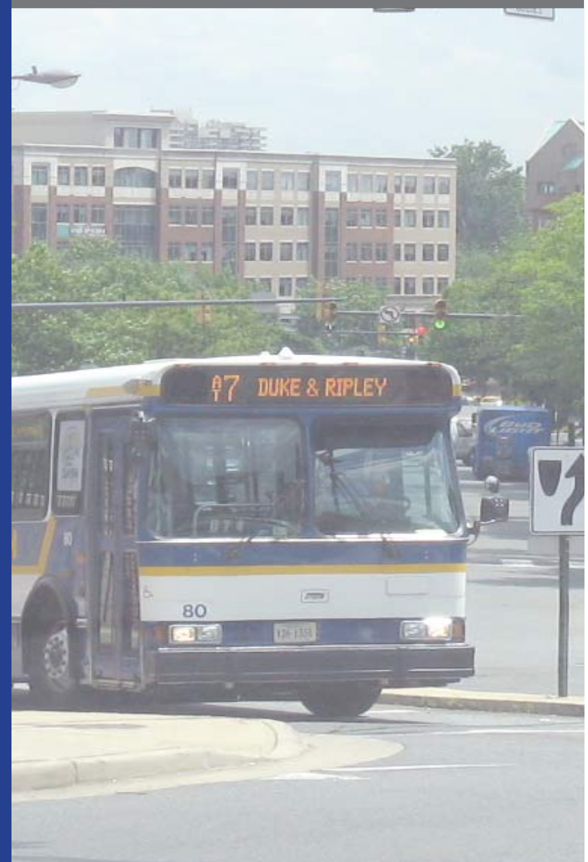
Draft

CityofAlexandria

Transitway Corridor Feasibility Study

Corridor B



April 2012

Kimley-Horn and Associates, Inc.

RK&K

Transitway Corridor Feasibility Study

Draft - Corridor B (Duke Street / Eisenhower Avenue)

April 2012

Prepared For:

City of Alexandria
Department of Transportation & Environmental Services
301 King Street
City Hall
Alexandria, Virginia

www.alexandriava.gov

Prepared By:

Kimley-Horn and Associates, Inc.

Suite 400
11400 Commerce Park Drive
Reston, Virginia
703.674.1300
www.kimley-horn.com

Rummel, Klepper & Kahl, LLP
10306 Eaton Place
Willow Wood II, Suite 240
Fairfax, VA 22030
703.246.0028
www.rkk.com

Table of Contents

List of Figures

List of Tables

Duke Street

introduction

Background

Traffic congestion is a challenging reality in nearly every urban community in the Washington Metropolitan area. Alexandria is subject to travel demand from residents and workers within its jurisdictional boundary and by people traveling through the city. Peak periods extend for multiple hours in the morning and evening on typical weekdays. Incidents and special events occur on a regular basis and add to the already challenging travel conditions. Improving mobility by solely adding car-carrying capacity along existing transportation corridors is an investment with diminishing returns in Alexandria. The physical, monetary, societal, and environmental costs of widening existing streets and constructing new streets to increase single-occupant vehicle mobility in Alexandria are burdens that would be vastly outweighed by the benefits that would be borne by the community.

Comprehensive evaluations of regional transportation system show that a transportation strategy focused on multimodal mobility has the potential to provide the most significant benefit to the City of Alexandria at a manageable cost. A cornerstone of the City's multimodal approach to transportation is high-quality and high-capacity transit facilities and services. Such transit facilities and services are defined by their ability to provide real-time information, desirable amenities, and an enjoyable travel experience to its users.

Transportation Master Plan Context

The Alexandria Transitway Corridor Feasibility Study was incepted to build on principles and concepts developed in the city's adopted Transportation Master Plan (2008), which envisions the following:

> "…a transportation system that encourages the use of alternative modes of transportation, reducing dependence on the private automobile. This system will lead to the establishment of transit-oriented, pedestrian friendly village centers, focused on neighborhood preservation and increased community cohesion, forming a more urban, vibrant and sustainable Alexandria. The City will promote a balance between travel efficiency and quality of life, providing Alexandrians with transportation choice, continued economic growth and a healthy environment."

Figure 1.1: Metrorail in Alexandria

The City's transportation vision, articulated in the Transportation Master Plan, is supported by the following guiding transportation principles:

1. Alexandria will develop innovative local and regional transit options.
2. Alexandria will provide quality pedestrian and bicycle accommodations.
3. Alexandria will provide all its citizens, regardless of age or ability, with accessibility and mobility.
4. Alexandria will increase the use of communications technology in transportation systems.
5. Alexandria will further transportation policies that enhance quality of life, support livable, urban land use and encourage neighborhood preservation, in accordance with the City Council Strategic Plan.
6. Alexandria will lead the region in promoting environmentally friendly transportation policies.
7. Alexandria will ensure accessible, reliable and safe transportation for older and disabled citizens.

Alexandria's citizens are already served by the city's interconnected network of streets; local bus service principally provided by DASH and Metrobus; Metrorail services along the Blue and Yellow lines at the Van Dorn, Eisenhower Avenue, King Street, and Braddock Road stations; and a growing network of sidewalks, trails, and bikeways.

The Transportation Master Plan provides guidance for the long-term adaptation of the city's transportation system to expand pedestrian and bicycle networks, high-quality transit services and facilities, and the role of streets.

While a valuable asset to the Washington Metropolitan area and Alexandria, Metrorail's alignment through the city limits its ability to serve the entirety of Alexandria (Figure 1.1). Regional bus services augment Metrorail by providing a significant amount of coverage throughout the city; however, they are not able to provide the quality and frequency of service ultimately envisioned by city leaders and desired by the traveling public. To realistically achieve the goal of offering high-quality transit services and facilities in key corridors citywide, the Transportation Master Plan identified three corridors (Figure 1.2) for high-quality, frequency, and capacity transit service expansion.

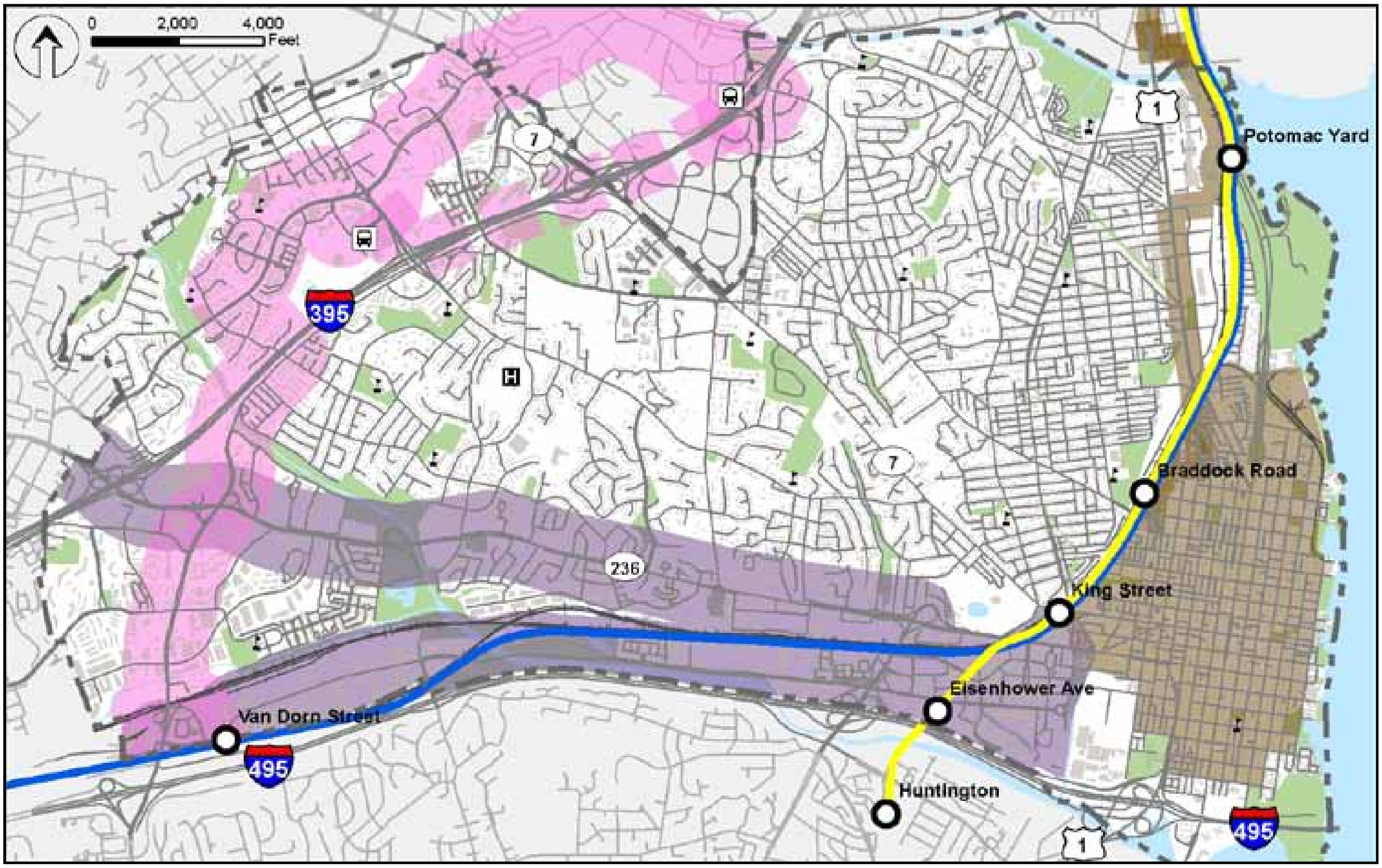
Corridor A: North-South

Corridor A would approximately follow US 1 (Jefferson Davis Highway and Patrick and Henry Streets) from the Fairfax County line in the south to the Arlington County line in the north. It would have the potential to seamlessly connect to planned transit corridors in Fairfax and Arlington Counties. Corridor A would provide services to through-commuters who currently drive along the US 1 corridor and to residents and employees with origins and destinations along the corridor; would function as an alternative to Metrorail services (Blue and Yellow lines); and would improve access to key destinations within the city and in Fairfax and Arlington Counties such as Old Town, Potomac Yard, Crystal City, the Pentagon, and Ft. Belvoir.

Corridor B: Duke Street/Eisenhower Avenue

This corridor would follow Duke Street/ Eisenhower Avenue between Fairfax County to the west and the vicinity of the King Street

Figure 1.2: Transportation Master Plan Identified Transitway Corridors



Metrorail station to the east. Corridor B has the potential to serve the Eisenhower East area, Landmark Mall, Foxchase, Alexandria Commons, King Street Metrorail station, and portions of Old Town. The alignment of the corridor in an approximate east/west orientation would also allow it to connect to Corridor A at US 1 and to Corridor C at Van Dorn Street and Landmark Mall.

Corridor C: Van Dorn Street/Beauregard Street

Corridor C would run along portions of Walter Reed Drive, Beauregard Street, Sanger Avenue, and Van Dorn Street. To the north, the corridor could extend to the Pentagon area and/or could connect to Shirlington. To the south, the corridor would directly connect to the Van Dorn Street Metrorail station, Corridor B, and eventually into Fairfax County. Key destinations along the corridor include the Van Dorn Street Metrorail station, Landmark Mall/Van Dorn Street commercial areas, Kingstowne, the Mark Center, Shirlington, and the Pentagon.

Transportation Master Plan Transitway Goals

The Transportation Master Plan states that the implementation of transit facilities and services in these corridors would seek to achieve the following:

- Provide a seamless transit feeder network
- Focus investments on mobility needs
- Integrate key elements with transit plans in surrounding jurisdictions
- Advocate policy to encourage future transit supportive land-use

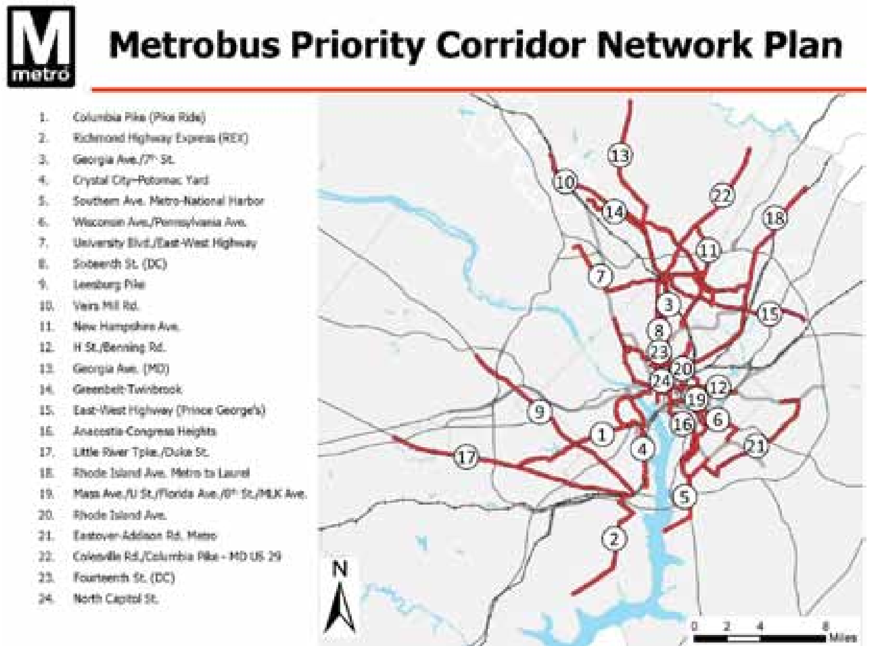


Figure 1.3: WMATA Priority Corridor Network Plan Schematic

Figure 1.4: WMATA Priority Corridor Network Plan Map

Regional Plan Context

Also recognizing the limitations of the existing rail transit and local bus network within the Washington Metropolitan area to serve people's mobility needs today and into the future, the Washington Metropolitan Area Transit Authority (WMATA) and Metropolitan Washington Council of Governments (MWCOG) developed plans for surface-running priority corridor transit services. Figures 1.3 and 1.4 show the designated corridors. Suggesting the benefit of investing in the region's surface transit system, when implemented, WMATA's analyses indicate that regional transit boardings could increase by 3 to 4 percent in the service area. WMATA has three goals for its priority corridor network (PCN):

- Improve competitiveness of bus transit
- Support existing and planned land use and economic development
- Improve efficiency of the transportation system

The plan-designated corridors are candidates for improvements to services through measures such as increases in service frequency (decrease in headways), conversion of general purpose travel lanes to bus-only lanes, transit signal priority (TSP), queue jump lanes, off-board fare collection, and branding. WMATA's PCN follows 23 of the most heavily used Metrobus corridors in the region, covering more than 235 miles of roadway and 250,000 unlinked daily trips. The 23 corridors account for more than half of the daily boardings for all Metrobus routes in the region. There are three designated corridors in Alexandria:

1. US 1 from Pentagon Metrorail station to the Braddock Road Metrorail station
2. Route 7 (Leesburg Pike) from Tysons Corner (West Park) to King Street Metrorail Station

3. Little River Turnpike/Duke Street from City of Fairfax (Route 123) to King Street Metrorail Station

Corridors 1 and 3 overlap portions of two of Alexandria's transitway corridors. Corridor 1 is the northern portion of Corridor A (North-South) in Potomac Yard and northern US 1. Corridor 3 follows Corridor B (Duke Street/ Eisenhower Avenue) along the Duke Street alignment.

Building on WMATA's PCN is a planned interconnected system of other regional priority corridors designated by individual jurisdictions. In 2009, responding to the opportunity for the region to take advantage of economic stimulus funds from the federal government, the MWCOG Transportation Planning Board submitted an application on behalf of the region for funding from the Transportation Investments Generating Economic Recovery (TIGER) grant program administered by the U.S. Department of Transportation (USDOT).

The application contained a request for funding for fourteen priority bus corridors throughout the region, as shown in Figure 1.5. Nine of the corridors included in the application were the same as those identified in WMATA's PCN; however, the application also included the following five new corridors:

1. Van Dorn to the Pentagon via Shirlington in Virginia
2. US-1 Transitway from King Street to the Pentagon in Virginia
3. Theodore Roosevelt Bridge to K Street NW in the District of Columbia
4. The Fourteenth Street Bridge from I-395 to K Street in the District of Columbia
5. Express bus on freeways, specifically I-66 and I-95/I-395

Figure 1.5: MWCOG Planned Priority Bus Corridors

Similar to WMATA's PCN, the MWCOG identified corridors mirror several of those identified in Alexandria's Transportation Master Plan. Corridor 1 is largely Corridor C (Van Dorn/Beauregard) while Corridor 2 the northern and central portion of Corridor A (North-South).

