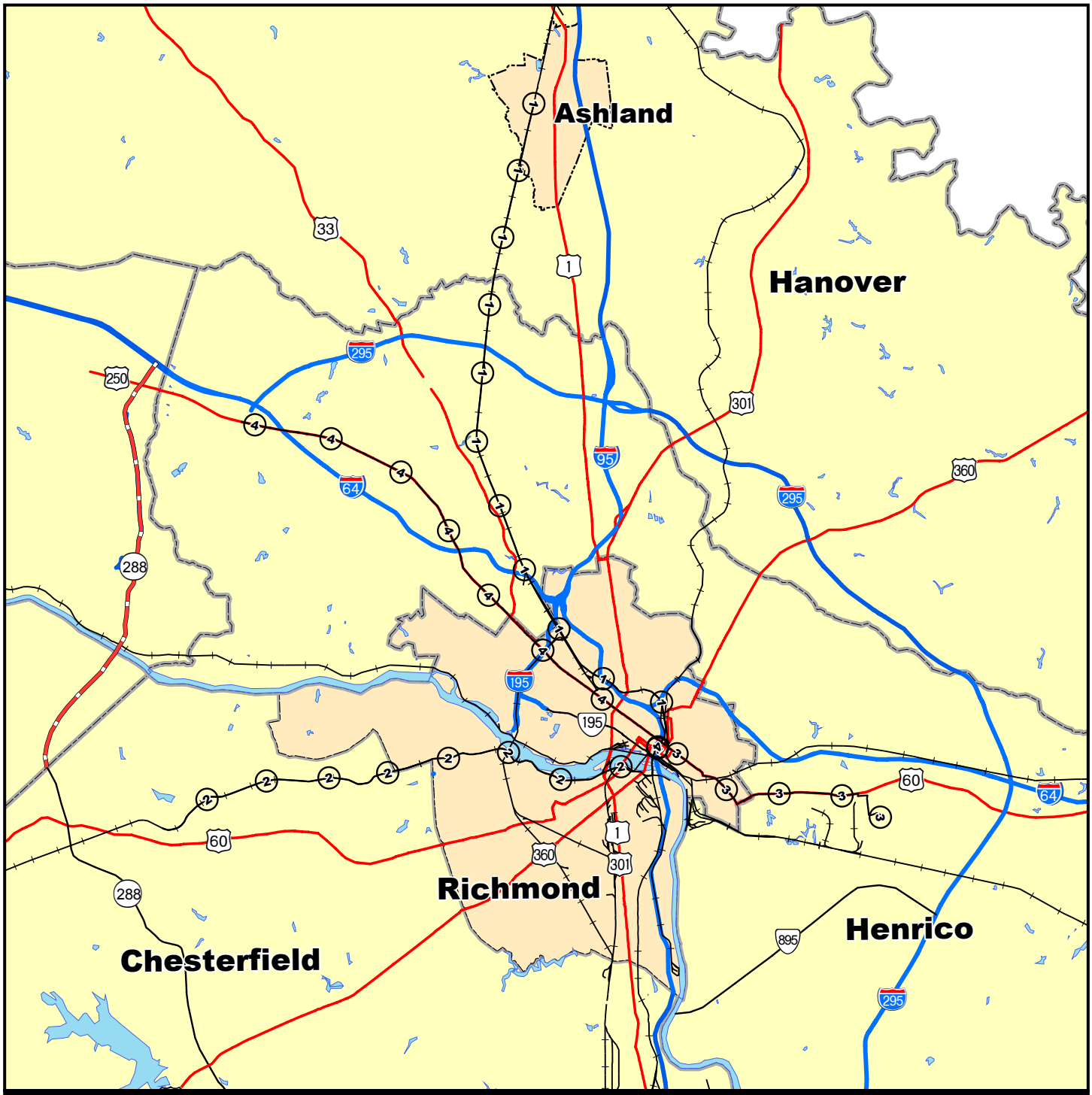
Criteria	Daily Boardings	Cost	Cost per Boarding	Transit Dependency	Congestion Relief Potential	Weighted Average Score	Rank
Commuter Rail	(x 2)	(x 2)	(x 2)	(x1)	(x1)		
Ashland	10	4	8	3	4	3.6	5
Hanover	10	4	10	4	3	3.9	7
Midlothian	10	4	8	4	4	3.8	6
Petersburg	10	6	8	4	3	3.9	7
Providence Forge	10	6	10	3	4	4.1	10
Light Rail							
Boulevard	8	8	6	4	5	3.9	7
Boulevard South	4	8	2	3	5	2.8	2
Midlothian	4	10	4	4	4	3.3	4
RIC	4	8	2	2	5	2.6	1
Short Pump	2	10	4	3	5	3.0	3

4.7.5 Selected Alternatives

Two meetings were held by the Rail Transit Development Committee to review the results of this screening process, and to recommend alternatives for further review. After considering the criteria and several other factors the committee recommended studying the four following alternatives (Figure 4-1).

- Richmond International Airport Light Rail
- Short Pump Light Rail
- Ashland Commuter Rail
- Midlothian Commuter Rail

RIC light rail was the best performing alternative in the screening process. The decision not to study Broad to South Boulevard Light Rail was based on the fact that the alternative was not part of the Richmond Long Range Transportation Plan, and that it partially duplicated the route of a preferred light rail alignment to Short Pump. The study committee chose not to study Midlothian Light Rail, the fourth-best performer, and instead selected the Midlothian Commuter Rail because they preferred to study two light rail and two commuter rail alternatives. The best performing commuter rail alternatives were Ashland and Midlothian.



Screened Alternatives Figure: 4-1

1-1-1- Main St. Station to Ashland (Commuter Rail)
2-2-2- Main St. Station to Midlothian (Commuter Rail)
3-3-3- Main St. Station to Airport (Light Rail)
4-4-4- Main St. Station to Short Pump (Light Rail)

N

2 1 0 2 Miles

5.0 Further Analysis

Each of the four screened alternatives was more closely considered to identify opportunities and issues relevant to further development as a rail transit corridor. This included additional field review to identify conceptual engineering issues that would affect potential operations. This analysis relied upon professional judgment and transit planning and engineering experience. For each alternative, issues were identified that would be re-examined more thoroughly during the next phase of project development. For example, various alignment possibilities were identified for the two light rail transit alternatives; however, during this preliminary review, there is insufficient analysis to recommend one course of action over another.

Future studies for potential transit corridors in the region would more thoroughly evaluate the various options and associated costs and benefits for each potential alignment. This would occur during an Alternative Analysis (AA) of transit improvements in the Richmond region. More information about the need for these studies is presented in Section Eight, Next Steps.

5.1 *Main Street Station*

As defined throughout the study, each of the four screened alternatives terminates in Downtown Richmond at or near Main Street Station. Main Street Station is currently under renovation by the City of Richmond to restore passenger rail service to the City. The station was last used for rail passenger service several decades ago. The station was identified as the hub of future rail transit services in downtown Richmond due to several advantages:

- Potential commuter rail lines would use existing or expanded railroad infrastructure that passes through Main Street Station.
- Phase III of the station renovation plan envisions creation of a multi-modal transportation center in the station including space for inter-city bus terminal facilities, local buses, taxis, and airport shuttle services.
- The station is convenient to downtown, and close to the redeveloping mixed-use neighborhoods of Shockoe Bottom, Shockoe Slip, and Tobacco Row.
- The City is studying (separately) a Downtown Richmond Streetcar System with two preliminary route options, each passing directly in front of the renovated station on Main Street.

Despite the advantageous location of Main Street Station as a future rail transit hub, providing successful commuter rail or light rail transit service to the station will pose challenges. The sections below indicate some issues related to commuter rail or light rail service at Main Street Station. These issues should be addressed during the next phase of planning for rail transit in the Richmond region.

5.1.1 Commuter Rail Service

Current and future railroad improvements planned for Main Street Station include additional station tracks, Amtrak ticketing facilities, and additional siding tracks between

the Station and the existing Amtrak station at Staples Mill Road. These improvements are planned to accommodate passenger rail service at Main Street Station as well as the future Southeast High Speed Rail service from Richmond to other southeast cities. These planned improvements are intended to prevent passenger train activity from interfering with freight trains that will continue to use the tracks adjacent to the station.

Commuter rail service at the station will add new demands for platform space in addition to that being provided for current and future passenger trains. Preliminary planning for commuter rail services should include an assessment of rail operations at the station to determine if sufficient capacity exists with the planned track improvements. The study should include identification of necessary commuter rail layover facilities, and identification of train movements through the station during peak commuting periods.

A critical need identified in the Southeast High Speed Rail Improvement Study is for a bypass track or passing sidings at Acca Yard to allow through train movements (both freight and passenger) while yard operations are in progress.

5.1.2 Light Rail Transit Service

To maximize the multi-modal opportunities between future light rail transit and other modes planned for the renovated Main Street Station, LRT platforms should be closely integrated with the station. However, LRT services entering the station can not use tracks available to passenger or freight trains due to safety regulations. Therefore a separate track and station platform infrastructure would need to be built. LRT station platforms locations adjacent to the Main Street Station are limited by the I-95 piers to the south and west. However, potential platform locations include the area immediately east of the station or to the north of the existing train shed building. The area to the north of the train shed may be more feasible to provide service to either of the east-west oriented light rail alternatives. A LRT station located here could include a mezzanine platform oriented across and above the existing railroad viaducts on the north side of the train shed building. The LRT mezzanine station and platforms would be accessible from the northern edge of Main Street Station via elevators, escalators and stairways.

Figure 5-1 Under Interstate 95

Figure 5-2 Area north of Train Shed

5.2 *Richmond International Airport Light Rail*

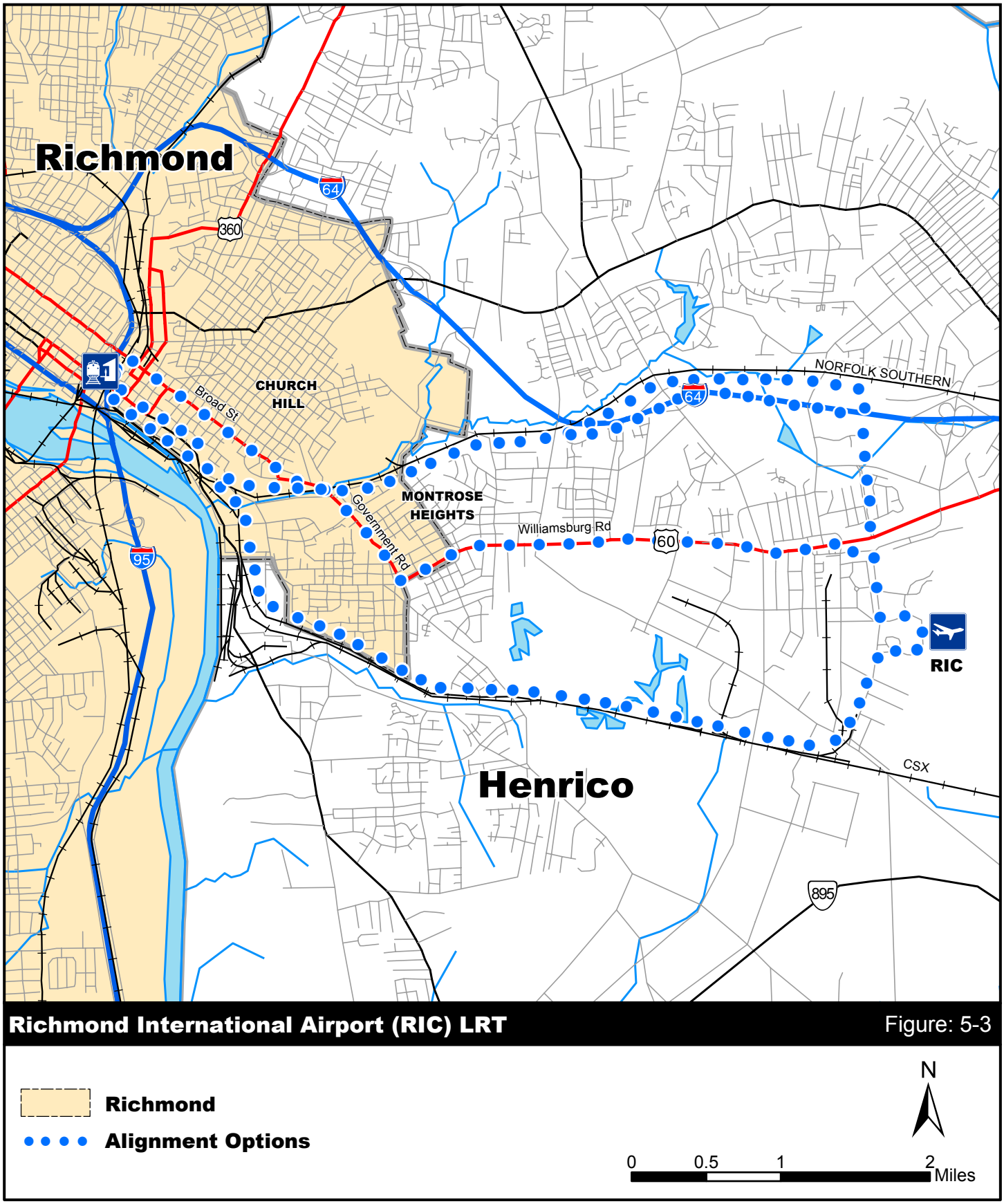
Light rail transit service to the Richmond International Airport would operate along an approximately six-mile long corridor between Main Street Station in downtown Richmond, and the airport terminal in Henrico County east of Richmond. The airport is the region's principal commercial air carrier, with approximately 1.2 million enplanements in 2001. [2] The following general issues concern the development of light rail transit service to the airport.

