Greater RVA Transit Vision Plan: Near-Term Strategic Technical Analysis

Final Report
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Background & Purpose of Study

The Greater RVA Transit Vision Plan was completed in 2017 and established a long-term vision for transit in the Richmond region. The plan was developed through a collaborative process involving regional stakeholders and the public. It is a guide to long-term transit investments and expansion as the Richmond region continues to grow, using the year 2040 as a benchmark for achieving the plan's goals. To develop the long-term transit vision, relevant factors were analyzed to characterize transit demand. These factors included existing land uses, existing demographics and trends, population and employment characteristics, adopted future land use plans, forecasted population and employment densities, and opportunities to link people with jobs and services throughout the region. The analysis identified where demand for increased transit service appeared to be greatest to develop the foundation for a future 2040 transit network that would effectively serve the Richmond region.

Since the endorsement of the Greater RVA Transit Vision Plan in April 2017, significant regional transit improvements have occurred. These improvements include the opening of the GRTC Pulse Bus Rapid Transit (BRT), GRTC local service expansion to Short Pump in Henrico County, and implementation of the Richmond Transit Network Plan (RTNP). Most recently, new local service serving the US Route 1/301 corridor in Chesterfield County was launched on a demonstrative basis in March 2020. These improvements indicate progress toward the goals established in the Greater RVA Transit Vision Plan.

The purpose of the *Greater RVA Transit Vision Plan: Near-Term Strategic Technical Analysis* was to build upon the success of recent transit improvements and develop a near-term strategy to advance transit in the Richmond region toward the long-term vision established in the Greater RVA Transit Vision Plan. This study assumed near-term improvements would occur within the next five to ten years; however, exact implementation timelines for study recommendations will be based on local and regional priorities and availability of funding. While the Greater RVA Transit Vision Plan identified 34 future transit corridors over a range of service types (BRT, local, and express), the Near-Term Strategic Technical Analysis focused on the 20 high-frequency (20-minute or less service) corridors identified in the Greater RVA Transit Vision Plan. As part of the Near-Term Strategic Technical Analysis, these high-frequency corridors were further evaluated to identify the most viable corridors for near-term implementation and determine the requisite service type and service plan. The Greater RVA Transit Vision Plan network is depicted in **Figure 1**. The Near-Term Strategic Technical Analysis evaluation corridors are shown **Figure 2** and listed in **Table 1**.

The Near-Term Strategic Technical Analysis methodology consisted of three steps: Initial Screening, Detailed Analysis, and Implementation Feasibility. Each step narrowed down the most viable corridors for near-term, high-frequency service. The result of the analysis steps was the identification of prioritized corridors for near-term local service implementation that continue to advance the region toward the vision established in the Greater RVA Transit Vision Plan. Details on the three analysis steps and recommended corridors for near-term implementation, as well as next steps for implementation, are provided in the following sections of the report.

Figure 1. Greater RVA Transit Vision Plan Network

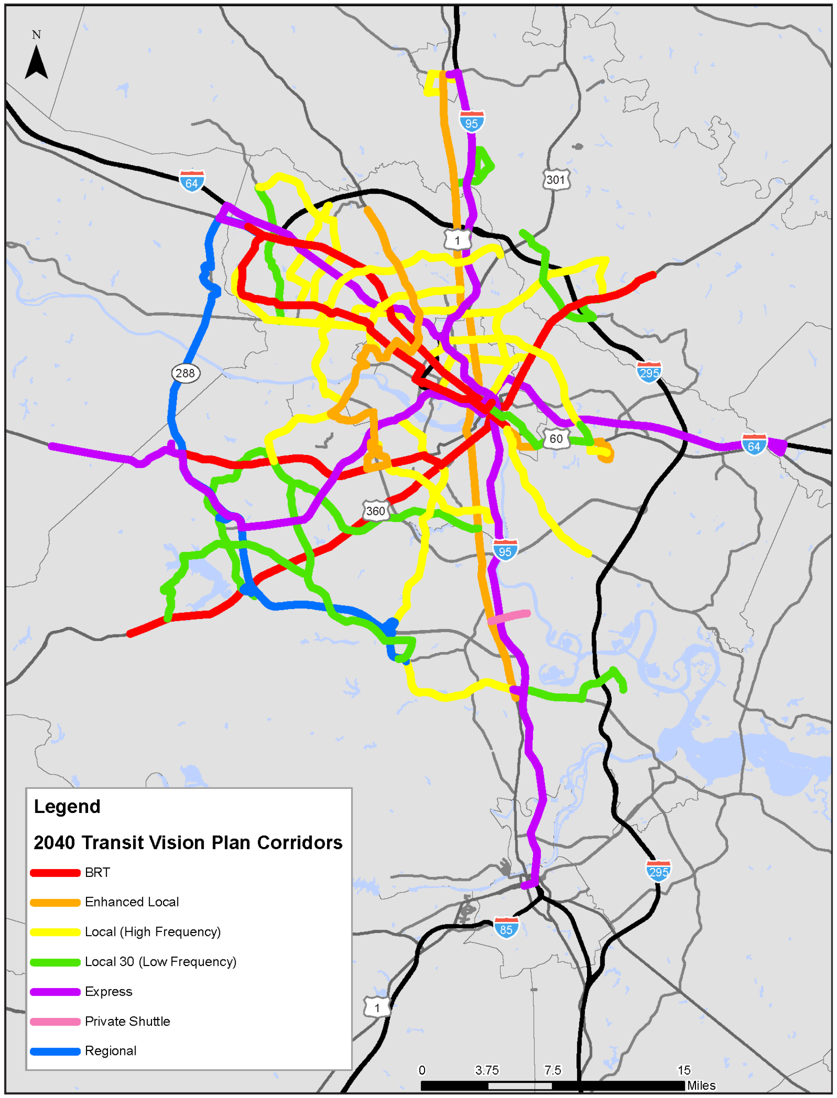

Figure 2. Near-Term Strategic Technical Analysis Evaluation Corridors

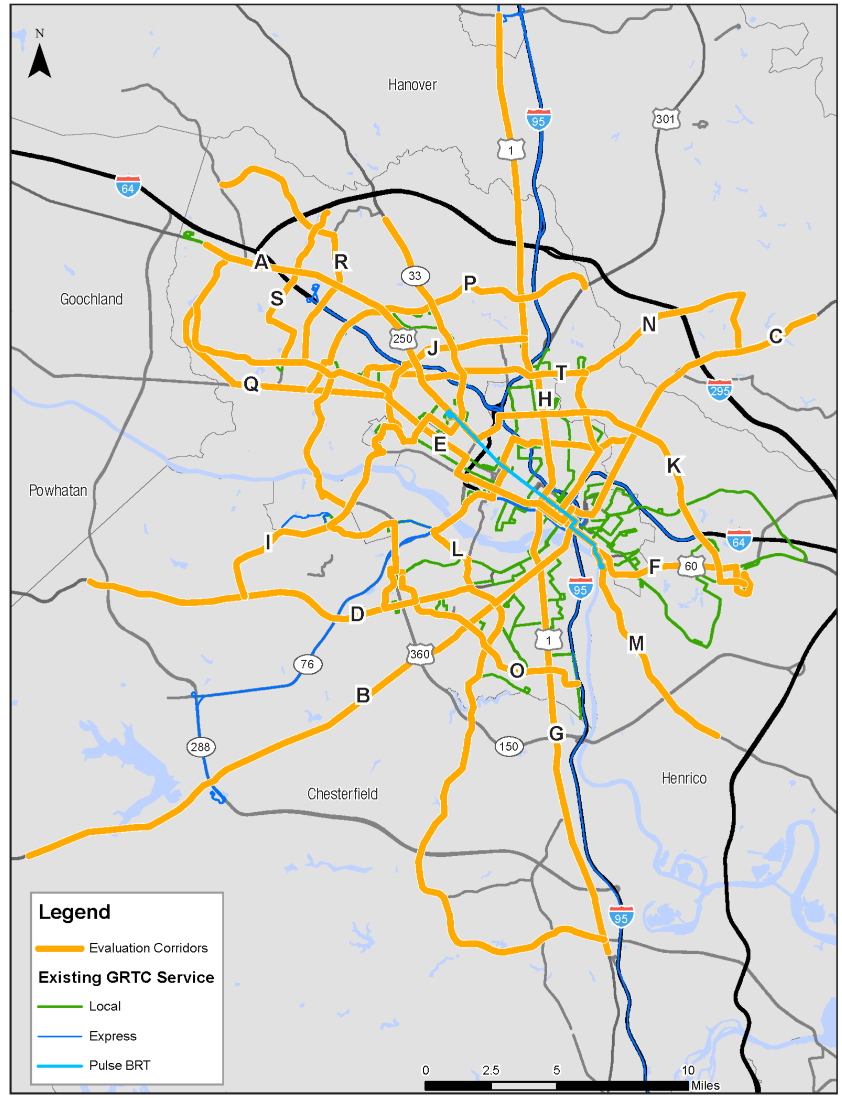

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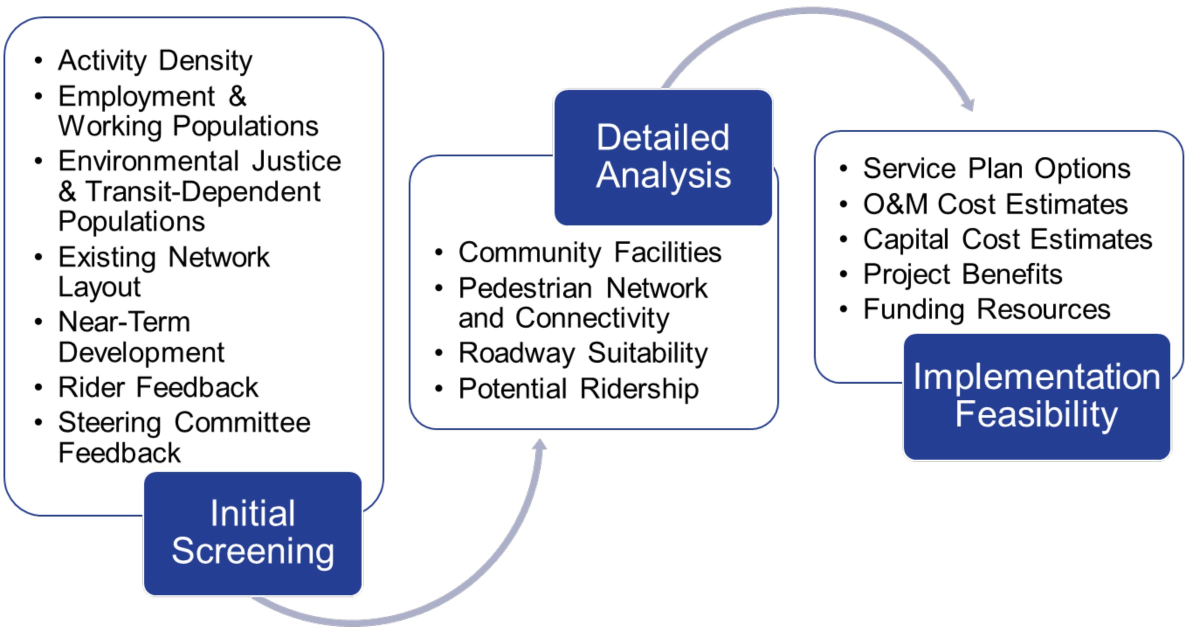
Table 1. Near-Term Strategic Technical Analysis Evaluation Corridors

A.	Broad Street – Short Pump
B.	Hull Street
C.	Mechanicsville Turnpike
D.	Midlothian Turnpike
E.	West End South
F.	Airport via Route 60
G.	Jeff Davis South to Chester
H.	Route 1 to Ashland
I.	West End Route 6 – Staples Mill/Route 33
J.	Glenside to Midlothian
K.	Laburnum Avenue – Willow Lawn to Airport
L.	Iron Bridge Road – City to Jeff Davis
M.	Route 5 South
N.	Lee Davis Road
O.	Warwick Road
P.	West End and Midlothian
Q.	West End Route 3 – Lauderdale
R.	West End Route 4 – Pemberton Nuckols
S.	West End Route 5 – Innsbrook
T.	West End Route 7 – Regency to Azalea

Methodology

The Near-Term Strategic Technical Analysis methodology was composed of three steps: Initial Screening, Detailed Analysis, and Implementation Feasibility, as illustrated in **Figure 3**. The goal of these three steps was to identify the corridors that were the most viable for near-term, high-frequency service (20-minute or less service) from the 20 high-frequency corridors established in the Greater RVA Transit Vision Plan. Each step in the methodology built upon the previous step, increasing the level of analysis and reducing the number of corridors or corridor segments considered viable for near-term local service implementation.

