



# COUNTYWIDE TRANSIT NETWORK STUDY **FINAL REPORT**

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## CHAPTER ONE: STUDY PROCESS

This report describes the process and outcome for the Countywide Transit Network Study (CTNS), conducted by the Fairfax County Department of Transportation (FCDOT). The report is organized chronologically and describes the study purpose and process; and discusses the key findings and lesson learned at each stage of the study. The report consists of seven chapters:

- **Chapter 1** provides a high-level summary of the study process and overview of study activities;
- **Chapter 2** describes the development of the purpose and need for a High Quality Transit Network (HQTN);
- **Chapter 3** describes the baseline conditions established for both land use and the transportation network and the resulting transportation system performance;
- **Chapter 4** describes the development and evaluation of initial alternative concepts to best serve future desire for travel with high quality transit connections;
- **Chapter 5** presents the proposed network, as of summer 2013, recognizing the importance of coordination with several ongoing corridor studies underway by partner agencies;
- **Chapter 6** presents the proposed network, as of winter 2016, subsequent to completion of major partner agency study milestones; and
- **Chapter 7** presents detailed descriptions for the four new HQTN corridors not currently under detailed study by other agencies, including station locations and alignment reference maps.

This report also contains a set of detailed Appendices documenting study analyses and findings in greater detail. **Appendix A:** Study Context and Process, contains supporting data for the

### FREQUENTLY USED ACRONYMS

The following acronyms are used frequently throughout this document. A full set of acronyms and definitions is contained in the Glossary.

- CLRP = Constrained Long Range Plan
- CTNS = Countywide Transit Network Study
- DPZ = Fairfax County Department of Planning and Zoning
- EPTC = Enhanced Public Transportation Corridors
- FCDOT = Fairfax County Department of Transportation
- HQTN = High Quality Transit Network

### STUDY PURPOSE

Establish the most effective way to serve the County's future growth by improving public transit.

contents of this final report and **Appendices B through F** serve as technical memoranda for specific topics as referenced in the text.

The basis for development of the HQTN is a series of Enhanced Public Transportation Corridors (EPTC), a concept initially introduced during the 1990-1991 Planning Horizons update of the Fairfax County Comprehensive Plan. These corridors, which carry higher volumes of inter-county and/or intra-county vehicular traffic, are designated for the provision of major



public transportation facilities (such as rail transit, commuter rail, light rail (LRT), bus rapid transit (BRT) and/or high occupancy vehicle (HOV) lanes). Mode specific decisions for these corridors should be based upon the results of a comprehensive alternatives analysis. The EPTCs represent general alignments for these major public transportation facilities.

The *Countywide Transit Network Study* was initiated to analyze the Comprehensive Plan's Enhanced Public Transportation Corridors and provide more specific planning guidance including:

- How the planned corridors can best serve as an interconnected network;
- What transit functions, modes, technologies, and station locations will be most effective to help serve the objectives of the Fairfax County Comprehensive Plan; and
- Which specific transit types should be recommended for each corridor.

The proposed HQTN combines Metrorail, commuter rail, LRT, BRT, and express bus services into an integrated transit system connecting the County's activity centers with each other and to the rest of the region, providing a sound platform for the County's economic and quality of life objectives.

### WHAT IS A HIGH QUALITY TRANSIT NETWORK?

A High Quality Transit Network (HQTN) provides high travel speeds and reliable travel times for both rail and bus transit vehicles on exclusive or managed rights-of-way that allow transit vehicles to avoid traffic congestion.

On May 4, 2009, the Fairfax County Board of Supervisors (BOS) directed staff to develop a framework for discussion of cultivating a vision for a Countywide connected transit network and to draft an outline for a potential Countywide transit study. The BOS subsequently directed staff "to include coordinated efforts that are already underway." A connected Countywide multimodal transportation network is needed to help maintain balance between land use and transportation in Fairfax County. A robust, interconnected, regional transit network is needed, as part of that multimodal approach, to support future growth within the County and to provide a feasible alternative to congested highway corridors.

The development of the HQTN synthesized the best of three different knowledge bases:

- Expertise available from other jurisdictions, nationwide and globally, as gleaned from an extensive literature review of the state of the practice;
- Technical analysis of travel demand, capital costs, and effects on key environmental and community resources; and
- Coordination with neighboring jurisdictions and robust rounds of public outreach.

The efforts within each of these three areas are summarized below and described in greater detail in the following Chapters of this report.



## State of the Practice Reviews

The CTNS included a literature review of the state of the practice in transportation network planning and implementation for similar jurisdictions, both locally and nationwide. The literature review identified the state of the practice for adjacent jurisdictions in the Washington DC region, 10 benchmark jurisdictions identified nationwide, and 10 relevant international transit systems.

The literature review confirmed several basic principles on which the CTNS was predicated, including:

- understanding and strengthening the regional framework;
- considering the appropriate function for different transit corridors before selecting a transit mode or technology;
- considering stakeholder needs and interests to both right-size transit systems and develop project champions; and
- designing the system to meet long-term goals with phased implementation over time.

The literature review also demonstrated the need to seek context-sensitive solutions. While the bullet points above demonstrate the procedural foundations of successful transit systems, the application of those foundations result in a variety of network configurations and characteristics that are molded to serve unique demographic, economic and topographic environments. The literature review, therefore, was most helpful in framing the technical analyses and collaborative engagement processes described below.

The full literature review is provided in **Appendix B**.

## Technical Analysis

The CTNS included robust technical analyses that developed quantitative measures of effectiveness for a series of alternative HQTN concepts and configurations to assess the performance of both individual corridors and the overall network. These analyses included travel demand analyses, land use measures and transit system effects, and an assessment of cost effectiveness.