- RIC is currently undergoing a major capital expansion of airport facilities, including increased parking capacity, ten new airline gates, improved terminal roadways, and a new air traffic control tower. The improvements are scheduled for completion in 2006, and do not currently contain plans for rail transit service to the airport. Further planning for rail transit service to the airport should be closely coordinated with the Capital Region Airport Commission, the owner and operator of RIC.
- Rail transit service connecting downtown Richmond with the airport would need to balance travel time to the airport with enhanced transit services to the neighborhoods located between RIC and downtown. If emphasis is placed upon a short travel time, then fewer intermediate stations and less transit service to neighborhoods would be available. Conversely, if more intermediate stations are located along the route, LRT service would be available to more residents, yet this would compromise a planned short travel time to the airport. The selection of a preferred alignment will determine this balance.
- Airports generate a significant number of trips in addition to the passengers arriving and departing on aircraft at the terminals. These trips include the regular commuting patterns of the large base of employees and support personnel required to operate the airport and all of its affiliated services. Planning for rail transit service to the airport should consider all of these trip types to maximize the benefit and potential ridership.
- Provision of rail transit service to the airport would affect other travel modes currently used by airport travelers such as taxis, hotel shuttles, and private limousines. During the planning for airport rail transit service, coordination with current service providers should occur.
- Revenue from airport parking fees could be affected by rail transit service. Coordination with RIC should discuss the airport's plans for integrating the service into the ground-side access plans for airport passengers.

5.2.1 Potential Alignments

Within the corridor, there would be several potential alignments to provide service to the airport from Main Street Station (see Figure 5-3). Capital costs estimates for these alignments range from $374 million to $420 million. Issues related to each alignment are described in the following sections. These options, as well as others that may be identified, would be more fully considered during an Alternatives Analysis (AA) or Draft Environmental Impact Statement (DEIS) phase of study. The information presented here should be considered a preliminary assessment of the major issues that have been identified for this alternative.

[2] Federal Aviation Administration (FAA) 2001 Enplanements by State



Richmond International Airport (RIC) LRT Figure: 5-3

East Broad Street to Church Hill

This alignment was used for development of an operating concept, and for ridership estimating. The alignment would follow Broad Street from Shockoe Bottom to Church Hill. The route would travel in a narrow street right-of-way through Church Hill, a historic residential neighborhood. LRT service on this portion of the alignment would likely require light rail and vehicular traffic to share the single travel lane to avoid removal of on-street parking (Figure 5-4). This type of operation is rarely used in new light rail transit system operations due to the resulting slow transit operating speeds. At the end of East Broad Street in Church Hill is Chimborazo Park and the Battlefield Park Visitor Center. From this location, the grade of the hill would make connections further east along the current alignment of Government Road challenging. It may be possible to avoid the steep grade by descending the hill beginning near 31st Street between Chimborazo Park and Liberty Hill Park. This would likely involve construction on elevated track using bridge structures. From the base of hill, the alignment could continue either adjacent to the Norfolk Southern right-of-way, along Stony Run Drive, or along Williamsburg Road.

Figure 5-4 East Broad Street at 31st Street

Main Street

Another potential alignment option is to continue east along Main Street. This alignment would not have the grade issues encountered in the Church Hill neighborhood; however operations would still likely occur in mixed traffic on street. As would be the case on East Broad Street, on-street operations are likely to cause impacts to existing on-street parking. The alignment would provide direct service to the redevelopment occurring in Shockoe Bottom and along Tobacco Row. There would likely be several potential stop locations in these areas.

Dock Street / Cary Street / Viaduct

Dock and Cary Streets are the front door to the riverfront area and the redeveloping Shockoe Bottom and Tobacco Row districts. Alignment along Dock Street would be within the floodplain of the James River, and would therefore be unadvisable unless constructed on an elevated structure or viaduct similar to the existing railroad structure. East of 17th Street, Cary Street is a narrow street that provides direct access to the redeveloping Tobacco Row warehouses. Use of these streets would affect the existing traffic patterns and access points located along the floodwall. Use of either the viaduct or Cary Street alignments would require a transition from Main Street Station south to the riverfront. This could likely be constructed on new structures, or along surface streets such as 17th or 18th Streets.

Figure 5-5 Main Street at 18th Street

Williamsburg Road

On-street alignments east of downtown could follow the general path of Williamsburg Road or Government Road through Montrose Heights. This general alignment was used for the preliminary analysis, including the operating concept and ridership estimating. The existing development patterns and street width of the roadway corridor in this vicinity are not favorable for in-street operations and would likely affect numerous homes and businesses along the roadway. A parallel alignment along this corridor may be possible, potentially behind development located adjacent to the roadway; however this option would likely require significant negotiations and property acquisition costs. Further east toward the airport, Williamsburg Road widens to a commercial highway, and eventually becomes a four-lane divided highway section. Near the airport it would be easier to construct light rail adjacent to the roadway corridor, however there would likely be numerous commercial properties affected. This portion of Williamsburg Road also provides access to I-64 by connecting to Laburnum Avenue and Airport Drive, and therefore there are generally higher traffic volumes in this area.

Figure 5-6 Dock Street, RR Viaduct, Floodwall

Figure 5-7 Williamsburg Rd at Futura Ave

Norfolk Southern RR corridor (West Point line)

The Norfolk Southern railroad line to West Point travels east out of Richmond along Gillie Creek. Slightly west of Laburnum Avenue, the railroad passes underneath Interstate 64, and continues east on the north side of the interstate. This is an active freight line, and therefore the existing tracks could not be used for light rail service. A light rail alignment parallel to the railroad corridor would require extensive coordination with Norfolk Southern railroad. For safety reasons, significant separation distances would be required between the rail line and proposed light rail tracks. Additionally, in some instances railroads have requested the construction of crash walls to separate the transit alignments from railroad rights of way. Due to the preliminary nature of this study, coordination was not sought from the railroad with regard to these issues; however these observations come from previous experience planning rail transit systems. Future studies should closely work with the railroad owners to determine the likelihood of parallel operations within or adjacent to existing railroad-owned right-of-way. A potential benefit of a rail corridor alignment (or other exclusive guideway alignment) would be the likelihood of higher operating speeds due to the lack of mixed operations with vehicle traffic. Additionally, it may be possible to connect this alignment with a future park and ride facility located adjacent to Interstate 64. A direct connection to the airport is not

possible from the railroad corridor, and thus the alignment would need to turn south before or along Airport Drive.

CSX RR corridor (Newport News line)
The CSX line to Newport News departs Richmond along the James River on a viaduct structure, then heads east following the alignment of Almond Creek. It passes south of the airport terminal by approximately one mile. This corridor is actively used for both passenger and freight operations, and therefore light rail transit could not operate on the existing track infrastructure. It may be possible to construct a separate track infrastructure generally parallel to this alignment, however this would be subject to the same coordination issues identified above. Access to the airport could be achieved along Airport Drive south or Lewis Road, or on a new alignment.

Figure 5-8 Amtrak trains on viaduct

Airport Access
Terminal access at the airport would depend upon coordinated planning and design with the Capital Regional Airport Commission. The current capital expansion underway at the airport is resulting in some reconfigured terminal roadway access, including separating departing and arriving passenger drop-off and pick-up locations. Integrating a transit stop into this location could result in a further revision of groundside access. There appears to be sufficient land area on the grounds of the airport facility to integrate light rail transit access, however, no specific alignment was prepared for this study. Light rail alignments accessing the airport from the north could potentially use an alignment parallel to Airport Drive, with access to the terminal along Richard E. Byrd Terminal Drive. For alignment access from the south (the CSX railroad corridor), a similar arrangement would follow Airport Drive South to the terminal. A logical location for an airport light rail station would be close to the passenger terminal to enable convenient passenger access. Other light rail systems with such access arrangements include Metrolink at the St. Louis Airport, and the Baltimore light rail line at Baltimore Washington International Airport, and the Metropolitan Area Express (MAX) LRT to the Portland, OR International Airport. Each of these examples provides direct passenger access to the airport passenger terminal.

5.2.2 Operating Concept

The Airport LRT would carry roughly 19,000 weekday boardings, with a majority of trips beginning or ending downtown, though a significant portion of trips would occur outside peak periods. A reasonable assumption for the Airport line would have it operate during peak hours with two-car trains every ten minutes. The corresponding loads would be comparable to comfort levels provided on suburban rail transit systems, where passengers prefer a little more space, and would be appropriate for an airport line on which some portion of passengers may be carrying bulky luggage. During off-peak periods, policy headways would prevail and loadings would be light – perhaps a train every 15 minutes; or every 30 minutes if loads are very light.

5.2.3 Summary of Airport Light Rail

Table 5-1 summarizes the characteristics of the Richmond International Airport LRT line. The capital cost is identified as a range due to the various potential alignments that were considered during this phase of study. Operating cost methodologies, revenue forecasts, and estimated annual subsidy requirements are explained in Section 6.2. The operating cost estimates were based upon the alignment along West Broad Street (through Church Hill) and Williamsburg Road to the airport. Ridership forecasts for the alternative were also conducted for this corridor.

Table 5-1 Summary of Airport Light Rail

Characteristic	Value
Length (miles)	6.4 – 7.2
Capital Cost Estimate ($ Millions)	$374 - $420
Weekday Boardings	19,100
Estimated Annual Operating Costs ($ Millions)	$7.0
Estimated Annual Farebox Revenue ($ Millions)	$3.23
Estimated Annual Subsidy ($ Millions)	$3.77

5.3 *Short Pump Light Rail*

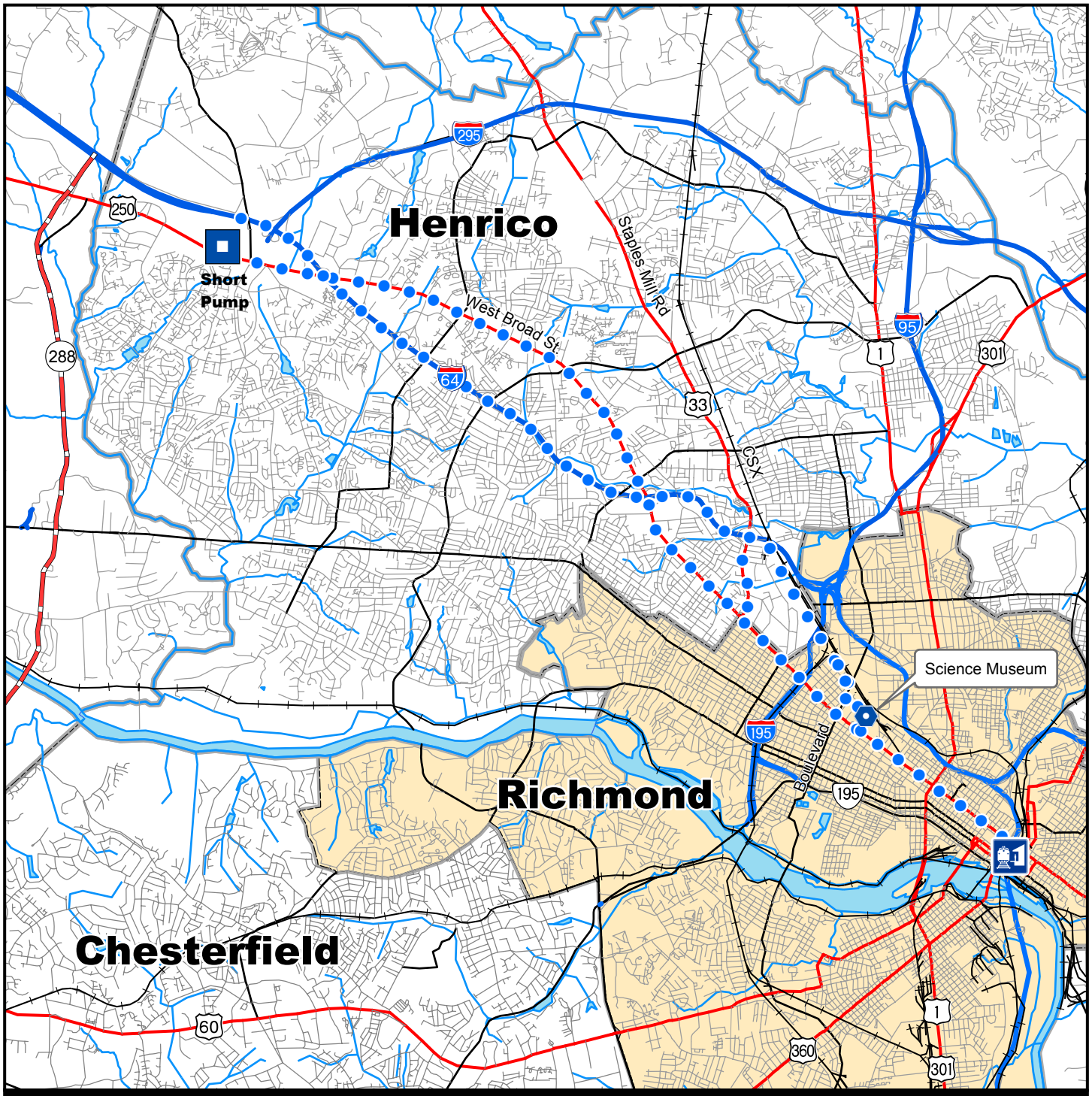
The Short Pump light rail corridor is approximately fourteen miles long and would connect Main Street Station with suburban Henrico County and the growing Short Pump area to the west of Richmond. The preliminary capital cost estimate developed for the alternative ranged from $791 Million to $812 Million. Various potential alignments were identified for the alternative. For preliminary analysis, including the operating concept and ridership estimating, the corridor was identified along Broad Street and West Broad Street (US Route 250) to Short Pump.