Figure 3. Near-Term Strategic Technical Analysis Methodology



A Steering Committee was established at the outset of the project to provide input and make recommendations throughout the course of the work. The steering committee included representatives from the Virginia Department of Rail & Public Transportation (DRPT), GRTC, RideFinders, the localities in the transit service area including the City of Richmond, Chesterfield County, Henrico County, Hanover County, and the Town of Ashland along with three representatives from the PlanRVA Community Transportation Advisory Committee (CTAC), and PlanRVA staff. The Steering Committee played an important role in providing feedback and direction throughout the course of this project and the results presented in this report reflect input from the Steering Committee.

Initial Screening

Overview

Initial Screening

- Activity Density
- Employment & Working Populations
- Environmental Justice & Transit-Dependent Populations
- Existing Network Layout
- Near-Term Development
- Rider Feedback
- Steering Committee Feedback

Initial Screening was the first step to determine which corridors were most viable for near-term implementation of high-frequency service. This step looked at all 20 high-frequency corridors identified in the Greater RVA Transit Vision Plan (as shown in **Figure 2**Error! Reference source not found. and listed in **Table 1**) and considered three data-driven analysis metrics: activity density; employment and working populations; and environmental justice and transit-dependent populations. These metrics assessed the potential near-term demand and need for transit service along a corridor. Each metric was analyzed for the area within 0.5 miles of a corridor, which represents a generally accepted walking distance for transit users, and typically equates to an approximate 10-minute walk. This is a commonly used distance in analyses for assessing transit demand, including transit-oriented development planning and assessments of Federal Transit Administration Capital Investment Grants.

In addition to the three data-driven analysis metrics, the existing GRTC transit network, GRTC rider feedback, known development potential, and Steering Committee input were considered during Initial Screening. The proposed corridors were overlaid on top of existing GRTC routes to understand how these corridors might connect and overlap with the existing transit network. GRTC rider feedback provided valuable information on riders' desires for more frequent service or service expansion to specific locations throughout the Richmond region. Site development activity—proposals approved but not built-- along corridors were identified as another factor that may drive additional transit demand. For purposes of this study, potential near-term development considered high-employment generating land uses, such as multi-story office buildings or retail shopping centers as well as multi-family residential developments totaling more than 100 units. Zoning permit approval data detailing number of units for residential projects and square footage for non-residential projects was provided by Henrico County, Chesterfield County, and the City of Richmond. In addition, at an August 8, 2019 work session on the Initial Screening, the Steering Committee validated that analysis results were consistent with their knowledge of the local area and reached a consensus on the corridors which showed the greatest viability for high-frequency, near-term service and, therefore, should be advanced to the Detailed Analysis step.

Initial Screening Metrics

Activity Density

Activity density, or the density of people and jobs along a corridor, is an indicator of the level of demand for transit service in the area. Activity density was calculated as the population and employment density per acre. Activity density was determined for each Traffic Analysis Zone (TAZ) within 0.5 miles of the corridors using 2017 population and employment estimates from the Richmond Tri-Cities Regional Travel Demand Model socioeconomic data. The DRPT Multimodal System Design Guidelines [1] were used as a reference to understand the expected level of demand based on activity density as these guidelines provide a framework for planning multimodal corridors based on different environments characterized by varying intensities of activity density. The DRPT Multimodal System Design Guidelines assign a supported transit service for six ranges of activity density, as shown in **Table 2**.

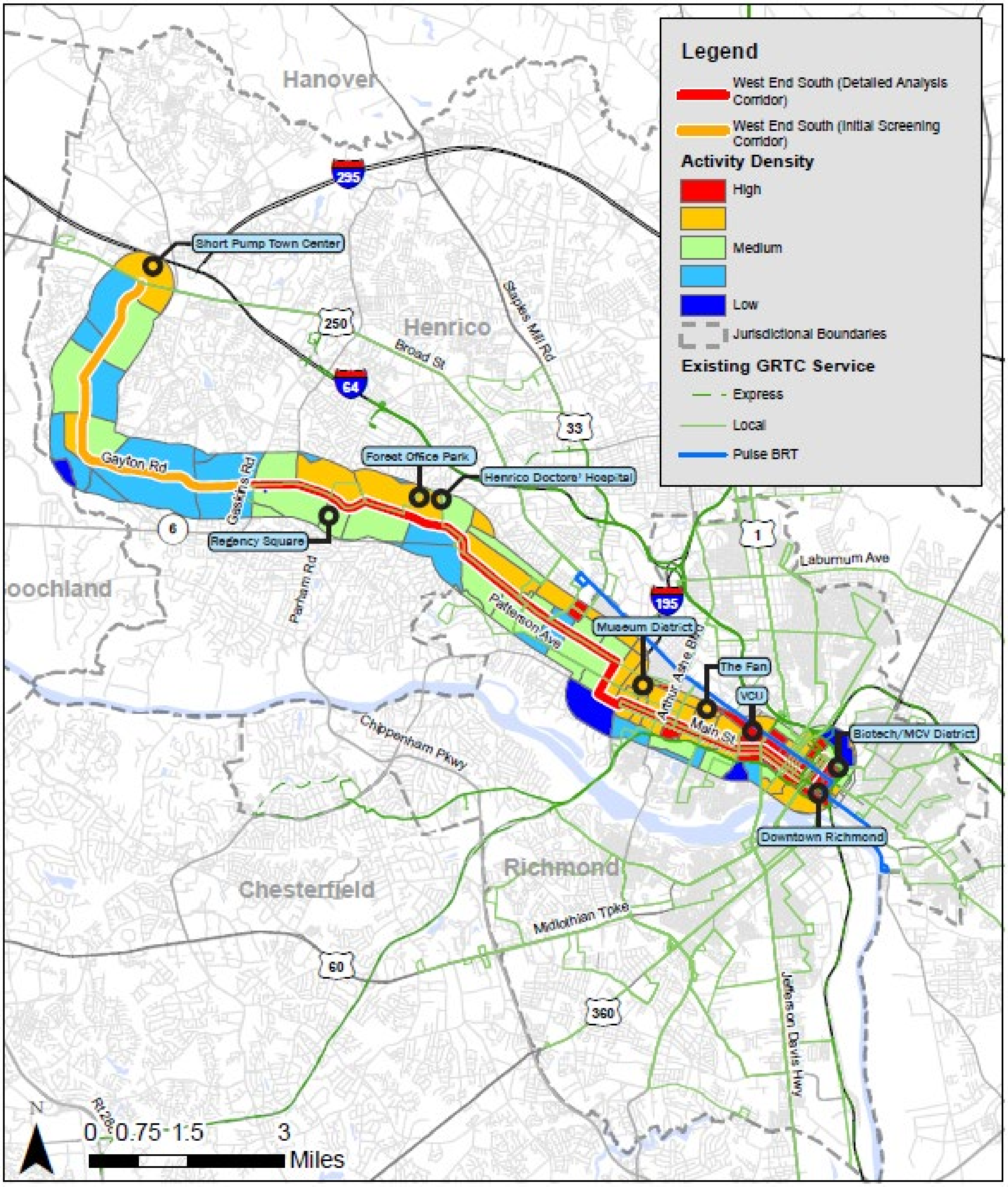
Table 2. Supported Transit Service by Activity Density

Activity Density (Jobs and People per Acre)	Supported Transit Service
1 or less	Demand Response
1 to 10	Demand Response
10 to 25	Fixed Route Bus
25 to 60	Express Bus
60 to 100	BRT/LRT
100 or more	LRT/Rail

Activity density for a sample corridor (West End South) is depicted in **Figure 4**. Areas with a minimum of 10 residents and employees per acre are supportive of fixed route service, which corresponds with TAZs shown in green, orange, or red on the sample map. Areas in blue which have fewer than 10 residents and employees per acre would generally not warrant fixed route service, according to the DRPT Multimodal Design Guidelines. Activity density maps for all Initial Screening corridors are provided in **Appendix A**.

[1] "Multimodal System Design Guidelines," Virginia Department of Rail and Public Transportation. October 2013.

Figure 4. Sample Corridor Activity Density Map



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Employment and Working Populations

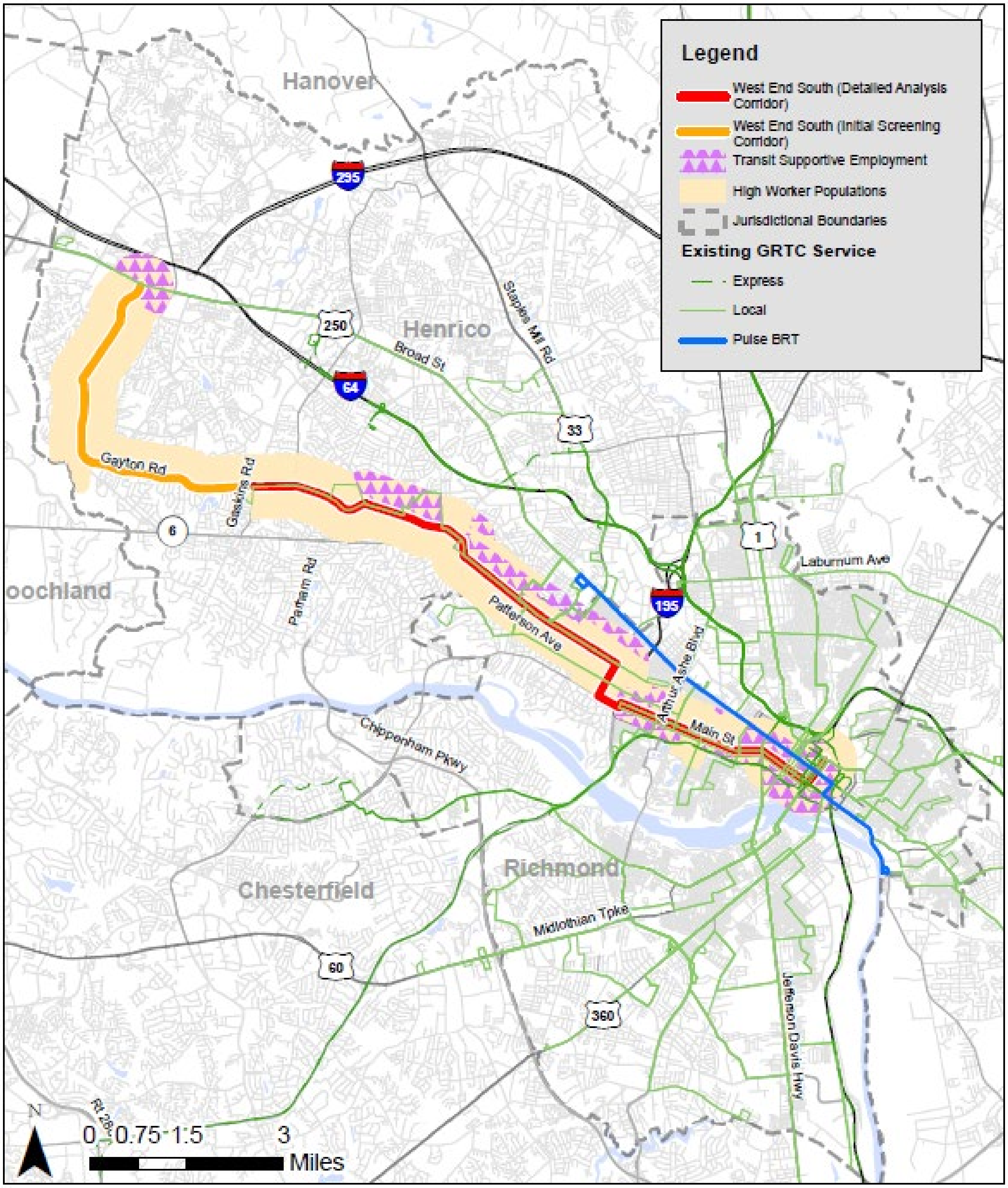
The ability to connect employees to job locations can be another indicator of the demand and need for transit service. To better understand these potential connections, transit-supportive employment and high worker populations were identified for each corridor as part of the Initial Screening step.

Transit-supportive employment areas were defined as locations meeting the DRPT Multimodal Design Guidelines thresholds for fixed route service based on employment density alone. Employment density was determined for each TAZ using 2017 employment estimates from the Richmond Tri-Cities Regional Travel Demand Model. The threshold for transit-supportive employment areas was 10 employees per acre, in line with the minimum activity density requirements for fixed-route bus service.

High worker populations were defined as the top quartile of U.S. Census tracts for workers per acre in the PlanRVA Transportation Planning Organization (TPO) or designated urbanized area. Data from the 2016 American Community Survey (ACS) 5-year estimates was used to identify the top quartile relative to the Richmond area, which included tracts that had 2.34 workers per acre or more.

Transit-supportive employment and high worker population areas are shown for a sample corridor (West End South) in **Figure 5**. Employment and working population maps for all Initial Screening corridors are provided in **Appendix A**.