- The travel demand analyses applied both the regional MWCOG travel demand model and a quick-response sketch-level planning model developed for the study. The

### RELEVANT NATIONAL AND INTERNATIONAL EXAMPLES

The CTNS literature review summarizes transferable lessons learned from relevant jurisdictions both nationwide and worldwide, including:

#### Nationwide

- Atlanta, GA
- Denver, CO
- Minneapolis, MN
- Montgomery County, MD
- Orlando, FL
- Portland, OR
- Providence, RI
- Santa Clara County, CA
- Seattle, WA
- Ventura County, CA

#### Worldwide

- North America: Ottawa, Toronto, and Vancouver
- South America: Buenos Aires, Curitiba, and Quito
- Africa: Cape Town
- Asia: Ahmedabad, Delhi, Guangzhou, Hangzhou, and Shanghai



application of, and parameters for, these travel demand models are discussed in greater detail in Chapters 3 and 4, with technical details included in **Appendices D and E**.

- The land use analyses included consideration of adopted MWCOG Cooperative Forecasts, the planned land use envisioned in the Comprehensive Plan, and possible alternative land use concepts in coordination with the Fairfax Forward planning efforts led by the Fairfax County Department of Planning and Zoning (DPZ), with a focus on potential land use changes in the Richmond Highway and Route 28 corridors, and sensitivity tests considered in the Kingstowne Community Business Center. The land use analyses also considered the degree to which alternative HQTN configurations affected station area measures of effectiveness. The development of land use alternatives is summarized in Chapter 3 and the land use measures of effectiveness are detailed in **Appendix F**.
- The cost-effectiveness analysis included development of capital cost estimates and a comparison to projects proceeding through the FTA's New Starts implementation process as a practical gauge for assessing cost-effectiveness. Details on cost estimates and cost-effectiveness are provided in Chapters 5 and 6 and **Appendix A**.

For each of these technical analyses, the HQTN and its component corridors were evaluated for a 2050 horizon year, with a comparison to the transportation network already incorporated in the MWCOG Constrained Long Range Plan (CLRP) as a baseline.

### **Coordination with Local Jurisdictions and Public Outreach**

The CTNS included extensive coordination with a wide range of constituents, including:

- The general public;
- Federal, state, regional, and local agency staff;
- Elected and appointed officials; and
- Organizations reflecting particular geographic or functional interests, such as civic associations.

The coordination efforts included approaches tailored to the needs of these different constituents. The approach included casting a wide net to engage the greatest number of people through social media and other means of electronic communication, conducting in-person meetings with interested constituent groups as well as the broader general public, and close working relationships with partner agency staff through the project's technical working group.

### **Social Media**

The CTNS included a series of social media initiatives to reach community members in their living rooms and workplaces and on their own schedules:

- The project website was maintained with public meeting information and materials throughout the project duration.
- An online survey to help define and prioritize study goals and objectives, using the SurveyMonkey platform, was launched in March 2012 and maintained through August



2012 (until after the first set of public meetings). The results of the survey are discussed in Chapter 2 and full results are included in **Appendix C**.

- A discussion platform using IdeaScale during the primary development and evaluation of concepts and alternatives in 2012 and 2013 facilitated interactive conversations on a variety of topics.
- Information was pushed to interested County residents via a project e-mail list from 2012 through 2014 and via the Fairfax Alerts process and the County's Facebook page during 2015 and 2016.

### Public Meetings

The study team held four sets of public meetings to present work completed to date and solicit feedback on subsequent study stages, covering the following topics:

- Goals/objectives (July 2012);
- Corridor functions (November 2012);
- Proposed concept (July 2013); and
- Recommended HQTN (February 2016).

Relevant public materials and feedback for each set of meetings are presented by topic in the remaining chapters of this report.

### Technical Working Group

The study team established a Technical Working Group, consisting of federal,

### TECHNICAL WORKING GROUP MEMBERS

The CTNS Technical Working Group consisted of representatives from the following agencies (and the acronyms below are used elsewhere in this report to identify these agencies):

#### Federal and State Agencies

- Federal Transit Administration (FTA)
- District of Columbia Department of Transportation (DDOT)
- District of Columbia Planning Department
- Virginia Department of Rail and Public Transportation (DRPT)
- Virginia Department of Transportation (VDOT)

#### Regional Agencies

- Metropolitan Washington Airports Authority (MWAA)
- Metropolitan Washington Council of Governments (MWCOG)
- Northern Virginia Transportation Authority (NVTA)
- Northern Virginia Transportation Commission (NVTC)
- Potomac Rappahannock Transportation Commission (PRTC)
- Washington Metropolitan Area Transit Authority (WMATA)
- Virginia Railway Express (VRE)

#### Local Agencies

- Fairfax County
- City of Alexandria
- Arlington County
- City of Fairfax
- City of Falls Church
- Town of Herndon
- Loudoun County
- Montgomery County
- Maryland-National Capital Park and Planning Commission (MNCPPC)
- Montgomery and Prince George's Counties
- Prince George's County
- Prince William County
- Town of Vienna
- Fort Belvoir
- George Mason University



Public meetings were one of several avenues used to solicit ideas for transit network connections. Pictured above are public meeting attendees and facilitators reviewing the study area maps.

exchanged technical information with individual agencies throughout the study, particularly in regards to coordinating parallel study efforts.

### **Board of Supervisors Meetings**

The study team briefed the Board Transportation Committee (BTC), a committee of the whole Board, at major project milestones generally associated with public outreach process. The BTC meetings where the CTNS was discussed were held on:

- February 14, 2012, announcement of the CTNS kickoff;
- September 18, 2012 to review goals and objectives and baseline conditions;
- June 25, 2013 to review initial proposed recommendations;
- September 17, 2013 to review project status and coordination with ongoing studies; and
- December 1, 2015 to review draft recommendations.