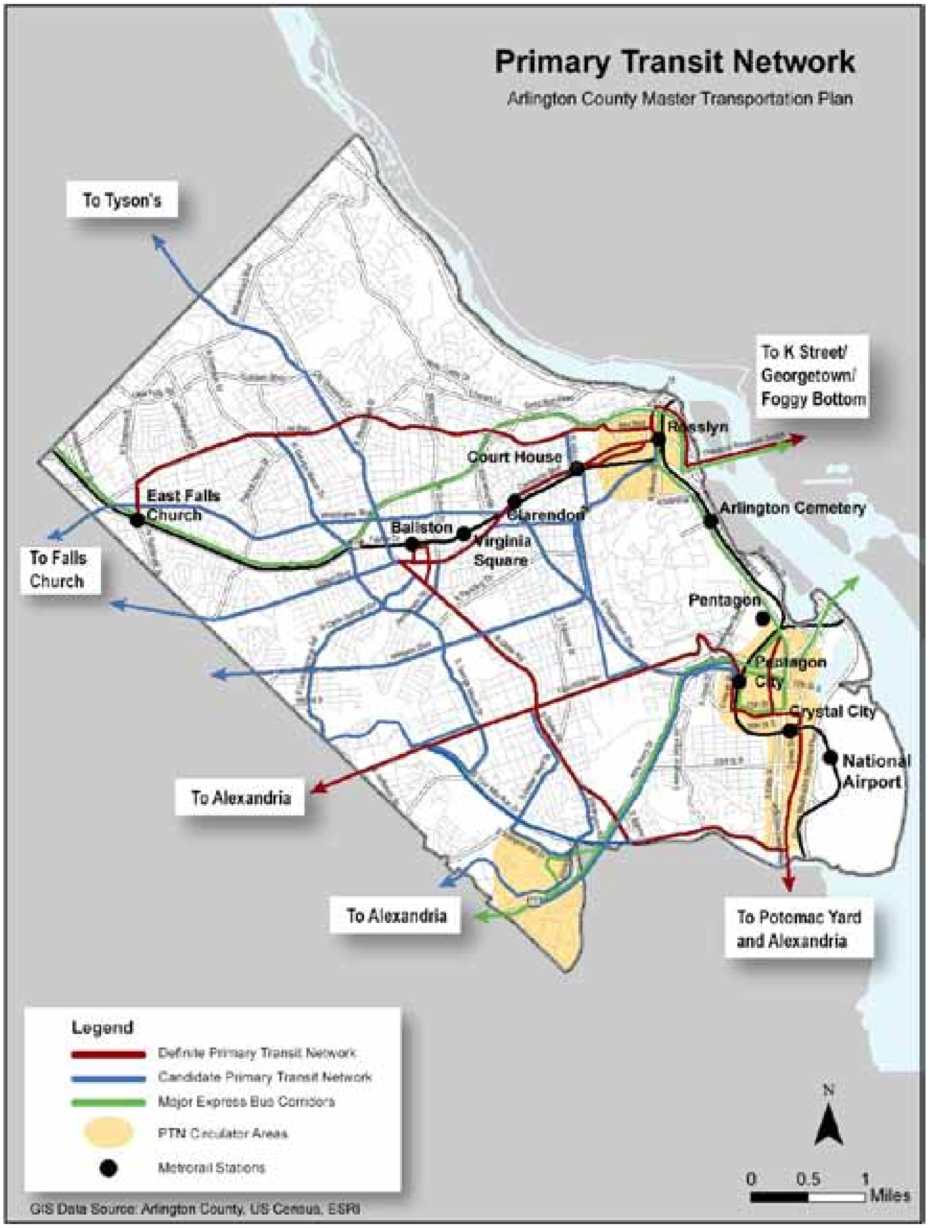


Figure 1.6: Arlington County Planned Primary Transit Network

Neighboring Jurisdiction Plans Context

Arlington County

Arlington and Fairfax Counties each have long-term visions for high-capacity and high-quality transit facility and service expansions. Arlington's primary transit network (PTN) identifies key corridors for the implementation of transit services as shown on Figure 1.6. The PTN is envisioned by Arlington County as a network of transit lines that operate every 15 minutes or less for at least 18 hours a day, 7 days a week. In addition to Metrorail lines through the county, the PCN includes Metrobus and ART bus as well as future streetcar or bus rapid transit lines. On designated PTN roadways, transit operations will receive priority. Corridors that have the potential to eventually connect to Alexandria include the following definite PTN corridors:

- Crystal City/Potomac Yard Corridor. Active coordination and investment between Arlington County and Alexandria is underway in this corridor. Portions of this corridor were awarded TIGER funds for implementation. This corridor is the northern section of Alexandria's Corridor A (North-South).
- Columbia Pike Corridor. Active coordination is underway between Arlington County, Fairfax County, and Alexandria. The Arlington County and Fairfax County sections currently have an Federal Transit Administration guided Alternatives Analysis and NEPA effort underway. This corridor has the potential to connect to northern portions of Alexandria's Corridor C (Van Dorn/Beauregard).

Fairfax County

Like Alexandria, Fairfax County will continue to invest in its transportation future. The identification of the Enhanced Public Transportation Corridor (EPTC) network was one approach developed by the county to address pressing mobility concerns. The EPTC concept was initially introduced during the 1990-1991 Planning Horizons update to the Fairfax County Comprehensive Plan. The approximately 132-mile network of nine EPTCs is entirely within Fairfax County. The EPTCs are intended to serve intra- and inter-county trip purposes. The combination of the EPTCs, the high-quality transit network (HQTN) is intended to provide transit service at a level that is competitive with travel by private vehicle, while being reliable, safe, and attractive to users.

While Fairfax County already provides and has access to local and express bus services, county leaders recognize that these services are made less attractive and effective by deteriorating traffic conditions and roadway congestion. The following EPTCs, representing general alignments, are identified in Fairfax County's Comprehensive Plan:

- Interstate 66 from Prince William County to Arlington County
- Interstates 95/395 from Prince William County to City of Alexandria
- Interstate 495 American Legion Bridge to Woodrow Wilson Bridge
- US 1 (Richmond Highway) & Route 241 (North Kings Highway) from Prince William County to Huntington Metrorail & Woodrow Wilson Bridge
- Route 7 (Leesburg Pike) from Tysons Corner to the City of Alexandria
- Route 28 from Route 267 (Dulles Toll Road) to Prince William County
- Route 267 (Dulles Toll Road) from Route 28 to Interstate 66
- Route 7100/7900 (Fairfax County Parkway/Franconia-Springfield Parkway) from Route 267 (Dulles Toll Road) to Frontier Drive
- Long Branch Railroad (serving Fort Belvoir) from Franconia-Springfield Metrorail Station to Route 1

Fairfax County's US 1, I-95, I-395, I-495, and Route 7 corridors all have the potential to connect with portions of Corridors A (North-South), B (Duke Street/Eisenhower Avenue), and C (Van Dorn/Beauregard) in Alexandria.

Crystal City/Potomac Yard Transit Improvements Project

The Crystal City/Potomac Yard (CCPY) Transit Improvements Project is jointly sponsored by the City of Alexandria and Arlington County in cooperation with WMATA and the Virginia Department of Rail and Public Transportation (DRPT). Figure 1.7 shows Sections A, B, and C of the CCPY project. The project's purpose is to provide high-capacity and high-quality bus service in the five-mile section of the US 1 corridor between the Pentagon in Arlington County and the Braddock Road Metrorail station in Alexandria.

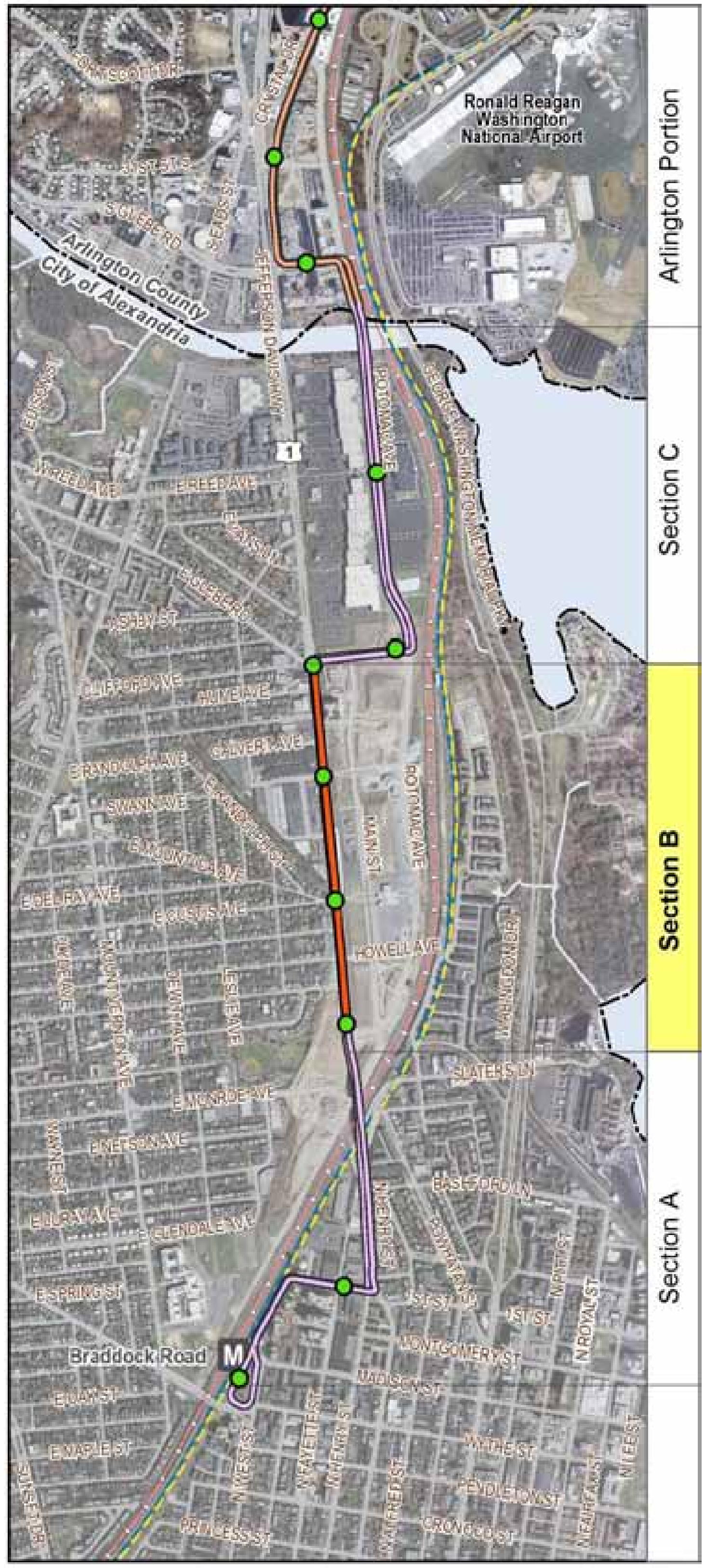


Figure 1.7: Crystal City/Potomac Yard Transit Improvements Project Plan Schematic

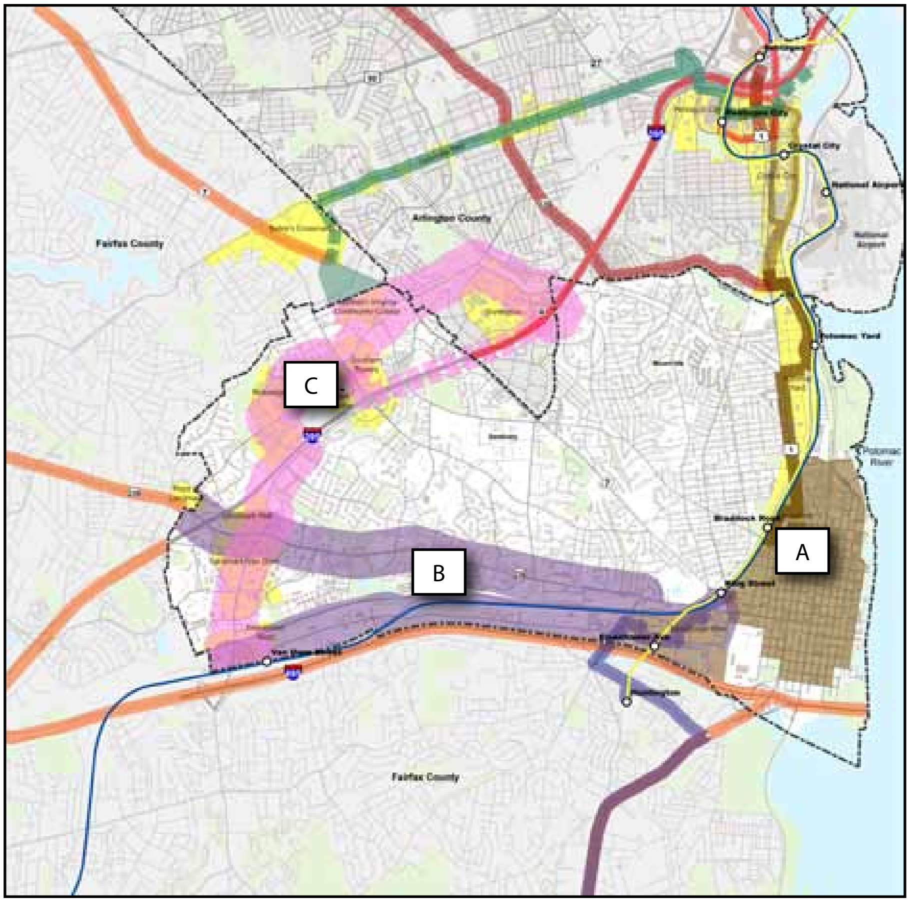


Figure 1.8: Regionally Planned High-Capacity Transit Lines in the Vicinity of Alexandria

The project is in various stages of development, ranging from Alternatives Analysis to construction. In 2010, the City of Alexandria, through MWCOG, received a TIGER grant to build Section B of the Transitway (section from E. Glebe Road to E. Monroe Avenue) in the median of US 1. The City expects that Section C will be built in coordination with the redevelopment of North Potomac Yard. Portions of Section A will be built in coordination with the redevelopment of properties to the north of the Braddock Road Metrorail station.

Purpose of Dedicated Transit Corridors

Local and regional planning studies indicate that maintaining people's mobility in the future will require a diverse transportation system and significant multimodal network investments. The region will need to continue to improve its vehicular transportation network, but also will need to heavily invest in pedestrian and bicycle networks and transit facilities and services in a coordinated manner. While congestion is unlikely to be substantially affected by multimodal investments, people will benefit significantly through the increased number of real choices in the way they travel.

The implementation of WMATA's PCN, MWCOG's additional priority transit corridors, Fairfax County's EPTCs, Arlington County's PTN, and Alexandria's transitway corridors will create the next generation high-capacity transit network in the region. Figure 1.8 shows each of the plan designated corridors in the context of the City of Alexandria.

This transit network will be coordinated with other transit services and facilities regionally and will have the ability to independently serve inter- and intra-jurisdictional trips. When interconnected, this network will offer currently unmet or underserved transit travel demand with attractive, competitive transit services, helping to increase transit ridership, manage vehicular demand on major travel corridors, and increase mobility in a sustainable manner.

In the context of Alexandria, Corridors A (North-South), B (Duke Street/Eisenhower Avenue), and C (Van Dorn/Beauregard) will provide access to

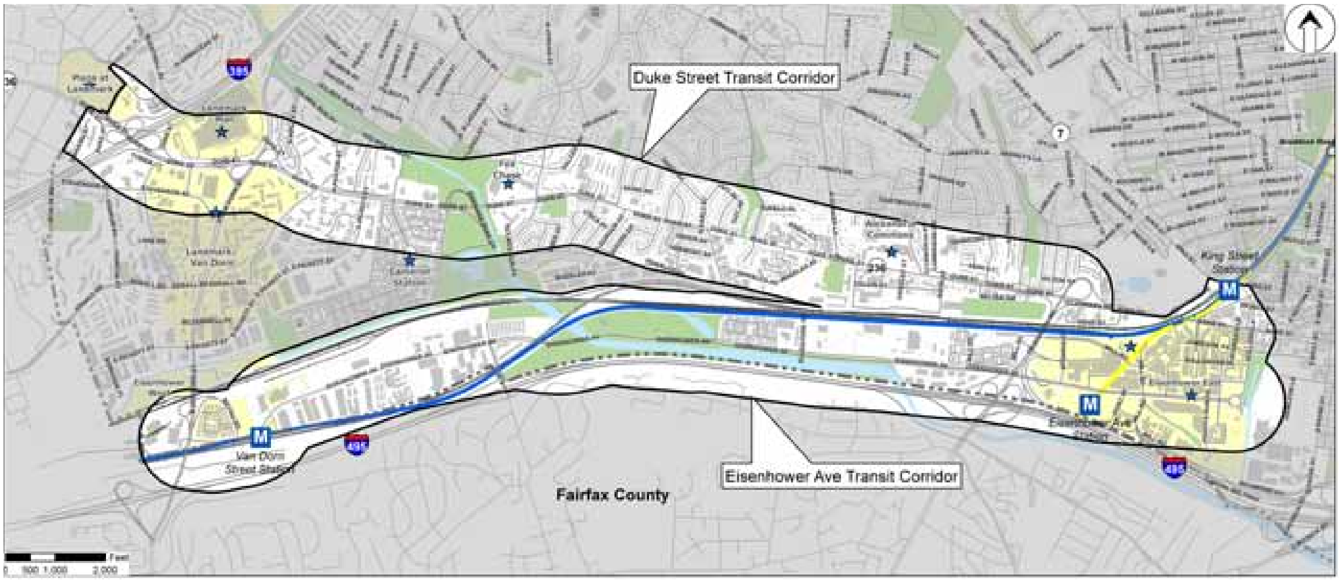


Figure 1.9: Corridor B Study Area

the city's existing and planned major population and activity centers, connectivity to neighboring Arlington and Fairfax Counties and their planned transit corridors, and access to local and regional transportation facilities and services.

The corridors will also increase the number of residents and employees in and traveling through Alexandria with convenient access to attractive reliable transit services. Figure 1.8 shows the planned transit corridors in relation to existing and planned development in Alexandria and adjacent areas of Arlington and Fairfax Counties.