Figure 5. Sample Corridor Employment and Working Populations Map



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Environmental Justice and Transit-Dependent Populations

By incorporating Environmental Justice (EJ) populations into the analysis metrics, the project team places high value on equitable transportation service and meaningful involvement of all people, regardless of race, ethnicity, income, national origin, disability or educational level, with respect to the development, implementation, and enforcement of laws, regulations, and policies.[2]

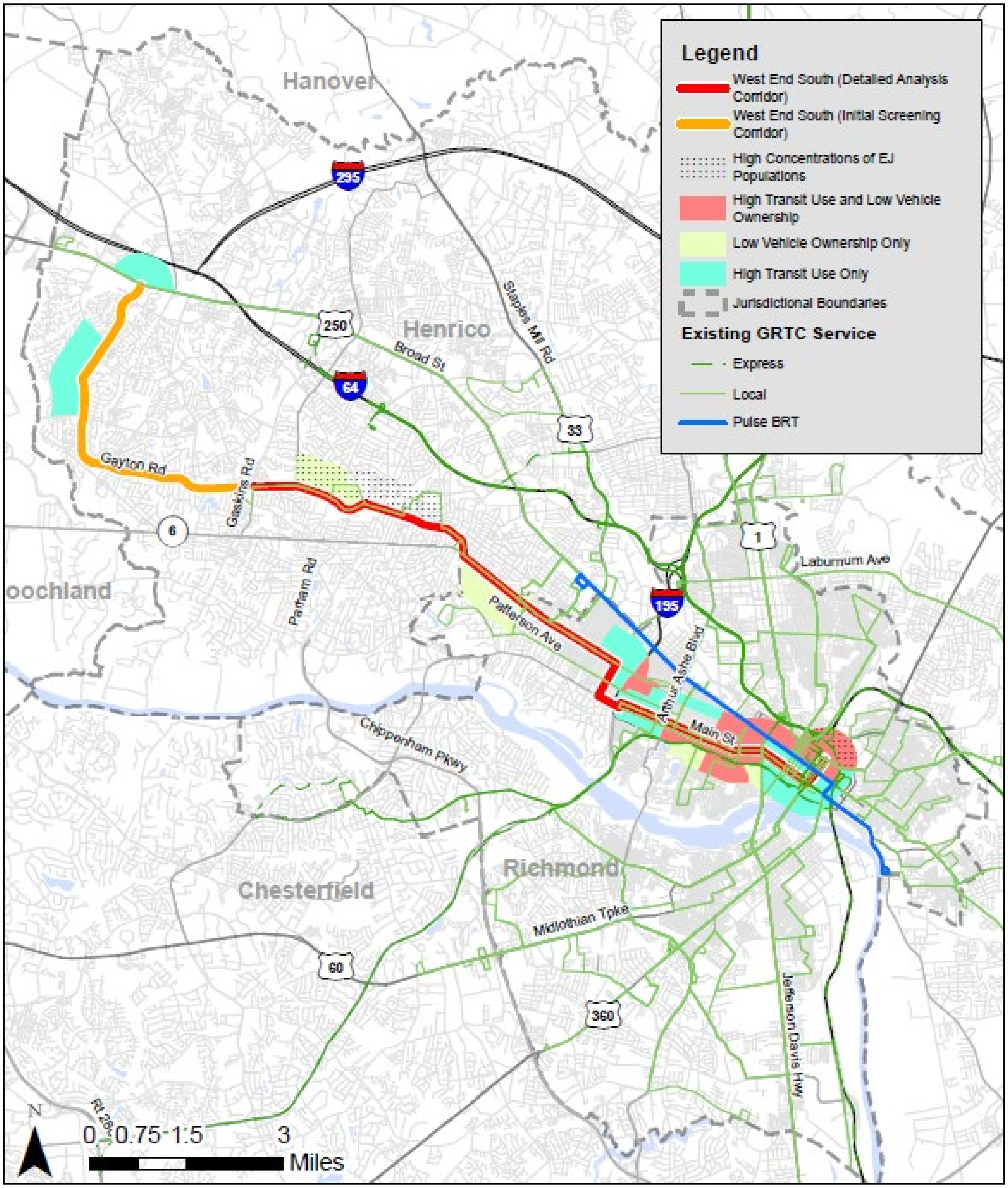
To ensure that the needs of these populations are strongly factored as part of this planning process, an EJ population index was developed. This index considers individuals with disabilities, low-income households, elderly populations, speakers with limited English proficiency, and households with low-vehicle ownership data from the 2016 ACS 5-year estimates. Census tracts with high concentrations of EJ populations, taken as the top 20% of all census tracts in the PlanRVA TPO area by EJ population index, were identified within 0.5 miles of the corridors. The EJ population index methodology used in this study matches the methodology used for PlanRVA's Richmond Regional Park and Ride Investment Strategy study.

In addition to identifying high concentrations of EJ populations, locations of transit-dependent populations, or groups of people who have limited transportation mode options and rely on transit to make most trips, were identified. Factors used to identify transit-dependent populations were low vehicle ownership and high transit use. Low vehicle ownership was defined as the lowest quartile of census tracts by average number of vehicles owned per household, according to 2017 ACS 5-year estimates. To avoid identifying smaller or single person households as having low vehicle ownership, the average number of vehicles per household was normalized by average number of persons per household. The lowest quartile for vehicle ownership was found to be fewer than 0.63 vehicles per person per household. High transit use was defined as the highest quartile of census tracts using transit to get to work as a percentage of all modes, according to the 2017 ACS 5-year estimates. The highest quartile of census tracts for using transit to get to work had a transit mode share of 2.63% or greater.

Environmental Justice and transit-dependent populations metrics for a sample corridor (West End South) are depicted in **Figure 6**. Environmental Justice and transit-dependent populations maps for all Initial Screening corridors are provided in **Appendix A**.

[2] https://www.transportation.gov/transportation-policy/environmental-justice/environmental-justice-strategy

Figure 6. Sample Corridor Environmental Justice and Transit-Dependent Populations Map



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Results

Using the Initial Screening data-driven analysis metrics, the Steering Committee reviewed the 20 corridors recommended for high-frequency transit by the Greater RVA Transit Vision Plan to determine which corridors or segments were most likely to be ready for high-frequency service in the near-term. The Steering Committee reached consensus on which corridors should be advanced to the Detailed Analysis step. This resulted in three levels of recommendations for the corridors:

1. Full Corridor from the Greater RVA Transit Vision Plan recommended for Detailed Analysis
2. Partial Corridor from the Greater RVA Transit Vision Plan recommended for Detailed Analysis
3. Greater RVA Transit Vision Plan corridor Not Recommended for Detailed Analysis

The analysis results from the Initial Screening step are summarized in the matrix shown in **Figure 7**. The matrix ranks the corridors relative to one another for each analysis metric and divides the ranked results evenly into high, medium, and low categories. For EJ and transit-dependent populations, the matrix results are based on the number of acres with high EJ index score and high concentrations of transit-dependent populations along each corridor, respectively. In cases where a partial corridor was considered, the matrix illustrates how the rankings changed when the analysis metrics for only a selected portion of the corridor were considered.

The recommendations from the Initial Screening step are summarized **Figure 8** and **Table 3**. Details on the specific recommendations for each corridor can be found in **Appendix A**. The corridors shown in red in **Figure 8** and listed in the two left most columns in **Table 3** were recommended to advance to the Detailed Analysis step. Existing activity density was a key factor when determining which corridors or portions of corridors could support high-frequency service in the near term. In some instances, the existing activity density indicated that the full corridor recommended in the Greater RVA Transit Vision Plan was not ready to support high frequency service in the near term, but a portion of the corridor might and should be considered for further analysis.

Of the 20 high-frequency corridors evaluated in the Initial Screening step, three full corridors and nine partial corridors from the Greater RVA Transit Vision Plan were recommended for Detailed Analysis. The eight corridors not recommended for further analysis by the Steering Committee were, in most cases, were not recommended due to insufficient activity density to support high-frequency service in the near term. Although these corridors were not considered ready for high-frequency service in the near term, it is recognized that lower frequency service or service in the longer term may still be warranted given the increased demand and development activity. For the eight corridors not recommended to advance to the Detailed Analysis step, potential next steps for further study and alternative considerations for the near term are discussed in **Appendix A**.

Figure 7. Near-Term Strategic Technical Analysis Initial Screening Evaluation Matrix

		Activity Density (Population and Employment Per Acre)		Transit Supportive Employment (Employees Per Acre)		High Worker Populations (Workers per Acre)		Environmental Justice Populations (Number of Acres in Census Tracts with High EJ Index Scores)		Transit-Dependent Populations (Number of Acres with High Concentrations of TD Populations)	
		Full Corridor	Partial Corridor	Full Corridor	Partial Corridor	Full Corridor	Partial Corridor	Full Corridor	Partial Corridor	Full Corridor	Partial Corridor
A	Broad Street - Short Pump	High	High	High	High	High	High	Low	Low	Medium	Medium
B	Hull Street	Medium		Medium		Medium		High		High	
C	Mechanicsville Turnpike	High		High		Low		Low		Medium	
D	Midlothian Turnpike	High	High	High	High	Medium	High	Medium	Medium	High	High
E	West End South	High	High	High	High	High	High	Low	Low	Medium	Medium
F	Airport via Route 60	High	High	High	High	High	Medium	Medium	Medium	Medium	Medium
G	Jeff Davis South to Chester	High	High	High	High	Medium	Medium	Medium	Medium	High	High
H	Route 1 to Ashland	High	High	High	High	Medium	High	Medium	Low	High	High
I	West End Route 6 – Staples Mill / Rt 33	Medium	Low	Medium	Medium	Medium	Low	Medium	Low	Medium	Low
J	Glenside to Midlothian	Low	Medium	Low	Medium	Low	High	Low	Low	Low	Low
K	Laburnum Avenue – Willow Lawn to Airport	Low		Medium		Low		High		Medium	
L	Iron Bridge Road - City to Jeff Davis	Low	Low	Low	Low	Medium	High	High	High	High	High
M	Route 5 South	Low		Low		Low		Low		Low	
N	Lee Davis Road	Medium		Medium		Low		Medium		High	
O	Warwick Road	Low		Low		Medium		High		High	
P	West End and Midlothian	Low	Low	Low	Medium	Low	High	High	Low	Low	Low
Q	West End Route 3 – Lauderdale	Medium		Low		High		Low		Low	
R	West End Route 4 – Pemberton Nuckols	Medium	Medium	Medium	Medium	High	High	High	Medium	Low	Low
S	West End Route 5 – Innsbrook	Medium		High		High		High		Low	
T	West End Route 7 – Regency to Azalea	Medium	Medium	Medium	Medium	High	High	Medium	Medium	Medium	Medium
Low / Medium / High		Low = 2.0 - 8.0 Medium = 8.1 - 11.0 High = 11.1 - 18.0		Low = 0 - 3.5 Medium = 3.51 - 6 High = 6.01 or more		Low = 0 - 2.06 Medium = 2.061 - 2.5 High = 2.51 or more		Low = 0 - 2,100 Medium = 2,101 - 3,000 High = 3,001 or more		Low = 0 - 750 Medium = 751 - 1,500 High = 1,500 or more	

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Figure 8. Near-Term Strategic Technical Analysis Initial Screening Corridor Recommendations