More information about the project public participation, stakeholder involvement and feedback that guided the study efforts are described in the remaining chapters of this report.

state, regional, and local transportation planning and operating agencies to facilitate an understanding of the long range transportation needs and initiatives from a regional perspective. This understanding helped inform and create the desired interconnected transit network. The Technical Working Group met in advance of each of the four sets of public meetings to help refine the materials and messages for the public meetings and exchange information on current initiatives that might be relevant to the study. In addition, the study team conducted separate meetings and



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## CHAPTER TWO: PURPOSE AND NEED

From a broad perspective, the purpose of the CTNS is to determine the type of transit systems needed to accommodate anticipated economic growth throughout the County over the next several decades. The specific outcome is a recommended network of high quality transit corridors that can be developed in a cost-effective way to serve the County's long term needs

From a narrower perspective, the study is tasked with defining the alignments, station locations, and right-of-way needs for the recommended high quality transit corridors, providing greater detail for the Enhanced Public Transportation Corridors (EPTCs) in the Comprehensive Plan.

The study team examined alternative network concepts, weighing the benefits of mobility vs. accessibility in Fairfax County. This process started with the problem statement described below. Study goals and objectives were developed through a public involvement process to address these problems.

### Problem Statement

At the outset of the study, the study team identified the need to determine three primary characteristics, with a series of questions to be answered for each one:

1. Determine future Countywide transit needs:
  - Which highway corridors show a very high level of congestion in future?
  - What quality of transit service do we need?
  - Where do we need exclusive right-of-way?
2. Determine travel markets:
  - Which of the County's activity centers have the highest level of person travel demand to, from, within, or between them?
  - Where is travel demand greatest for connecting the County with other jurisdictions in the Washington DC region?
  - Which desire lines can best be served by high-quality transit lines?
3. Determine Countywide connected transit network:
  - Where are there gaps in the network?
  - Where should connections occur?
  - How well are the needs to move people and goods and to support economic growth being served?

The study team decided it was important to synthesize both robust technical analysis and stakeholder feedback in answering these questions. In particular, community feedback was valuable in defining study goals and objectives. The initial feedback was conducted primarily through an online survey and an initial public meeting, as described below.

### Online Survey

The study team used an online survey to gauge public opinion regarding the purpose and need for better transit connectivity and the value of achieving different goals and objectives. On March 23, 2012 the Fairfax County Department of Transportation (FCDOT) launched the public involvement process of the CTNS with an online survey hosted on the SurveyMonkey website. The study team used this online survey to gauge public opinion regarding the purpose and need



for better transit connectivity and the value of achieving different goals and objectives. The survey was available until after the first set of project public workshops which were held in July 2012, with a survey closing date of August 6, 2012. **Exhibit 2-1** provides an example of the survey format.

The purpose of the online survey was to help the County define and prioritize study goals and objectives, through a non-scientific, self-selected, sampling of values regarding transit planning elements as they affect the quality of life for those who live, work, shop, or have other business in Fairfax County. The survey consisted of 28 questions, organized into three areas:

- Questions 1 through 7 were stated-preference questions regarding individuals’ desires for travel options in deciding where to live and how to travel to activity centers within the County.
- Questions 8 through 16 were demographic questions about the survey respondents’ age, gender, ethnicity, income, housing type, household size, and employment status.
- Questions 17 through 28 were questions regarding their current travel patterns.

The 1,376 responses to the survey provide the County with an understanding about land use and transportation values and priorities for those traveling in Fairfax County. Highlights of the results were used to help define study goals and objectives:

- Support for transit investment is widespread, as is the recognition of the variety of purposes transit serves. At least two thirds of respondents believe it is either important, or very important, for the Washington DC region to invest in transit in order to:
  - Reduce travel time (86%);
  - Provide travel options (choice riders) (83%);
  - Take cars off the road (81%);
  - Increase economic development (79%);
  - Provide travel options (non-drivers) (78%);
  - Reduce carbon footprint (76%); and
  - Create attractive mixed-use centers (68%).

### Exhibit 2-1 | Online Survey Format

**Fairfax County 2050 Transit Study**

The Fairfax County Department of Transportation is conducting a 2050 Transit Study during 2012 to determine how public transit system expansion plans can best serve the county’s long-term economic growth objectives. Transit systems can be designed to serve many different objectives. This survey will help us understand your needs and preferences for traveling within or through Fairfax County and how your travel needs are connected to other elements affecting your quality of life. We expect this survey will take you about 10 minutes to complete and we thank you for your participation.

Tell us about how important travel options are for you.

**1. How important is it for you to live in a place that provides:**

	Not Very Important	Somewhat Important	Important	Very Important
As large of a house as you can afford	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A front yard and / or back yard	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A mix of different housing sizes, types and styles	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
A mix of different ages and incomes among your neighbors	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
An easy walk (under 10 min) to work	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
An easy walk (under 10 min) to shopping / dining / entertainment / cultural destinations	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
An easy walk (under 10 min) to healthcare or a pharmacy	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
An easy walk to recreational facilities (i.e. park or fitness center)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Easy access to the highway	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Easy access to rail transit by park-and-ride	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Easy access to rail transit by walk / bike	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Easy access to rail transit by bus	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Easy access to bus transit	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Privacy from neighbors	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Quality public schools	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
Other (please specify below)	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Page 1

The online survey asked respondents about both preferred places to live and ways to travel as well as their current travel patterns



- Respondents indicate a preference for residing in communities with plentiful amenities, including retail and recreational opportunities, within walking distance that are often associated with transit-oriented development (TOD).
- Transportation system reliability is slightly more important than either travel speed or cost. Renters consider costs more important than homeowners.
- Travelers are more willing to walk a longer distance to rail modes than to bus modes. The willingness to walk longer distances decreases with age, but not with income.
- Transit is needed to connect all of the County's activity centers, with importance generally correlated with size. Each of the County's activity centers generated interest from more than 200 survey respondents indicating that it is important to them to be able get to that center by transit. More than 800 respondents indicated it is important for them to be able to get to Tysons Corner, and at least 500 respondents indicated it is important to be able to get to the Dulles/Route 28 Corridor, Fairfax Center/Fair Oaks, Reston, or Vienna by transit.
- Survey respondents value mobility, with a fairly strong preference towards transit systems that make fewer stops even though the walk to those stops will be longer. Respondents have a slight preference for transit trips that do not involve a transfer.
- Transit users and non-transit users, alike, have generally similar values regarding the characteristics of places and the attributes of the transportation system that they value the most. Not surprisingly, a key exception is that regular transit users place a higher value on investing in transit and those who do not regularly use transit place a higher value on investing in roads.