General Issues

- Broad Street is a major arterial that passes through the heart of downtown Richmond. It provides critical vehicular access to existing office, institutional, commercial and residential areas throughout the west side of Richmond. An on-street light rail alignment along Broad Street would require a comprehensive study of downtown traffic patterns in order to integrate light rail operations. Of particular concern will be the integration of light rail operations with traffic signal timing.

- In downtown Richmond, buildings and sidewalks line the edge of West Broad Street. It is an urban development pattern that is generally supportive of public transit due to pedestrian access and a higher density. West of the Boulevard, the building density and urban scale of the downtown transitions to a suburban character. Off-street parking lots are located in front of buildings, which are set back considerably from the edge of the street. In this area, the character of development is less pedestrian-friendly, and more oriented toward automobiles. In this type of setting, light rail transit systems are generally more reliant on feeder bus service or park and ride lots oriented toward commuters.

- The western terminus for this corridor was identified as the rapidly developing Short Pump area of Henrico County, near the junction of Interstate 295 and Interstate 64. A potential consideration could be further extension of the corridor west to the new Virginia Route 288 in Goochland County. The new limited access roadway will serve as the western beltway of the Richmond region. A light rail transit line to this terminal location could provide park and ride access for downtown commuters from the northwest region of Richmond. Additionally, the office parks and corporate centers developing along Route 288 will likely evolve into a major employment center. A direct transit connection to downtown Richmond could facilitate interactions with state government, provide access to higher education and other institutions downtown, as well as connect to the large population of potential employees living along the transit route.



Short Pump Light Rail Figure: 5-9

Richmond

Alignment Options

N

0 0.5 1 2 Miles

5.3.1 Potential Alignments

Within the corridor, there is more than one potential alignment to provide service to the Short Pump area from Main Street Station (Figure 5-9). Issues related to each alignment are described in the following sections. These options, as well as others that may be identified, would be more fully considered during an Alternatives Analysis (AA) or Draft Environmental Impact Statement (DEIS) phase of study. The information presented here should be considered a preliminary assessment of the major issues that have been identified for this alternative.

Broad Street to Science Museum

On-street alignment of light rail in downtown Richmond would likely follow Broad Street, although other potential routes would be evaluated during future studies. Heading west from a Main Street Station light rail platform, the alignment would likely be on an elevated track structure as it climbed the incline to Broad Street. Near 14th Street, the alignment would transition to street grade along East Broad Street. Various alternatives should be considered to determine how to align light rail tracks along Broad Street.

Figure 5-10 E. Broad Street at 17th Street

Potential options include operating in a barrier-protected median down the center of the street, operating independently along both sides of the street, or operating in both directions along only one side of the street adjacent to the sidewalk. Additionally, it would be possible to configure Broad Street for one-way automobile travel, and another parallel street for the other direction. These different configurations would be developed in further studies of light rail transit through downtown. Development of these alternatives would need to be closely coordinated with comprehensive study of integrated light rail and vehicular traffic flow through downtown. Regardless of the on-street configuration, integrating light rail service into West Broad Street downtown will require a comprehensive evaluation of existing and proposed traffic patterns. For example, it may be necessary to exclude left turns along West Broad Street across the light rail alignment. These turn restrictions will impact traffic flow, and require additional alternatives for traffic patterns through downtown.

Figure 5-11 E. Broad Street at 11th Street

West Broad Street: Science Museum to Short Pump

As noted above in the general issues discussion, the density and urban layout of Richmond is different west of the Science Museum. This transition actually begins near Belvidere Street as the length of the city blocks increases. Further west there is less accommodation for on-street parking, and west of the Boulevard, off-street parking lots generally line the edge of Broad Street at the front of commercial businesses. These conditions combine so that West Broad Street begins to operate more like a primary arterial highway and less like a major urban street. Longer blocks induce higher traffic speeds, and mid-block driveways increase the number of turning vehicles. These access points introduce turning movement conflicts that would make on-street integration of light rail transit more complicated.

Figure 5-12 W. Broad Street near Boulevard

Henrico County

West of Richmond, in the Henrico County portion of the West Broad Street corridor, the alignment becomes a multi-lane commercial highway. In some locations the roadway is divided, and consists of six or eight lane typical sections with left turn lanes at major intersections. Shopping centers and automobile oriented commercial establishments line the corridor. There is no on-street parking; instead all parking is accommodated in individual off-street parking lots affiliated with each commercial establishment. Although the right-of-way is significantly wider than sections of West Broad Street in downtown Richmond, there would be numerous challenges to integrating light rail along the roadway. These would include:

Figure 5-13 W. Broad Street at Gaskins Road

- Difficulty integrating LRT into mixed operations with street traffic
- Impacts to business access points along US 250
- Traffic signal timing issues (numerous left turns)
- Limited physical area for station platforms between street and commercial properties
- Challenging pedestrian connections along route

Science Museum Rail Spur

The Science Museum of Virginia is located in the former Broad Street Station, the passenger terminal of the Richmond Fredericksburg and Potomac Railroad. The railroad track infrastructure for the station, including passenger shelters is still in place behind the museum. This unused railroad right-of-way would provide a potential opportunity to align light rail transit service from West Broad Street behind the Science Museum, and further west to the Boulevard, Interstate 64, or the CSX railroad right-of-way in the vicinity of Acca Yard. Either of these three options would provide an alternative to operating light rail transit down the highway corridor of West Broad Street in Henrico County.

Figure 5-14 Science Museum

The Boulevard was one of the potential light rail alternatives identified earlier in the study. Use of the Boulevard right-of-way would provide light rail from West Broad Street to either Interstate 64 or the CSX railroad corridor at Acca Yard. The Boulevard crosses the CSX railroad corridor on a bridge structure near Leigh Street. On the north side of the bridge, Boulevard passes by the current site of the Greyhound intercity bus terminal, the Diamond baseball stadium and the Arthur Ashe Jr Athletic Center before intersecting Interstate 64 and Interstate 95 at Exit 78.

Figure 5-15 Railroad Right-of-Way

Staples Mill Road

Staples Mill Road intersects West Broad Street near the city limits of Richmond. The segment of Staples Mill Road between West Broad Street and Interstate 64 would pose some of the same challenges identified above for West Broad Street in Henrico County. The roadway is a highway corridor with automobile oriented uses including numerous access points and commercial establishments along its length. At the Interstate 64 interchange, it would likely be necessary to construct an elevated section of light rail to access the median of Interstate 64.

Interstate 64

Several new light rail transit systems operate within the median or the right-of-way of existing limited access freeways. This can be accomplished with exclusive guideways operating either along elevated structures, or within barrier-separated tracks built along the highway corridor. One potential benefit of this type of alignment includes opportunities to integrate commuter facilities such as highway accessible park and ride lots directly into station planning. Additionally, modern light rail transit vehicles can operate at speeds approaching 60 miles per hour when given an exclusive guideway such as would be necessary in a freeway corridor. Alignments within freeway sections therefore provide faster service between station areas, and faster average operating speeds along the line. One drawback of an alignment in a highway corridor is the difficulty of constructing higher density development (Transit Oriented Development or TOD) adjacent to the stations. Highway LRT stations may also be difficult to access as a pedestrian, and may be more expensive due to the need to build pedestrian overpasses, escalators and elevators to provide access to the station platform from the surrounding area. Additionally, Interstate 64 was not designed to reserve space in the median for light rail transit corridor. Bridge overpasses and ramps will pose engineering challenges to integrate a light rail alignment through the corridor. Despite these drawbacks, Interstate 64 alignment for the Short Pump LRT corridor should be considered as an alternative to a West Broad Street alignment through Henrico County.

Figure 5-16 I-64 East at Pemberton Road

Figure 5-17 I-64 East at Staples Mill Rd

CSX Rail Corridor / Acca Yard

The Broad Street Station track mentioned above joins the existing CSX main line near Leigh Street and the Boulevard. Approximately two miles northwest the rail line crosses under Interstate 64 just north of Acca Yard. Along this two-mile segment, it may be possible to construct an exclusive LRT alignment on structure or barrier separated guideway that would provide a connection between Interstate 64, the Broad Street Station track, and West Broad

Figure 5-18 Acca Yard

Street in downtown Richmond. There would be numerous difficulties in accomplishing this, yet it should be investigated. Likely challenges include the already crowded Acca Yard facilities, a number of industrial properties adjacent to the rail line, and the need for extensive coordination with CSX railroad. The benefit of this alignment would be a direct connection with Interstate 64 west of its junction with Interstate 95, a potential LRT station at Boulevard, and a direct connection to downtown Richmond behind the Science Museum.

5.3.2 Operating Concept

The Short Pump LRT would carry about 33,000 weekday boardings, again with a majority of trips beginning or ending downtown. Most likely, the portion of the Short Pump Line west of Richmond's city limits, where development becomes more auto-oriented and suburban, would carry primarily commuters. Land uses along this portion of the Line, which include many large retailers and auto-oriented restaurants and services, would not be conducive to a significant number of midday transit trips. On the other hand, portions of the line that would be within Richmond, where development is much more urban and pedestrian-friendly, would attract a fair number of midday trips, for errands, downtown shopping, lunch appointments and special events.

Therefore, the Short Pump LRT is a good candidate for creating two routes – a long route to the end of the Line, and a shorter one that serves from downtown to roughly the edge of Richmond, to the point at which low-density, auto-oriented suburbs begin. Given the nature of land use, development and trip patterns, the longer line's loadings would peak dramatically during rush hours. The longer line also would serve some reverse commutes and some limited evening shopping at the big boxes along I-64/Broad Street. The shorter line would serve many work trips within Richmond as well as many midday and evening non-work trips and special events. During peak hours, only the longer route would operate, effectively providing frequent service along the entire line, running two-car trains every ten minutes. Peak hour loadings would be high between Boulevard and downtown, though trains still would provide more than enough capacity to accommodate demand. Ten-minute headways also should provide enough space between successive trains to be compatible with single-tracking in some sections on Broad Street through downtown, to preserve parking in front of local businesses. However, dwell times in this section also would be long, due to both many boardings and alightings and traffic signals. Keeping schedule would be difficult through this section for the same reasons. Thus, double-tracked sections should be frequent and long enough to provide enough operational flexibility to insure rapid service with limited delays. Signals on Broad Street also should be preempted by light rail vehicles, since the rail vehicles, during the time of their approach to intersections, would carry many more people than all of the automobiles using the cross streets combined.

During off-peak periods, the short and long routes on the Short Pump Line both would run at 30-minute headways, for a combined 15-minute off-peak headway in the City of Richmond. The longer route would provide even 30-minute headways throughout the midday to the commuter-oriented park-and-ride lots, malls and big boxes along I-64 and western Broad Street. The long route's midday service probably would carry few passengers. Within Richmond, the long and short routes would overlap to provide relatively frequent midday service.

5.3.3 Interlining Airport and Short Pump Light Rail Lines

Interlining occurs when a transit line operates consecutively along two radial transit lines. For example, LRT trains could operate inbound from the Airport to Main Street Station, and then continue outbound along the Short Pump line. Service is provided to both lines with one train and one operator. The Short Pump trains could interline nicely with the Airport Line, which would operate with the same peak headways and train consists. If the Airport Line runs during off-peak hours only every 30 minutes (instead of every 15), then one or the other Short Pump route could interline to the airport. With both routes providing through service to the Airport Line during the midday, good connectivity to interregional travel would be maintained throughout the day.