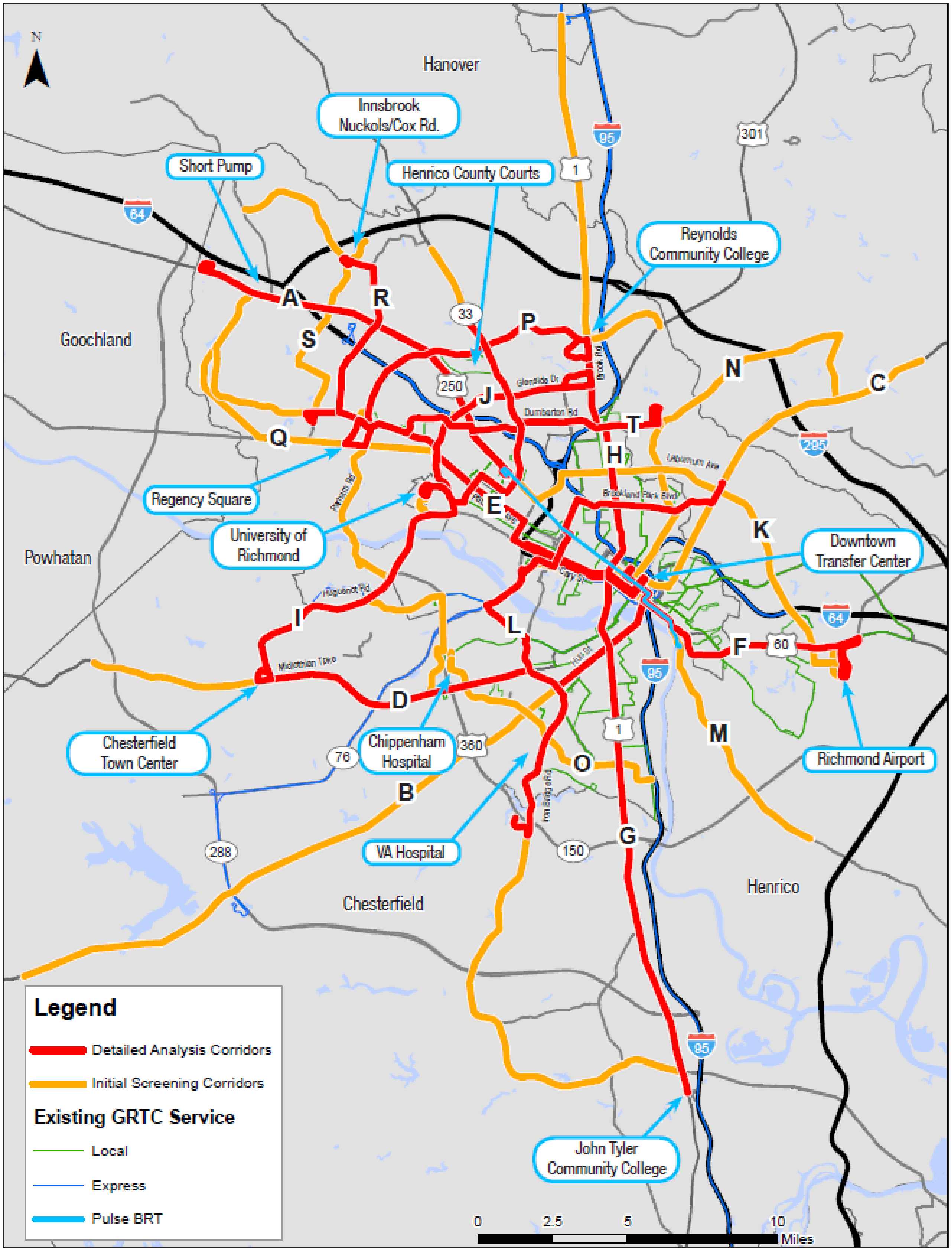

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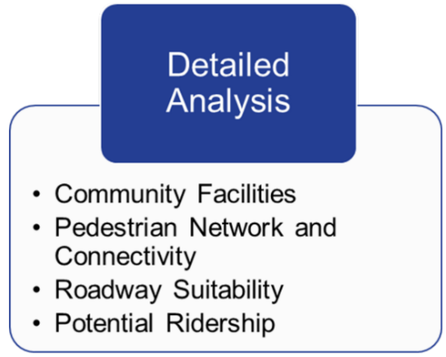
Table 3. Near-Term Strategic Technical Analysis Initial Screening Results

Full Corridor Recommended for Detailed Analysis	Partial Corridor Recommended for Detailed Analysis	Corridor Not Recommended for Detailed Analysis
A. Broad Street – Short Pump	**D.** Midlothian Turnpike (Downtown Richmond to Chesterfield Towne Center)	**B.** Hull Street
F. Airport via Route 60	**E.** West End South (Downtown Richmond to Gayton Crossing Shopping Center)	**C.** Mechanicsville Turnpike
G. Jeff Davis South to Chester	**H.** Route 1 to Ashland (Downtown Richmond to Reynolds Community College)	**K.** Laburnum Avenue – Willow Lawn to Airport
	I. West End Route 6 – Staples Mill/ Route 33 (Chesterfield Towne Center to Staples Mill Marketplace)	**M.** Route 5 South
	J. Glenside to Midlothian (University of Richmond to Belmont Park)	**N.** Lee Davis Road
	L. Iron Bridge Road – City to Jeff Davis (Henrico Plaza Shopping to Ukrop Park/SwimRVA Complex)	**O.** Warwick Road
	P. West End and Midlothian (Regency Square Shopping Center to Reynolds Community College)	**Q.** West End Route 3 – Lauderdale
	R. West End Route 4 – Pemberton Nuckols (Regency Square to Innsbrook Office Park)	**S.** West End Route 5 - Innsbrook
	T. West End Route 7 – Regency to Azalea (Regency Square Shopping Center to Henrico County Center for the Arts)	

Detailed Analysis

Overview



Detailed Analysis was the second step in determining which corridors were most viable for near-term implementation of high-frequency service. This step looked at the 12 corridors (three full corridors and nine partial corridors) identified in the Initial Screening step and evaluated each corridor using additional data-driven metrics and Steering Committee feedback. The analysis metrics considered in this step included the presence of community facilities, pedestrian network and connectivity, roadway suitability, and ridership potential. These analysis metrics primarily assessed each corridor's ability to attract enough riders to support high-frequency service in the near term and identified the additional physical infrastructure that would be needed to support the service.

The Steering Committee participated in a December 10, 2019 work session to review the results of the Detailed Analysis, provide input on near-term viability of the corridors for high-frequency service, and reach consensus on which corridors should be advanced to the Implementation Feasibility step.

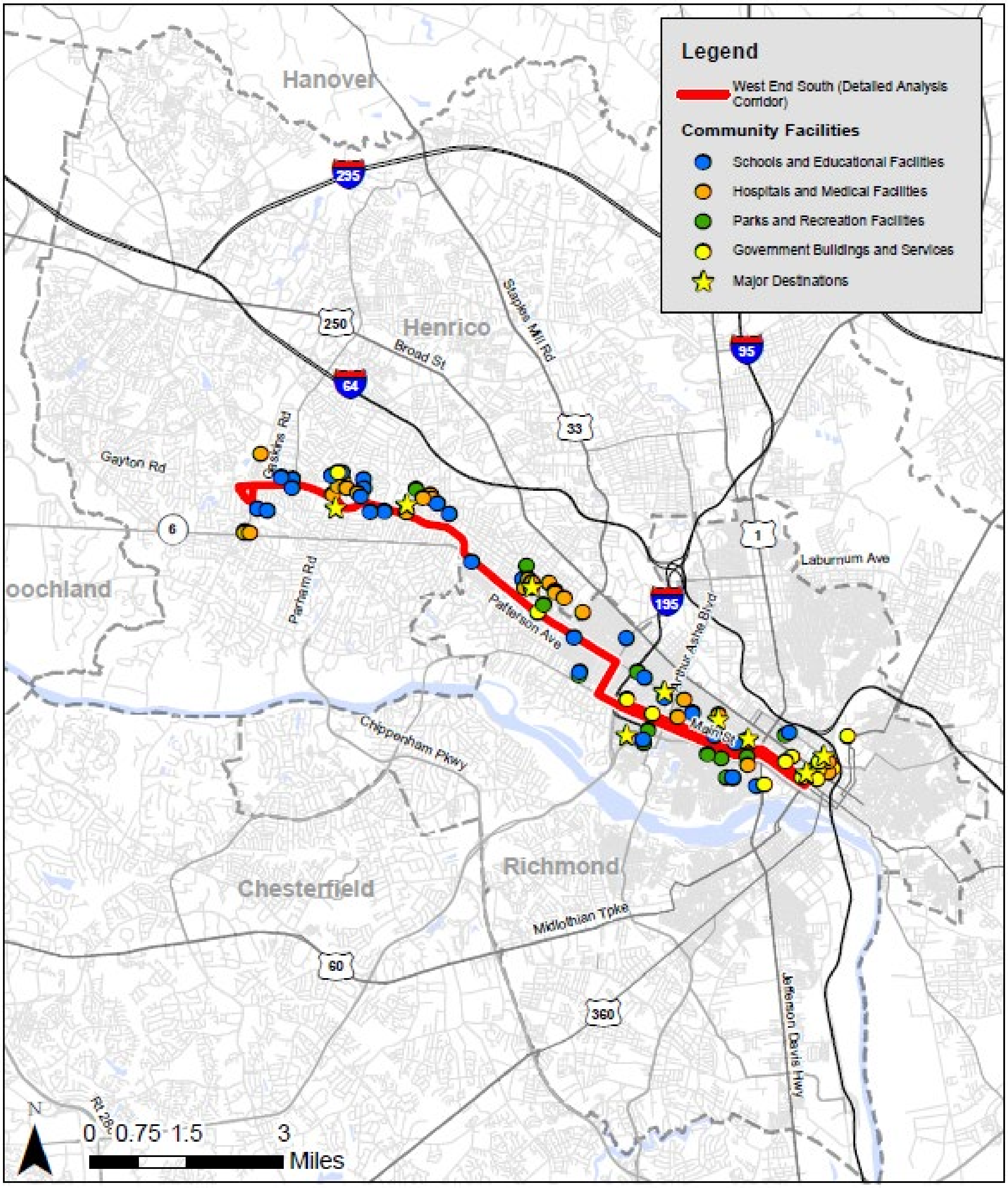
Detailed Analysis Metrics

Community Facilities

The presence of community facilities is an indicator of the need to provide people with access to these services and the resulting demand for transit access. Community facilities within 0.5 miles of each corridor were identified. These facilities include destinations such as schools and educational facilities, hospitals and medical facilities, parks and recreation facilities, government buildings and services (including post offices; courts; city, county, and state offices; and libraries), and grocery stores. These destinations are essential to everyday life, and high-frequency service to these destinations can increase the quality of life of residents in the Richmond region. Community facilities GIS data was gathered from public websites of Henrico County, Chesterfield County, and the City of Richmond. Major destinations were identified and included large shopping centers, universities, industrial or commercial districts, large parks, and county and city government centers.

Community facilities for a sample corridor (West End South) are shown in **Figure 9**. Maps showing community facilities along all Detailed Analysis corridors are provided in **Appendix A**.

Figure 9. Sample Corridor Community Facilities Map



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Pedestrian Network and Connectivity

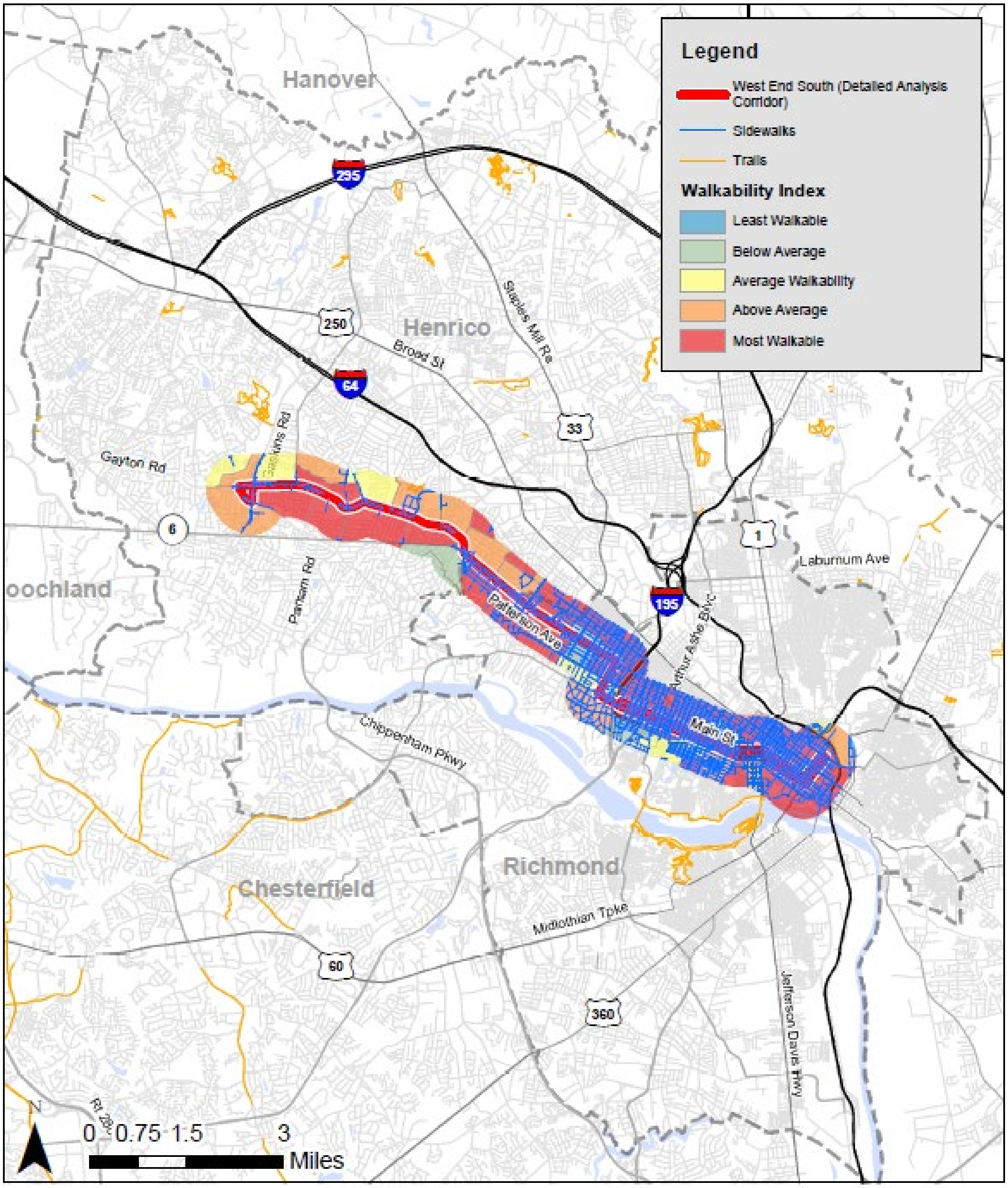
The presence of pedestrian infrastructure is an indicator of transit accessibility and connectivity to surrounding destinations and community facilities. To assess the existing pedestrian network, the linear feet of roadway (excluding limited-access highways) within 50 feet of a pedestrian facility (sidewalks and trails) was measured for the area within 0.5 miles of each corridor. Locations of existing pedestrian facilities were provided in GIS layers by Henrico County, Chesterfield County, and the City of Richmond.