A complete analysis of the survey questions and answers is provided in **Appendix C**.

### **Introductory Public Meeting**

The study team held a public meeting at two locations during July 2012 (at the Fairfax County Government Center on July 16 and at Hayfield Secondary School on July 19) to kick off the project and gauge public opinion on purpose and need, as well as goals and objectives. This meeting had two components:

- **Setting the Stage:** Providing contextual information about the study parameters and the foreseeable future for land use and transportation conditions that would form the baseline for alternative scenarios to be tested.
- **Mapping the Future:** An interactive dialogue where participants were encouraged to draw on maps to indicate where they thought high quality transit connections should go. These maps showed proposed land use destinations and forecast development densities to give the proposed connections context.

The public meeting presentation described the study background and scope. About 50 people attended one of the two meetings. Attendees were generally enthused about the study topic and the opportunity to help shape the County's transit system. Means to increase transit connectivity and ridership were among the most valued objectives from a dot-voting perspective. Common concerns expressed included ensuring that cost-effectiveness, traffic congestion, and ways to increase the attractiveness of transit were incorporated in the study.



## Development of Goals, Objectives, and Measures of Effectiveness

The study team considered the guidance in the Comprehensive Plan and the input provided through the public outreach process. The study team found that, while the community held many different perspectives on what a good transit network should achieve, the different ideas provided by the community supported at least one of the study’s three basic goals. These goals were: to help the County improve connections; to achieve planned growth and investment goals; and to maintain a high quality of life. These goals were simplified to one-word summaries:

- **Connect:** Provide more transportation choices for Fairfax County and regional connectivity.
- **Grow:** Support local and regional economic development goals.
- **Thrive:** Strengthen quality of life by making transit-friendly, sustainable investments.

Exhibit 2-2 shows the nine objectives that were associated with the goals to Connect, Grow, and Thrive. The degree to which alternative network concepts fulfill these objectives is presented in subsequent report chapters.

### Exhibit 2-2 | Study Goals and Objectives

Goal	Objective
<b>CONNECT</b> Provide more transportation choices for Fairfax County and regional connectivity	1. Enhance transit connections
	2. Increase ridership
	3. Improve directness of travel
	4. Consider cost-effectiveness
<b>GROW</b> Support local and regional economic development goals	5. Increase value of existing development
	6. Encourage transit oriented development
<b>THRIVE</b> Strengthen quality of life by making transit-friendly, sustainable investments	7. Increase access to cultural venues and community facilities
	8. Reduce environmental impacts
	9. Support countywide vision

The study goals and objectives are structured to demonstrate how a High Quality Transit Network will help Fairfax County Connect, Grow and Thrive

## Key Lessons for Next Steps

The review of study purpose, need, goals, and objectives led to the following key findings that helped inform the next steps of the study:

- While traffic congestion is a widespread concern among residents, there is also a recognition that transit system investments should not be predicated on reducing traffic congestion;
- Citizens recognize that transit investments provide key benefits in terms of increasing access to opportunities, which helps increase property values, thereby increasing economic development and the tax base; and
- A strategic choice needs to be made between access and mobility, which should be examined from a network perspective to see how they compare in meeting study goals and objectives.



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## CHAPTER THREE: BASELINE CONDITIONS

The baseline conditions for the Proposed HQTN Concept development are composed of:

- A 2050 land use forecast reflecting expected long-term development yields recommended in the Comprehensive Plan; and
- A transportation network reflecting the 2040 Constrained Long Range Transportation Plan (CLRP).

The combination of a regionally constrained transportation plan and a longer-term land use plan was selected for three reasons:

1. First, since the primary study objective is to identify an ultimate transit network, a master plan horizon is more appropriate to test than a constrained 25-year forecast. The Comprehensive Plan has development potential significantly higher than the amount that is anticipated to be absorbed by 2040.
2. Second, local land use plans are set by the jurisdiction and can be changed more easily. Conversely, development of regional transportation plans require extensive coordination between multiple jurisdictions. This effort is seen in regional Metropolitan Washington Council of Governments (MWCOC) Constrained Long Range Plan (CLRP), subregional Northern Virginia Transportation Authority (NVTA) TransAction plan, and Washington Metropolitan Area Transit Authority (WMATA) Transportation Plans. Because of the effort required to develop a base transportation plan, the selection of the current CLRP for 2040 is a pragmatic starting point for the study.
3. Finally, the effect of testing a 2050 land use plan against a 2040 transportation network creates some additional travel demand pressures that help identify which corridors are most promising for high-capacity transit.

Both the land use and transportation elements of the baseline condition are described further in the following paragraphs, followed by an assessment of the transportation system performance using the MWCOC travel demand model.

### **Land Use Assumptions (Initial/Refined)**

The Fairfax County Comprehensive Plan includes a Concept for Future Development that identifies a series of mixed use centers where development growth is planned. Most of the County's land has already been developed, meaning that future growth will occur primarily through infill development and redevelopment of properties within these mixed use centers.