5.3.4 Summary of Short Pump Light Rail

Table 5-2 summarizes the characteristics of the Short Pump LRT line. The capital cost is identified as a range due to the various potential alignments that were considered during this phase of study. Operating cost methodologies, revenue forecasts, and estimated annual subsidy requirements are explained in Section 6.2. Ridership forecasts for the alternative were conducted along Broad Street (US Route 250) to Short Pump. The operating concept developed for the alternative considered an alignment along West Broad Street and Interstate 64.

Table 5-2 Summary of Short Pump Light Rail

Characteristic	Value
Length (miles)	13.6 – 13.9
Capital Cost Estimate ($ Millions)	$791 - $812
Weekday Boardings	33,700
Estimated Annual Operating Costs ($ Millions)	$11.7
Estimated Annual Farebox Revenue ($ Millions)	$5.64
Estimated Annual Subsidy ($ Millions)	$6.06

5.4 *Midlothian Commuter Rail*

Figure 5-19 Midlothian Bridge

The Midlothian commuter rail corridor runs approximately 15 miles from Main Street Station to a potential terminal station in the vicinity of Otterdale Road. The preliminary estimated capital cost of the line is $81 Million. The alignment is depicted in Figure 5-21 and follows an existing railroad corridor owned by Norfolk Southern. The rail line is currently in use for rail freight. The alignment is south of the James River, and crosses the river over a single track bridge (Figure 5-19). During the preliminary analysis phase of the study, the ridership model indicated that the commuter rail line attracted approximately 1,700 boardings per day, and included 6 stations located along its length. The capital cost for the line was estimated to be approximately $81 million dollars based upon a per-mile average cost of $5.75 Million. The following general issues were identified with regard to operation of a commuter rail line along this corridor.

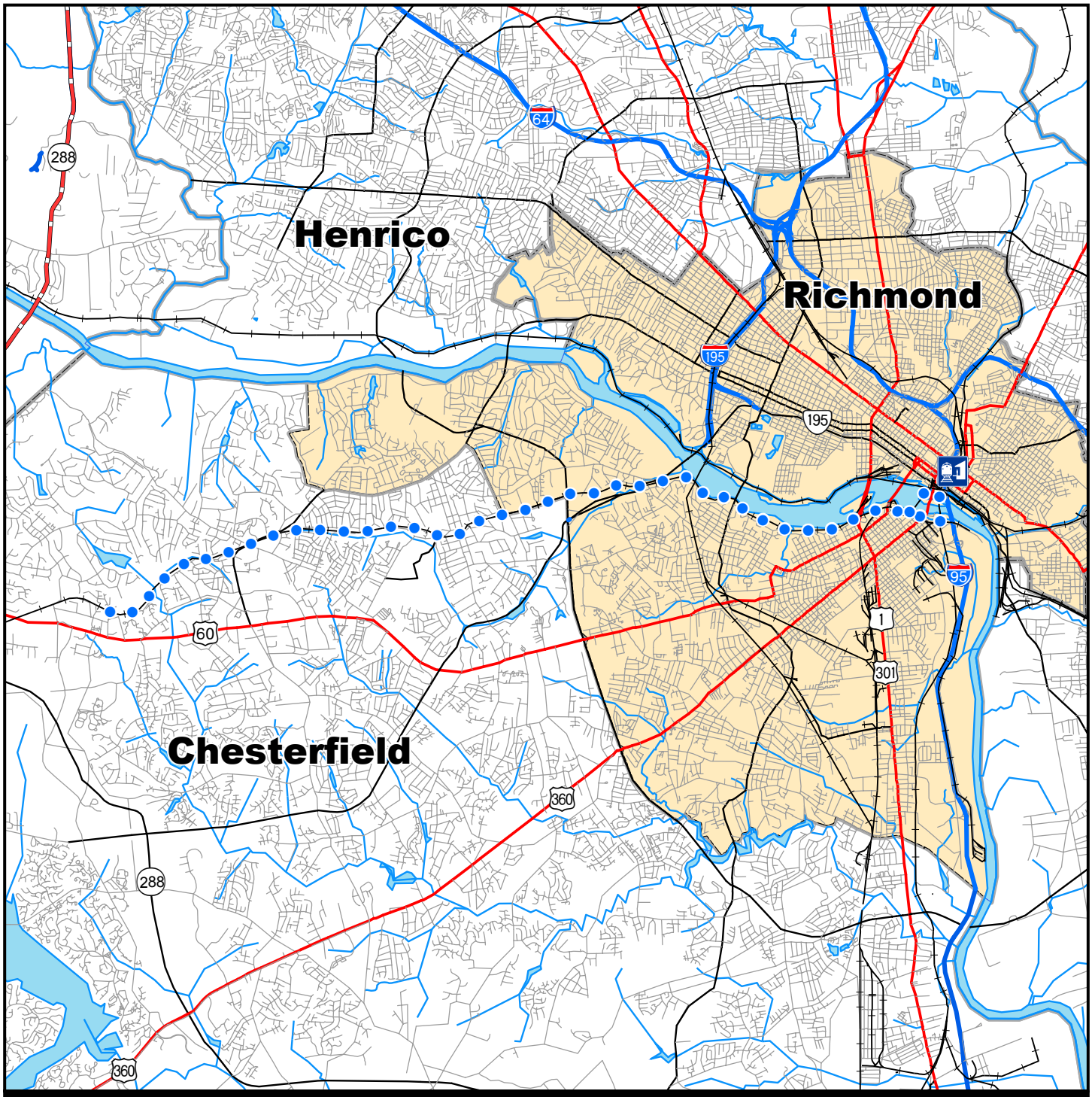
5.4.1 Amtrak Integration

Unlike the Ashland Commuter Rail line, there is no existing passenger rail service along this corridor. Although the corridor has been studied for Richmond to Bristol passenger rail service, there currently is no passenger service operating along the line, meaning that there are no current opportunities to integrate or layer commuter rail services with existing passenger rail services. Should funding become available to initiate the Richmond to Bristol passenger service, it may be possible to integrate the planning for commuter rail service with the start of long distance inter-city services to Bristol.

5.4.2 Downtown Terminus

Figure 5-20 Triple Crossing

Currently there is no usable direct rail connection in place between Main Street Station and the Norfolk Southern railroad right-of-way. To provide service to a downtown terminal station will require capital expenditures to either construct a new station platform and passenger shelter, or repair an abandoned railroad interchange to provide access to Main Street Station. A new platform if constructed could be located approximately 2 1/2 blocks from Main Street station inside the flood wall and adjacent to the Canal Walk. Due to the geometric constraints of the site and the surrounding area, it would be difficult to construct a passenger station at this location. Instead, limited outdoor facilities would likely be constructed adjacent to the station platform. Another option would be to reconfigure service to the “Rocketts” railroad interchange. The interchange is located on the south side of the floodwall adjacent to the James River, and a new wye track would connect the Norfolk Southern right-of-way to the CSX rail line that passes Main Street Station.



Midlothian Commuter Rail Figure: 5-21

Richmond

Alignment Options

N

0 0.5 1 2 Miles

5.4.3 Potential Station Locations

During this phase of the study six potential station locations were identified for the Midlothian commuter rail line. The stations locations include the following:

- Downtown terminus
- Manchester Bridge
- Gravel Hill Road or Sheila Lane
- Buford Road vicinity (historic Bon Air station location)
- Robius Road vicinity
- Otterdale Road vicinity (terminal station)

Norfolk Southern currently owns the rail corridor. Any operations along the rail line would need to meet the service requirements that Norfolk Southern may stipulate with regard to their continued use of the line. Typically freight railroads require commuter rail operations to be transparent to their ongoing freight operations, meaning that commuter rail operations do not add delay to freight trains. To completely ensure no interruptions in freight service would require the addition of track along the length of the line, or the use of several passing sidings along the rail line. Another option to provide commuter rail service along the right-of-way would be to buy the railroad line from Norfolk Southern. Ownership of the line would allow the operating authority flexibility in train scheduling, and potentially avoid the need to add track capacity. However, it would result in complete responsibility for track and right-of-way maintenance.

The passenger train equipment used to provide service, including locomotives and passenger coaches needs to be maintained and repaired in appropriate facilities designed for such work. Additionally, since the rail line is part of a longer line that connects Richmond with southwestern Virginia, there should be a location for the equipment to "lay over" between commuting periods so that it is out of the way of through trains. No such layover or maintenance facilities exist along the current line, and would therefore need to be constructed. These layover facilities and maintenance yards are typically located near existing freight yards along the service area. There are existing Norfolk Southern rail yards along the right-of-way, including at Belle Island, adjacent to and below the Sun Trust Bank building located on the south side of the Manchester Bridge.

Unlike light rail stations, many of which are designed to integrate into urban neighborhoods or planned high-density station areas in suburban settings, commuter rail lines typically attract park and ride passengers. This is partly due to the hours of service of commuter rail lines, which are heavily oriented toward peak period trips in a peak direction. Assuming this type of service pattern for operations in Richmond would require planning for convenient access from the region's highway network, and extensive amounts of parking at proposed stations, particularly those near the terminus of the line. In light of this

Figure 5-22 Otterdale Road

Figure 5-23 Near Riverside Drive

consideration, the study team extended the preliminary line's terminus approximately one additional mile to a vicinity near Otterdale Road and Midlothian Turnpike. This location is within ½ mile of an interchange with the new State Route 288, and would provide excellent opportunities to attract park and ride patrons from other areas of western Richmond. There appear to be various sites potentially available for future station and park and ride facilities, however there is a lack of available station locations near downtown.

Other potential station locations along the line do not have the same land availability as the Otterdale Road location. However, the potential station at Sheila Lane would be adjacent to or behind the Chippenham Center, an existing shopping center with a Lowe's and Wal-Mart Store. Although there appears to be only a small amount of adjacent land for a station and additional parking, it may be possible to share the shopping center parking lot, and use some spaces for commuter rail parking. Potential shared use parking arrangements such as this require negotiations and coordination, but they can prove to be mutually rewarding for the transit agency and the parking lot owner.

Figure 5-24 Wal-Mart Parking Lot

5.4.4 Operating Concept

Commuter rail typically operates with locomotive-hauled coaches in a push-pull configuration. In a push-pull configuration, the locomotive remains at the same end of the train regardless of the direction of travel. This enables the train to operate in two directions without the need to switch the location of the locomotive to the other end of the train. The last passenger coach of the train is known as a cab car, and contains operating controls for the engineer to use when the coach is leading the train.

The Midlothian commuter rail would generate about 850 directional trips per weekday, heavily oriented toward downtown. The service would require two train sets of two coaches each. An appropriate operating plan for the type and level of demand would operate four inbound trips during the AM peak, four outbound trips during the PM peak, and perhaps one round midday trip to provide continuity of service. No service would be provided on weekends.

5.4.5 Summary of Midlothian Commuter Rail

Table 5-3 summarizes the characteristics of the Midlothian Commuter Rail alternative. Operating cost methodologies, revenue forecasts, and estimated annual subsidy requirements are explained in Section 6.2.

Table 5-3 Summary of Midlothian Commuter Rail

Characteristic	Value
Length (miles)	14.1
Capital Cost Estimate ($ Millions)	$81
Weekday Boardings	1,700
Estimated Annual Operating Costs ($ Millions)	$1.6
Estimated Annual Farebox Revenue ($ Millions)	$0.58
Estimated Annual Subsidy ($ Millions)	$1.01

5.5 *Ashland Commuter Rail*

The Ashland Commuter Rail corridor stretches 18 miles from the historic Ashland train station to Main Street Station. The potential alignment for the commuter rail line is depicted in Figure 5-28. The preliminary capital cost estimate for the line and all associated equipment and infrastructure is $103 Million. The mostly double track line is currently in heavy active use for both freight and passenger rail services. The line is owned by CSX Corporation, and is located entirely within the corridor of potential passenger rail improvements known as the Southeast High Speed Rail corridor (the line is on the first segment of the SEHSR, between Washington, D.C. and Richmond). Preliminary ridership analysis performed for the study indicated that 1,800 boardings per average weekday would occur on the line.