In addition to identifying the existing infrastructure, people's desire to walk, or "walkability", in the vicinity of the corridor was considered important to determine. A National Walkability Index of the Environmental Protection Agency (EPA) scores the walkability of census block groups based on the mix of employment types, amount of occupied housing, intersection density, and predicted commute mode split. It is important to note that this index does not take into account terrain or the availability of pedestrian facilities. Instead, a high National Walkability Index score indicates an area that might be desirable to walk in if there were safe sidewalks and trails.

To add a realistic factor, the existing pedestrian infrastructure was overlaid on the National Walkability Index data to highlight areas where there may be a strong desire to walk but lack sidewalk/trail facilities. This information helped to identify gaps in the pedestrian network and locations where sidewalk may need to be added as part of implementing transit service.

The pedestrian network and National Walkability Index surrounding a sample corridor (West End South) is shown in **Figure 10**. Pedestrian network and connectivity maps for all Detailed Analysis corridors are provided in **Appendix A**.

Figure 10. Sample Corridor Pedestrian Network and Connectivity Map



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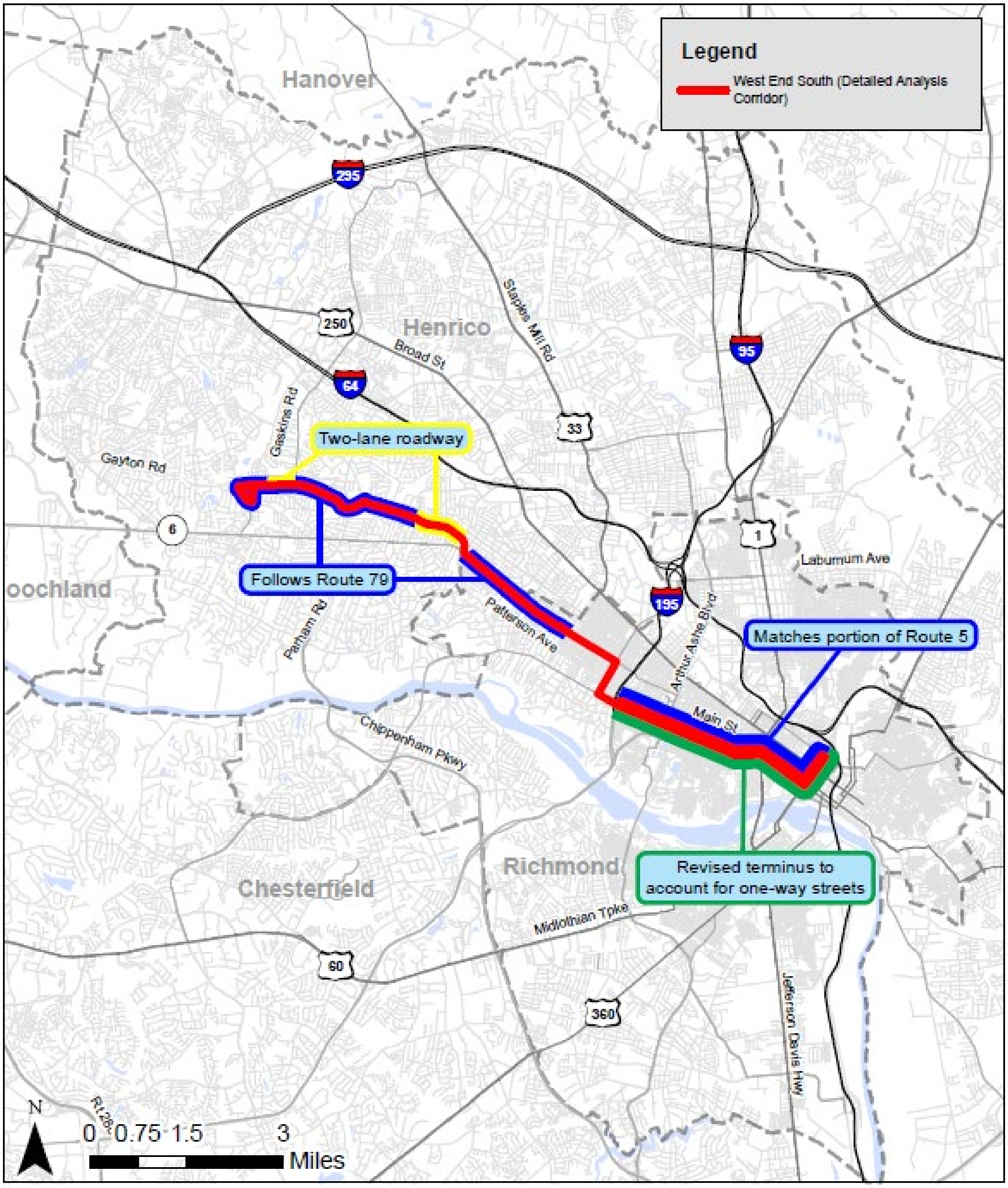
Roadway Suitability

The characteristics of the existing roadway corridors making up the network often dictate the suitability of a corridor to accommodate transit service. Roadway characteristics including one-way streets, two-lane roadways, intersections that present challenges for bus maneuvers, and inefficient or illogical termini locations were identified along each of the 12 corridors. Implementation of transit service on corridors with physical limitations requires an extra level of analysis since implementation can result in additional capital costs for roadway improvements. Transit service along one-way streets requires buses to run along different streets when traveling inbound and outbound, which can cause rider confusion. In addition, buses running on two-lane roadways can cause traffic congestion and delays when buses stop to let passengers on and off. Roadway geometry that could create difficult turning maneuvers for buses may require intersection improvements prior to operating transit service. Inefficient or illogical termini locations may result in longer travel times and be detrimental to on-time performance while not supporting strong ridership.

In addition to identifying roadway characteristics of each corridor, segments where the Detailed Analysis corridors overlapped with existing GRTC routes were identified. Since transit service is already provided along these segments, minimal roadway improvements are likely to be needed to implement additional transit service at these locations.

The roadway suitability characteristics for a sample corridor (West End South) are shown in **Figure 11**. Roadway suitability maps for all Detailed Analysis corridors are provided in **Appendix A**.

Figure 11. Sample Corridor Roadway Suitability Map



Ridership Potential

Ridership potential is an indicator of the demand for transit service along a corridor. This metric was estimated for each of the 12 corridors using existing GRTC ridership (as of January 2019) and associated activity density. To develop ridership potential, the TAZs within 0.5 miles of existing GRTC routes were identified and divided into low, medium, and high activity density categories. The TAZs were evenly divided into the three activity density categories and for each category, an average daily ridership per TAZ was calculated. As this study is focused on implementation of high-frequency service, only existing GRTC routes with frequencies less than 60 minutes (i.e. 15-minute or 30-minute service) were used in the calculation. Furthermore, TAZs with exceptionally high ridership and TAZs containing more than two GRTC local routes were removed from the calculation since these locations were considered outliers and not representative of the ridership potential expected along the corridors. The resulting ridership per TAZ along existing GRTC routes is summarized in **Table 4** for each of the three activity density categories.

Table 4. Average Daily Ridership by Activity Density Category

Activity Density Category	Number of TAZs	Average Daily Ridership per TAZ
Low	56	42.6
Medium	57	50.3
High	55	66.2

Next the TAZs within 0.5 miles of the proposed corridors were classified into the same low, medium, and high activity density categories. The average daily ridership per TAZ based on the existing GRTC routes and associated activity density category were applied to the TAZs along the 12 corridors. The ridership potential for each TAZ along a corridor was added together to calculate a total corridor average daily ridership potential. An average daily ridership potential range was calculated for each corridor as +/- 25% of the average daily ridership potential. A summary of the ridership potential ranges for each Detailed Analysis corridor is provided in **Table 5**. The ridership potential ranges presented are inclusive of existing ridership; therefore, net new ridership on a corridor with existing GRTC service would be less than what is shown in the ridership potential ranges.

To allow for equitable comparison of corridors of varying lengths, ridership productivity metrics were calculated for each of the corridors. These metrics included boardings per mile, boardings per trip, and boardings per hour. While longer distance corridors may have higher total ridership potential, these corridors also require more service miles, trips, and service hours operating to run the same frequency as a shorter distance route. As a result, the ridership productivity metrics provide a means to compare the effectiveness of transit service in each corridor regardless of the corridor length. The ridership productivity metrics for each of the corridors are provided in **Table 5** as well as in **Appendix A**.

It is important to note that ridership *potential* developed for this study is intended to provide a high-level comparison among corridors and should not be confused with ridership *forecasts*. Ridership forecasts would take into consideration other elements such as person trip patterns within each corridor, service levels, regional transit network connectivity, auto versus transit speeds and associated travel times, transit fares, and parking costs.

Table 5. Ridership Potential by Corridor

Corridor	Daily Ridership Potential Range	Boardings per Mile Range	Boardings per Trip	Boardings per Hour
A. Broad Street – Short Pump	1,000 – 1,700	87 – 148	13	19
D. Midlothian Turnpike	2,300 – 3,900	161 – 266	30	30
E. West End South	2,400 – 4,100	151 – 258	32	28
F. Airport via Route 60	1,500 – 2,500	143 – 238	20	26
G. Jeff Davis South to Chester	2,000 – 3,400	120 – 204	26	22
H. Route 1 to Ashland	1,900 – 3,100	176 – 287	25	32
I. West End Route 6 – Staples Mill/ Route 33	1,300 – 2,200	73 – 119	17	16
J. Glenside to Midlothian	600 – 1,100	69 – 126	8	15
L. Iron Bridge Road – City to Jeff Davis	1,700 – 2,800	94 – 155	22	20
P. West End and Midlothian	700 – 1,200	63 – 108	9	14
R. West End Route 4 – Pemberton Nuckols	500 – 900	61 – 110	7	13
T. West End Route 7 – Regency to Azalea	900 – 1,400	77 – 120	12	17

Results

Using the Detailed Analysis data-driven analysis metrics, the Steering Committee reviewed the 12 corridors identified in the Initial Screening step and assessed their viability for high-frequency service in the near-term. At a work session on December 10, 2019, the Steering Committee reached consensus on which corridors should be advanced from the Detailed Analysis step to the Implementation Feasibility step.

The analysis results from the Detailed Analysis step are summarized in the matrix shown in **Figure 12**. Similar to the matrix from the Initial Screening step, each Detailed Analysis corridor was ranked relative to one another for each analysis metric and divided evenly into high, medium, and low categories to allow for a comparison of corridors. Community facility matrix results were based on the number of facilities within 0.5 miles of each corridor. Pedestrian network coverage was ranked based on the percentage of roadway within 0.5 miles of each corridor with pedestrian facilities. For walkability, an average National Walkability Index score was calculated for each corridor. Due to the qualitative nature of the roadway suitability metric, this analysis metric was not included in the matrix but was considered in the overall evaluation. The corridors recommended to advance to the Implementation Feasibility step are shown in **Figure 13**, **Figure 14**, and **Table 6**. Ridership potential and related productivity metrics were the key factors when determining which Detailed Analysis corridors could support high-frequency service in the near term.

Of the 12 high-frequency corridors evaluated in the Detailed Analysis step, five corridors were recommended for Implementation Feasibility assessment. The seven corridors that were not recommended for further analysis by the Steering Committee were, in most cases, not recommended due to insufficient ridership potential to support high-frequency service in the near term. Although these corridors were not determined to be ready for high-frequency service in the near term, lower frequency service may still be warranted, and in some cases is already operating or planned for operation along these corridors. In addition, the Jeff Davis South to Chester (G) corridor was not recommended to advance to the Implementation Feasibility step because implementation of new 30-minute service began in March 2020. The Steering Committee recommended observation of this new service before evaluating the corridor for higher frequency service. For the seven corridors that were not recommended to advance to the Implementation Feasibility step, potential next steps for further study and alternative considerations for the near term are discussed in **Appendix A**.