The Concept for Future Development was initially developed as part of the Fairfax County Planning Horizons, a major revision of both the policy and land use recommendations of the County's Comprehensive Plan, adopted in 1990 (Policy Plan) and 1991 (Area Plans). During Planning Horizons, six land use concepts that represented possible futures for Fairfax County and three different transportation systems were evaluated to understand the potential impacts of each. A preferred alternative was developed and formed the basis for the Concept for Future Development. The Board of Supervisors adopted an updated Concept for Future Development in 2012.

The development of land use assumptions for the study consisted of three separate steps:



1. **MWCOG Forecasts:** Use of the currently adopted MWCOG land use forecasts for the most distant horizon year of 2040. The study started with the Round 8.0 forecasts in spring 2012; these forecasts were updated to reflect Round 8.4 forecasts in fall 2015;
2. **Development of 2050 Forecasts:** Development of forecasts that reflect a more distant horizon year, nominally labeled as 2050. Within Fairfax County, the 2050 forecasts reflected estimates of Comprehensive Plan yield. For instance, Tysons Corner was presumed to grow to its planned extent of about 200,000 jobs and 100,000 residents, significantly different from the 153,000 jobs and 33,000 residents forecast for 2040 in Round 8.0. These forecasts, generally referred to as “2050 Initial Scenario,” also reflected estimates for Comprehensive Plan updates underway, but not yet adopted as of 2013, such as for Reston, Baileys Crossroads, and Seven Corners. In other regional jurisdictions, the MWCOG forecasts were extrapolated to 2050 by adding the 2030-2040 growth increment to the 2040 total;
3. **Richmond Highway and Dulles Suburban Center:** Consideration of refined Comprehensive Plans for two transit corridors, Richmond Highway and the Dulles Suburban Center where current Fairfax Forward planning studies will evaluate land use changes. Along Richmond Highway, the study team conducted an interagency charrette to examine land use potential for the activity centers of Huntington, Penn Daw, Beacon Hill, Hybla Valley, South County, and Woodlawn. In the Dulles Suburban Center, the study team examined a rebalancing of jobs and housing within the current Plan density guidelines at potential transit stations to achieve a ratio that would maximize the potential for transit usage within the corridor.

**Exhibit 3-1** summarizes the total number of jobs and population in Fairfax County (including the independent cities of Fairfax and Falls Church) for each of these land use scenarios. A continuing theme for both this study and the concurrent Fairfax Forward planning efforts is the consideration of encouraging increased residential development within jobs-heavy activity centers. As indicated in **Exhibit 3-1**, the difference between the Round 8.4 forecasts for 2040 and the 2050 Initial Scenario is an increase of 237,000 jobs, but only 52,000 residents, representing a need for workers from outside the County. In contrast, the Refined and Final forecasts reduce the total number of jobs slightly and substantially increase the resident population to help shift the jobs-housing ratio to a more balanced relationship.



### Exhibit 3-1 | Land Use Scenarios

SCENARIO	POPULATION	JOBS
RD 8.4 2015	1,159K	694K
RD 8.4 2040	1,406K	931K
2050 Initial (2013)	1,458K	1,202K
2050 Refined (2013)	1,550K	1,174K
2050 Final (2016)	1,614K	1,180K

The study examined three alternative 2050 scenarios that reflected Comprehensive Plan development yields without a market absorption constraint

**Exhibit 3** of the Executive Summary shows the 2050 Final transit-supportive development densities assumed for the assessment of HQTN performance. The development of the three 2050 scenarios is described in greater detail in **Appendix A**.

### Transportation System Assumptions

The transportation network for the study utilized the MWCOG CLRP 2040 horizon year as the baseline for travel demand modeling. The definition of the CLRP changes on an annual basis:

- For the initial model scenarios conducted during 2012 and 2013, the key CLRP transit system improvements in northern Virginia included the Silver Line, the Columbia Pike Streetcar, and City of Alexandria’s West End Transitway;
- For the final model scenario completed in early 2016, the CLRP had been modified with notable transit system changes including the removal of the Columbia Pike Streetcar and the addition of the Transform 66 HOT lanes, the Richmond Highway BRT and the Duke Street Transitway within the city of Alexandria.

The CLRP includes investment in key transit facilities throughout the region, as well. Notably, both 2013 and 2016 models included the construction of the Purple Line and Corridor Cities Transitway in Maryland, the H Street streetcar in the District of Columbia, and key bus route service improvements regionwide.

### Transportation Systems Analysis Approach

The transportation systems analysis approach applied two basic study tools and a variety of analysis approaches to examine future conditions. The MWCOG travel demand model is a state-of-the-practice analysis tool for regional travel demand applied for a variety of policy and planning purposes. The model applies a “four-step” process of:



- **Trip generation** (how many person trips are generated by the land uses throughout the region?);
- **Trip distribution** (where do those person trips begin and where do they end?);
- **Mode split** (how many of those trips are transit riders, auto drivers, auto passengers, or non-motorized trips?); and
- **Trip assignment** (for the trips in motor vehicles, including transit, which routes or roadways do they travel along?).

### **Transportation System Performance**

**Exhibit 3-2** compares key travel demand model outputs from a systems-level perspective to gauge change over time:

- The total number of weekday transit riders from a regional perspective provides an assessment of overall transit system stability and the effects of actions either regional (such as the increase in development that occurs over several decades) or subregional (such as the investment in transit services focused on Fairfax County);
- The total number of weekday transit riders from a Countywide perspective provides a similar assessment, but on a more localized level;
- The total Countywide mode share percentage using transit for all trip purposes identifies the degree to which a land use and transit network combination is useful in fulfilling needs for all travel purposes; and
- The total Countywide mode share percentage using transit for just the journey to work identifies the degree to which a land use and transit network combination is useful in linking potential workplaces and residences, since high-quality transit systems serve a higher proportion of journey-to-work trips than do other modes of travel.