Figure 5-25 Amtrak locomotive

5.5.1 Potential Station Locations

Potential Station Locations were identified at the following locations:

- Ashland
- Elmont Road
- Greenwood Road
- Mountain Road
- Hungary Road
- Parham Road
- Dumbarton
- Staples Mill Road
- Virginia Union
- Main Street Station

Figure 5-26 Ashland Station

5.5.2 General Issues

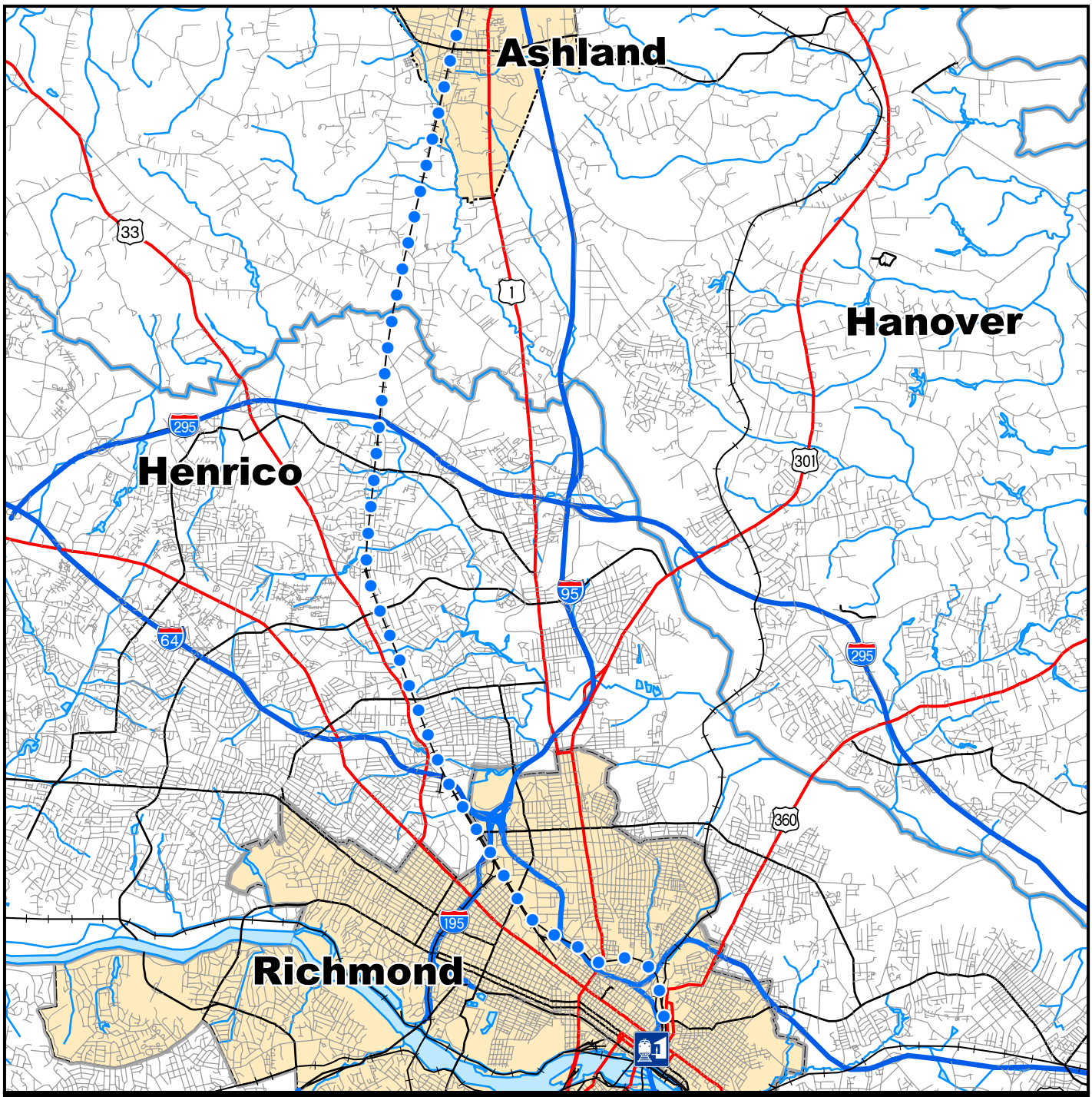
Unlike the Midlothian Commuter Rail corridor, the terminal station along the Ashland line is a historic railroad station located in the middle of the town. Although the corridor largely parallels Interstate 95, the Ashland train station is not in a suitable location to develop a large park and ride facility, nor is the station conveniently accessible from major highways. This would reduce the opportunity to use the station's terminus as a major park and ride facility. It is unlikely that Ashland's population density near

the station is sufficient to attract the same potential riders that a large park and ride facility would attract.

South of Ashland existing development would not support significant ridership at potential station locations identified at Elmont Road or Greenwood Road. However, unlike Midlothian, these station locations represent opportunities for new stations, or even transit oriented development, should future development in their vicinity occur. The decision to plan stations in these locations would be re-evaluated during the next phase of study.

Figure 5-27 Elmont Station Area

Adjacent to Old Washington Highway, the CSX rail line passes underneath Interstate 295 between Exit 45 (Woodman Road) and Exit 49 (Staples Mill Road). This location could serve as a potential future park and ride access from either existing interchange location, or possibly from a new interchange. By virtue of the direct access to Interstate 295, this potential park and ride station location could serve a vital role enhancing the potential for ridership from this location.



Ashland Commuter Rail Figure:5-28

Richmond

Alignment Options

N

0 0.5 1 2 Miles

At Acca Yard, significant freight congestion issues would hamper the development of any form of passenger rail, whether Amtrak's high speed service or potential commuter rail services to Ashland. These issues were addressed in the Southeast High Speed Rail study. Improvements suggested include additional track capacity from Staples Mill Road through to Acca Yard, and potentially beyond the yard. The additional tracks would enable freight car operations at the yard to not interfere with passenger services, which the present track layout does not permit. Without these improvements or similar efforts proposed as part of the Ashland Commuter Rail, there would be no ability to operate additional passenger services through the yard.

Just south of Acca Yard, there is a potential opportunity to provide intermodal connection between the Ashland Commuter Rail system and the potential Short Pump LRT system.

A Virginia Union University potential station stop adjacent to the school would provide access to the school.

Figure 5-29 ROW Near Virginia Union University

As discussed in the Midlothian Commuter Rail section above, layover and maintenance facilities would need to be constructed somewhere along right-of-way. Existing rail yard facilities along the right-of-way, particularly at Acca Yard, are probably not capable of being expanded or developed for these types of facilities. However, much of the northern portion of this corridor is undeveloped, and therefore it should be possible to locate a suitable location for such facilities during project planning and design.

The Ashland commuter rail would carry about 900 directional trips per weekday, also heavily oriented toward downtown. The service would operate just like the Midlothian service, with two coaches per train, except that it would require three (instead of two) train sets, since the Ashland Line is longer. An appropriate service plan for the Ashland Line would have it operate four inbound trips during the AM peak, four outbound trips during the PM peak, and one midday round trip – just like the Midlothian Line.

In addition, Amtrak provides two midday trips in each direction along the Ashland corridor, and a cooperative agreement between Amtrak and the transit authority could allow transit passengers to ride between Richmond and Ashland for a nominal charge or as part of their monthly fee for a transit pass.

5.5.3 Interlining Ashland and Midlothian Routes

Another important operational issue is whether the two lines can interline through Main Street. Interlining involves through-routing service from one route directly onto another route, without requiring a transfer or change of equipment, and with minimal or no layover. Interlining the services would provide substantially more operating flexibility.

If the services cannot interline because their tracks are physically separate, a few complications would arise. First, if both lines are constructed, two maintenance shops and yards would be needed, for just six to eight cars each, unless trains from one service could be shuttled to the other line's yard via existing tracks owned by private railways, which would require resolving some additional institutional and operational issues. Such small, separate facilities also would be relatively cost inefficient. Second, if the services do not interline, then less flexibility would be provided regarding where the trains can layover midday. Main Street's geometric constraints would make the provision of midday layover tracks potentially expensive at that location. Thus, trains ideally would layover at some point outside of downtown but nearby. A consolidated layover facility could be less expensive and potentially provide greater operational flexibility than two separate layover facilities.

On the other hand, interlining the services would require connecting the two lines via a much more expensive way to cross the James River. Despite the operational efficiencies that could be achieved by interlining the services, the expense of crossing the river still may not be justified, especially for so few riders.

5.5.4 Summary of Ashland Commuter Rail

Table 5-4 summarizes the characteristics of the Ashland Commuter Rail alternative. Operating cost methodologies, revenue forecasts, and estimated annual subsidy requirements are explained in Section 6.2.

Table 5-4 Summary of Ashland Commuter Rail

Characteristic	Value
Length (miles)	17.9
Capital Cost Estimate ($ Millions)	$103
Weekday Boardings	1,800
Estimated Annual Operating Costs ($ Millions)	$2.47
Estimated Annual Farebox Revenue ($ Millions)	$0.82
Estimated Annual Subsidy ($ Millions)	$1.65

6.0 Financial Components

6.1 *Capital Cost Estimates*

Capital cost estimates were prepared for the ten preliminary alternatives during the preliminary alternatives screening process (see Section 4.3 for methodology). The following table summarizes the capital costs for the screened alternatives.

Table 6-1 Summary of Capital Costs

Corridor	Length (miles)	Unit Cost ($ Millions)	Cost Estimate ($ Millions)
Commuter Rail			
Ashland	17.9	$5.75	$103
Midlothian	14.1	$5.75	$81.1
Light Rail			
Richmond Int'l Airport (RIC)	6.4 – 7.2	$58.41	$374 - $420
Short Pump	13.6 – 13.9	$58.41	$791- $812

6.2 *Operating Cost Estimates*

6.2.1 Light Rail Operating Cost Estimate

Model Description
For light rail (LRT), the study team examined both lines, comprised of a total of three routes:

- Airport Line: Main Street Station to Airport
- Short Pump Line: Main Street Station to Short Pump via Broad Street and I-64 corridor
- Short Pump Line: Main Street Station to I-195 via Broad Street (weekday off-peak only)

While all three routes would serve downtown and Main Street Station, for operational purposes these lines are independent of one another and are analyzed as such. The same operations model and operating assumptions were applied to all three, as described below.

The LRT O&M cost model used vehicle hours of service as the primary variable. The O&M costs were developed by first estimating vehicle operations for the proposed LRT system. Next, a proposed service schedule was developed to determine the amount of service that will be produced annually. Finally, unit costs were applied to the annual operating service output to estimate the annual O&M costs.

LRT Operations Model

An operations model produced by PB used the following assumptions:

- A maximum operating speed of 65 mph in segments of exclusive right-of-way
- A maximum operating speed equal to the posted speed limit in segments of mixed traffic
- Signal preemption for at-grade crossings
- Closures of numerous minor crossings (i.e., right turns still possible, but left turns prohibited, both to and from the minor cross streets))
- An average acceleration rate of 2.1 mph/s, varying depending on speed
- An average deceleration rate of 2.9 mph/s, varying depending on speed
- A dwell time of 20 seconds at each station
- A 25% probability of encountering a red signal at major cross streets (the probability is set low, to reflect for preemption)
- A 10% minimum recovery time at the end of each one-way run

In addition, a 10% contingency was added to each segment's travel time to account for the impedances of track geometry that were not accounted for among the assumptions above.

Short Pump

The proposed "Long" Short Pump LRT was estimated to require 38.4 minutes to serve 24 stations on a 13.6-mile one-way trip, for a moderate average operating speed of 21.2 miles per hour. Once the alignment reaches I-64, its full grade separation would afford very fast operating speeds; however, relatively short station spacing and on-street operations within Richmond would slow operating speeds. Overall, the line as examined would obtain an average operating speed for lines like it in other U.S. cities.

The proposed "Short" Short Pump LRT, operating only so far as the Richmond city limits, would require about 18.2 minutes to serve 12 stations on the 4.1-mile route, for a relatively slow operating speed of about 13.6 miles per hour. The route would operate slowly because of its short station spacing and high volume of boardings and alightings. Although the speed is fairly slow for light rail in general, it would represent a great improvement over local bus services, which typically experience operating speeds of just 6 to 8 mph.

Airport

The proposed Airport LRT service was estimated to have a one-way running time of 23.6 minutes, serving 15 stations on a 6.4-mile alignment. The line's operating speed would average about 16.3 mph, once again relatively slow, since the line as studied would make numerous stops on the way to the airport. With stations spaced closer to a mile apart from one another (i.e., half as many stations), the line could attain an average operating speed of roughly 22 mph and connect the airport to downtown in just 17.5 minutes. For purposes of O&M costing, the slower, 23.6-minute one-way run time is assumed to be conservative.

LRT Service Assumptions

Both LRT lines were assumed to operate with two-car trains during all periods. Operating schedules and headway assumptions are provided below:

Period	Time	Headway (min.)		
		Short Pump (Long Route)	Short Pump (Short Route)	Airport
Weekday				
Early Morning	5:30 AM to 6:30 AM	30	30	15
AM Peak	6:30 AM to 9:00 AM	10		10
Midday	9:00 AM to 4:00 PM	30	30	15
PM Peak	4:00 PM to 6:30 PM	10		10
Early Evening	6:30 PM to 9:00 PM	30	30	15
Late Evening	9:00 PM to Midnight	30		30
Weekend				
Early Morning	5:30 AM to 9:00 AM	30		30
Midday	9:00 AM to 9:00 PM	15		15
Late Evening	9:00 PM to Midnight	30		30

LRT O&M Cost Model and Cost Estimates
Annual operating costs for the LRT alternatives are largely a function of vehicle-hours of LRT service. Vehicle-hours (or service-hours) are closely associated with labor wages, which are paid on a per-hour basis. Other cost factors, such as the distance traveled by the vehicles (closely related to maintenance costs), the overall size of the system, power and distribution costs, and so on, correlate with vehicle-hours. Thus, for a rough cut at estimating O&M costs, vehicle-hours serves as a very approximate cost variable.