Figure 12. Near-Term Strategic Technical Analysis Detailed Analysis Evaluation Matrix

		Ridership Potential (Average Daily Riders)	Boardings Per Mile	Boardings Per Trip	Boardings Per Hour	Community Facilities (Number within 0.5 miles)	Pedestrian Network Coverage (Percentage of Roadway Network with Pedestrian Facilities)	Walkability (Average National Walkability Index Score)
A	Broad Street - Short Pump	Medium	Medium	Low	Medium	High	Medium	High
D	Midlothian Turnpike	High	High	High	High	Low	Medium	Medium
E	West End South	High	High	High	High	High	High	High
F	Airport via Route 60	Medium	Medium	Medium	High	Low	Medium	Low
G	Jeff Davis South to Chester	High	Medium	High	Medium	Medium	Medium	Low
H	Route 1 to Ashland	High	High	Medium	High	Medium	High	High
I	West End Route 6 – Staples Mill / Rt 33	Medium	Low	Medium	Medium	High	Low	Medium
J	Glenside to Midlothian	Low	Low	Low	Low	Low	Low	High
L	Iron Bridge Road - City to Jeff Davis	Medium	Medium	Medium	Medium	Medium	Medium	Low
P	West End and Midlothian	Low	Low	Low	Low	High	Low	Medium
R	West End Route 4 – Pemberton Nuckols	Low	Low	Low	Low	Low	Low	Medium
T	West End Route 7 – Regency to Azalea	Low	Low	Low	Medium	Medium	Low	Medium
Low / Medium / High		Low = Less than 1,200 Medium = 1,200 - 2,400 High = More than 2,400	Low = Less than 100 Medium = 100 - 200 High = More than 200	Low = Less than 15 Medium = 15 - 25 High = More than 25	Low = Less than 15 Medium = 15 - 25 High = More than 25	Low = Less than 45 Medium = 45 - 65 High = 65+	Low = Less than 40% Medium = 40 - 60% High = Greater than 60%	Low = 7.8 - 8.3 Medium = 8.3 - 8.8 High = 8.8 - 9.6

Figure 13. Near-Term Strategic Technical Analysis Detailed Analysis Corridor Recommendations

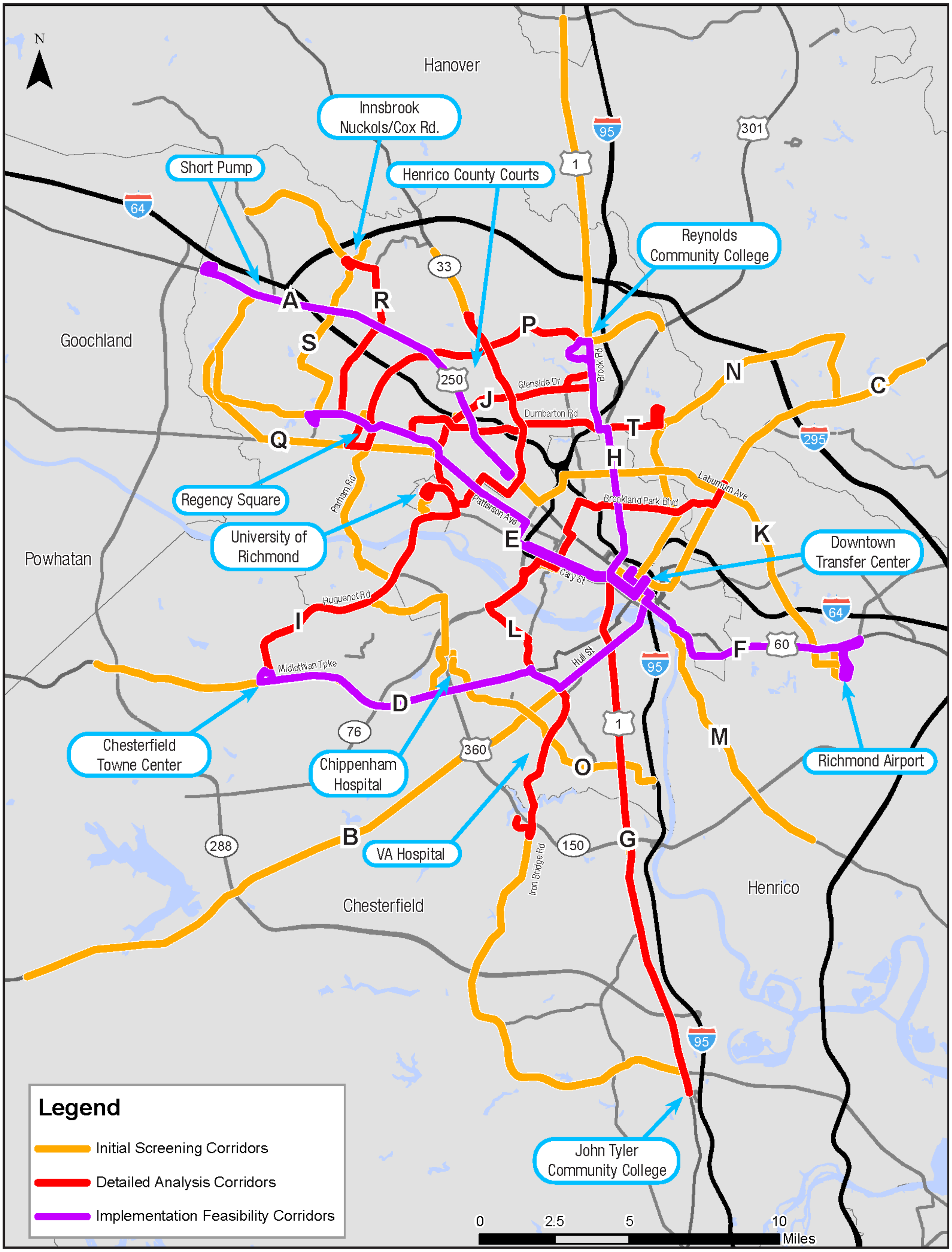


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Figure 14. Corridors Selected for Implementation Feasibility Analysis

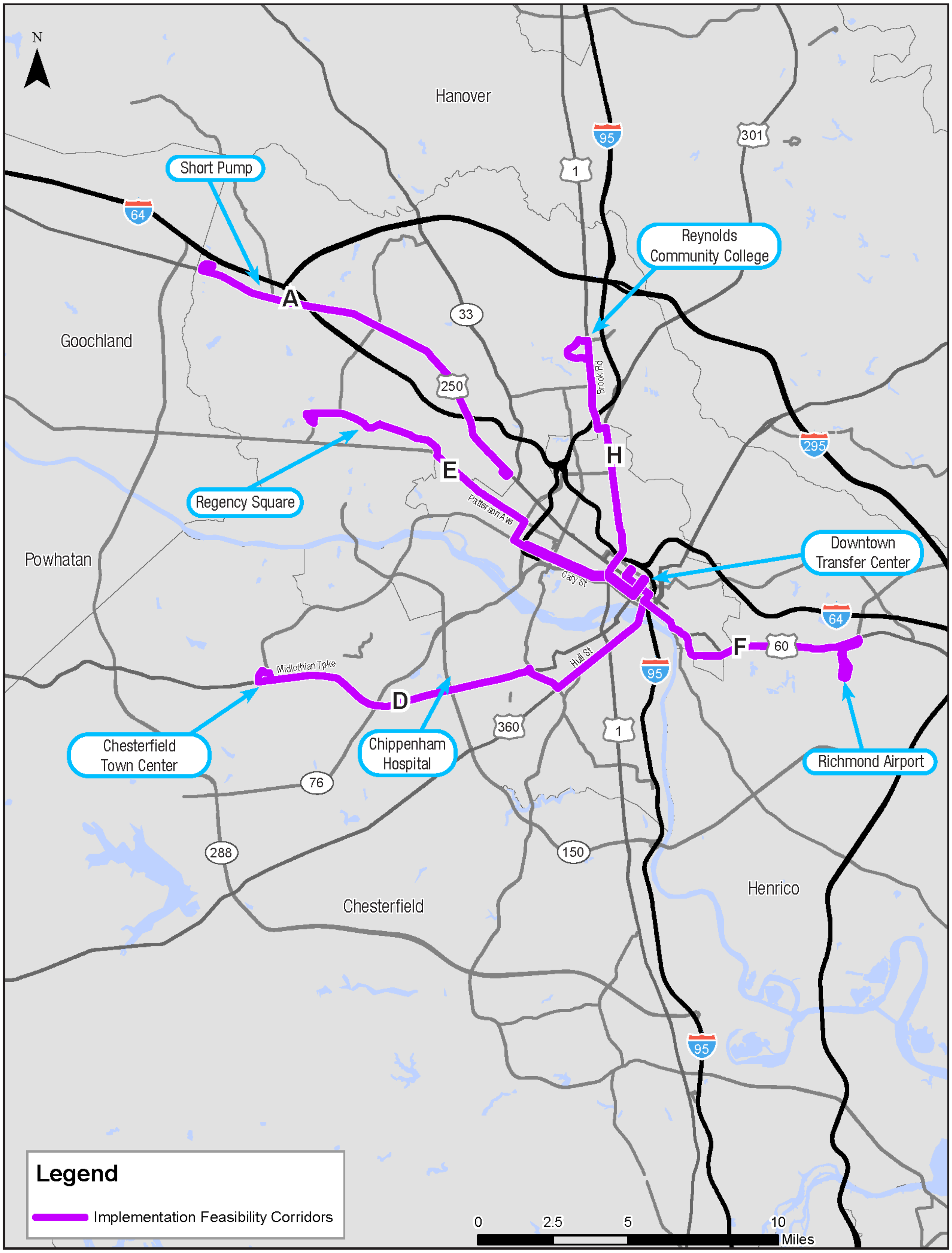

Table 6. Near-Term Strategic Technical Analysis Detailed Analysis Results

Corridor Selected for Implementation Feasibility	Corridor Not Selected for Implementation Feasibility
A. Broad Street – Short Pump	**G.** Jeff Davis South to Chester
D. Midlothian Turnpike (Downtown Richmond to Chesterfield Towne Center)	**I.** West End Route 6 – Staples Mill/ Route 33 (Chesterfield Towne Center to Staples Mill Marketplace)
E. West End South (Downtown Richmond to Gayton Crossing Shopping Center)	**J.** Glenside to Midlothian (University of Richmond to Belmont Park)
F. Airport via Route 60	**L.** Iron Bridge Road – City to Jeff Davis (Henrico Plaza Shopping to Ukrop Park/SwimRVA Complex)
H. Route 1 to Ashland (Downtown Richmond to Reynolds Community College)	**P.** West End and Midlothian (Regency Square Shopping Center to Reynolds Community College)
	R. West End Route 4 – Pemberton Nuckols (Regency Square to Innsbrook Office Park)
	T. West End Route 7 – Regency to Azalea (Regency Square Shopping Center to Henrico County Center for the Arts)

Implementation Feasibility

Overview

Implementation Feasibility was the final step in determining which corridors were most viable for near-term implementation of high-frequency service. This step looked at the five corridors identified in the Detailed Analysis step and evaluated potential service plan options on each corridor, operations and maintenance and captial costs to implement each service plan option, community benefits of the service, and potential funding resources.

Implementation Feasibility

- Service Plan Options
- O&M Cost Estimates
- Capital Cost Estimates
- Project Benefits
- Funding Resources

The Steering Committee participated in a April 3, 2020 work session to review the Implementation Feasibility analysis, provide input on near-term viability of service options presented, and share information on planned capital investments along the corridors that could support advancement of high-frequency service.

Implementation Feasibility Metrics

Service Plan Options

Service plan options were developed for each of the five corridors that advanced to the Implementation Feasibility step. The service plan options represented a range of service frequencies and hours of operation that could be implemented. A minimum of two service plan options were developed for each corridor using the following general assumptions:

- Option 1 typically assumed 15-minute service on the inner portions of the route alignment and 30-minute service on the outer portion of the alignment.
- Option 2 typically assumed 15-minute service on the entire corridor (peak and midday).

All corridor service plan options assumed service was provided seven days a week, including late evenings. The service plans included less frequent service on Sundays and during late evening periods.

Existing GRTC routes were considered when developing service plan options for the proposed corridor routes. Modifications were made to existing GRTC routes to accommodate the proposed corridor routes. These modifications were intended to serve as a starting point for understanding how the proposed routes could be incorporated into the existing GRTC network but do not represent ultimate recommended service changes, which would be addressed prior to service implementation.

Details of the service plan options for each corridor, including maps, can be found in **Appendix A**.