**Exhibit 3-2** shows several trends that form the basis for understanding alternative network performance:

- As the region adds development over time, the total number of transit trips in the region will increase by 55%, from 1,078,000 in 2007 to 1,667,000 in the 2050 Initial Land Use Scenario due to both an increase in land use and investment in transit systems regionwide;
- The number of Countywide transit trips over the same time period will increase by 116%, from 152,000 in 2007 to 329,000 in the Initial Land Use Scenario, faster than the 26% increase in population or the 69% increase in jobs. This is due, in part, to the concentration of growth in TOD activity centers such as Tysons, Reston/Herndon, and Dunn-Loring/Merrifield, as well as the investment in the Silver Line;
- The Final Land Use Scenario includes a refocusing of TOD in Fairfax County to improve jobs/housing balance, increasing the number of 2050 residents by 11% over the Initial Land Use Scenario, but reducing the number of 2050 jobs by 2%; and
- The fact that the Countywide transit ridership grows at a significantly higher rate than the number of residents and jobs is also reflected in the increase in transit mode share.



**Exhibit 3-2 | Tested Transit Network Ridership**

MEASURE OF EFFECTIVENESS	2007	2050 CLRP BASELINE WITH INITIAL LAND USE (2013)	2050 CLRP BASELINE AND FINAL LAND USE (2016)
Total regional weekday transit riders (000s)	1,078	1,667	1,883
Total Countywide weekday transit riders (000s)	152	329	413
Total Countywide mode share percentage	3.9%	5.8%	7.1%
Total Countywide Home-Based Work mode share percentage	12.5%	15.6%	18.5%

This table shows how the transit ridership is expected to grow based on baseline assumptions for the study in 2013 and 2016

**Key Lessons for Next Steps**

The development of the baseline conditions yielded several key findings that helped inform the remainder of the study:

- The regional travel demand model is a robust tool best suited for examining corridor-level and route-level alternatives, but cumbersome for the purposes of assessing and visualizing broader person travel demand and desire lines. A sketch-level travel demand model was a valuable tool to quickly ascertain expected effects of substantial changes to the transit network and applied for the initial review of alternatives;
- The assessment of buildout conditions is appropriate for a comprehensive planning approach and to examine synergies between land use and transportation network assumptions beyond the typical 20-25 year planning horizon. The designation of a “horizon year” of 2050 is necessary for communications convenience, but should not be considered a forecast as much as a general sense of property development yields at such time as the real estate market matures to the level anticipated by planning and zoning policies;
- The assessment of travel demand for a 2050 horizon year does not indicate project readiness for implementation. In particular, the feasibility of Orange Line and Blue Line Metrorail extensions are long-range possibilities. Further interagency coordination is needed to address Metrorail core capacity issues, the relative effectiveness of alternative modes, and interjurisdictional coordination regarding land use plans and transportation; and



- The assessment of travel demand, transit ridership, and transit system cost-effectiveness needs to reflect current fiscal realities, but not be rigidly bound by those policies.



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## CHAPTER FOUR: INITIAL ALTERNATIVE CONCEPTS

The study team developed a series of initial transit system concepts that reflected the study goals and objectives, incorporated the baseline land use and transportation conditions, and examined alternative transit system functions. The primary objective of the initial alternative concepts was to examine the potential for connecting different areas of the County based on an assessment of travel desire lines. This objective resulted in four primary activities described in this chapter:

- The development of a Transit Sketch Model to facilitate a quick-response assessment of travel demands at a person-trip level and the degree to which better transit system proximity and transit system speeds could shift demand for auto travel to transit travel;
- The consideration of discrete functions to provide either transit system accessibility or transit system mobility and the tradeoffs between the two types of transit functions;
- The evaluation of alternative transit concepts which provided various levels of accessibility and mobility; and
- The presentation of these concepts to the public at the November 2012 Network Concepts Public Meeting.

Many transit system stakeholders are focused on identifying a preferred transit mode or technology as one of the first elements of the transit planning process. However, the well-known statement that “form follows function” is relevant in this case. The form, or mode, of transit should be selected after considering the function of the corridor. For the initial alternative concepts in the CTNS, the innovative use of the Transit Sketch Model and the focus on commuter and destination corridors facilitated the consideration of function before mode.

### Transit Sketch Model Development

The study was designed to consider a wide range of transit network scenarios to serve long-range travel demands. One challenge with any long-range transit system forecasting approach is the complexity of regional travel demand models such as the Metropolitan Washington Council of Government’s (MWCOC) Cube/Voyager model. This model is currently used by the region for air quality conformity and by member jurisdictions for transit corridor planning and environmental documents such as Alternatives Analyses. The level of detail included in the regional model, which has 3,723-Transportation Analysis Zones (TAZs), makes it suitable for corridor-specific analyses, but excessively resource-intensive for an examination of a wide range of possible network scenarios.

The study team developed a Transit Sketch Model to leverage the power of the MWCOC model’s trip tables and model relationships within a quick-response structure to examine the effect of alternative transit routes and station locations on transit mode share, and therefore transit ridership, for origin-destination pairs. The Transit Sketch Model aggregated travel patterns into 63 travel-sheds (32 in Fairfax County and 31 for the rest of the region) with a network that includes only the key fixed-guideway transit system components including Metrorail, VRE commuter rail, and HOV lanes for express bus services.

The Transit Sketch Model included an assessment of both the levels of accessibility and mobility afforded by different transit network configurations. For accessibility, the model



considered how much development was within walking distance of an HQTN station. For mobility, the model considered the transit travel time between travel-sheds. The study found a relationship between the transit accessibility, mobility, and transit mode share from the MWCOG model itself. In other words, changes to the accessibility and mobility between any pair of travel-sheds led to an estimate of a change in mode share for trips between those travel-sheds. The change in mode share associated with a transit system change could then be multiplied by the magnitude of forecasted 2050 person-trips between travel-shed pairs to estimate increased transit ridership. Additional information on the development and application of the Transit Sketch Model is provided in **Appendix C**.