Corridor B (Duke Street/Eisenhower Avenue)

The section of Corridor B examined as part of the High-Capacity Transit Corridor Feasibility Study extended along Duke Street and Eisenhower Avenue for approximately four miles from Landmark Mall to the King Street Metro Station, as shown in Figure 1.9.

Corridor B follows an important local and regional route for commuters traveling east and west, through the southern section of Alexandria. Corridor B is particularly critical for providing direct and indirect connections to major destinations in the area including:

- Eisenhower East
- Landmark Mall
- Cameron Station
- Fox Chase
- Alexandria Commons
- Old Town
- Van Dorn Metro
- King Street Metro
- Eisenhower Avenue Metro

As previously described, sections of Corridor B are included in WMATA's PCN and MWCOG's priority transit corridor plan. Improving the capacity and quality of transit service through Corridor B would create a much needed resource for through commuters as well as underserved areas of Alexandria that lack high-capacity and high-quality transit. Corridor B offers few mode choices and travelers have little incentive to use transit.

The purpose of Corridor B is to improve the accommodation of east/west trips and provide increased access to high-capacity and high-quality transit services. Corridor B would provide potential benefits including:

- Direct service to destinations along the corridor not served by Metrorail
- Increased high-capacity and high-quality transit coverage for southern Alexandria
- Increased number of travel choices for trips along the Duke Street/Route 236 corridor
- Increased connectivity to Metrorail

Corridor Work Group for Corridor B

The City of Alexandria initiated an extensive public outreach program at the onset of the project. In September 2010, the Alexandria City Manager established the High Capacity Transit Corridor Work Group (CWG), as part of the Transitway Corridor Feasibility Study. The purpose of this group was to review technical and financial issues for each of the project corridors. The mission of CWG was to provide input on issues such as route alignments, mode, cross sections, land use considerations, ridership, and financing.

CWG members represented a wide range of interests within Alexandria. The CWG representation for Corridor B included: two members of Council (non-voting), one representative from the Planning Commission, one representative of the Transportation Commission, one representative of the Budget and Fiscal Affairs Advisory Committee, one representative of the Chamber of Commerce, two representatives appointed by the Alexandria Federation of Civic Associations, and one citizen with transit industry expertise.

Between July 21, 2011 and March 15, 2012, six meetings related to Corridor B were held with the CWG. Meetings were structured to provide an opportunity for the study team to present updates and share the latest information and findings. Various project elements were shared including route alignments, typical cross-sections, methods of operation, types of vehicles allowed, land use considerations, ridership, and costs.

During Corridor Work Group Meetings, official CWG members and the public provided feedback on the materials presented. The prevalent themes of CWG comments and input helped guide the alternative selection process.

Duke Street near Cameron Station

Introduction

The Corridor B study area is bounded to the west by the City line and to the east by the King Street Metrorail Station. The study corridor is approximately four miles long and has existing bus service operating along the full length.

Duke Street and Eisenhower Avenue are classified as arterials within the study area. The study area includes several parks, stream crossings, residential and commercial areas.

Providing high-capacity and high-quality transit services in Corridor B will be challenging. Challenges and constraints for Corridor B include:

- Significant peak hour traffic congestion on Duke Street and surrounding side streets and ramps
- Generally narrow street rights-of-way
- Land use compatibility
- Residential parking on service roads
- Poor pedestrian and bicycle connectivity

The following sections provide additional information on these challenges and summarize general existing multimodal transportation, land use and development conditions.

Travel Patterns and Activity Centers

Alexandria's location adjacent to Washington, D.C. and Arlington County creates an environment where regional traffic passes through the community and is destined for locations within the community. Many area commuters travel east to Old Town and/or north to Washington, D.C. and Arlington County. Corridor B serves as the area's primary east-west travel corridor via important city roadways such as Duke Street and Eisenhower Avenue. In addition, tens of thousands of transit trips traverse Alexandria each day using a myriad of bus services as well as Metrorail and Virginia Railway Express (VRE).

Major destinations outside of Corridor B within Alexandria include Old Town, Potomac Yard, and the Mark Center area. Destinations within the study area include Landmark Mall, and the Van Dorn corridor, Eisenhower East, Cameron Station, Carlyle, and Alexandria Commons.

Transportation Conditions

MWCOG's fiscally constrained long-range plan includes limited major east-west roadway capacity increases in the study area during the next 20 years. MWCOG's travel demand forecasts show that peak period travel demand model on Duke Street and Eisenhower Avenue will increase during the next 20 years. Furthermore, these routes will continue to have travel demand that outpaces their capacity in part because they effectively parallel the Capital Beltway, which is predicted to be significantly over-capacity in the future.

Regional Traffic Influences

Regional congestion is a major influence on travel conditions in Alexandria. Congestion on the Capital Beltway (I-95/I-495) and Shirley Highway (I-395) divert some longer through trips onto arterial facilities such as Duke Street and Eisenhower Avenue as well as other routes in Alexandria. Traffic diverting through the city streets increases significantly during incidents on the region's major freeway links. Regional through trips diverted to local routes limit capacity available to Alexandrians for shorter distance trips and contribute to the substantial congestion that exists within the study corridor.

Local Transportation Conditions

Duke Street

The Duke Street study corridor was divided into five segments between the west City limit and King Street Station to the east. The following briefly describe characteristics within each section evaluated.

Segment 1

- Oasis Drive to Landmark Mall
- Approximately 0.5 miles
- Four lanes with a raised-curb landscaped median
- Curb to curb width of 90 feet
- ROW width varies due to I-395

This section was later dropped from consideration for this study. When Fairfax County begins consideration of the Route 236 corridor for high-capacity transit services, coordination should be undertaken to ensure that a seamless transitway is implemented between Fairfax County and the City of Alexandria.

Segment 2

- Landmark Mall to Jordan Street
- Approximately 1.5 miles
- Six lanes with a median or left-turn lane
- Curb to curb width varies from 90 feet to 130 feet
- ROW width varies from 110 to 180 feet

Segment 3

- Jordan Street to west of Quaker Lane
- Approximately one mile
- Four-lane undivided section
- Curb to curb width varies from 46 feet to 100 feet
- ROW width varies from 60 feet and 120 feet

Segment 4

- Quaker Lane to Roth Street
- Approximately one mile
- Four lanes with a left-turn lane
- Curb to curb width varies from 60 feet to 82 feet
- ROW width varies from 80 feet to 110 feet

Segment 5

- Roth Street to Diagonal Road
- Approximately one mile
- Six lanes with a raised-curb landscaped median or left-turn lane
- Curb to curb width varies from 66 feet to 90 feet
- ROW varies from 90 feet to 190 feet

There is no on-street parking along Duke Street, with the exception of service roads that provide parking between N. Jordan Street and Wheeler Avenue.

Source: 2009 VDOT AADT; *Daily traffic on Eisenhower Avenue between Van Dorn Street and Telegraph Road estimated

Figure 2.1: Average Daily Traffic Volumes

Eisenhower Avenue

The Eisenhower Avenue study corridor was divided into six segments between Van Dorn Street to the west and John Carlyle Street to the east.

Segment 1

- Van Dorn Street to the Police Department Range
- Approximately 0.4 miles
- Four-lane undivided section with left-turn lanes at intersections
- Curb to curb width varies from 52 feet to 60 feet with a ROW width of 80 feet

Segment 2

- Police Department Range to Clermont Avenue
- Approximately 0.8 miles
- Four lanes with a two-way left-turn lane
- Curb to curb width in Segment 2 is 52 feet and the ROW is 80 feet wide

Segment 3

- Clermont Avenue to the railroad bridge
- Approximately 0.2 miles
- Four lanes with a raised-curb landscaped median and left-turn lanes
- Curb to curb width of 88 feet
- ROW width of 120 feet

Segment 4

- Railroad bridge to the driveway at 3965 Eisenhower Avenue
- Approximately 1.5 miles
- Four-lane undivided cross section
- Curb to curb width of 48 feet
- ROW of 70 feet

Segment 5

- Driveway at 3965 Eisenhower Ave to Telegraph Road
- Approximately 0.3 miles
- Four lane median divided with left-turn lanes
- Curb to curb width varies from 64 feet to 88 feet
- ROW width varies from 98 feet to 120 feet

Segment 6

- Telegraph Road to John Carlyle Street
- Approximately 0.8 miles
- Four lanes with a raised-curb landscaped median and left-turn lane
- Curb to curb width varies from 60 feet to 74 feet
- ROW varies from 80 feet to 115 feet

Eisenhower Avenue is bordered by a number of residential, commercial, and industrial uses, all of which have off-street parking.

Daily Traffic Volumes

Existing (2009) average daily traffic volumes on the study area streets are shown in Figure 2.1. Duke Street carries the following daily traffic:

- 66,000 vehicles per day (vpd) between S. Van Dorn Street and I-395
- 39,000 vpd between Van Dorn Street and N. Pickett Street
- 33,000 vpd between N. Pickett Street and Telegraph Road
- 23,000 vpd between Telegraph Road and Diagonal Road

Traffic along Eisenhower Avenue varies between 9,500 vpd and 21,700 vpd.

Traffic Flow and Analysis

To better understand general traffic flow conditions along the major east-west routes in Corridor B, weekday peak period travel time runs were conducted on Duke Street and Eisenhower Avenue. The travel time runs were conducted multiple times in each direction during the peak period and measured the travel speed and delay. Peak period travel times along Duke Street were collected in Fall 2010 and are summarized in Table 2.1. The travel time runs were conducted between Beauregard Street to the west and S. Washington Street to the east, a distance of 4.5 miles.   A summary of the average travel speeds during the weekday peak periods are shown on Figures 2.2 and 2.3. Eisenhower Avenue data is not shown since the travel speeds were relatively consistent and generally representative of free-flow conditions throughout the corridor.

Table 2.1: Duke Street Peak Period Travel Times

Direction	AM Travel Time	PM Travel Time
Eastbound	21 minutes	23 minutes
Westbound	19 minutes	24 minutes

Figure 2.2: AM Peak Period Travel Speeds

Legend
Signaled Intersection
Corridor Travel Speed Range
Low (5 mph or Less)
Moderate
High (More than 35 mph)

Figure 2.3: PM Peak Period Travel Speeds

Legend
Signaled Intersection
Corridor Travel Speed Range
Low (5 mph or Less)
Moderate
High (More than 35 mph)

Transit Use

Several transit providers operate service along Duke Street and Eisenhower Avenue. Existing services within the study corridor include DASH, Metrobus, Metrorail, and Fairfax Connector. There is considerable demand for these existing services, which is one of the reasons high-capacity transit services are being studied in this corridor. Existing transit routes are shown on Figure 2.4. Although the Blue Line of the Metrorail parallels the study corridor, there is limited access to stations due to its location and the limited connectivity between Duke Street and Eisenhower Avenue.

The Yellow Line of the Metrorail serves the eastern portion of the study corridor running north to south with stops at Eisenhower Avenue and King Street. Existing Metrorail ridership is summarized in Table 2.2.

DASH services run along Duke Street and Eisenhower Avenue. Metrobus runs east-west along Duke Street and runs north-south surrounding side streets. The Fairfax County Connector provides service north-south in the western part of the corridor and connects to the Van Dorn Metrorail Station; however, service does not extend east of the Van Dorn Metrorail station or along Duke Street east of Van Dorn Street. Existing bus ridership is summarized in Table 2.3.

Table 2.2: Existing Metrorail Ridership

Station	Average Weekday Boarding
Van Dorn	3,653
Eisenhower Avenue	2,094
King Street	9,306

Source: WMATA 2011

Table 2.3: Existing Bus Ridership

Service Provider	Bus Route	Average Weekly Boardings	Headway Peak / Off-peak
DASH	Route AT1 Route AT7 Route AT8	1,765 1,015 2,628	20 min / 30 min 20 min / 30 min 15 min / 30 min
WMATA	Route 29K Metrobus REX	2,272 3,685	30 min / 60 min 30 min / 30 min
Fairfax County Connector	#109 #231 #232 #306 #321 #322	811 294 310 201 1,099 1,079	30 min / 30 min 30 min / 30 min 30 min / 60 min 60 min / 60 min 30 min / 60 min 30 min / 60 min

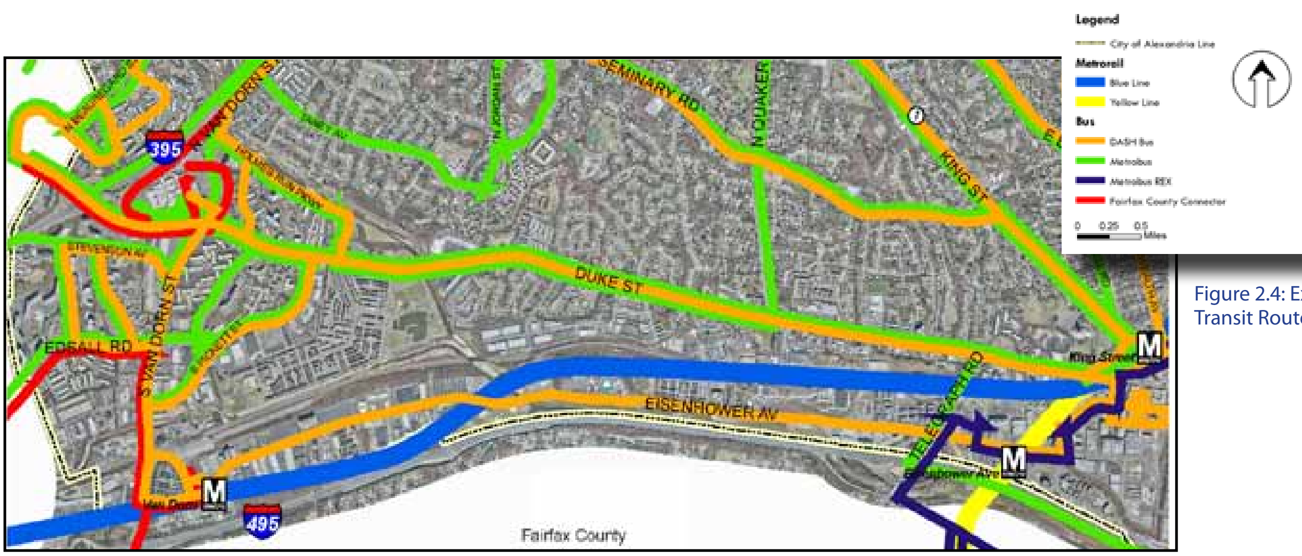


Figure 2.4: Existing Transit Routes

Figure 2.5: Existing Bicycle Facilities

Pedestrian Network

The study area along Duke Street and Eisenhower Avenue contains a somewhat disconnected network of sidewalks that flank either one or both sides of the roadways. Sidewalks are located along Duke Street through the corridor.

The condition of the sidewalks is generally poor. They are narrow, in deteriorating condition, and do not meet Americans with Disabilities Act (ADA) requirements.

The existing sidewalk along Eisenhower Avenue is relatively continuous along the corridor; however, there are locations where sidewalk is missing and worn paths exhibit the need for sidewalks. Many sections of sidewalk and features within the sidewalk do not meet ADA requirements. Specific examples include:

- Horizontal clear way inadequate at protruding utilities
- Pedestrian ramps without detectable warning surfaces
- Tree roots creating trip hazards and an uneven surface

There are also many residential and business entrances located along the corridors that intersect the sidewalk. Many of these entrances have characteristics that contribute to them not meeting minimum requirements for accessibility

Bicycle Networks

There are numerous on-street and off-street bicycle routes in the study area; however, many are in poor condition and do not connect well with one another. Existing bicycle facilities are shown in Figure 2.5.

Off-street bikeways are also located throughout the study area. Beginning at the western terminus of the study area, the off-street bike path approximately follows Holmes Run connecting many area parks. The path crosses the Metrorail tracks and then runs adjacent to the south side of Eisenhower Avenue to the Metrorail station.

Currently, there are limited bike path connections to streets parallel to Duke Street. While there are bike routes along adjacent parallel streets, the connections to Duke Street are indirect via Eisenhower Avenue, Taney Avenue, and Wheeler Avenue.

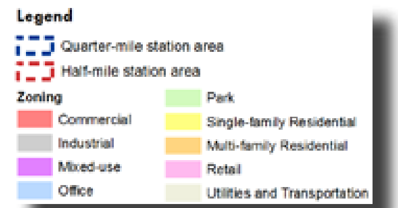


Figure 2.6: Land Use in the Study Area

Land Use and Development

General

Land use in the study area is shown on Figure 2.6. Along the Duke Street corridor, land use is primarily commercial and residential with the commercial uses concentrated at the eastern and western limits of the corridor. The land uses along the Eisenhower Avenue corridor are primarily industrial and utility/transportation with some public open space just north of I-495. The Eisenhower Avenue corridor also contains several areas designated for office use. Major redevelopment and planning initiatives are concentrated on both ends of the study corridors surrounding the Landmark Mall / Van Dorn area to the west and the Eisenhower East / Carlyle area to the east.

Population and Employment

The study area has relatively high population and employment density. The approximate population within one quarter mile of the project corridor along Duke Street is 21,500 people (2010). The approximate population within one quarter mile of the Eisenhower Avenue corridor is 7,300 (2010).