Operations and Maintenance Costs

Operations and maintenance costs for each service plan option were estimated using a rate of $7.627 per total bus-mile, which is inclusive of deadhead mileage to and from the GRTC garage. This rate was provided by GRTC and is reflective of operations and maintenance costs for GRTC's existing service as of January 2020.

Total bus-mile estimates were developed for each service plan option. Revenue bus-miles, the distance that a bus travels while it is in revenue service carrying customers, were calculated based on the route alignment and service frequency. Deadhead bus-miles, the distance that a bus travels when it is not serving customers, were estimated using GRTC's systemwide ratio of total-to-revenue bus-miles of 11.3% (based on GRTC's 2018 National Transit Database submittal).

Capital Costs

Capital costs, inclusive of vehicles, bus stops, shelters, sidewalks, intersection improvements, and transit signal priority, were estimated for each of the five corridors that advanced to the Implementation Feasibility step. Capital cost estimates were developed to provide an understanding of the magnitude of capital investment associated with implementing new service on the proposed corridors. While certain capital costs such as vehicles and bus stops are necessary to initiate transit service, other capital expenditures, such as sidewalks and intersection improvements, could be implemented in a phased approach.

Capital cost estimates were developed for each service plan option based on unit costs and account for the vehicles required to operate service, the length of the corridor, and the existing infrastructure along the corridor. Unit costs were based on actual construction costs of recently completed projects and cost estimates for planned improvements provided by GRTC, Chesterfield County, Henrico County, City of Richmond, and VDOT. **Table 7** summarizes unit costs, in year 2020 dollars. Specific assumptions for each capital cost component are detailed below.

Table 7. Capital Cost Component Unit Costs

Capital Cost Component	Unit Cost
Vehicles	$467,000 per bus
Bus Stops	$9,000 per stop
Shelters	$23,000 per shelter
Sidewalks	$510,000 per mile (Low)
	$1,012,000 per mile (High)
Intersection Improvements	$48,000 per signalized intersection
Transit Signal Priority	$7,000 per bus (new and existing)
	$9,100 per signalized intersection

- **Vehicles** – Vehicle costs assumed a 40-foot Gillig CNG Low-Floor bus at the current negotiated GRTC contract price. The total vehicle cost per corridor accounted for additional vehicles needed to run each service plan option. Depending on the available vehicles in GRTC's fleet at the time of service implementation, the number of additional vehicles required may be less than the estimated amount.
- **Bus Stops** – Bus stop costs assumed installation of basic amenities including a sign, bench, trash can, and waiting area pad (to allow for bus ramp deployment) on portions of the corridor not presently served by transit. Stops were assumed every ¼ mile, in alignment with the service design guidelines in GRTC's Transit Development Plan (TDP), and on both sides of the roadway, although no specific locations were identified. The unit cost estimate per bus stop was based on new stops in Chesterfield County on US Route 1, GRTC-contracted costs for bus stop amenities, and bid costs for projects in Richmond, Henrico County, and Chesterfield County.
- **Shelters** –Shelters were assumed in areas with a high activity density (greater than 25 people and jobs per acre). Shelters were assumed every mile on both sides of the roadway in these locations, but no specific locations were identified. The unit cost estimate was based on GRTC-contracted costs for large shelters including purchase and installation.
- **Sidewalks** – Sidewalk costs were assumed for portions of each corridor where no existing sidewalks are present (including segments where sidewalk projects are currently programmed but not yet installed). Since sidewalk costs are variable dependent upon site conditions, a range of unit costs was used. The lower unit cost estimate for sidewalks was based on the per-mile cost of improvements on US Route 1 in Chesterfield County and John Rolfe Parkway in Henrico County[3]. The higher unit cost estimate for sidewalks was based on per-mile costs provided in VDOT Transportation and Mobility Planning Division's (TMPD) planning-level cost estimate spreadsheet and costs for the Wistar Road project in Henrico County[4].
- **Intersection Improvements** – Intersection improvements were assumed to include pedestrian signal heads, push buttons, marked crosswalks, and ADA-accessible curb ramps. Since the intersections within the City of Richmond typically have these features, intersection improvement costs were assumed only at signalized intersections outside of city limits. Unit cost estimates were based on a variety of intersection improvement projects in Richmond, Henrico County, and Chesterfield County.
- **Transit Signal Priority (TSP)** – TSP costs included the hardware costs for all buses (new and existing) operating in the corridor and each signalized intersection in the corridor. Unit cost estimates were based on a proposed Hampton Roads Transit TSP project.

Details of the capital costs for each corridor service plan option, provided by component, are provided in **Appendix A**.

[3] https://henrico.us/projects/john-rolfe-parkway-sidewalk/
[4] https://henrico.us/projects/wistar-road-sidewalk/

Corridor Benefits

Corridor benefits were evaluated using results of the data-driven analysis metrics from the Initial Screening and Detailed Analysis. The analysis metrics were compared across the five Implementation Feasibility corridors (rather than between all 20 high-frequency corridors) to provide an understanding of the relative corridor benefits and to facilitate regional discussions in order to prioritize corridors for near-term local service implementation. A summary of the analysis metrics from the Initial Screening and Detailed Analysis steps are listed in **Table 8**.

Table 8. Analysis Metrics Used for Evaluating Relative Corridor Benefits

Initial Screening Metrics	Detailed Analysis Metrics
Activity Density *(Population and Employment per Acre)*	Ridership Potential *(Average Daily Riders)*
Transit-Supportive Employment *(Employees per Acre)*	Boardings per Mile
High Worker Populations *(Workers per Acre)*	Boardings per Trip
Environmental Justice Populations *(Acres within Census Tracts with High EJ Index Scores)*	Boardings per Hour
Transit-Dependent Populations *(Acres within Census Tracts with High Concentrations of Transit-Dependent Populations)*	Community Facilities *(Number within ½ Mile)*
	Pedestrian Network Coverage *(Percentage of Roadway Network with Sidewalks)*
	Walkability *(Average National Walkability Index Score)*

Implementation Feasibility Analysis

Service Plan Options

A summary of service plan options with spans of service and service frequencies for each corridor is provided in **Table 9**. For service plan options where two different termini are listed (such as Corridor D Option 1, which lists both Chesterfield Towne Center and Spring Rock Green as western termini), every other bus on the route would continue onto the farthest limits of the corridor. These service plan options combined would provide 15-minute service in the areas of the corridor where service overlaps. In the Corridor D Option 1 example, this would result in 15-minute service between Downtown and Spring Rock Green and 30-minute service between Spring Rock Green and Chesterfield Towne Center.

Table 9. Summary of Service Plan Options

Corridor	Service Option	Span of Service	Frequency					
			Weekday Peak	Weekday Mid	Weekday Night	Saturday Day	Saturday Night	Sunday
A	Option 1	Weekday: 6:00 am – 11:00 pm Saturday: 6:00 am – 11:00 pm Sunday: 10:00 am – 10:00 pm	15 min	30 min	30 min	30 min	30 min	30 min
A	Option 2	Weekday: 6:00 am – 11:00 pm Saturday: 6:00 am – 11:00 pm Sunday: 7:00 am – 10:00 pm	15 min	15 min	30 min	15 min	30 min	30 min
D	Option 1	*Downtown to Chesterfield Towne Center:* Weekday: 5:00 am – 12:30 am Saturday: 6:00 am – 11:30 pm Sunday: 6:30 am – 11:30 pm	30 min	30 min	30 min	30 min	30 min	30 min
D	Option 1	*Downtown to Spring Rock Green:* Weekday: 6:00 am – 9:00 pm Saturday: 6:00 am – 9:00 pm	30 min	30 min	30 min	30 min	30 min	n/a
D	Option 2	*Downtown to Chesterfield Towne Center:* Weekday: 5:00 am – 12:30 am Saturday: 6:00 am – 11:30 pm Sunday: 6:30 am – 11:30 pm	15 min	15 min	30 min	15 min	30 min	30 min
E	Option 1	*Downtown to Regency Mall:* Weekday: 6:00 am – 12:30 am Saturday: 6:00 am – 11:30 pm Sunday: 7:00 am – 11:30 pm	30 min	30 min	30 min	30 min	30 min	30 min
E	Option 1	*Downtown to Nansemond:* Weekday: 6:00 am – 9:00 pm Saturday: 6:00 am – 9:00 pm	30 min	30 min	30 min	30 min	30 min	n/a
E	Option 2	*Downtown to Regency Mall:* Weekday: 6:00 am – 12:30 am Saturday: 6:00 am – 11:30 pm Sunday: 7:00 am – 11:30 pm	15 min	15 min	30 min	15 min	30 min	30 min

Table 9. Summary of Service Plan Options (Continued)

Corridor	Service Option	Span of Service	Frequency					
			Weekday Peak	Weekday Mid	Weekday Night	Saturday Day	Saturday Night	Sunday
F	Option 1	Weekday: 5:00 am – 12:00 am Saturday: 5:00 am – 12:00 am Sunday: 5:00 am – 12:00 am	30 min	30 min	30 min	30 min	30 min	30 min
	Option 2	Weekday: 5:00 am – 12:00 am Saturday: 5:00 am – 12:00 am Sunday: 5:00 am – 12:00 am	15 min	15 min	15 min	15 min	15 min	15 min
	Option 3	*Route 7A/7B (combined frequency):* Weekday: 5:00 am – 12:00 am Saturday: 5:00 am – 12:00 am Sunday: 5:00 am – 12:00 am	15 min	15 min	15 min	15 min	15 min	15 min
	Option 4	*Airport via Route 60 corridor (F) and Route 7A/7B (combined frequency):* Weekday: 5:00 am – 12:00 am Saturday: 5:00 am – 12:00 am Sunday: 5:00 am – 12:00 am	*F:* 30 min *7A/7B:* 15 min	*F:* 30 min *7A/7B:* 15 min	*F:* 30 min *7A/7B:* 15 min	*F:* 30 min *7A/7B:* 15 min	*F:* 30 min *7A/7B:* 15 min	*F:* 30 min *7A/7B:* 15 min
H	Option 1	*Downtown to Parham:* Weekday: 6:00 am – 12:30 am Saturday: 6:00 am – 11:30 pm Sunday: 7:00 am – 11:30 pm	30 min	30 min	30 min	30 min	30 min	30 min
		Downtown to Azalea: Weekday: 6:00 am – 9:00 pm Saturday: 6:00 am – 9:00 pm	30 min	30 min	30 min	30 min	30 min	n/a
	Option 2	*Downtown to Parham:* Weekday: 6:00 am – 12:30 am Saturday: 6:00 am – 11:30 pm Sunday: 7:00 am – 11:30 pm	15 min	15 min	30 min	15 min	30 min	30 min

Operations & Maintenance Costs

A summary of operations and maintenance cost (O&M) estimates for each service plan option is presented in **Table 10**. For each service plan option, the minimum number of vehicles needed to provide service during the peak hours of operation was determined. Fleet vehicle requirements accounted for both peak vehicles as well as spare buses to allow for vehicle maintenance and ensure reliable transit service on the corridor. Additional fleet vehicle requirements for the service plan options evaluated ranged from four to nine new buses, depending on the service plan option and service frequency. Annual O&M costs provided in the table are in addition to costs for existing GRTC service along the corridor. Additional annual O&M costs ranged from approximately $500,000 to nearly $5,000,000, depending on the service plan option.

Table 10. Summary of Operations and Maintenance Requirements and Costs by Service Plan Option

Corridor	Service Option	Peak Vehicles	Fleet Vehicles	Annual Revenue Hours	Annual Revenue Miles	Total Bus-Miles (Est.)	Annual O&M Cost
A	Option 1	3	4	4,600	68,600	76,200	$581,000
	Option 2	3	4	12,500	186,600	207,300	$1,581,000
D	Option 1	4	5	26,600	268,400	298,200	$2,274,000
	Option 2	5	6	32,400	338,900	376,500	$2,872,000
E	Option 1	3	4	18,200	263,000	292,200	$2,229,000
	Option 2	5	6	27,400	366,200	406,800	$3,103,000
F	Option 1	3	4	20,800	244,100	271,200	$2,068,000
	Option 2	5	6	32,500	449,800	499,700	$3,811,000
	Option 3	4	5	28,200	322,900	358,800	$2,736,000
	Option 4	7	9	49,000	567,000	629,900	$4,804,000
H	Option 1	3	4	17,000	100,800	112,000	$854,000
	Option 2	4	5	21,500	143,200	159,100	$1,213,000

Capital Costs

A summary of capital cost estimates associated with each service plan option is presented in **Table 11**. Two capital cost estimates, low and high, were provided for each service plan to show the range of capital costs that could be incurred. The low capital cost estimate accounted for vehicles and bus stops necessary to initiate transit service. The high capital cost estimate accounted for vehicles, bus stops, shelters, sidewalks (higher unit cost), intersection improvements, and transit signal priority and could be implemented in a phased approach. For Corridor A: Broad Street – Short Pump, there was no difference in capital cost between service plan options as Option 1 and Option 2 require the same number of peak and fleet vehicles.