### **Desire Line Analysis**

Travel to, from, within, and through Fairfax County comprises many overlapping travel patterns. The Fairfax County Transit Sketch Model was developed to quickly ascertain expected effects of substantial changes to the transit network. This process provides an order-of-magnitude assessment of corridor-level transit ridership in a quick-response fashion. The initial objectives of the sketch model process are to:

- Organize the 2050 person-trip travel patterns into a series of logical network concepts to define general expectations for levels of ridership;
- Identify activity centers where limited and strategic changes to the levels of density or changes to the jobs/housing balance might help increase transit system ridership;
- Examine the potential for organizing elements of the HQTN into commuter corridors, destination corridors, or circulator corridors, particularly in corridors where the primary mobility and accessibility needs are less clear based on prior efforts and public input (including Route 1, Route 7, Route 236, and Route 28);
- Identify key findings and organizing principles for presentation at the Network Concepts Public Workshop in November 2012; and
- Identify key elements of a proposed High Quality Transit Network for analysis in the full MWCOG model after incorporating feedback from the Network Concepts Public Workshop.

**Exhibit 4-1** provides a depiction of travel desire lines, representing the intensity of demand for person-travel in certain corridors that may be best suited for transit destination corridor treatment, as well as the potential for aggregation of multiple desire lines into commuter transit corridors. This exhibit represents 2050 peak period travel demand for person-trips across travel-shed boundaries. Bandwidths of different colors were used to show varied levels of travel demand, with the greatest demand in thick red lines and lesser travel demand in progressively thinner lines of lighter color.

Generally, the dark red lines in the inner core jurisdictions of Alexandria and Arlington County reflect the intensity of travel demand in those locations where land use densities are highest.

Within Fairfax County, the color and thickness of desire lines suggest logical groupings of travel demand along the Orange and Silver Metrorail Lines, the Route 28 corridor between Centreville and Reston, the Richmond Highway corridor between Fort Belvoir and Alexandria, and the Route 7 corridor between Tysons and Alexandria. The desire for person-travel in these



corridors is a leading indicator of the potential for high levels of transit corridor ridership in both the subsequent Transit Sketch Model runs as well as the MWCOG model.

The desire lines also show Tysons' emerging role as a new downtown in 2050. Heavy desire lines connect Tysons to McLean and Merrifield. A wide range of more narrow desire lines radiate from Tysons to several surrounding travel-sheds.

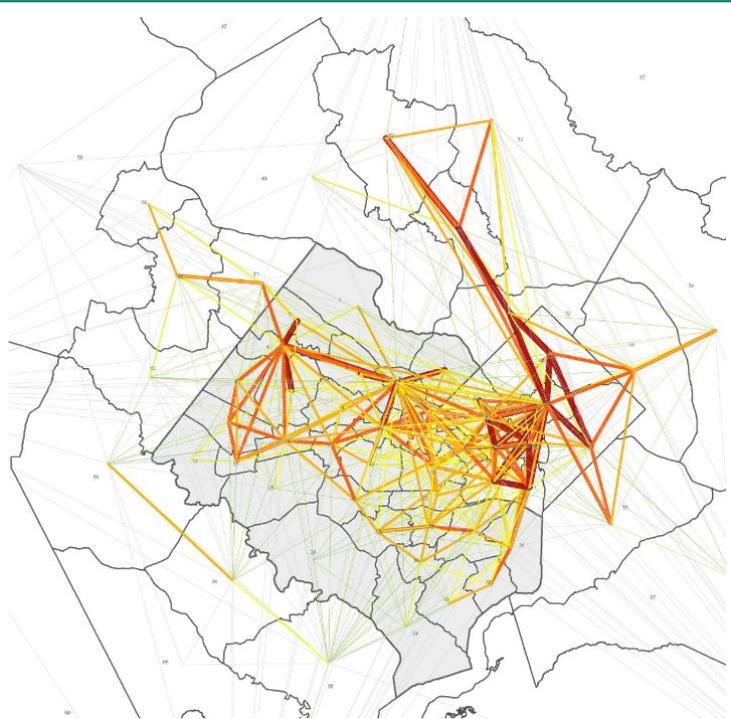
This examination of desire lines led to the consideration of alternative transit networks to serve the desire for person-travel in a manner that would facilitate the formation of effective transit lines for both commuter and destination functions, as described in the following paragraphs.

### **Consideration of Commuter and Destination Network Functions**

Every transportation system and service has to provide a balance between access and mobility. Access is defined as the ability to enter the transportation system and mobility is defined as the efficiency of movement once the user has entered the system. The two functions are continually in some state of conflict with each other; the act of providing access reduces mobility, and vice-versa. This conflict is well documented through the concept of roadway functional classification; access from adjacent parcels onto driveways is most effectively provided on local streets (with slower speeds, limiting mobility for longer trips) and mobility is most effectively provided by freeways (also called "limited access" roadways, without driveways).

The same friction between access and mobility applies to transit systems, with transit stops and stations providing the access in lieu of driveways. The participants in the online survey indicated a slight preference for "mobility" over "access," although the study team recognized that a self-selection concern may exist with stated preference surveys; anyone who expresses a preference for mobility in a transit system likely presumes that they have already been granted access by a stop or station along their travel path as contrasted with a presumption that a desired, highly mobile, transit system is passing them by.

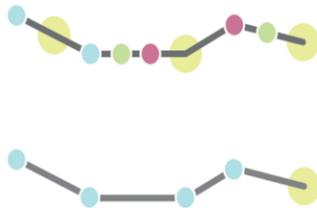
#### **Exhibit 4-1 | 2040 Travel Desire Lines**



This map uses bandwidths to show the relative intensity of 2040 peak period person trips between travel-sheds.



## Exhibit 4-2 | Transit Corridor Function



**Destination corridors**, like the Metroway BRT in Alexandria, connect neighborhoods to multiple activity centers, functioning primarily to provide **access**.