According to MWCOG, the approximate population density surrounding the two corridors ranges from zero people per square mile (centered in the industrial areas) to over 25,000 people per square mile. The majority of the study area has a population density of between 4,000 to 14,999 people per square mile. The western portion of the study area on both sides of S. Van Dorn Street contains the highest population densities (from 15,000 to more than 25,000 people per square mile). Populations within the Duke Street corridor are predicted to increase to 25,000 people by 2030, an increase of approximately 16 percent. Populations within the Eisenhower Avenue corridor are predicted to grow by nearly 50 percent, reaching a population of 10,900 people by 2030. Existing and currently forecasted population densities within the project corridor are shown on Figures 2.7 and 2.8. Population trends are shown in Table 2.4.

Existing employment density is shown on Figure 2.9.

Projected employment density data for 2030 follows a similar trend as population growth with significant increases around the Eisenhower Avenue Station and also north and west of the Van Dorn Station (see Figure 2.10). Employment is expected to rise between 31% and 54% in the project study area between 2010 and 2030. Employment trends are summarized in Table 2.5.

Table 2.4: Population Summary

Corridor	2010	2030	Percent Increase
Duke Street	21,500	25,000	16%
Eisenhower Avenue	7,300	10,900	49%

Table 2.5 Employment Summary

Corridor	2010	2030	Percent Increase
Duke Street	17,900	23,400	31%
Eisenhower Avenue	20,000	30,700	54%

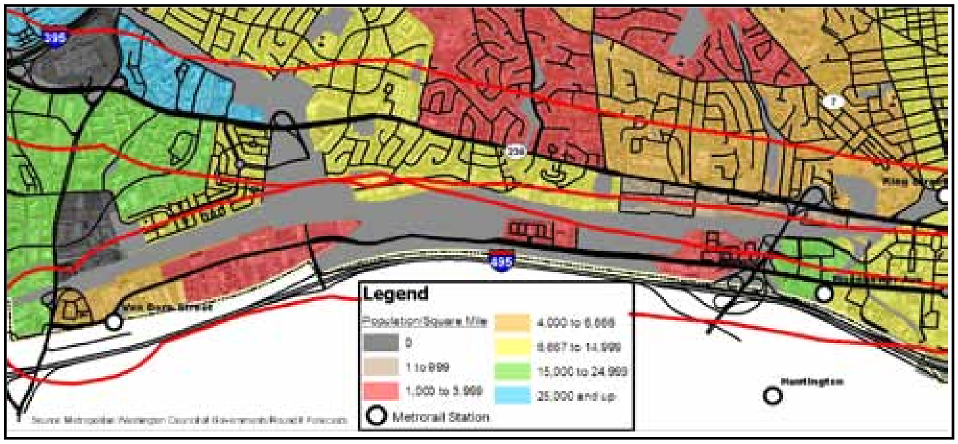


Figure 2.7: Existing Population Density (2010)

Source: MWCOG Round 8 Forecasts

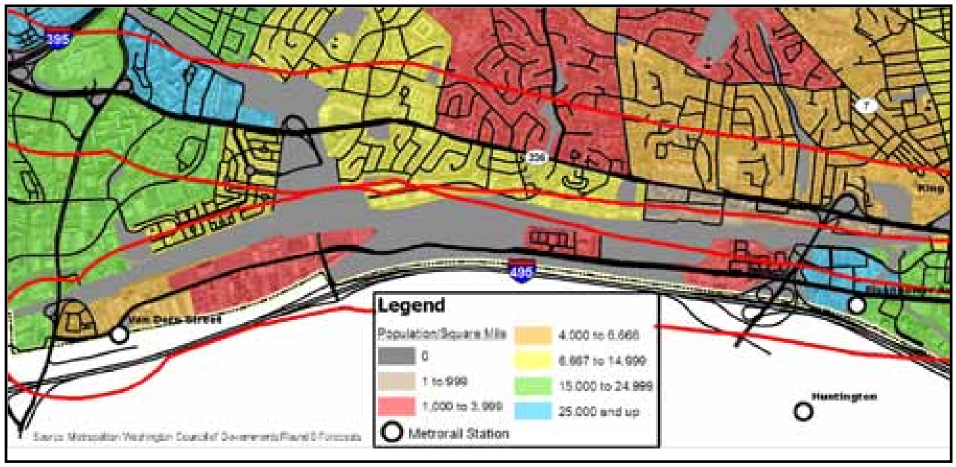


Figure 2.8: Projected Population Density (2030)

Source: MWCOG Round 8 Forecasts

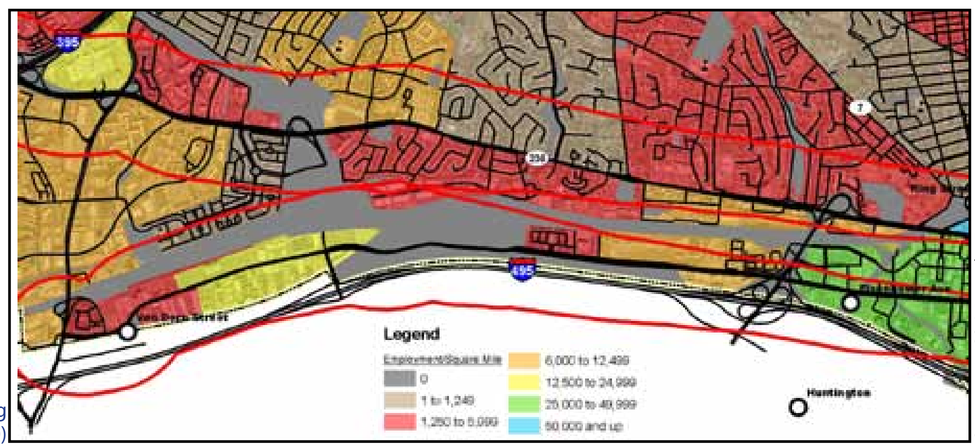


Figure 2.9: Existing Employment Density (2010)

Source: MWCOG Round 8 Forecasts

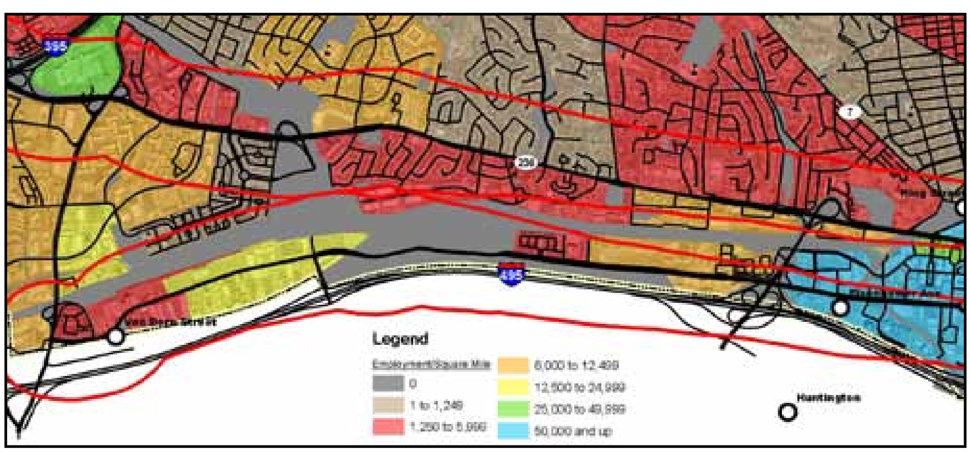


Figure 2.10: Projected Employment Density (2030)

Source: MWCOG Round 8 Forecasts

With the array of challenges and constraints in the study corridor, the first focus of the study was on the alignment itself. Initially, the study evaluated alignment concepts along both Duke Street and Eisenhower Avenue. Following the alignment evaluation, the study turned its attention to the Preliminary Screening, Secondary Screening, Refined Alternatives and the Recommended Alternative for Duke Street. The following sections describe the alignments and concepts studied as well as provide a summary of evaluations conducted.

Alignment Concepts

Three alignment concepts were considered for the transitway in Corridor B: Duke Street, Eisenhower Avenue, or a combination of Duke Street and Eisenhower Avenue.

The three alignment concepts were evaluated using the following criteria:

- Service/connectivity to local population, employment, and other destinations
- Service/connectivity to regional population, employment, and other destinations
- Connections to other transit services
- Operational quality of transit service
- Quality of roadway operations in the corridor

The combined Duke-Eisenhower alternative was eliminated from consideration due to the limited connectivity that exists between Duke Street and Eisenhower Avenue and the extreme monetary and impact cost associated with creating sufficient connections.

The preliminary evaluation showed a greater demand for high-capacity transit along Duke Street due to higher population density and a higher concentration of destinations within the corridor, as detailed in Chapter 2. Additionally, the highest density areas along Eisenhower Avenue are currently served by Metrorail, limiting the potential to capture new transit ridership. Last, Eisenhower Avenue is restricted by various natural and built environment barriers such as Cameron Run, I-495, the Metrorail tracks, freight and passenger railroad tracks, and park land. Eisenhower Avenue has the potential to serve as an express east-west route connecting to metro on both ends of the corridor, but it did not justify high-capacity transit service within the corridor.

Based on the results of the preliminary evaluation, feedback from the Corridor Work Group (CWG), and public input, Duke Street was selected as the preferred location for a dedicated transitway. Additionally, it was recommended that existing transit service along Eisenhower Avenue be improved through expanded service and enhanced passenger amenities.

Preliminary Screening

Six preliminary transitway alternatives were evaluated for the Duke Street alignment. As shown in Figure 3.1, the six preliminary alternatives were created from various combinations of three possible design elements.

The design elements consisted of lane operations (mixed-flow versus dedicated-lane); footprint impacts (right-of-way impacts versus auto lane impacts); and runningway location (curb-running versus median-running). Median running transit was not considered for scenarios with mixed flow because left turning vehicles would impede transit flow.

The process of combining the elements into six alternatives is outlined in Figure 3.1.

Primary characteristics of each alternative are summarized on the following pages.

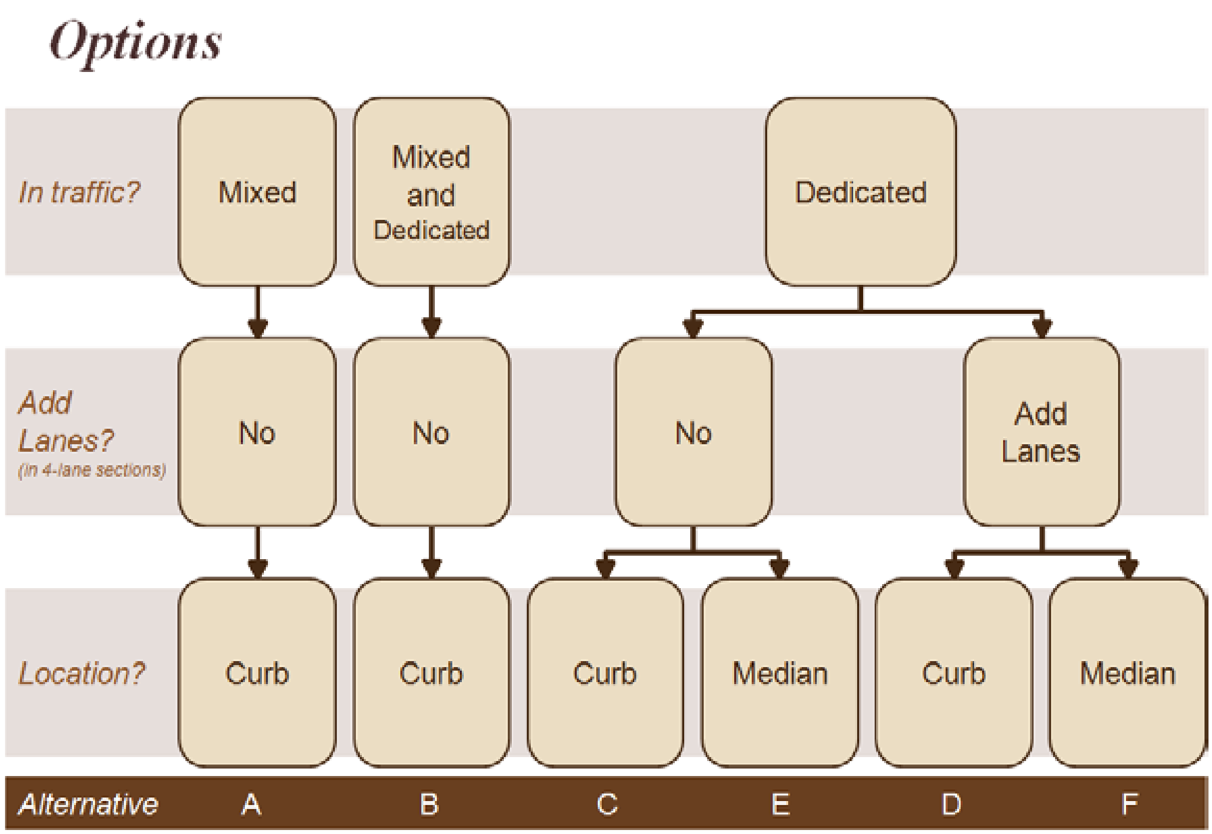


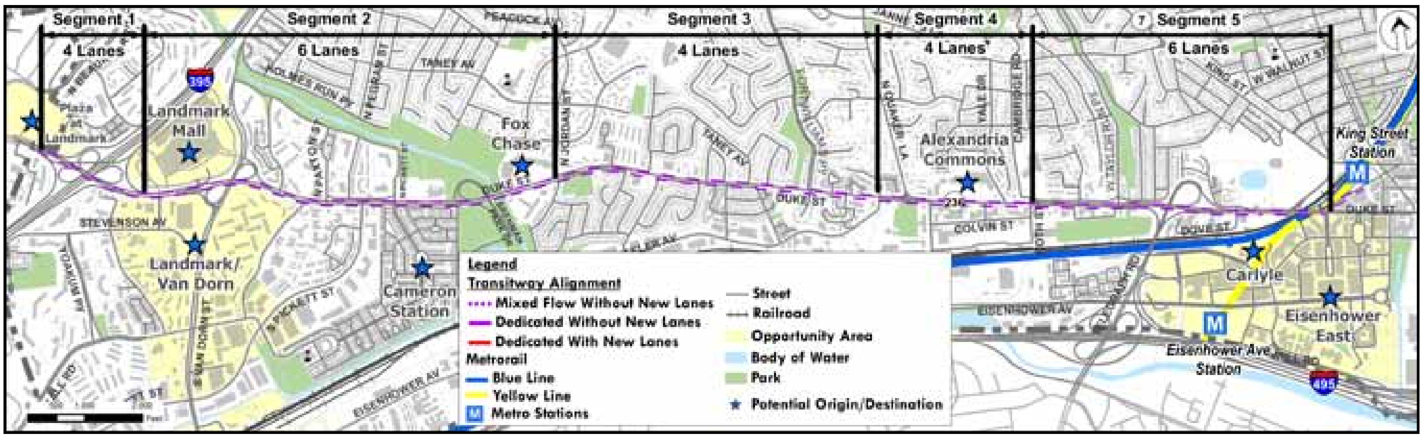
Figure 3.1: Preliminary Alternatives Development

Alternative A: Curb Running in Mixed Flow

Alternative A is shown in Figure 3.2 and summarized below:

- Transit operates in mixed flow for full length of corridor
- Transit operates along curb and shares the lane with right turns in most locations
- Concept uses queue jumps and transit signal priority (TSP) at intersections
- Improvements impact property and service roads to accommodate queue jumps (complete streets impacts were not accounted for in this level of screening and were studied in later rounds of screening)

Figure 3.2: Alternative A - Curb Running in Mixed Flow

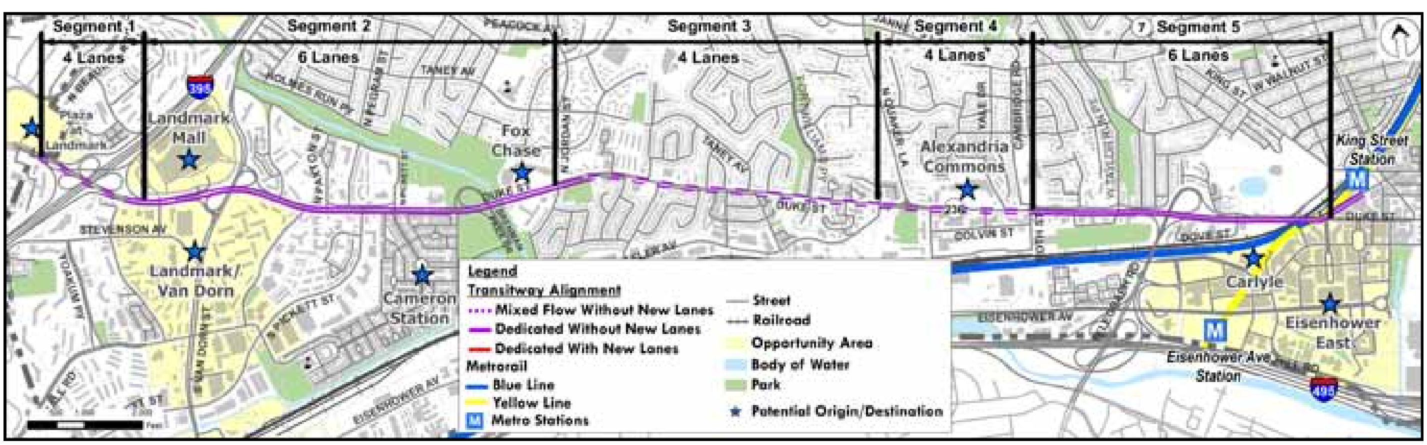


Alternative B: Curb Running in Mixed Flow and Dedicated Lanes

Alternative B is shown in Figure 3.3 and summarized below:

- Transit operates in mixed flow on 4-lane segments (2 miles total) and in dedicated lanes on 6-lane segments (2.5 miles total) to reduce property impacts
- Transit operates along curb and shares the lane with right turns in most locations
- Concept uses queue jumps and TSP at intersections
- Improvements impact property and service roads to accommodate queue jumps (complete streets impacts were not accounted for in this level of screening and were studied in later rounds of screening)

Figure 3.3: Alternative B - Curb Running in Mixed Flow and Dedicated Lanes

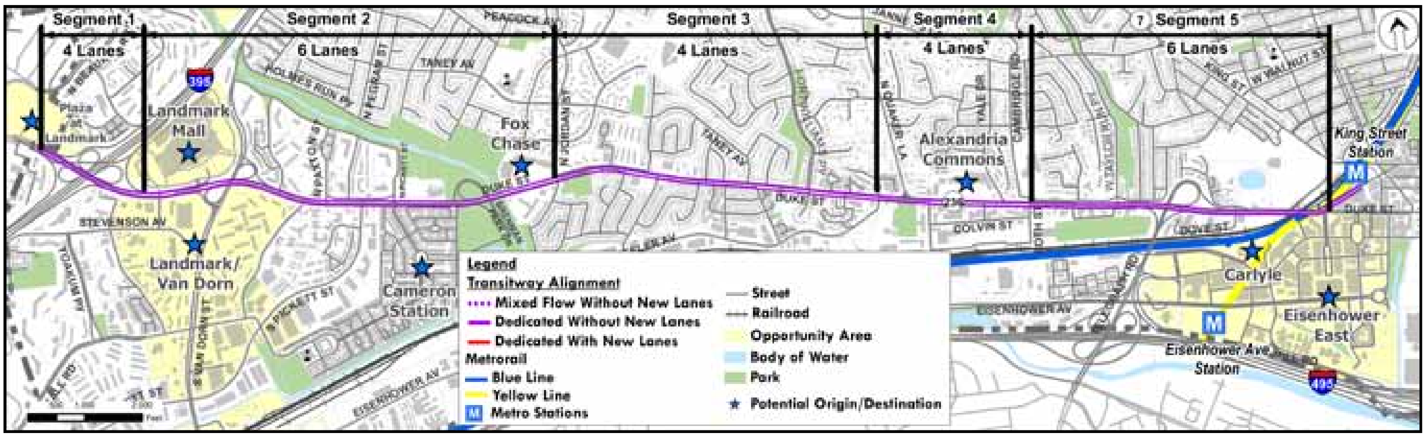


Alternative C: Curb Running in Dedicated Lanes without New Lanes

Alternative C is shown in Figure 3.4 and summarized below:

- Transit operates in dedicated lanes for full length of corridor
- Duke Street is reduced to one lane in each direction for general purpose traffic in 4-lane segments (2 miles total)
- Transit operates along curb and shares the lane with right turns in most locations
- Improvements have minimal impact to property and service roads (complete streets impacts were not accounted for in this level of screening and were studied in later rounds of screening)

Figure 3.4: Alternative C - Curb Running in Dedicated Lanes without New Lanes

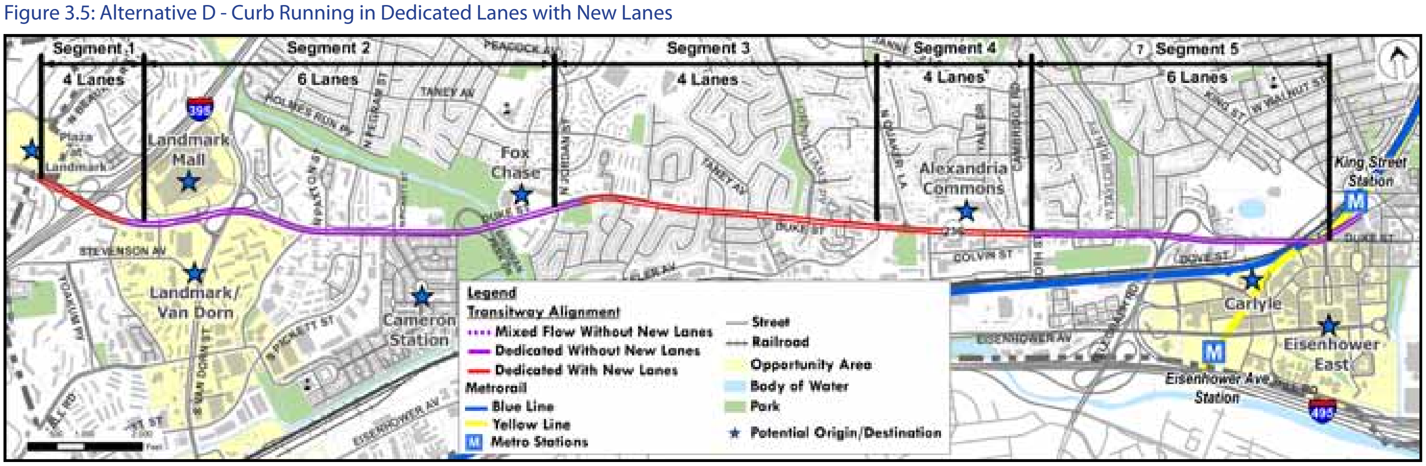


Alternative D: Curb Running in Dedicated Lanes with New Lanes

Alternative D is shown in Figure 3.5 and summarized below:

- Transit operates in dedicated lanes for full length of corridor
- Duke Street is widened in 4-lane segments (2 miles total)
- Transit operates along curb and shares the lane with right turns in most locations
- Improvements impact property and service roads (complete streets impacts were not accounted for in this level of screening and were studied in later rounds of screening)

Figure 3.5: Alternative D - Curb Running in Dedicated Lanes with New Lanes

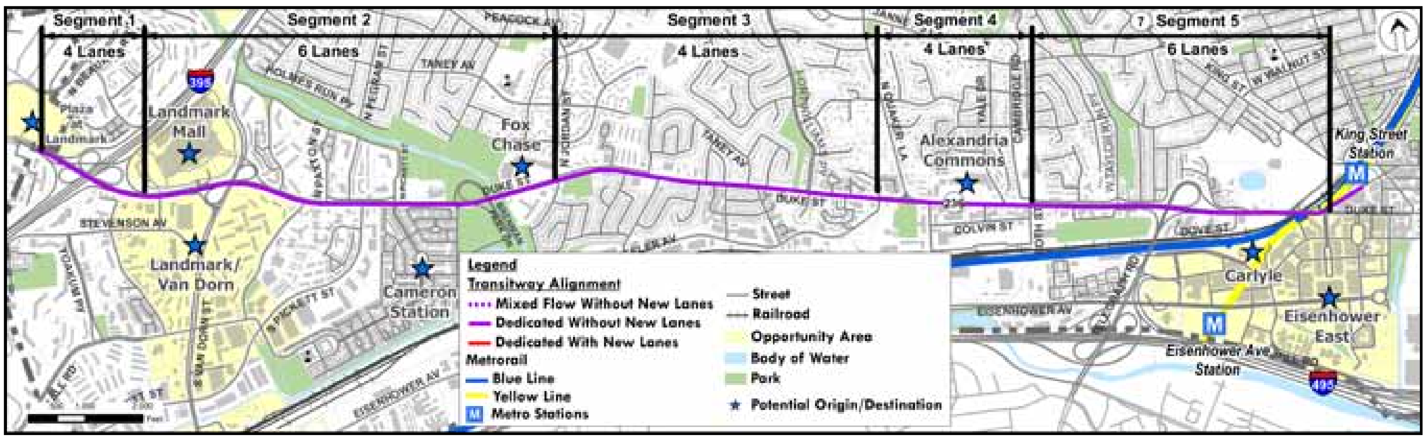


Alternative E: Median Running in Dedicated Lanes without New Lanes

Alternative E is shown in Figure 3.6 and summarized below:

- Transit operates in dedicated lanes for full length of corridor
- Duke Street is reduced to one lane in each direction for general purpose traffic in 4-lane segments (2 miles total)
- Transit operates in dedicated lanes within the median for the full length of the corridor
- Improvements have minimal impact to property and service roads (complete streets impacts were not accounted for in this level of screening and were studied in later rounds of screening)

Figure 3.6: Alternative E - Median Running in Dedicated Lanes without New Lanes

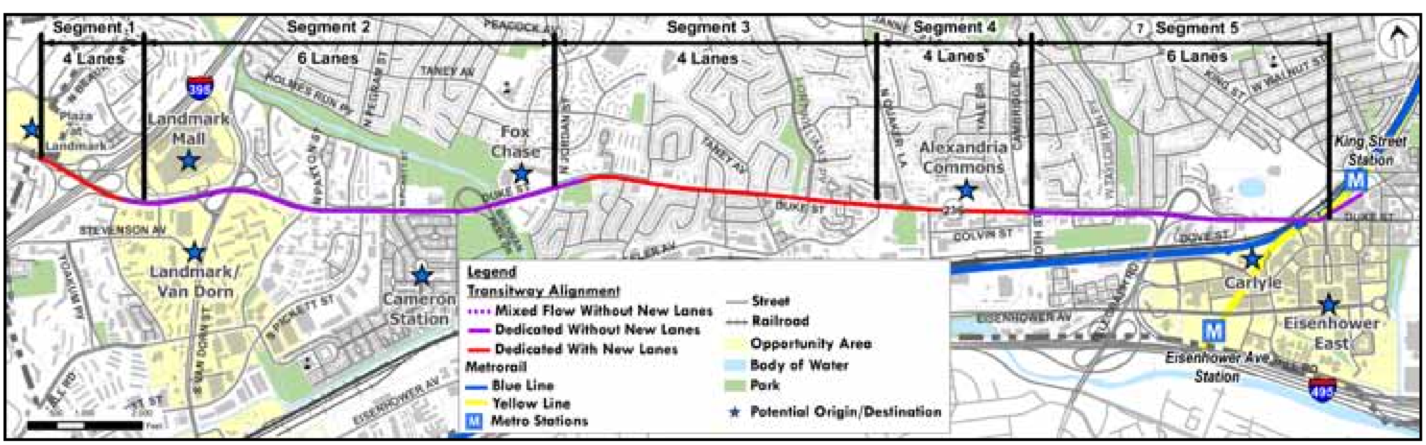


Alternative F: Median Running in Dedicated Lanes with New Lanes

Alternative F is shown in Figure 3.7 and summarized below:

- Transit operates in dedicated lanes within the median for the full length of corridor
- Duke Street is widened in 4-lane segments (2 miles total)
- Improvements impact property and service roads (complete streets impacts were not accounted for in this level of screening and were studied in later rounds of screening)

Figure 3.7 Alternative F - Median Running in Dedicated Lanes with New Lanes



	Preliminary Screening Criteria	A	B	C	D	E	F
	In traffic?	Mixed	Both	Dedicated	Dedicated	Dedicated	Dedicated
	Add lanes?	No	No	No	Add a lane	No	Add a lane
	Location?	Curb	Curb	Curb	Curb	Median	Median
Effectiveness	Transit Connectivity	Fair	Fair	Fair	Fair	Fair	Fair
Effectiveness	Avoidance of Congestion	Poor	Fair	Best	Best	Best	Best
Effectiveness	Transit Travel Times	Poor	Fair	Best	Best	Best	Best
Effectiveness	Intersection Priority	Poor	Fair	Best	Best	Best	Best
Effectiveness	Runningway Status (Percent already in place)	Fair	Fair	Best	Poor	Best	Poor
Effectiveness	Runningway Configuration (Percent dedicated)	Poor	Fair	Best	Best	Best	Best
Effectiveness	Phasing	Best	Best	Fair	Poor	Fair	Poor
Impacts	Natural Environment Impacts	Fair	Fair	Best	Poor	Best	Poor
Impacts	Property Impacts	Fair	Fair	Best	Poor	Best	Poor
Impacts	Impacts to Existing Streetscape	Fair	Fair	Best	Poor	Best	Poor
Impacts	Noise and Vibration	Fair	Fair	Fair	Poor	Best	Best
Impacts	Traffic Flow Impact	Fair	Fair	Poor	Best	Poor	Best
Impacts	Pedestrian Accommodation	Best	Best	Best	Best	Fair	Fair
Impacts	Bicycle Accommodation	Poor	Poor	Fair	Fair	Best	Best
Impacts	Parking Impacts	Fair	Fair	Best	Poor	Best	Poor
Cost	Capital Cost	Fair	Fair	Best	Poor	Fair	Poor
Cost	Operating Cost	Poor	Poor	Best	Best	Best	Best
Cost	Funding	Fair	Fair	Best	Poor	Fair	Poor

NOTE: Data to evaluate Cost Per Rider is not available at this time

Rating: ● Best ◑ Fair ○ Poor

Figure 3.8 Preliminary Evaluation Summary

Preliminary Screening Summary

The six alternatives were screened using an initial set of evaluation criteria that reflected CWG and public priorities, as well as were measures suitable for comparing the alternatives. These criteria and the results for the alternatives are presented in Figure 3.8.

The alternatives and associated screening were presented to the CWG and public on November 17, 2011. Based on the feedback from the CWG and public input, two alternatives were eliminated from further consideration and four were retained for further analysis as summarized in Table 3.1.

Subsequently, the four remaining alternatives were restructured and renamed to the four alternatives retained for further study, as depicted in Figure 3.9.

Table 3.1: Alternatives Analysis Summary

Alternative	Justification	Result
A: Curb Running in Mixed Flow	• Offers no benefit over Alternative B	Eliminated from consideration
B: Curb Running in Mixed Flow and Dedicated Lanes	• Preferred by CWG due to minimal extent of impacts to property and traffic • Viewed as base alternative for implementation within existing footprint • Consider modified Alternative B with dedicated lanes at narrowest segment utilizing service road right-of-way (coined B+)	Consider alternative and a variation (B+) using service roads for further analysis
C: Curb Running in Dedicated Lanes without New Lanes	• Fewer impacts to property and environment, but adverse impact on traffic • Should be modified to consider reversible lane configuration	Consider alternative for further analysis in combination with Alternative D by implementing a reversible lane
D: Curb Running in Dedicated Lanes with New Lanes	• Preferred by some members of CWG due to uniformity and improved operations • Viewed as efficient and effective • Would reduce congestion, but result in greater impacts to property and environment • Should be modified to consider reversible lane configuration in order to use auto lane in off-peak direction	Consider alternative for further analysis in combination with Alternative C by implementing a reversible lane
E: Median Running in Dedicated Lanes without New Lanes	• Fewer impacts to property and environment, but extensive adverse impact on traffic	Eliminated from consideration
F: Median Running in Dedicated Lanes with New Lanes	• Viewed as worst-case scenario from property and environment impact perspective • Should be analyzed further since this alternative would provide the best transit operations	Consider alternative for future analysis

Figure 3.9 Alternatives Retained

Secondary Screening

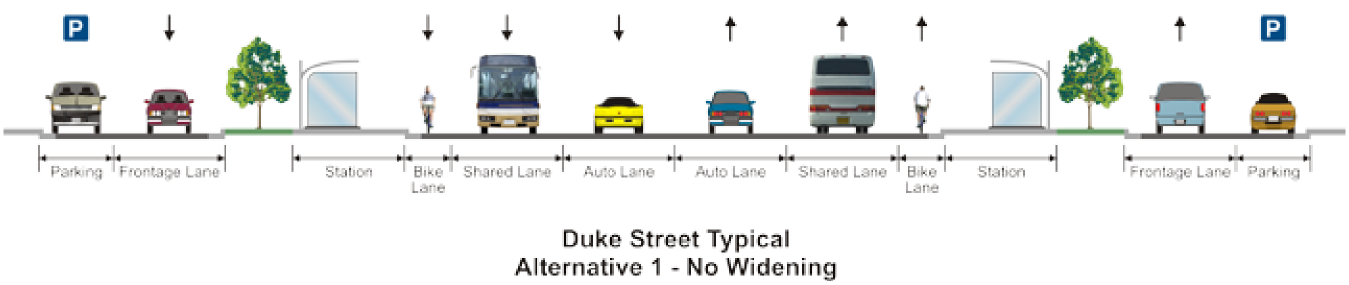
The four retained alternatives were defined in more detail during the secondary screening. Due to comments received from CWG and the public, bike lanes and complete street considerations were added to each of the alternatives in order to be consistent with the City's complete streets policy adopted by City Council in April 2011. Typical sections and key features of each retained alternative are presented below.