Variation in total capital cost was largely driven by corridor length. To allow for relative comparison between corridors of varying lengths, capital costs per mile for each service plan option are presented in **Table 12**.

Table 11. Capital Cost Ranges by Service Option

Corridor	Service Option	Low Capital Cost	High Capital Cost
A	Option 1	$ 1,870,000	$ 24,250,000
	Option 2		
D	Option 1	$ 2,740,000	$ 40,050,000
	Option 2	$ 3,210,000	$ 40,510,000
E	Option 1	$ 1,920,000	$ 12,450,000
	Option 2	$ 2,860,000	$ 13,400,000
F	Option 1	$ 1,870,000	$ 23,150,000
	Option 2	$ 2,800,000	$ 24,090,000
	Option 3	$ 2,340,000	$ 34,630,000
	Option 4	$ 3,740,000	$ 44,570,000
H	Option 1	$ 2,190,000	$ 15,440,000
	Option 2	$ 2,650,000	$ 15,910,000

Table 12. Capital Cost Ranges by Service Option Normalized per Mile

Corridor	Service Option	Low Capital Cost per Mile	High Capital Cost per Mile
A	Option 1	$ 163,000	$ 2,108,000
	Option 2		
D	Option 1	$ 192,000	$ 2,800,000
	Option 2	$ 224,000	$ 2,833,000
E	Option 1	$ 121,000	$ 793,000
	Option 2	$ 180,000	$ 843,000
F	Option 1	$ 178,000	$ 2,205,000
	Option 2	$ 267,000	$ 2,294,000
	Option 3	$ 100,000	$ 1,474,000
	Option 4	$ 111,000	$ 1,319,000
H	Option 1	$ 203,000	$ 1,474,000
	Option 2	$ 245,000	$ 1,473,000

Corridor Benefits

Relative corridor benefits according to data-driven analysis metrics evaluated in the Initial Screening and Detailed Analysis steps are provided in **Table 13** and **Table 14**. Darker shades of red indicate that a given corridor had a higher performance for that analysis metric when compared to the other four corridors.

Table 13. Relative Benefits of Corridors by Initial Screening Metrics

Corridor	Activity Density	Transit-Supportive Employment	High Worker Populations	Environmental Justice Populations	Transit-Dependent Populations
A					
D					
E					
F					
H					

Table 14. Relative Benefits of Corridors by Detailed Analysis Metrics

Corridor	Ridership Potential	Boardings per Mile	Boardings per Trip	Boardings per Hour	Community Facilities	Pedestrian Network Coverage	Walkability
A							
D							
E							
F							
H							

Low High

Steering Committee Feedback and Recommendations

As part of the Near-Term Strategic Technical Analysis, the 20 high-frequency corridors identified in the Greater RVA Transit Vision Plan were further evaluated to identify the most viable corridors for near-term implementation and determine the requisite service type and service plan. Using Implementation Feasibility analysis metrics in combination with analysis metrics from the Initial Screening and Detailed Analysis, the Steering Committee reviewed the high-frequency corridors and assessed their overall viability for near-term local service implementation.

At a work session on April 3, 2020, the Steering Committee determined that service plan options presented for three corridors were most feasible for near-term implementation as presented below, along with the specific reasons these corridors were prioritized and considerations for implementation.

- **Corridor D: Midlothian Turnpike - Service Plan Option 1**
    - Provides 15-minute service between Downtown and Spring Rock Green and 30-minute service to Chesterfield Towne Center (served by every other bus)
    - Provides access for environmental justice populations and transit-dependent populations
    - Addresses priority to provide a connection between Downtown and Chesterfield Towne Center identified in the 2019 GRTC Ridership Survey (Appendix B)
    - Implementing the Option 1 service plan allows time to monitor corridor ridership and increase service frequency when the demand for service increases
    - Implementation should be coordinated with service improvements to Corridor H, given that portions of both corridors overlap with existing service on the GRTC Route 1A/B/C
    - Several sidewalk and intersection improvement projects along the corridor and within Chesterfield County are programmed in the Six-Year Improvement Program which will help to address missing links in the pedestrian network and improve accessibility
- **Corridor F: Airport via Route 60 - Service Plan Option 3 (Improvements to GRTC Routes 7A/7B)**
    - Provides for more frequent service between Downtown and the Richmond Airport by increasing service frequency on the high-performing GRTC Route 7A/7B to 15-minute service on the trunk
    - Provides greater access to employment opportunities and retail destinations along the corridor
    - Implementing the Option 3 service plan allows time to monitor demand for a more direct connection between Downtown and the Richmond Airport and determine if or when demand for high-frequency service may be warranted for this corridor
    - Addresses priority to provide a more direct connection between Downtown and the Richmond Airport identified in the 2019 GRTC Ridership Survey (Appendix B)
    - Adding service to the airport via Route 60 was not identified as a top priority by the Steering Committee for near-term, high-frequency service implementation due to the low activity density along Route 60 and corresponding ridership uncertainty

  - Existing GRTC Route 7A/7B is one of GRTC's highest ridership routes and has been identified for improved service frequencies in GRTC's Transit Development Plan
  - Several sidewalk and intersection improvement projects along the corridor and within Henrico County are programmed in the Six-Year Improvement Program which will help to address missing links in the pedestrian network and improve accessibility
- **Corridor H: Route 1 North - Service Plan Option 1**
  - Provides 15-minute service between Downtown and Azalea Avenue and 30-minute service to Parham Road (served by every other bus)
  - Supports access to employment for transit-dependent populations
  - Connection between Downtown and Brook Road is responsive to priorities from the GRTC Ridership Survey
  - Implementing the Option 1 service plan allows time to monitor corridor ridership and increase service frequency when the demand for service increases
  - Implementation should be coordinated with service improvements to Corridor D, given that portions of both corridors overlap with existing service on the GRTC Route 1A/B/C
  - Several sidewalk and intersection improvements along the corridor are programmed in the Six-Year Improvement Programs for Henrico County and VDOT, which will help to address missing links in the pedestrian network and improve accessibility

While service plan options in other corridors may also be feasible in the near-term, these three recommended service plan options should take highest priority in continuing to advance the region toward the vision established in the Greater RVA Transit Vision Plan. Exact implementation timelines for study recommendations will continue to be based on local and regional priorities and availability of funding.

Potential Funding Sources

A variety of federal, state, and local funding sources are available that can be utilized to implement new transit service. These funding sources are applicable for different service implementation elements including planning and design of routes and associated infrastructure improvements; infrastructure construction including sidewalks and intersection improvements; transit capital improvements such as bus fleet expansion, bus stops, and technology investments; marketing efforts; and operations and maintenance expenses. The applicable uses specific to each funding source are summarized in **Table 15**. Additional details on each funding source are provided in **Appendix C**.

Table 15. Potential Funding Sources with Applicable Service Implementation Activities

	Planning and Design	Construction of Infrastructure Improvements	Transit Capital Improvements	Marketing	Operations and Maintenance Expenses
Federal					
REGIONAL SURFACE TRANSPORTATION BLOCK GRANT (RSTBG) PROGRAM	✓	✓	✓	✓	
BETTER UTILIZING INVESTMENTS TO LEVERAGE DEVELOPMENT (BUILD) GRANTS	✓	✓	✓		
TRANSPORTATION ALTERNATIVES SET-ASIDE	✓	✓	✓		
FTA SECTION 5303 – METROPOLITAN PLANNING	✓				
CONGESTION MITIGATION AND AIR QUALITY (CMAQ) IMPROVEMENT PROGRAM	✓	✓	✓	✓	✓
State					
SMART SCALE	✓	✓	✓		
DRPT CAPITAL ASSISTANCE		✓	✓		
DRPT OPERATING ASSISTANCE					✓
DRPT DEMONSTRATION PROJECT ASSISTANCE	✓	✓	✓	✓	✓
DRPT TECHNICAL ASSISTANCE PROGRAM	✓			✓	
Local					
CENTRAL VIRGINIA TRANSPORTATION AUTHORITY	✓	✓	✓	✓	✓
DEVELOPER NEGOTIATED SITE IMPROVEMENTS		✓	✓		✓
LOCAL GENERAL FUNDS	✓	✓	✓	✓	✓

Next Steps

Implementation Activities

A variety of activities need to occur to implement high-frequency service on the recommended corridors. While these activities will vary in scope and intensity, major implementation activities can generally be classified into the following four categories.

- Identify and secure funding
- Corridor planning
- Vehicle procurement
- Design and construct improvements

These implementation activities are not necessarily sequential and in many cases are interrelated. Given the geographic extents of the recommended corridors, implementation activities will require ongoing regional coordination and collaboration.

Identify and Secure Funding

Funding is needed to support planning and design, capital expenditures and vehicle procurement, and operations and maintenance costs for new transit service. Identifying and securing funding for enhanced service and corridor improvements should start with local jurisdictions and GRTC working together to determine local investments that could be leveraged to secure regional, state, and federal funding. Many potential funding sources have limitations on applicable uses and require matching funds.

Corridor Planning

While the Greater RVA Transit Vision Plan Near-Term Strategic Technical Analysis recommends corridors and service plans for high-frequency service, further planning within each corridor will be needed prior to implementation. Additional planning efforts will be particularly important to appropriately phase corridor improvements to support the enhanced transit services. These additional corridor planning efforts may include:

- Identifying bus stop and shelter locations
- Prioritizing locations where sidewalk and intersection improvements should be constructed
- Identifying technology improvements, such as transit signal priority, and coordinating improvements with existing technologies operated by GRTC and local jurisdictions, such as traffic signal timings and automatic vehicle location and passenger counting systems
- Identifying and evaluating potential opportunities for connections to additional transportation options, such as train stations, airports, park and ride lots and other carpool/vanpool locations
- Refining route schedules for new service to align with existing GRTC service
- Finalizing fleet requirements for service operation

Corridor planning efforts should engage regional stakeholders and the broader public to ensure recommended improvements are responsive to community needs. While the Greater RVA Transit Vision

Plan included public outreach and GRTC regularly solicits public feedback on provided service, these systemwide engagement efforts are not able to capture the necessary corridor-specific understanding needed to implement high-performing transit service. GRTC's most recent passenger survey provides an indication of passenger preferences and priority destinations that would be served by the recommended high-frequency corridors; however, more community input will be necessary to refine service plans and stop locations for each individual corridor. A summary of the passenger survey can be found in **Appendix B**.

Vehicle Procurement

Vehicle procurement needs to occur well in advance of revenue service operations due to long lead times for bus delivery that can extend up to 18 months. As part of the procurement process, installation of vehicle-based technologies should be addressed such that new vehicles are delivered in service-ready condition.

Design and Construct Improvements

Based on needs identified during corridor planning, infrastructure improvements will need to advance through design and construction. Bus stops are required prior to service initiation. Other infrastructure improvements including shelters, sidewalks, intersection improvements, and transit signal priority may also warrant design and construction prior to revenue service on a corridor by corridor basis. Capital improvement projects will likely be broken out into different design and construction phases based on funding sources and local priorities. Jurisdictions should assess the appropriate timing of projects based upon corridor specific needs and incorporate the projects into their capital improvement programs as appropriate. In some cases, infrastructure improvement projects may be advanced ahead of transit service implementation while in other cases the improvements may be constructed after service is in operation.

Transit Technology

In addition to the implementation activities discussed in the section above, potential opportunities to integrate existing and emerging transit technologies into the Greater Richmond region's transportation network should be explored to enhance transit operations and improve customer experience and satisfaction. Existing transit technologies allow for accurate tracking of a bus's location (by agency or rider), fare payment, and optimizing transit vehicle flow by improving interactions with traffic signals. GRTC currently uses existing technologies including TSP, automated passenger counters (APCs), mobile fare payment, and real-time transit information systems. While these existing transit technologies continue to advance, there are also emerging transportation technologies and concepts that are changing the way travelers get from one place to another on a broader level. Integration of transit service with shared mobility services such as car sharing, ridesourcing, microtransit, dock and dockless bike and scooter sharing, and autonomous vehicles can help to provide a better overall mobility experience for customers.

Additional details on existing and emerging technologies are discussed in **Appendix D**. Implementation of high-frequency service should consider the appropriate transit technology to utilize in connection with the service. This may mean integration of new routes into GTRC's existing technology systems or the installation of additional technology for a specific route or systemwide. As technology advances, continued evaluation of opportunities to enhance transit service and better integrate transit into the overall transportation network in the Richmond region should occur.

Appendix

Appendix A: Near-Term Strategic Technical Analysis Details

Appendix B: GRTC Passenger Survey

Appendix C: Potential Funding Sources

Appendix D: Transit Technology Memorandum