Hourly O&M costs were developed to a much more detailed degree recently for similar studies of proposed LRT services in Indianapolis, Cincinnati, and Memphis. Averaging these studies' resulting per-hour cost estimates, the hourly rate was estimated to be $240 per vehicle service hour, expressed in Year 2003 dollars.

Short Pump
The proposed Short Pump LRT would require 21 peak vehicles (or a fleet of about 25). The "Long" line would annually provide about 784,000 vehicle-miles and 43,400 service-hours of service, while the "Short" line, which would operate during midday periods during the week, would provide about 146,000 vehicle-miles and 5,400 service-hours annually. The "Long" line would cost roughly $10.4 million annually to operate and maintain, while the "Short" line would cost about $1.3 million annually. Altogether, the Short Pump LRT would cost about $11.7 million.

Airport
The Airport LRT would cost much less to operate, despite its relatively low operating speeds, because it is proposed as a much shorter line. Requiring eight peak vehicles (or a fleet of 10) and providing 373,000 vehicle-miles and 29,100 service-hours annually, the Airport LRT would cost about $7.0 million each year to operate and maintain.

Operating Cost vs. Revenue
These estimates, of course, depend to a great extend on the service assumptions made, such as levels of service, station locations and periods of operation. The estimates provide reasonable "ballpark" figures for the O&M costs that the region could expect to observe if the two LRT services are constructed. Typically, farebox revenues generated by the new services recover anywhere from 20% to 60% of its O&M costs, leaving some costs to be paid for through subsidies, which normally entail the creation of a dedicated

public funding source. The following section describes potential farebox revenue for the two light rail alternatives.

6.2.2 Light Rail Revenue Estimate from Fares

For light rail transit systems, U.S. transit operators generally charge flat fares that match or are closely aligned with local bus fares. For preliminary estimating purposes, light rail fares for Richmond are assumed to match those of the Greater Richmond Transit Corporation's existing bus fares. This assumption would be reevaluated in all phases of further transit planning.

According to the 2000 National Transit Database, the Greater Richmond Transit Corporation collects an average of 62.2 cents in fares per boarding, expressed in Year 2000 dollars. The observed average fare includes normal cash fares as well as discounted fares, discounted passes, deeply discounted transfers, and so on. As a result of the large number of discounted fares that passengers use, the average fare per boarding is significantly lower than the published GRTC cash fare of $1.25. This difference between FTA reported fare per boarding and the published cash fare price is normal among transit systems nationwide.

Accounting for inflation, the GRTC's average fare in 2000 was about 67.2 cents per boarding when expressed in Year 2003 dollars.

The Short Pump Light Rail line would carry about 8.4 million annual boardings, for an estimated $5.64 million in annual farebox revenues. The Line would have a farebox recovery ratio of roughly 48.2% and would require an annual operating and maintenance subsidy of about $6.06 million.

The Airport Light Rail line would carry about 4.8 million annual boardings. The Line would generate about $3.23 million in annual farebox revenues, for a recovery ratio of 46.1%. The Line would require an annual subsidy of roughly $3.77 million to operate and maintain.

6.2.3 Commuter Rail Operating Cost Estimates

Model Description
For commuter rail, the study team examined two lines:

- Ashland Line: Main Street Station to Ashland
- Midlothian Line: Main Street Station to Midlothian

Similar to the LRT services, although both commuter rail routes would serve downtown and Main Street Station, for operational purposes these lines are considered as independent routes. The same operations model and operating assumptions were applied to both, as described below.

The commuter rail O&M cost model used vehicle hours of service as the primary variable. A similar approach was used as for estimating LRT costs: estimating vehicle

operations, developing a proposed service schedule, and applying unit costs to estimate annual O&M costs.

Commuter Rail Operations Model
An operations model was produced by PB and used the following assumptions:

- A maximum operating speed of 79 mph in segments of exclusive right-of-way
- A maximum operating speed equal to 35 mph near and through downtown Ashland, as well as near Main Street Station.
- Full priority and way protection for at-grade crossings (i.e., no delays due to cross street)
- Closures of some minor crossings
- An average acceleration rate of 0.73 mph/s, varying depending on speed
- An average deceleration rate of 1.25 mph/s, varying depending on speed
- A dwell time of 30 seconds at each station
- A 0% probability of encountering a red signal at major cross streets (the probability is set to zero, to reflect full priority)
- A 10% minimum recovery time at the end of each one-way run

In addition, a 10% contingency was added to each segment's travel time to account for the impedances of track geometry that were not accounted for among the assumptions above.

Ashland
The proposed Ashland Commuter Rail was estimated to require 36.4 minutes to serve 10 stations on a 17.9-mile one-way trip, for a fast operating speed of 29.6 miles per hour. Although the system was modeled with a speed limit of 79 mph, the distance required to reach this speed and then decelerate back to 0 mph would be roughly 2.2 miles. However, with only one exception, the longest station spacing in sections of 79 mph speed limits would be just 1.8 miles – long enough to reach just 65 mph. Thus, the system could be designed to 65 mph speeds in the longest sections between stations.

Midlothian
The proposed Midlothian Commuter Rail would require about 28.4 minutes to serve the 13.7-mile corridor of six stations, for a fast operating speed of about 29.0 miles per hour. The maximum speed of 79 mph could be reached on two short stretches of just 1/8-mile each. Thus, the system could be designed to lower speed limits without sacrificing much in the way of service quality.

Commuter Rail Service Assumptions
Both commuter rail lines were assumed to operate with two coaches during all periods. Both services also could accommodate all demand with four peak-direction trips during each peak period. In addition, it is assumed that one round trip would operate during the midday period, to provide some continuity of service.

Commuter Rail O&M Cost Model and Cost Estimates
As for LRT, annual operating costs for the commuter rail alternatives are largely a function of vehicle-hours of commuter rail service, for the same reasons discussed earlier. Vehicle-hours therefore serve as a very appropriate variable for estimating costs.

O&M costs were observed from all 18 commuter rail systems in the U.S. The average cost in 2000, according to the National Transit Database, was $412 per revenue-vehicle-hour or $11.59 per revenue-vehicle-mile. These estimates exclude the two smallest systems in Seattle and Fort Worth, which experience great operating inefficiency due to their small sizes. Both of these systems have costs of $52.34 per revenue-vehicle-mile – nearly five times the average and more than three times higher than any other system. It is possible that Richmond's system could encounter similar inefficiencies as the systems in Seattle and Fort Worth if it operates very limited service. For purposes of this estimate, we will use $412 per revenue-vehicle-hour as the unit cost.

Ashland
The proposed Ashland commuter rail would require nine peak vehicles, including six coaches and three locomotives. The line would annually provide about 6,000 vehicle-hours of service and cost roughly $2.47 million annually to operate and maintain.

Midothian
The Midlothian commuter rail would cost less because it would be a shorter line and require one less peak trainset. The Midlothian line would require about six peak vehicles, including four coaches and two locomotives. The line would annually provide about 3,900 vehicle-hours of service and cost roughly $1.59 million to operate and maintain.

Again, for both lines, actual costs may vary widely depending on how much (in)efficiency the systems experience as a result of their small size.

6.2.4 Commuter Rail Revenue Estimates from Fares

To estimate farebox revenues for commuter rail, an average fare per passenger-mile was estimated for existing commuter rail systems and applied to an estimate of passenger-miles for each commuter rail alternative.

Nine of the country's 18 commuter rail systems report revenue data to the Federal Transit Administration independently from other local bus and rail systems. Data from these nine systems provide enough breadth and independence to afford reliable estimates. Table 6-2 shows the nine systems, ordered from highest to lowest fare per passenger-mile. The systems' average fares per passenger mile show a "bell curve" distribution that varies from a high of 16.4 cents on Metro-North in the New York metro area, to a low of 7.7 cents on Tri-Rail in South Florida, expressed in Year 2000 dollars. The average among existing systems is about 12.5 cents per passenger-mile in Year 2000 dollars. Accounting for inflation of about 8.1% between 2000 and 2003, the figure rises to about 13.5 cents per passenger-mile in Year 2003 dollars. Among the nine sampled U.S. commuter rail systems, farebox recovery ratios vary from a high of 61.0% for Metro-North Commuter Rail to a low of 25.0% for Tri-Rail in South Florida, with an average of about 43.5%.

"Fare per boarding" also was examined as a possible unit of revenue. However, this variable was found to vary widely among commuter rail systems, since commuter rail systems generally charge distance-based fares, and their average fare per boarding therefore largely reflects the overall lengths of their lines. "Fare per boarding" showed a high standard deviation of 45% of its average. In comparison, "fare per passenger mile"

showed a more desirable standard deviation of just 20% of its average, confirming statistically that "fare per passenger mile" varies less among existing systems than "fare per boarding" and therefore provides a better predictor of fare revenues.

Table 6-2 Fare per Boarding and per Passenger-Mile for Selected U.S. Commuter Rail Systems (Year 2000 dollars)

Agency	Metro Area	Fare per Boarding	Fare per Passenger-Mile
Metro-North Commuter Railroad	New York	$4.65	$0.164
Long Island Railroad	New York	$3.38	$0.149
North Indiana Commuter Transportation District	Chicago	$3.78	$0.135
Virginia Railway Express	Washington, D.C.	$4.35	$0.130
Southern California Regional Transit Authority	Los Angeles	$6.40	$0.124
Northeast Illinois Regional Commuter Railroad Corporation	Chicago	$2.61	$0.120
Altamont Commuter Express - San Joaquin Regional Rail Commission	Stockton, CA	$1.23	$0.115
Peninsula Corridor Joint Powers Board	San Francisco / Oakland	$2.39	$0.110
Tri-County Commuter Rail Authority	Miami / Ft. Lauderdale	$2.30	$0.077
	Average:	**$3.46**	**$0.125**

The Ashland Commuter Rail line would carry about 6.11 million annual passenger-miles. Assuming an average fare per passenger-mile of 13.5 cents, the Ashland Commuter Rail would generate about $824,850 in annual farebox revenues, for a farebox recovery ratio of 33.4%. The Line would require an annual subsidy of roughly $1.65 million to operate and maintain.

The Midlothian Commuter Rail line would carry about 4.34 million annual passenger-miles, for an estimated $577,060 in annual farebox revenues. The Line would have a farebox recovery ratio of roughly 36.3% and would require an annual operating and maintenance subsidy of about $1.01 million.

6.3 *Potential Funding Sources*

The following describes a variety of Federal and State funding programs, as well as various user fee concepts and local partnerships that could help fund the proposed light and commuter rail lines. Federal funding programs provide the largest and most likely sources of funds for the proposed projects.

6.3.1 Federal Capital and Operating Assistance

Federal Capital Funding
Federal capital funding is authorized for transportation projects through the Transportation Efficiency Act of the 21st Century, or TEA-21. The Act covers a six-year period from 1998 through 2003 and authorizes various, sizeable transportation funding programs. Although reauthorization hearings have begun, details of the new program will not be known until the new bill is enacted, and this is not likely to occur until late 2003, at best. If new legislation is not enacted by the expiration date of the current legislation, the likeliest scenario is enactment of a continuing resolution, possibly with reduced funding levels, until the new bill is passed. The program descriptions that follow are based on the existing legislation, and may or may not carry into the new bill.

The Federal Highway Administration (FHWA) sponsors TEA-21's largest pot of money, called the Surface Transportation Program (STP), whose funds may be applied toward transit and highway capital projects. These funds are distributed through States, which means that the rail project would need to apply to the State of Virginia for these monies. The program also requires a 20% local/state match.

A 10% portion of each State's apportioned STP funds are set aside specifically for "Transportation Enhancements" – improvements that strengthen aesthetic, environmental, or cultural aspects of the nation's transportation system. For example, Transportation Enhancements funds could be applied toward the landscaping of light rail stations or to the contextually sensitive design of waiting areas. The State might have specific eligibility and selection criteria that exceed those specified in Federal legislation.

Another potential Federal funding source sponsored by FHWA is the Congestion Mitigation & Air Quality Improvement Program (CMAQ), whose funds can be used in EPA-designated air quality non-attainment and maintenance areas to fund transportation projects that would improve air quality. The Richmond metro area is one such area, and the proposed light and commuter rail lines therefore could qualify for CMAQ funds since the systems would improve air quality and reduce automobile traffic. If the rail lines use alternative fuel vehicles, the system's potential to qualify for CMAQ funding could improve considerably. CMAQ funds are typically used to fund operations of new transit service for up to three years. Due to this relatively short period of time, several transit operators relying on CMAQ funding for some or most of their operating expenses, attempt to transition to other operating sources during the three year period. Like STP funds, CMAQ funds are administered through the States. Projects can be identified through the statewide or local transportation planning processes or through suggestions from the public. The CMAQ program likewise requires a 20% state/local match.

The Federal Transit Administration (FTA) sponsors two Federal funding programs that the proposed light and commuter rail lines could use. FTA funding may be easier to qualify for, and the FTA-sponsored Federal share could be higher than 80% in some cases.