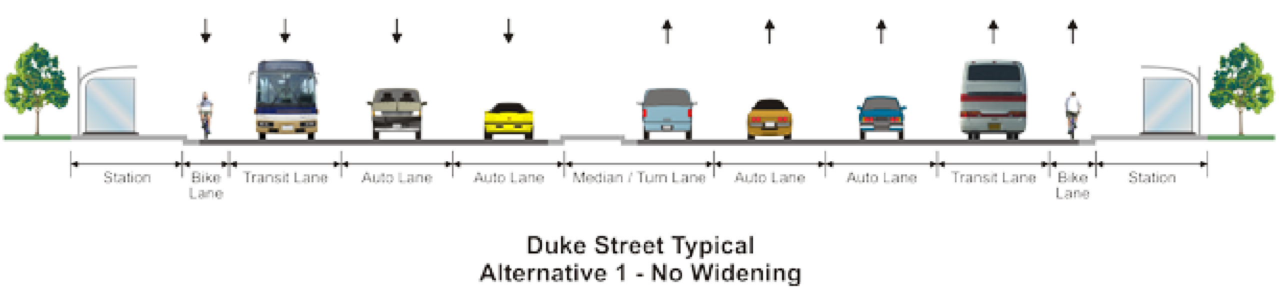
Alternative 1

The existing lane configuration is shown in Figure 3.10 and consists of the following:

- Transit operates along curb
- Transit operates in mixed flow on existing four-lane segments (2 miles total) and in dedicated lanes on existing six-lane segments (2.5 miles total)
- Concept uses existing lanes for transit and widens Duke Street to accommodate bicycle facilities and improved sidewalks
- Concept uses queue jumps where there are no dedicated lanes
- Improvements impact property and service roads to accommodate queue jumps and bike lanes
- Includes bike lanes or shared outside lane

Figure 3.10: Alternative 1 - Existing Lane Configuration



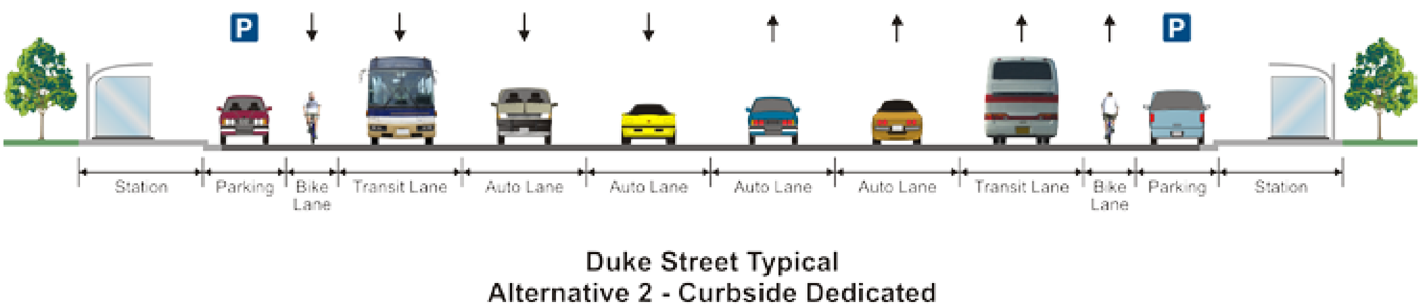


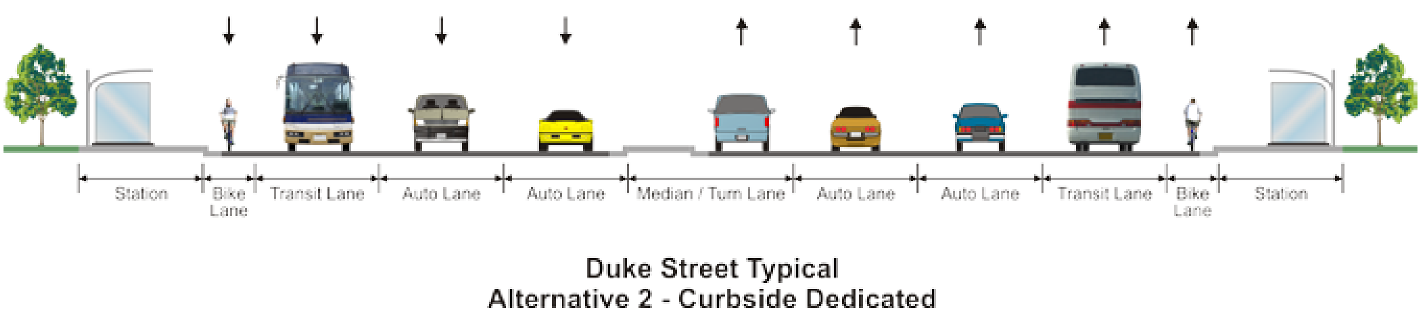
Alternative 2

Alternative 2 uses service road right-of-way. Details of this alternative are shown on Figure 3.11 and listed below:

- Transit operates along curb
- Transit operates in dedicated lanes for full corridor length (right turns for general traffic are permitted using the transit lane at intersections)
- Typical section adds one lane per direction in existing four-lane segments (2 miles total)
- Concept reduces impacts to property by shifting roadway centerline to make use of service roads
- Concept provides on-street parking in some locations to replace service road parking losses
- Includes bike lanes or shared outside lane

Figure 3.11: Alternative 2 - Service Road Right-of-Way



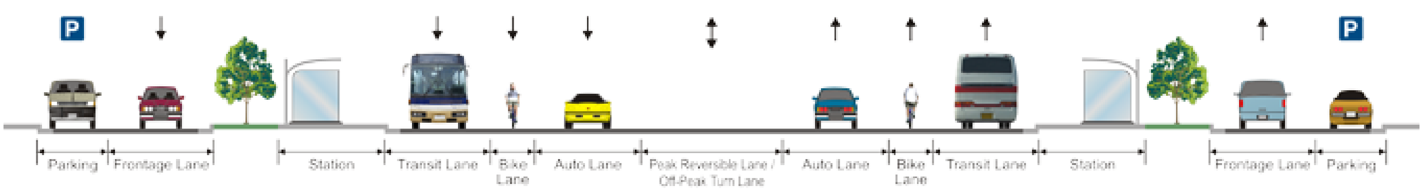


Alternative 3

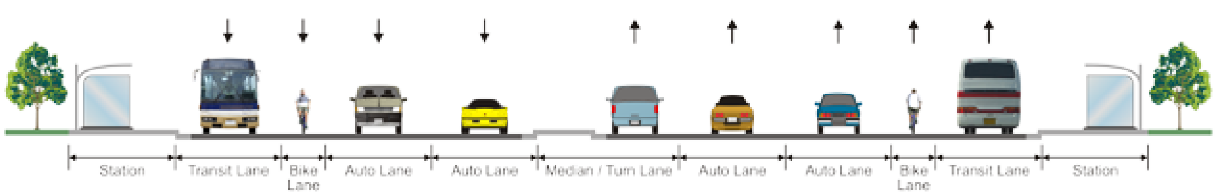
Alternative 3 uses a reversible lane to accomomdate transit in sections of the corridor where there is significant right-of-way constraint. It is shown in Figure 3.12 and consists of the following:

- Transit operates along curb
- Transit operates in dedicated lanes for full corridor length in peak period, peak direction (right turns for general traffic are permitted using the transit lane at intersections)
- Typical section adds ½ lane in each direction (1 lane total) in existing four-lane segments (2 miles total)
- Center lane functions as reversible lane for traffic during peak periods
- Center lane acts as a turn-lane during off-peak periods
- Reversible lane transitions at Jordan Street and Wheeler Avenue
- Improvements impact property and existing streetscape
- Concept maintains service roads
- Includes bike lanes or shared outside lane

Figure 3.12: Alternative 3 - Reversible Lane



Duke Street Typical
Alternative 3 - Curbside Dedicated with Reversible Lane



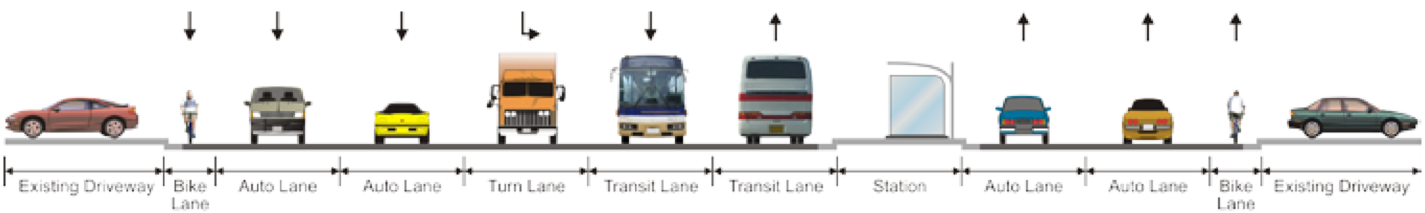
Duke Street Typical
Alternative 3 - Curbside Dedicated with Reversible Lane

Alternative 4

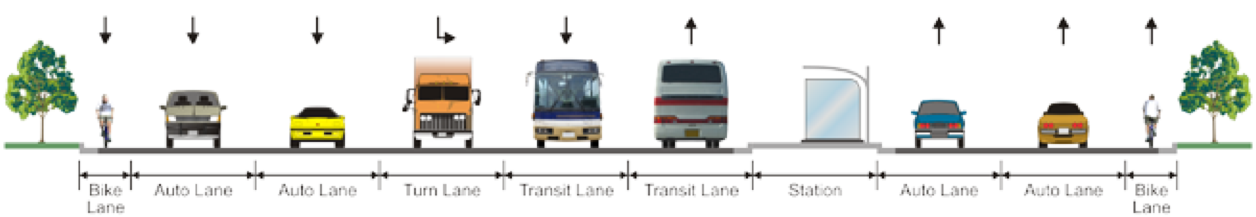
Alternative 4 uses the median for transit. Details are shown in Figure 3.13 and listed below:

- Transit operates in median
- Transit operates in dedicated lanes for full corridor length
- Typical section adds two lanes in each direction in existing four-lane segments (2 miles total)
- Improvements impact property significantly
- Concept removes service roads and driveways would be accessed directly from Duke Street
- Includes bike lanes or shared outside lane

Figure 3.13: Alternative 4 - Median Running



Duke Street Typical
Alternative 4 - Median Dedicated



Duke Street Typical
Alternative 4 - Median Dedicated

Figure 3.14: Secondary Screening Criteria and Results

Evaluation Criteria			Alternative 1	Alternative 2	Alternative 3	Alternative 4
		Description	Existing Configuration	Uses Service Road ROW	Reversible Lane	Median Running
Effectiveness	Coverage	Service to Regional Destinations	◑	◑	◑	◑
		Service to Population, Employment & Retail in the Corridor	●	●	●	●
		Transit Connectivity	●	●	●	◑
	Operations	Runningway Configuration(s)	◑	●	●	●
		Corridor Length	●	●	●	●
		Capacity	●	●	●	●
		Interoperability	●	●	●	●
		Avoidance of Congestion	○	◑	◑	●
		Transit Travel Times	○	◑	◑	●
		Ridership	○	◑	◑	●
		Intersection Priority	◑	●	●	●
	Alignment	Alignment Quality	●	◑	●	●
		Runningway Status	●	◑	◑	○
		Phasing	●	◑	◑	○
Impacts	Economic	Development Incentive	●	●	●	●
	Natural Environment	Natural Environment	●	◑	◑	○
		Parks and Open Space	●	◑	◑	○
	Neighborhood and Community	Property	●	●	◑	○
		Existing Streetscapes	●	○	◑	○
		Community Resources	●	◑	◑	○
		Demographics	●	◑	◑	○
		Noise and Vibration	◑	○	○	●
	Transportation	Traffic Flow Impact	◑	●	○	●
		Traffic Signals	○	◑	◑	○
		Multimodal Accommodation – Pedestrian	●	●	●	◑
		Multimodal Accommodation – Bike	◑	◑	◑	●
		Parking	●	◑	●	○
Cost	Cost Effectiveness	Capital Cost	●	◑	◑	○
		Right-of-Way Cost	●	◑	◑	○
		Operating Cost	○	◑	◑	●
		Order of Magnitude Cost Per Rider	○	◑	◑	●

Rating: ● Best ◑ Fair ○ Poor

Secondary Screening Summary

The four refined alternatives were screened using a set of detailed evaluation criteria. The secondary screening criteria and results are presented in Figure 3.14.

In addition to the relative comparison provided by the screening process, preliminary impacts, potential ridership estimates, and costs were developed for each of the four alternatives and are provided in Tables 3.2 and 3.3, respectively. Table 3.4 summarizes the advantages and disadvantages for each alternative.

The retained alternatives, secondary screening, impacts, and costs were presented to the CWG and the public on January 19, 2012. The comments received focused primarily on maintaining left-turn lanes; providing adequate pedestrian paths and refuges; and minimizing

Table 3.2: Preliminary Impacts and Riderhsip

Alternative	1	2	3	4
Description	Existing Configuration	Uses Service Rd ROW	Reversible Lane	Median Running
Park Impact	<0.25 acres	<0.25 acres	<0.25 acres	<0.5 acres
Water Impact	<0.1 acres	<0.1 acres	<0.1 acres	<0.1 acres
Property Impact	1.75 acres	3.5 acres	4 acres	7 acres
Potential Riderhsip	6,000 to 9,000 riders/day	8,000 to 12,000 riders/day	9,000 to 13,000 riders/day	12,000 to 16,000 riders/day

Table 3.3: Preliminary Planning - Level Cost Estimates

Alternative	1	2	3	4
Description	Existing Configuration	Uses Service Rd ROW	Reversible Lane	Median Running
Capital Cost Estimate (exclusive of vehicles, based on cost per mile within the City)	$22 M	$27 M	$26 M	$37 M
25-year Fleet Cost Estimate	$20 M	$16 M	$16 M	$13 M
Right-of-Way Cost Estimate	$5 M	$21 M	$22 M	$33 M
25-year Operating Costs	$67 M	$60 M	$60 M	$47 M
Preliminary Planning - Level Cost Estimates	$114 M	$124 M	$124 M	$130 M

Notes:

1. Planning level cost estimates are shown in year 2012 dollars and do not include additional contingency or escalation to a future year mid-point of construction. Estimates do not include costs for major utility relocations/new service, or the capital costs for roadway/streetscape improvements that may be implemented concurrently, but are not required for the transit project.
2. Though mode selection had been deferred during this study, BRT was assumed for the purpose of producing costs.

Table 3.4: Alternatives Comparison

Alternative	Advantages	Disadvantages
1: Use Existing Lanes for Transit	• Fewest negative impacts (including property) • Maintain service roads • Lowest capital cost • Easy to phase	• Worst transit operation due to shared lanes • Highest operating cost • Highest fleet cost • May be impacted by congestion on Duke Street • Longest transit travel time • Lowest ridership potential
2: Use Service Road Right-of-Way	• Minimal impact to traffic flow • High quality transit operation • Moderate capital, fleet, and operating cost • Some avoidance of congestion for transit	• Curvilinear alignment • On-street parking could disrupt transit operations • Impacts service roads and streetscape as a result
3: Reversible Lane	• Provides peak direction, peak period transit lane • Maintains most service roads • Moderate capital, operation and fleet cost • Provides turn lanes at some new locations to help traffic flow	• No dedicated lanes off-peak time and direction • Property impacts • Requires overhead gantries to control reversible condition • May be confusing to drivers due to changing lane use condition
4: Median Running	• Best transit operation by eliminating conflicts with driveways and traffic • Lowest fleet and operating cost • Avoids impacts from traffic congestion • Highest ridership potential	• Largest property impact • Eliminates service roads and parking (impact to 28 homes) • Highest capital cost • Highest right-of-way cost and impacts

impacts to residences and small business. The CWG and public expressed concern that the inclusion of bike lanes may require more right-of-way than anticipated. Consequently, Alternatives 1 and 3 were selected for further evaluation and Alternatives 2 and 4 were eliminated from further consideration. Table 3.5 provides a summary of the evaluation and alternatives for further consideration and refinement.

Table 3.5: Alternatives Analysis Summary

Alternative	Justifications	Result
1: Use Existing Lanes for Transit	• Low transit efficiency because dedicated transit lanes would not be provided between Wheeler Avenue and Roth Street • Preferred by some because it would protect neighborhoods by minimizing impacts to residential and commercial property and parking • Consider alternative for further analysis	Selected for further analysis
2: Use Service Road Right-of-Way	• Increased width of street for pedestrians to cross and would not provide adequate refuges for pedestrians • Moderate to high property impacts • Eliminated from consideration	Eliminated from further consideration
3: Reversible Lane	• Preferred by some because of the flexibility to retain service roads while providing dedicated transit lanes • Consider alternative for further analysis	Selected for further analysis
4: Median Running	• Service roads and residential parking would be significantly impacted or eliminated • High property impacts, especially between Jordan Street and Roth Street • Eliminated from consideration	Eliminated from further consideration

Refined Alternatives

Alternatives 1 and 3 were evaluated in greater detail with and without on-street bike lanes to determine property impacts. The typical sections and descriptions for these refined alternatives are summarized below.