FTA's Urbanized Area Formula Transit Grant, which is the second largest pot of Federal transportation money, is the transit counterpart to FHWA's Surface Transportation Program, and can be used for nearly any transit capital investment, including vehicles, stops and other facilities. The Grant is allocated to urban areas and will provide 80%

funding for most projects, but 95% funding for projects that provide bicycle access to mass transit. Some components of the proposed rail lines could be eligible for the 95% Federal funding category if bicycle access is incorporated. Formula funds usually are allocated for specific projects well ahead of time, and local project funding needs typically exceed available funding. Thus, the proposed projects would be competing with other smaller, local projects for these funds.

If the rolling stock is purchased by a unit of local government, specialized funds for clean-fuel vehicles may be available. The FTA-sponsored Clean Fuels Formula Grant Program can be applied toward projects that use or accommodate the use of low-emission or clean-fuel transit vehicles. For example, Clean Fuel funds could be used to purchase low-emissions buses to supply increased services on feeder routes, or to build alternative-fueling facilities or garages, or to purchase light and commuter rail vehicles. The Clean Fuels program authorizes FTA to fund 80% of eligible capital costs and requires a 20% local/state match.

“Clean fuels” that would qualify as eligible technologies include electricity, compressed natural gas (CNG), liquid natural gas (LNG), propane, biodiesel, and ethanol. Of these, electricity is the most practical fuel for the proposed rail services. Note, however, that the estimate of commuter rail capital cost in Table 6-1 does not include the cost of electrification.

TEA-21 provides New Starts Program funding, the most common source of construction funds for major new transit projects. The New Starts Program funds projects through a competitive evaluation process, first appraising each project’s performance in terms of pre-determined FTA criteria, and then ranking projects to fund those that perform best. Currently, about 300 projects nationwide totaling over $30 billion in capital costs are in the pipeline that leads to just $6 billion of New Starts funding. By law, New Starts monies can fund up to 80% of a project’s costs. However, competition for New Starts funding is so high that in practice, FTA does not match higher than 60%. Current proposals for the reauthorization of TEA-21 would further reduce the match amount to just 50%, placing an even greater onus on states and localities to identify other funding sources.

Applying for New Starts funding requires following FTA’s guidelines for project development and alternatives development, and working closely with the agency to insure that all methods for creating and evaluating the alternatives are conducted in a manner that yields correct comparisons among the alternatives. FTA places great importance on an evaluation of cost effectiveness and on there being a reasonable financial plan for the proposed project.

Federal Operating Funding

Over the past decade, the Federal government has pursued a policy of focusing more on capital projects and less on funding for transit operating expenses. As a result, almost all operating assistance originates from state and local sources. The only TEA-21 operating assistance for which the rail projects could qualify would be funds provided by FTA through its Urbanized Area Formula Transit Grant (discussed earlier) for preventive maintenance. No other dedicated source of Federal funding exists to subsidize operations.

6.3.2 State and Local Capital and Operating Assistance

User Fees
Passenger fares are the most common and sometimes most productive local source of operating funds. Fares typically cover anywhere from 20% to 60% of a system's operating costs. Ridership tends to be inelastic with respect to fares, such that higher fares generally yield more revenue, while lower fares increase ridership but nonetheless yield less revenue.

Also, the State or local governments have the option to charge highway tolls on local freeways, with revenues dedicated to improving transit and highway infrastructure and services.

Cost Sharing Partnerships
Another form of user fee subsidy could come from fees paid at local venues served by the proposed rail lines. For example, the convention center, which would be served with a direct LRT connection from the airport, could charge visiting groups a nominal "capital improvement fund" fee that could help offset some of the LRT system's costs. Similarly, the airport itself could add another dollar or two of passenger facility charges (PFCs) to each ticket sold for flights from the airport. PFCs are normally used for airport improvements and can be used to fund the construction and/or operation of the proposed LRT to the airport.

State and Local Support
The Richmond Area MPO develops a five-year Transportation Improvement Plan (TIP) and a 20-year financially Constrained Long-Range Plan – tools that govern the selection of funding for major projects. The TIP is updated annually, while the Long-Range Plan is updated every three years or less. Without direct legislation for special projects, receiving most types of public transportation funding, both from the Federal government and from the State, requires attaining a status on the TIP. Larger projects also require a place on the Constrained Long-Range Plan. In this way, the Richmond Regional MPO plays a significant role in deciding whether and how much public funding the projects could receive.

State and local governments could play a role in funding through one of the following means, listed from most to least financially productive:

- Being the primary recipient of a Federal grant whose purpose is to fund the proposed project
- Providing matching "local/state" funds for securing Federal funding
- Providing a discretionary grant, by vote of the City Council/Board of Supervisors or State Legislature
- Providing a discretionary grant, by decision of a City/County or State administrator

The most likely source of State funding would be through the Transportation Trust Fund, which the State uses to pay for transportation infrastructure projects. To become a recipient of Trust Fund monies, as well as any Federal monies that they can leverage, the project would need to be advanced to the region's Transportation Improvement Plan.

Tax
Most new rail projects in the U.S. require some type of new, dedicated funding source, such as a half-penny sales tax, to provide ongoing funding for the project. The new source helps leverage Federal money as well, which requires a local match, and helps strengthen a project's financial plan, since a dedicated funding source can be relied upon for many years into the future. Typically, a new tax is dedicated by law to fund the proposed project and other similar projects in the future. A new source of funding almost always is necessary to make a project financially viable. Thus, the public vote on the tax commonly becomes a vote of confidence (or lack thereof) in the proposed project. Voters essentially vote whether they want the project or not, making the project development process potentially very political.

There are many revenue mechanisms available that could provide the stable and dedicated source of funding for new capital and / or operating expenses incurred with a transit investment. The amount of yield for each mechanism varies based upon local conditions. Additionally, there are numerous political, legal and administrative issues pertaining to each that would need to be addressed before implementation. A listing of these sources includes[3]:

- Local Sales Taxes
- Corporate Income Taxes
- Employer Payroll Tax
- Personal Income Tax
- Real Estate Property Tax
- Personal Property (automobile) Tax
- Motor Fuel (Gasoline) Tax
- Motor Vehicle Registration Fees
- Parking Receipt Tax
- Surface Parking Surcharge
- Rental Car Tax
- Vehicle Emissions Fee
- Vehicle Privilege Fee
- Real Estate Transfer Tax
- Mortgage Recordation Tax
- Fund Balance Transfers
- Incremental Tax Financing District
- Benefit Assessment District
- Value Capture

6.3.3 Summary

Securing funding is vital to ensuring that any of the proposed rail projects could be constructed and subsequently operated and maintained. To the extent that the projects can secure funding from sources other than fares, they also can offer lower ticket prices and thereby carry a considerably larger portion of the market of potential riders.

[3] Source: Hartford (CT) Regional Transit Strategy, Parsons Brinckerhoff, May 2001. Revenue mechanisms identified by KPMG Consultants under contract to PB.

Numerous funding sources are available from the Federal government, via a place in the region's Transportation Improvement Plan. Most Federal sources will help defray capital expenses. Meanwhile, operating expenses are more challenging to cover. As identified above, there are numerous available non-federal sources of funding for transit capital and operating expenses. Table 6-3 identifies the percentage of federal, state and local funding proposed in several current FTA New Starts Transit projects.

Table 6-3 Funding Percentages (Federal, State. Local) for New Starts Projects

New Starts Projects	Section 5309 (New Starts)	Other Federal Funds	State total	Local total
Pittsburgh, PA: North Shore Connector	60%	20%	17%	3%
Charlotte, NC: South Corridor	50%	0%	25%	25%
Tampa Bay, FL: Regional Rail (3 corridors)	50%	0%	16%	34%
Columbus, OH: North Corridor LRT	50%	0%	24%	26%
Dallas, TX: Northwest / Southeast MOS	40%	3%	0%	57%
Denver, CO: West Corridor	60%	0%	0%	40%
Los Angeles, CA: Eastside Corridor LRT	55%	5%	27%	13%
New Orleans, LA: Desire Corridor Streetcar	60%	0%	0%	40%
Norfolk, VA: Norfolk LRT	50%	0%	25%	25%
San Diego, CA: Mid Coast Corridor	49%	0%	0%	50%
San Francisco, CA: Central Subway	70%	0%	14%	17%
Seattle, WA: Central Link LRT	20%	0%	0%	80%
Johnson County, KS: I-35 Corridor	80%	0%	0%	20%
Nashville, TN: East Corridor Commuter Rail	61%	19%	10%	10%
Wilsonville-Beaverton, OR	60%	0%	29%	11%
Harrisburg-Lancaster, PA: "CorridorOne"	33%	0%	17%	51%
Raleigh, NC: TTA Regional Rail	54%	2%	23%	21%

Source: FTA fiscal year 2004 New Starts Report

7.0 Overall Feasibility

This study has described the feasibility issues related to ten rail transit corridors identified in the Richmond MPO's Long Range Transportation Plan. Although the study included a preliminary screening of these corridors to identify four alternatives for further study, at this stage of planning it is difficult to discern a "feasible" rail transit corridor from one that is "infeasible". Significant data collection and analysis will be required for each potential alternative before meaningful results regarding potential costs and benefits of various modes become clear. Additionally, the candidate modes selected for a given corridor may change during the Alternatives Analysis phase of the study.

The study team identified evaluation criteria that will be useful in future stages of planning for transit investments in the Richmond region. The criteria listed in Table 7-1 are used by the FTA's New Starts process to compare candidate projects. The New Starts process is explained in more detail in Chapter 7, Next Steps. The criteria and their associated measures are designed to reflect the broad range of benefits and impacts which may be realized by the implementation of the proposed New Starts transit investment. The criteria are applied to projects that have entered the FTA's New Starts process, or are applying to enter the pipeline of potential projects. New Starts is a competitive process used by the FTA to identify which candidate projects to fund for planning, design or construction phases. These criteria are submitted annually by each New Start project's sponsoring agency based upon current data available from each study. The criteria are first developed during the alternatives analysis phase and are refined throughout the preliminary engineering and final design phases of project development. FTA periodically issues guidance on the calculation of these project justification measures, and issues updates regarding the use of the criteria.

Table 7-1 FTA New Starts Evaluation Criteria

Criteria	Measure(s)
Mobility Improvements	Hours of Transportation System User Benefits Low-Income Households Served Employment Near Stations
Environmental Benefits	Change in Regional Pollutant Emissions Change in Regional Energy Consumption EPA Air Quality Designation
Operating Efficiencies	Operating Cost per Passenger Mile
Cost Effectiveness	Incremental Cost per Hour of Transportation System User Benefit
Transit Supportive Land Use and Future Patterns	Existing Land Use Transit Supportive Plans and Policies Performance and Impacts of Policies Other Land Use Considerations
Other Factors	Project benefits not reflected by other New Starts criteria

Although these criteria and associated measures may change based on the next federal transportation funding legislation or as the New Starts program continues to evolve, it is important to understand the criteria before continuing rail transit planning in the Richmond region. At this preliminary phase of study, it is possible to qualitatively discuss the criteria, and the potential results of each of the four screened alternatives with regard to the criteria. These following sections are subjective in nature due to the preliminary stage of planning, and the associated lack of data to perform analysis. Future planning studies of these or other corridors should consider using these criteria during the identification of project goals and objectives.

7.1 *Mobility Improvements*

Mobility improvements describe the potential transportation benefits that would accrue from the proposed alternative. In a broad sense, this includes transit ridership, relief of roadway congestion, provision of transportation choices, and provision of services to transit-dependent populations. This criterion also captures the access to employment centers located along each transit corridor. Each of the four screened alternatives would improve mobility within the Richmond region. The data available from this study does not provide an opportunity to compare the mobility improvements of each alternative. At this phase of study, only ridership information is available. Of the four alternatives, the highest ridership is attributed to the Short Pump LRT line, and the lowest ridership is on the Ashland Commuter Rail line. Each alternative terminates downtown, and therefore provides access to downtown employment.

7.2 *Environmental Benefits*

The environmental benefits of transit investment in Richmond would be determined from the region's air quality modeling process. Air quality calculations for potential transit investments are normally conducted in the Alternatives Analysis phase of study, and are a requirement of the NEPA process. Due to their electrically-powered vehicles, light rail transit systems do not produce emissions from the transit vehicle. Most commuter rail systems are operated with diesel-powered locomotives that produce emissions from the locomotive. Despite this difference, both types of transit systems have the potential to provide environmental benefits to the region's air quality. The amount of benefit depends on the existing traffic congestion, and the proposed transit project's effect on the regional vehicular emissions.

7.3 *Operating Efficiencies and Cost Effectiveness*

These criteria measure efficiency and cost effectiveness of each alternative with regard to transit operations, and "transportation system user benefits". These measures require analysis of data that has not been developed for this phase of the study. This data would result from the more detailed ridership and operations costs estimates produced during Alternatives Analysis.

7.4 *Transit Supportive Land Use and Future Patterns*

This criterion measures the potential of the region's land use patterns to support transit ridership. A key component is the land use planning and zoning adjacent to potential transit stations. Most New Starts candidate projects develop Transit Oriented Development (TOD) overlay districts to apply to the planned station areas. In these locations, higher density development is often permitted with a subsequent reduction in the amount of required off-street parking. The intent of TOD planning is to create a higher density, walkable transit node with a variety of land use types (office, residential, commercial) within close proximity. Research has documented the positive effect this type of station-area land use planning can have on transit system ridership. There are no TODs currently planned for any of these potential corridors, and therefore there is no substantial difference between the four preliminary alternatives with regard to this measure. As regional transit planning progresses in the Richmond region, consideration of TOD at potential station areas will become a necessary component of the transit system planning.

8.0 Next Steps

This study has identified preliminary feasibility issues related to two specific rail transit modes, light rail transit and commuter rail transit, as applied to ten candidate transit corridors within the Richmond region. The results of this study will help to forward discussions of implementing rail transit in Richmond. To understand what steps the Richmond region should follow next, it is important to understand the current process necessary to advance a new fixed guideway transit corridor through project planning.

8.1 *New Starts Process*

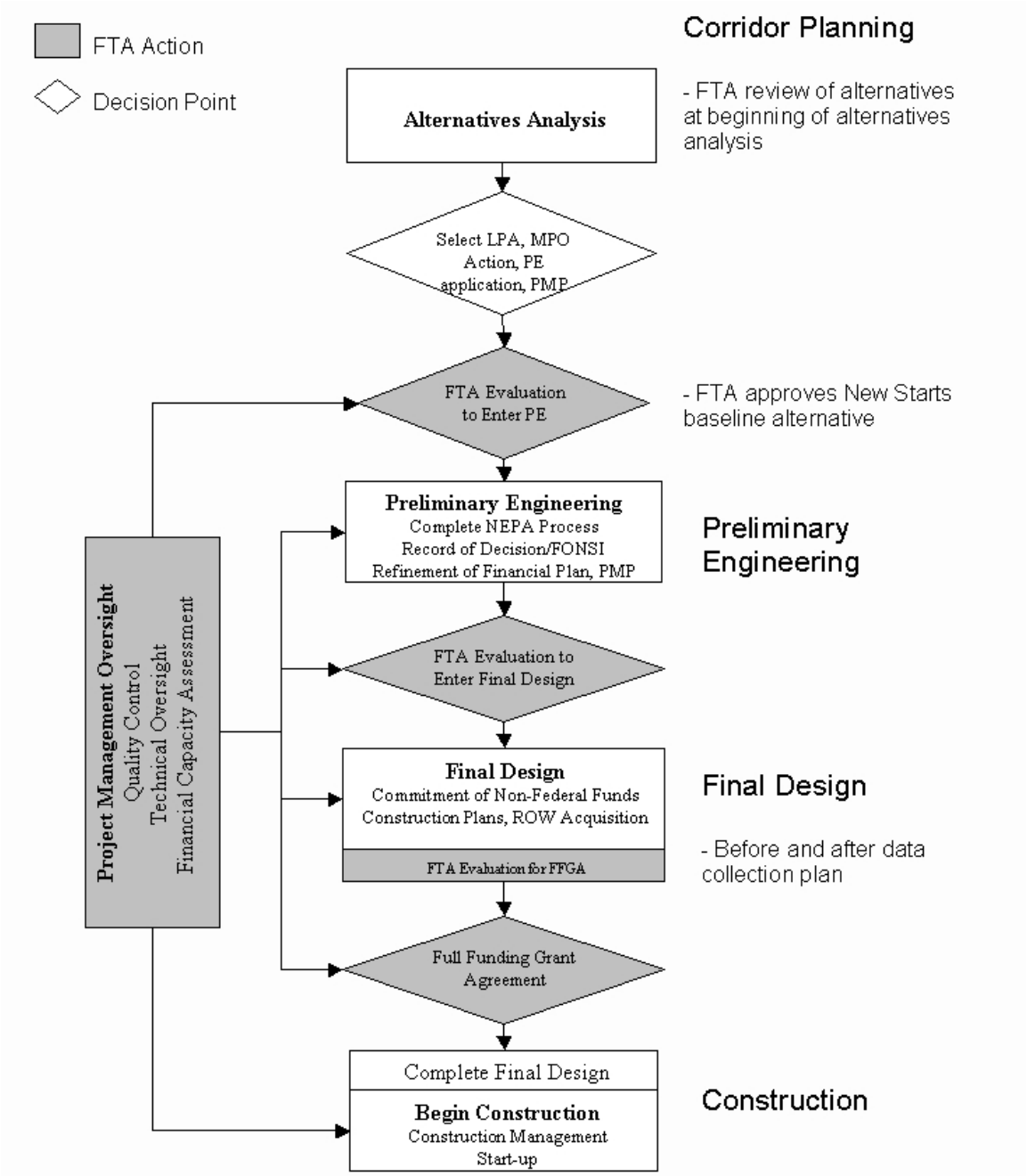
Implementing a new transit corridor in the Richmond region will likely require the use of federal funding sources. To use federal funds for major transit capital expenses, the FTA "New Starts" process is followed. The New Starts process guides all phases of new transit projects, from preliminary planning to construction and operation. The New Starts process has been in place for several years as part of both the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), and the Transportation Equity Act for the 21st Century (TEA-21). The rules and guidelines governing the New Starts process are periodically updated as policies are revised. The FTA recently updated their primary planning guidance for New Starts projects. "Advancing Major Transit Investments through Planning and Project Development" was released in January 2003, and is available on the FTA's website (www.fta.dot.gov). The New Starts process, as discussed in that document, is depicted in Figure 8-1, and briefly summarized below.

8.2 *Alternatives Analysis*

To begin the New Starts process, applicants should successfully complete a major planning study for a candidate corridor. The Alternatives Analysis (AA) is a multimodal planning study of the problems and a wide range of potential solutions for a given transportation corridor. One of the critical elements of the preparation of an Alternatives Analysis is the development of the transportation corridor's "problem statement", and the associated goals and objectives for the study. This process requires extensive coordination with potential project stakeholders and the public. The FTA has also expressed interest in participating in the identification of the problem statement for candidate New Starts projects.

All potentially feasible alternatives to solving the identified transportation problems should be addressed in the AA. Coordination with the FTA should occur throughout the alternatives analysis and especially during the development of alternatives. It is important to note that although this feasibility study examined light rail and commuter rail in Richmond, it is very likely that other transportation modes would be considered during the AA. These could include High Occupancy Vehicle (HOV) lanes, enhanced local bus service, Bus Rapid Transit (BRT), additional highway capacity, and other improvements. The AA concludes with the selection and adoption of a locally preferred alternative (LPA) by the MPO.

Figure 8-1 New Starts Process



Once a locally preferred alternative is chosen, further discussions should occur with the Federal Transit Administration regarding the definition and approval of the Baseline Alternative. The Baseline Alternative is used to compare the candidate project with a "baseline" of realistic improvements that would likely occur if the project is not funded or built. This will be necessary should a candidate project seek to advance into Preliminary Engineering and the New Starts Program.

8.3 *LRTP and TIP Adoption*

The LPA resulting from an AA must be included in the region's financially constrained Long Range Transportation Plan as a project programmed for more detailed planning and engineering analysis and for the preparation of a Draft Environmental Impact Statement (DEIS). In addition, the project must be adopted in the next Transportation Improvement Program (TIP) as a fully funded planning and environmental study with the appropriate levels of local, state and federal funding to carry out the analysis.

8.4 *Preliminary Engineering*

Preliminary Engineering follows the AA phase of project development. If the project will seek federal New Start funding, it will be necessary to receive permission from the FTA to enter the Preliminary Engineering Phase. This is based upon the requirements to enter the New Starts Program process which essentially consists of meeting three basic criteria:

- The project should be based on the results of alternatives analysis and the preliminary engineering done for the analysis;
- The project should be justified based on a comprehensive review of its mobility improvements, environmental benefits, cost effectiveness, and operating efficiencies;
- It must be supported by an acceptable degree of local financial commitment. This includes evidence of stable and dependable financing sources to construct, maintain, and operate the system extension. (See Section 6.3.2)

8.5 *National Environmental Policy Act*

Since federal funding would be used to construct a potential New Starts transit system in Richmond, the project will be regulated by the National Environmental Policy Act (NEPA) of 1969. In accordance with NEPA, a DEIS will be prepared for the corridor to identify the range of alternatives and their potential impact on the environment. The DEIS process of identifying alternatives and evaluating their impacts is similar, but not identical to the process that would be followed during an Alternatives Analysis. Often the DEIS and AA are completed at the same time, however it is not a requirement to do so. If completed separately, there should be frequent coordination between the development of alternatives identified in the AA and the DEIS. During the PE Phase, the NEPA process concludes with either a Record of Decision (ROD) on the Final Environmental Impact Statement (FEIS), or it will consist of a Finding of No Significant Impact (FONSI),

requiring no further analysis. Given the major infrastructure requirements of a new transit project, a FONSI is very unlikely.

8.6 *Recommendations*

Given the many major potential projects that are proposed for the Richmond region and the need for significant and limited local, state and federal financial resources, it will be necessary to prioritize investments within the long range planning process. It is recommended that regional stakeholders be identified for each potential transit corridor, and that they meet to discuss strategies for prioritizing and selecting projects for the financially constrained long-range plan. This prioritization and planning should occur with public input, and as part of the planning process to update the Long Range Transportation Plan for the Richmond region.

As part of this regional prioritization, the stakeholders should review the identified transportation problems of the region and determine if a transit investment is a potential solution. A central component to further planning for transit services is the development of a "purpose and need statement". This documents the transportation problems in the corridor, and identifies how the proposed project is needed as the solution to that transportation problem. The purpose and need statement is required in the NEPA process, and coordination with FTA will help the stakeholders identify a useful document. The development of the purpose and need statement will likely follow from identification of the goals and objectives for each potential investment corridor.

While developing goals and objectives for transit services in prospective corridors, project stakeholders should be cognizant of the need to broaden the consideration of transit modes beyond just light rail and commuter rail systems. For example, there are many new technologies that are enhancing bus services, and providing similar transit benefits with far lower costs than light rail transit. These technologies are referred to as Bus Rapid Transit (BRT), and include such improvements as off-board ticketing, exclusive guideways or travel lanes, traffic signal pre-emption, and other technological and operational enhancements to traditional bus service. FTA has several BRT demonstration projects underway across the country, and is regularly requesting potential New Starts applicants to consider BRT as an alternative during the Alternatives Analysis phase.

The Alternatives Analysis phase should likely focus on a single corridor to pursue further planning and project development. Most metropolitan areas contemplating New Starts rail transit projects advance a single corridor as the region's primary attempt at initiating a new transit service. A few metropolitan areas have conducted AA studies on more than one transit corridor at a time; Charlotte, NC and St. Louis, MO are two recent examples. These AAs were conducted as part of a region-wide study of potential fixed guideway transit services. It should be noted that undertaking such a coordinated study of multiple corridors is an expensive, time consuming and often-times political exercise. The multiple-corridor approach should only be undertaken if there is regional support for investment in several new transit corridors.

Public support for transit investments should be measured in the Richmond region. Several potential transit projects across the country have been challenged by the public's resistance to spending limited fiscal resources for transit improvements. Some

projects have been completely cancelled due to a lack of support in a voter referendum. In the current fiscal environment in Virginia, it would be difficult to find available funding in local budgets to pay the necessary local components of capital and operating expenses. Increasing fees or taxes is a challenging prospect that would require extensive public outreach to demonstrate the benefits of the investment. Given the early stage of planning, efforts should be made to gauge the public's support for new transit services in Richmond. If support is low, opportunities for public outreach regarding the benefits of transit investment should be pursued.

Project proponents should be prepared for a long project development process before any potential transit project in Richmond is implemented. The Federal New Starts process is a highly competitive process with far more projects in the pipeline then there is money to build. Due to this current backlog of projects, only the top performing projects are being funded for construction. Other projects must continue planning efforts just to stay in consideration. As an example, planning for a light rail transit system in the Hampton Roads region has been underway since 1988 when an initial planning study entitled *Planning for Restoration of Rail Service* was published. Over the ensuing years the original 18-mile alignment from downtown Norfolk to the Virginia Beach oceanfront was extensively studied, including the publication of a DEIS. In 1999, the project was reduced to a seven mile alignment entirely within the City of Norfolk, and a Supplemental DEIS was initiated. In the fall of 2002, the project received authority from the FTA to enter the Preliminary Engineering (PE) phase and to prepare the Final Environmental Impact Statement (FEIS). The PE/FEIS phase is scheduled to be completed in the fall/winter of 2003.

Lastly, beginning an Alternatives Analysis for a potential project will require significant additional work by the MPO and its staff. If pursuing this course of action, project proponents in the Richmond region should seek dedicated funding to conduct this additional planning. Many New Starts projects get initial funding through the support of the region's elected officials in either state or federal office. With the support of these officials, legislation is passed appropriating funds. Future funding for planning work beyond the Alternatives Analysis phases may be available from federal sources, including the FTA, however funding in future federal transportation legislation is more likely with the support of local elected officials.