Alternative 1

Alternative 1 (refined) is shown on Figure 3.15 and includes the following design elements:

- Transit operates in mixed flow on existing four-lane segments and in dedicated lanes on existing six-lane segments
- Concept uses queue jump lanes to avoid congestion and reduce disruption to Duke Street traffic
- Typical section adds a westbound lane between Jordan Street and Gordon Street, converting the existing two-way frontage road to one-way
- Typical section adds a westbound lane between Wheeler Avenue and S. Quaker Lane
- Alignment reconfigures the existing eastbound entrance ramp at Telegraph Road and access to adjacent property to accommodate a dedicated transit lane
- Alternative 1a would not have on-street bike lanes
- Alternative 1b would include on-street bike lanes

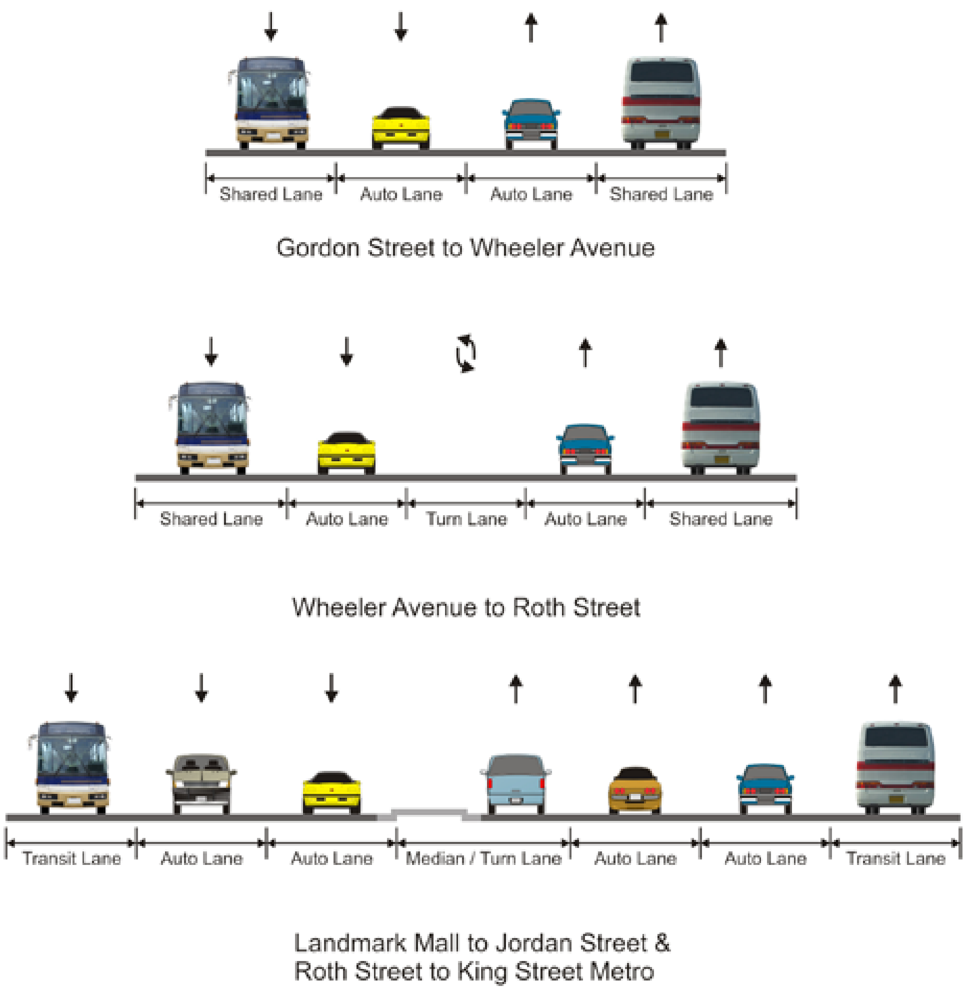


Figure 3.15: Alternative 1 Refined

Alternative 3

Alternative 3 (refined) is shown on Figure 3.16 and includes the following design elements:

- Identical to Alternative 1 between Landmark Mall and Gordon Street, between Roth Street and Taylor Run Parkway, and between Callahan Drive and King Street Metrorail
- Typical section adds an eastbound lane at Telegraph Road
- Typical section adds ½ lane in each direction (one lane total) between Gordon Street and Wheeler Avenue to provide reversible lane
- Typical section adds one lane adjacent to westbound roadway between Wheeler Avenue and Roth Street to accommodate heavy traffic flow between N. Quaker Lane and Telegraph Road
- Left-turn lane provided during off peak periods between Jordan Street and Wheeler Avenue
- Two center lanes between Wheeler Avenue and Roth Street could include optional two-way turn lane and/or additional auto lane(s) - further detailed traffic analysis needed
- Alternative 3a would not have on-street bike lanes
- Alternative 3b would include on-street bike lanes

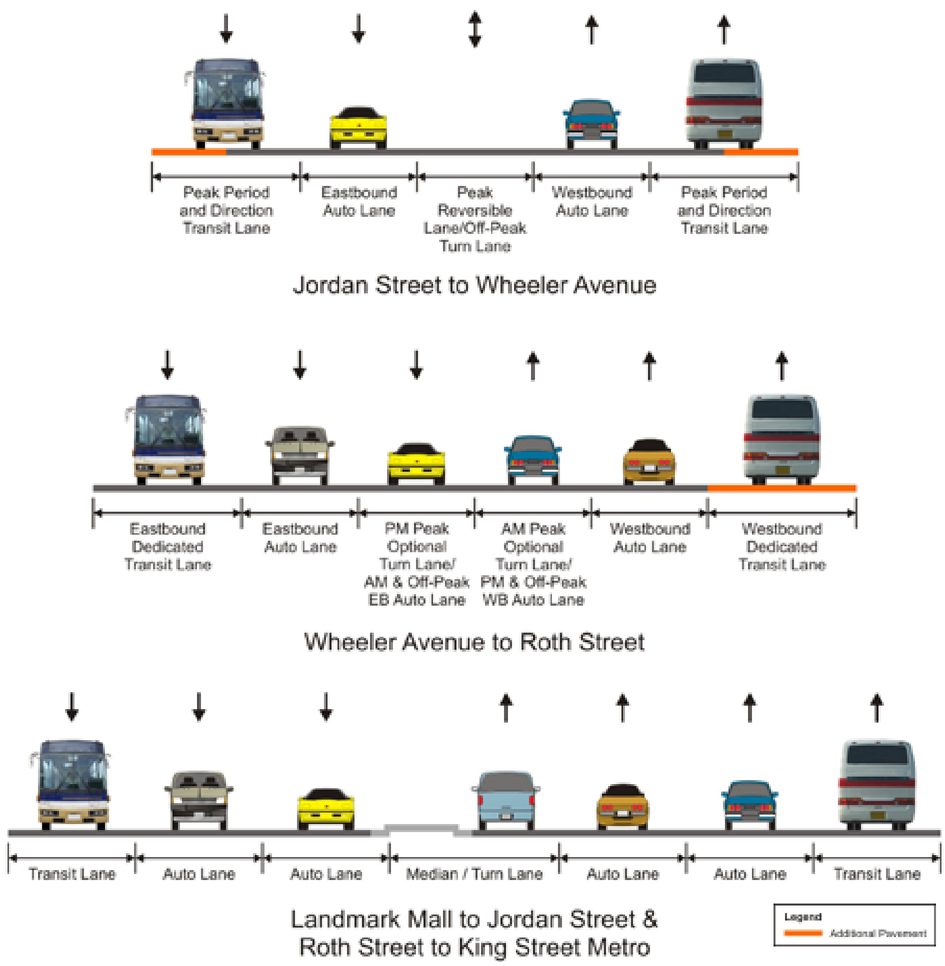


Figure 3.16: Alternative 3 Refined

Refined Alternatives Summary

Transit travel times were forecasted using methodology from the Transit Cooperative Research Program's Report 100: Transit Capacity and Quality of Service Manual, Second Edition. Under Alternatives 1 and 3 the one-way peak period travel times from Landmark Mall to the King Street Metrorail Station would be 22 minutes and 19 minutes, respectively.

Potential impacts and preliminary planning-level cost estimates for these alternatives are shown in Tables 3.6 and 3.7.

Table 3.6: Preliminary Impacts

Alternative	1a	1b	3a	3b
Description	Use Existing Lanes for Transit	Use Existing Lanes for Transit	Reversible Lane	Reversible Lane with Bike Lanes
Park Impact	<0.15 acres	0.20 acres	<0.15 acres	0.25 acres
Property Impact	1.0 acres 65 parcels	2.5 acres 100 parcels	1.5 acres 75 parcels	3.5 acres 160 parcels
Commercial Parking Impact	53 spaces	121 spaces	66 spaces	159 spaces
Residential Parking Impact	2 spaces	12 spaces	4 spaces	13 spaces

Table 3.7: Preliminary Planning - Level Cost Estimates

Alternative	1a	1b	3a	3b
Description	Use Existing Lanes for Transit	Use Existing Lanes for Transit	Reversible Lane	Reversible Lane with Bike Lanes
Capital Cost Estimate (exclusive of vehicles, based on cost per mile within the City)	$20 M	$40 M	$28 M	$53 M
25-year Fleet Cost Estimate	$20 M	$20 M	$16 M	$16 M
Right-of-Way Cost Estimate	$3.5 M	$8 M	$4 M	$12 M
25-year Operating Costs	$67 M	$67 M	$60 M	$60 M
Preliminary Planning - Level Cost Estimates	$111 M	$135 M	$108 M	$141 M

Notes:

1. Planning level cost estimates are shown in year 2012 dollars and do not include additional contingency or escalation to a future year mid-point of construction. Totals listed do not include costs for major utility relocations/new service, or the capital costs for roadway/ streetscape improvements that may be implemented concurrently, but are not required for the transit project.
2. BRT was the preferred mode for the purpose of producing costs.

Table 3.8: Alternatives Comparison

Alternative	Advantages	Disadvantages
1a: Use Existing Lanes for Transit	• Fewest property impacts • Maintains service roads	• Worst transit operation due to shared lanes • No Duke Street bicycle facility
1b: Use Existing Lanes for Transit with Bike Accommodations	• Maintains service roads • Provides bike lanes	• Worst transit operation due to shared lanes • Large property impacts due to bike lanes and streetscape enhancements
3a: Reversible Lane	• Quality transit operation • Maintains service roads	• Off-peak auto impact from Gordon to Wheeler • No Duke Street bicycle facility • Lane control gantries • Potentially confusing to drivers
3b: Reversible Lane with Bike Accommodations	• Quality transit operation • Maintains service roads • Provides bike lanes	• Off-peak auto impact from Gordon to Wheeler • Large property impacts due to bike lanes and streetscape enhancements • Lane control gantries • Potentially confusing to drivers

The advantages and disadvantages for each alternative are summarized in Table 3.8.

The purpose of the CWG meetings held on February 16, 2012 and March 15, 2012 was to review the refined analysis for the Duke Street alternatives and to receive a recommendation for a preferred alternative from the CWG.

The following significant comments were provided by the CWG and the public at the meetings:

- Bike lanes on Duke Street are not desired in section between Jordan Street and Telegraph Road due to property impacts
- Bike facility on Duke Street should be included near Landmark Mall to take advantage of planned redevelopment
- Include a bicycle/pedestrian connection to Eisenhower Avenue
- Pedestrian safety and accommodation along and across Duke Street is important
- Consider a phased approach to transit implementation – Alternative 1 to Alternative 3 with a bike facility
- Improved transit on Eisenhower Avenue should be part the overall corridor strategy
- Minimize impacts to residences and small businesses
- Concern with cut-through traffic in adjacent neighborhoods
- Some preference expressed for Alternative 1a and Alternative 3 with a modified approach to bicycle configuration in the central portion of the corridor where right-of-way is most constrained – renamed "3c"

Recommended Alternative

Based on feedback from the CWG and the public, as well as additional evaluation of bicycle connectivity options, a preliminary preferred alternative and phasing strategy were identified.

A combination of Alternatives 1a and 3c was the preferred approach for the Corridor B study. Together, these improvements would provide the opportunity to maximize the performance of the transitway, while minimizing property impacts along the corridor. While the most direct bike route would be along Duke Street, there would be significant property impacts if this were instituted – approximately one additional acre of right-of-way would be needed for the bike lanes.

Therefore, the combination of Alternatives 1a and 3c would provide flexibility to accommodate a continuous bicycle facility along Duke Street in the short- and long-term. The proposed continuous bicycle facility along the Duke Street corridor is shown on Figure 3.17. As shown, the bike component would include a combination of a parallel corridor (off Duke Street) and a multi-use path along one side of Duke Street.

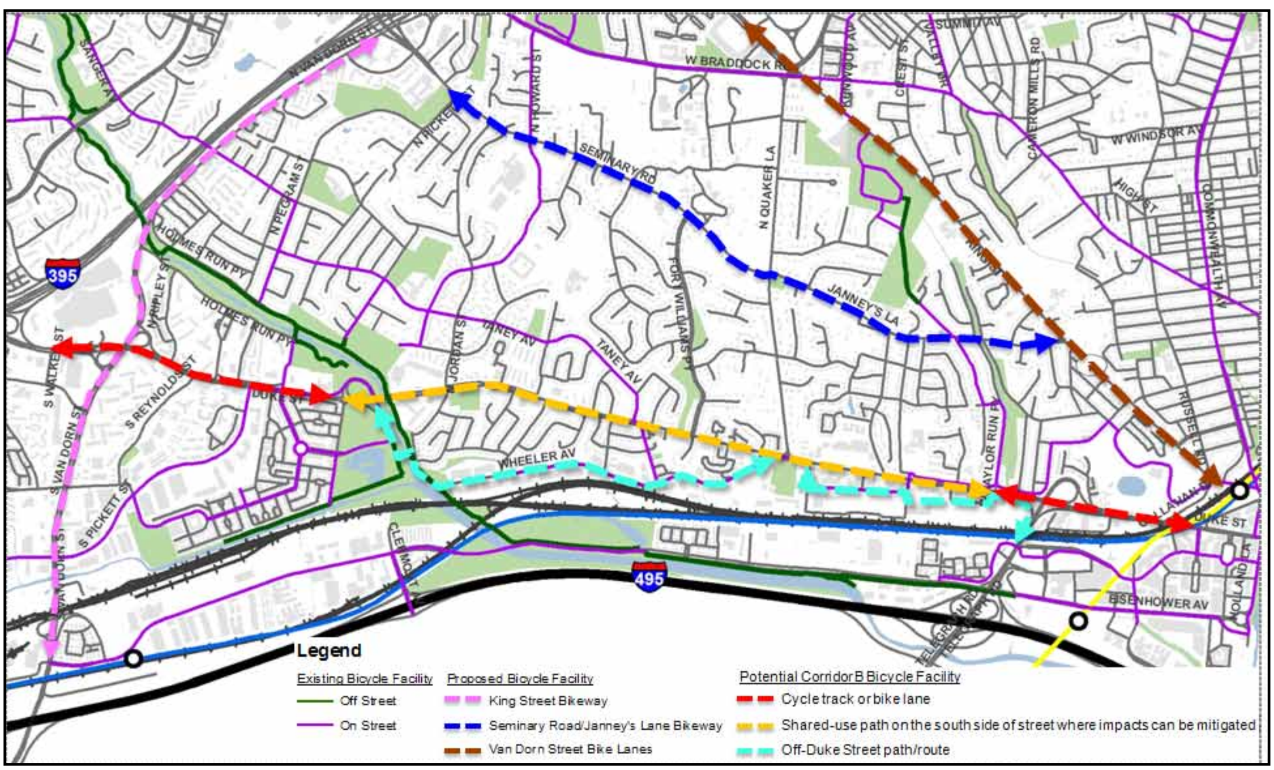
It is likely that in the near-term and prior to redevelopment of selected properties along Duke Street, the parallel facility would be pursued and constructed. Over time, right-of-way for the Duke Street bike facility could be secured through direct acquisition or as a part of larger infrastructure projects.

The City would continue to pursue transit service and facility enhancements along the Eisenhower Avenue corridor to provide frequent, high-quality services along Eisenhower Avenue.

Preliminary impacts and costs associated with the ultimate build of Alternative 3c are summarized in Tables 3.9 and 3.10.

Right-of-way along Duke street is limited and can accomodate either a narrow sidewalk / streetscape or narrow multi-use path. If future studies seek to implement a combination of standard width streetscape and multi-use path, then additional ROW would be needed.

Figure 3.17 Proposed Continuous Bicycle Facility



The impacts shown in Table 3.9 reflect a reduced roadway cross sectional width for the majority of the corridor east of Jordan Street. This change from the standard typical section was proposed to reduce impacts to residential and commercial properties in this section.

Though the original intent of this study was to develop a recommended alignment that could accommodate either BRT or streetcar, BRT is a more effective option and desireable choice due to lower capital cost, fewer ROW requirements and fewer system control elements. If the streetcar option were selected in the future, the ROW impacts may increase.

Table 3.9: Preliminary Impacts

Description	Impact
Park Impact	0.20 acres
Property Impact	2.0 acres 89 parcels
Commercial Parking Impact	75 spaces
Residential Parking Impact	6 spaces

Table 3.10: Preliminary Planning - Level Cost Estimates

Description	Cost Estimate
Capital Cost Estimate (exclusive of vehicles, based on cost per mile within the City)	$39 M
25-year Fleet Cost Estimate	$16 M
Right-of-Way Cost Estimate	$4 M
25-year Operating Costs	$60 M
Preliminary Planning - Level Cost Estimates	$119 M

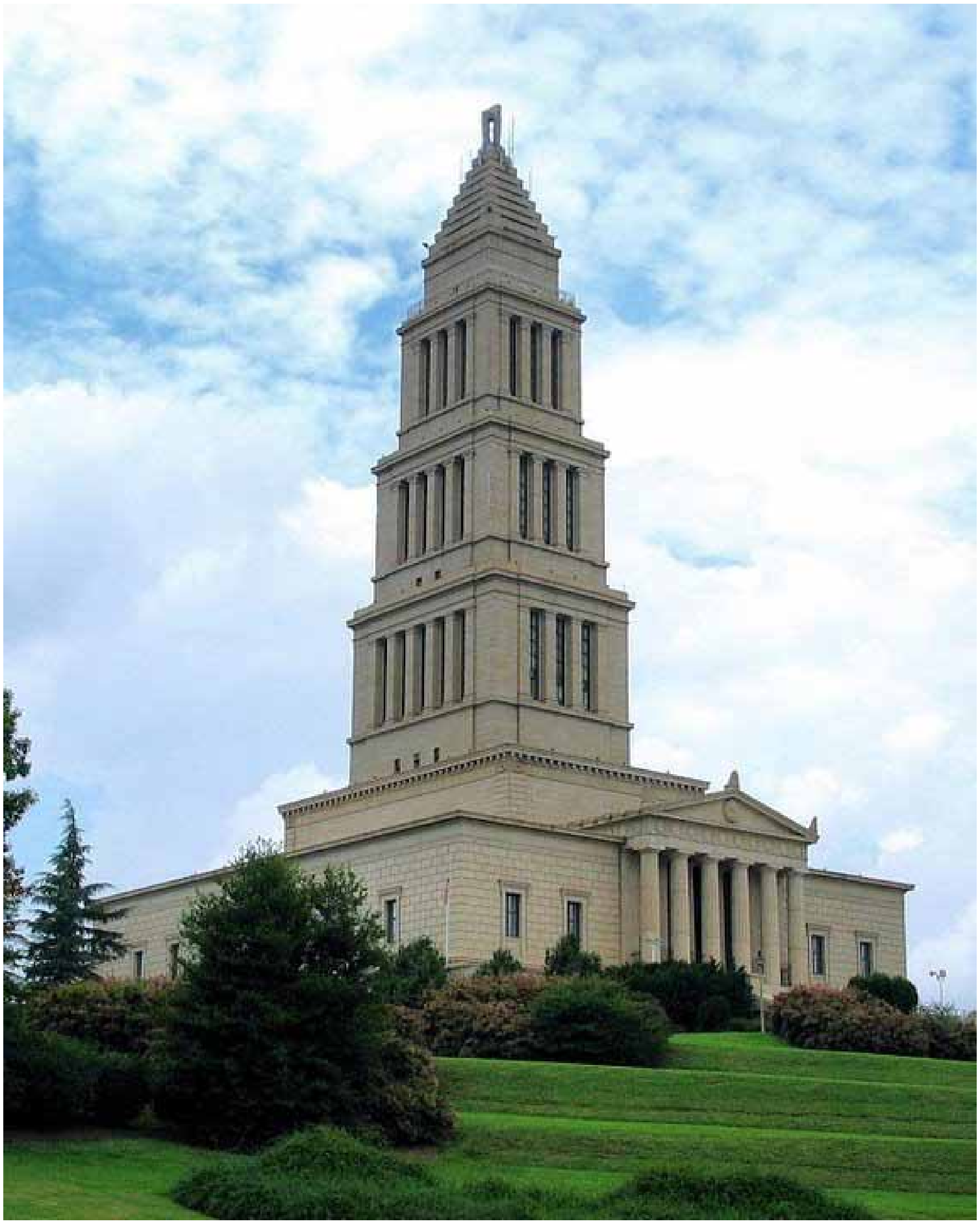
Notes:

1. Planning level cost estimates are shown in year 2012 dollars and do not include additional contingency or escalation to a future year mid-point of construction. Totals listed do not include costs for major utility relocations/new service, or the capital costs for roadway/streetscape improvements that may be implemented concurrently, but are not required for the transit project.
2. Though mode selection had been deferred during this study, BRT was assumed for the purpose of producing costs.

The formal recommendation for Corridor B, as defined and unanimously approved by the CWG on March 15, 2012, is presented below.

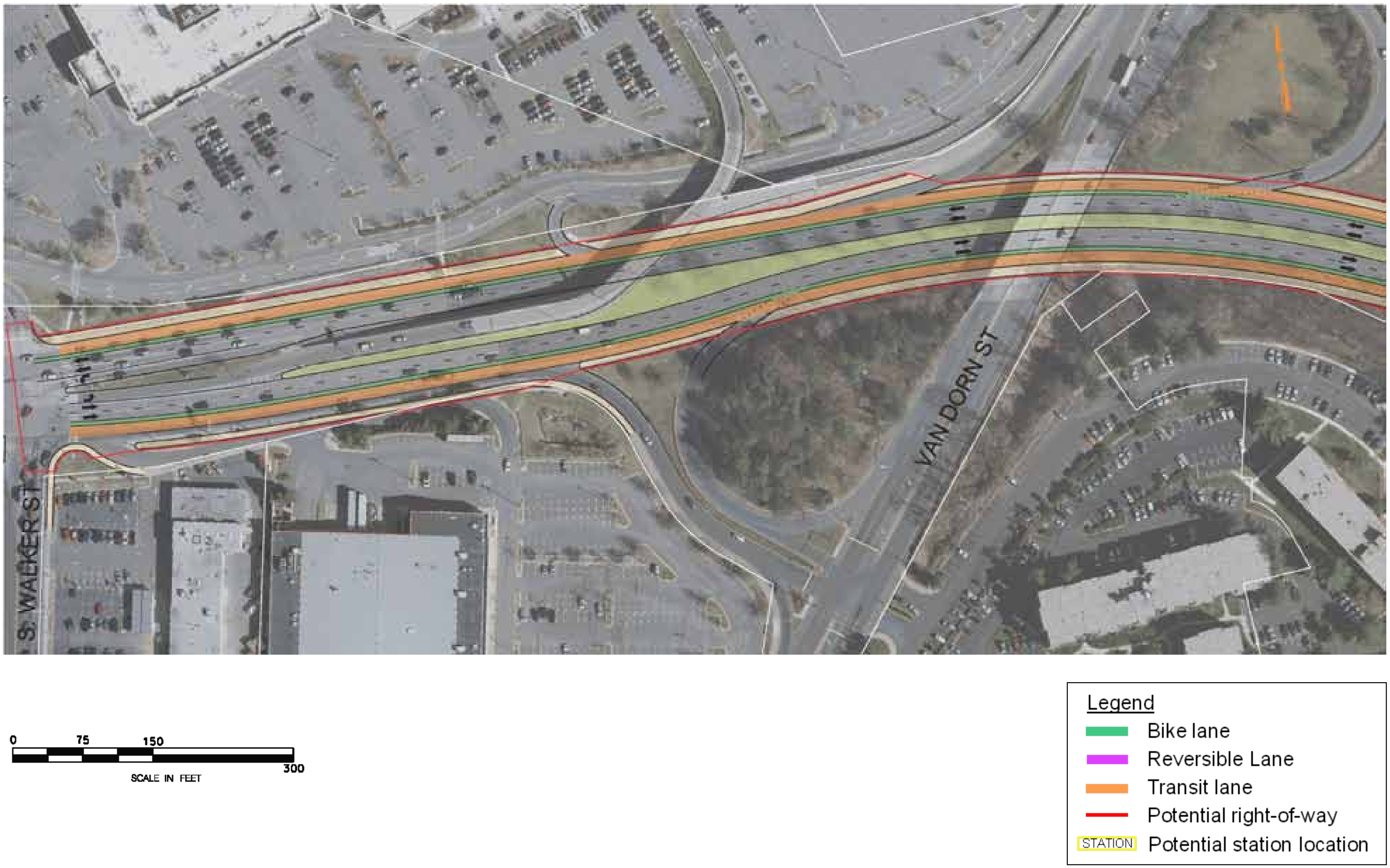
> "Alternative 1a would be the first phase of transitway implementation on Duke Street. It would create dedicated transit lanes in existing six-lane sections of Duke Street between Landmark Mall and Jordan Street and between Roth Street and Diagonal Road. In the remaining section of Duke Street between Jordan Street and Roth Street, transit would operate in mixed flow.
>
> A parallel off-corridor bicycle facility should be examined to accommodate bicyclists along Duke Street and improved pedestrian facilities would be provided at intersections and near transit stations. Preliminary implementation should prioritize enhanced pedestrian safety and improvements at Taylor Run Parkway.
>
> Alternative 3c would be the subsequent phase of transitway implementation on Duke Street. It would build on Alternative 1a by widening Duke Street to provide a reversible lane between Jordan Street and Roth Street.
>
> The reversible lane would be configured to allow Duke Street to accommodate a dedicated transit lane in the peak hour and peak direction of traffic flow during the a.m. and p.m. peak periods along Duke Street.
>
> Alternative 3c should continue to examine a bicycle facility along Duke Street along with corridor-wide pedestrian improvements. However, the Work Group believes that bicycles should be accommodated in this corridor if studies demonstrate that the streetscape can still be enhanced."

The alignment and limits of disturbance for the ultimate build of Alternative 3c are shown in Appendix A.



appendix a

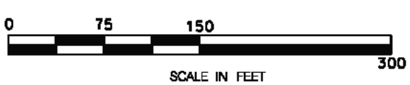
Alternative 3c - Landmark Mall to Van Dorn Street



Alternative 3c - Van Dorn Street to N. Paxton Street

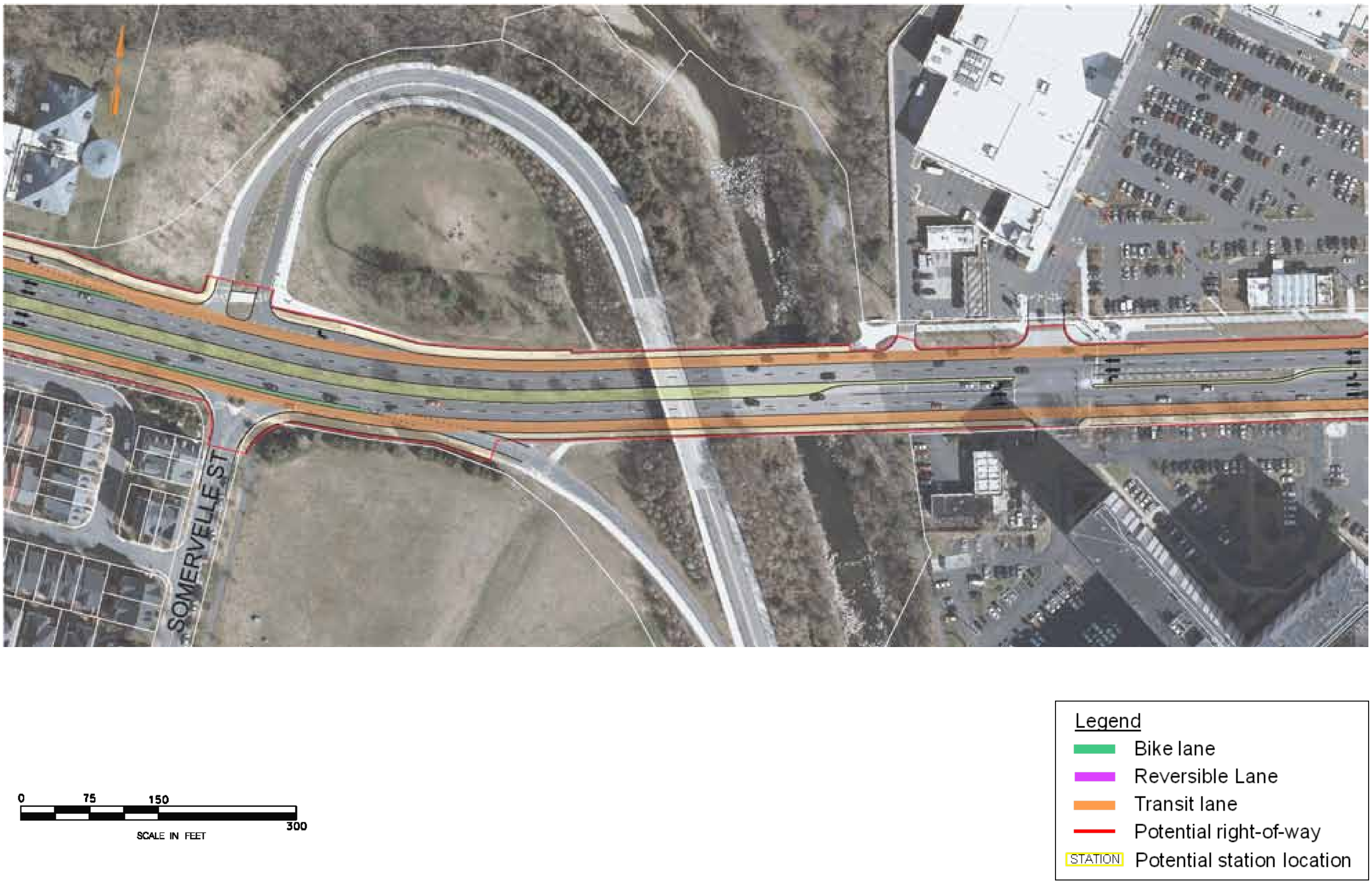
Legend

- Bike lane
- Reversible Lane
- Transit lane
- Potential right-of-way
- STATION Potential station location

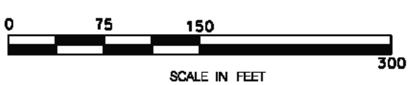


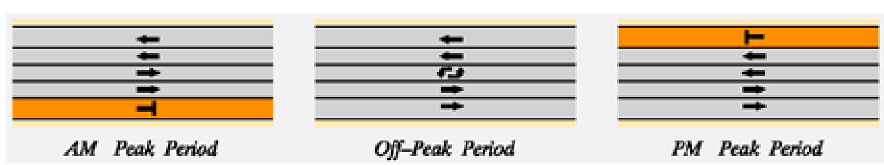
Alternative 3c -N. Paxton Street to Cameron Station

Alternative 3c - Cameron Station to Foxchase



Alternative 3c - Foxchase to S. Ingram Street

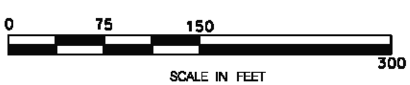


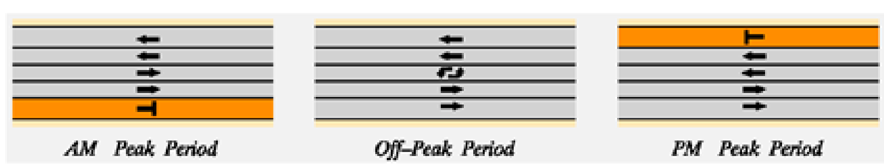


Legend
- Bike lane
- Reversible Lane
- Transit lane
- Potential right-of-way
- STATION Potential station location

Alternative 3c - S. Ingram Street to N. Floyd Street

Alternative 3c - N. Floyd Street to Ft. Williams Parkway

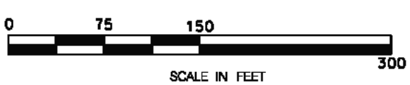


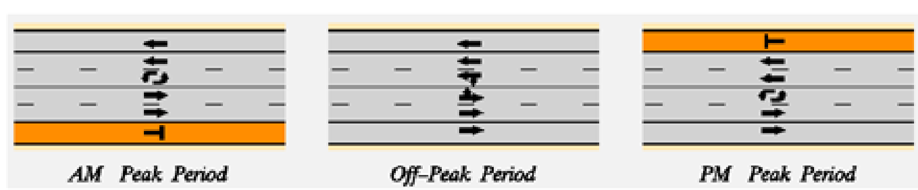


Legend
- Bike lane
- Reversible Lane
- Transit lane
- Potential right-of-way
- STATION Potential station location

Alternative 3c - Ft. Williams Parkway to N. Quaker Lane

Alternative 3c - N. Quaker Lane to Yale Drive





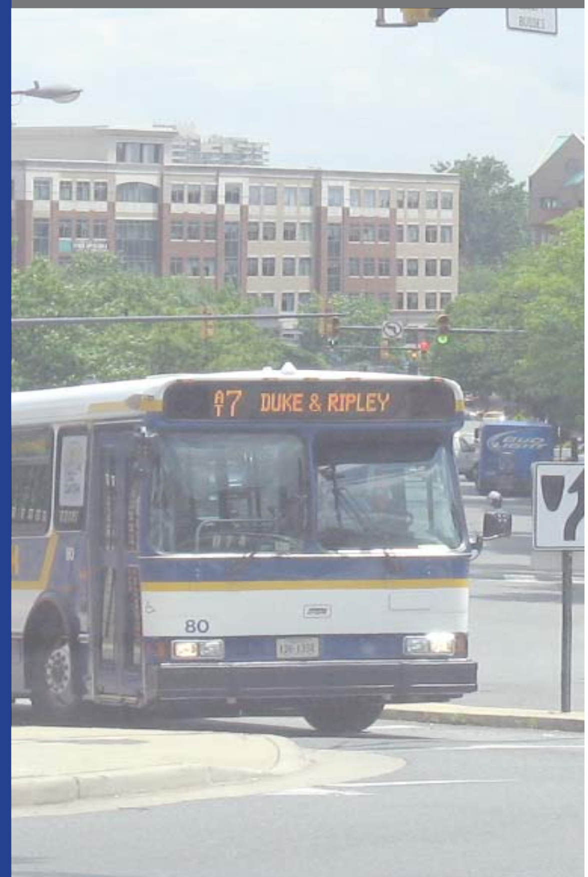
Legend
- Bike lane
- Reversible Lane
- Transit lane
- Potential right-of-way
- STATION Potential station location

Alternative 3c - Sweeley Street to Taylor Run Parkway

Alternative 3c - Taylor Run Parkway to Telegraph Road

Alternative 3c - Telegraph Road to Callahan Drive

Alternative 3c - Callahan Drive to Diagonal Road



Kimley-Horn and Associates, Inc.

RK&K

CITY OF ALEXANDRIA VIRGINIA