**Commuter corridors**, like the Virginia Railway Express, primarily serve one major activity center and tend to focus on journey-to-work trips and function primarily to provide **mobility**.

Individual transit lines can be designed to prioritize either access or mobility.

The provision of access and mobility in a transit system network is commonly described as being associated with either a commuter function or a destination function, as summarized in **Exhibit 4-2**.

The study team conducted an assessment of four different transit network concepts to assess the degree to which either a focus on transit mobility provided by commuter corridors or a focus on accessibility provided by destination corridors would

better help Fairfax County connect, grow, and thrive. Concepts for a commuter network and a destination network were developed to provide a “set of bookends” to assess system performance, and two hybrid concepts were developed to examine the tradeoffs between accessibility and mobility in the Orange Line/I-66 and Blue Line/I-95 corridors.

### Commuter and Destination Concepts

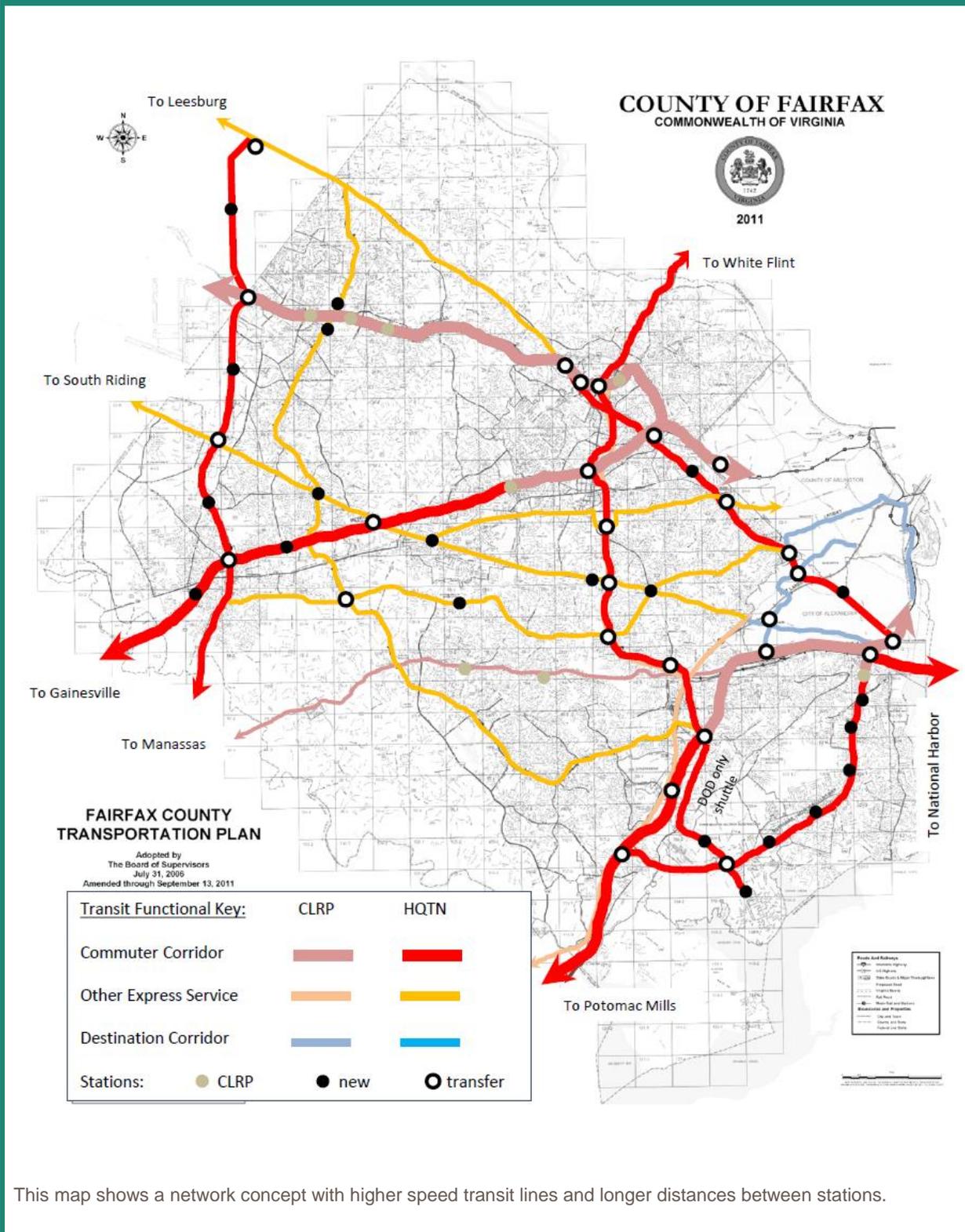
The two “bookend” concepts of focusing on mobility and access are shown graphically in **Exhibits 4-3 and 4-4**. The goal of the Mobility Focus network in **Exhibit 4-3** was to connect activity centers within Fairfax County and adjacent jurisdictions with high speed commuter corridors that best serve longer-distance trips. The goal of the Accessibility Focus network in **Exhibit 4-4** was to connect activity centers within Fairfax County and adjacent jurisdictions with high access transitways (light rail or bus rapid transit) that best serve shorter-distance trips.

### Hybrid Concepts

The two hybrid concepts, developed to examine options between the bookends, are shown graphically in **Exhibits 4-5 and 4-6**. **Exhibit 4-5** shows the Blended Approach / Orange Line Extension Concept which retains the proposed Orange Line Metrorail extension in the Comprehensive Plan and develops an accessibility focused transitway in the I-95 corridor. **Exhibit 4-6** shows the Blended Approach 2 / Blue Line Extension Concept which reverses the functions in the two corridors with an accessibility focus in the I-66 corridor and a mobility focus in the I-95 corridor.



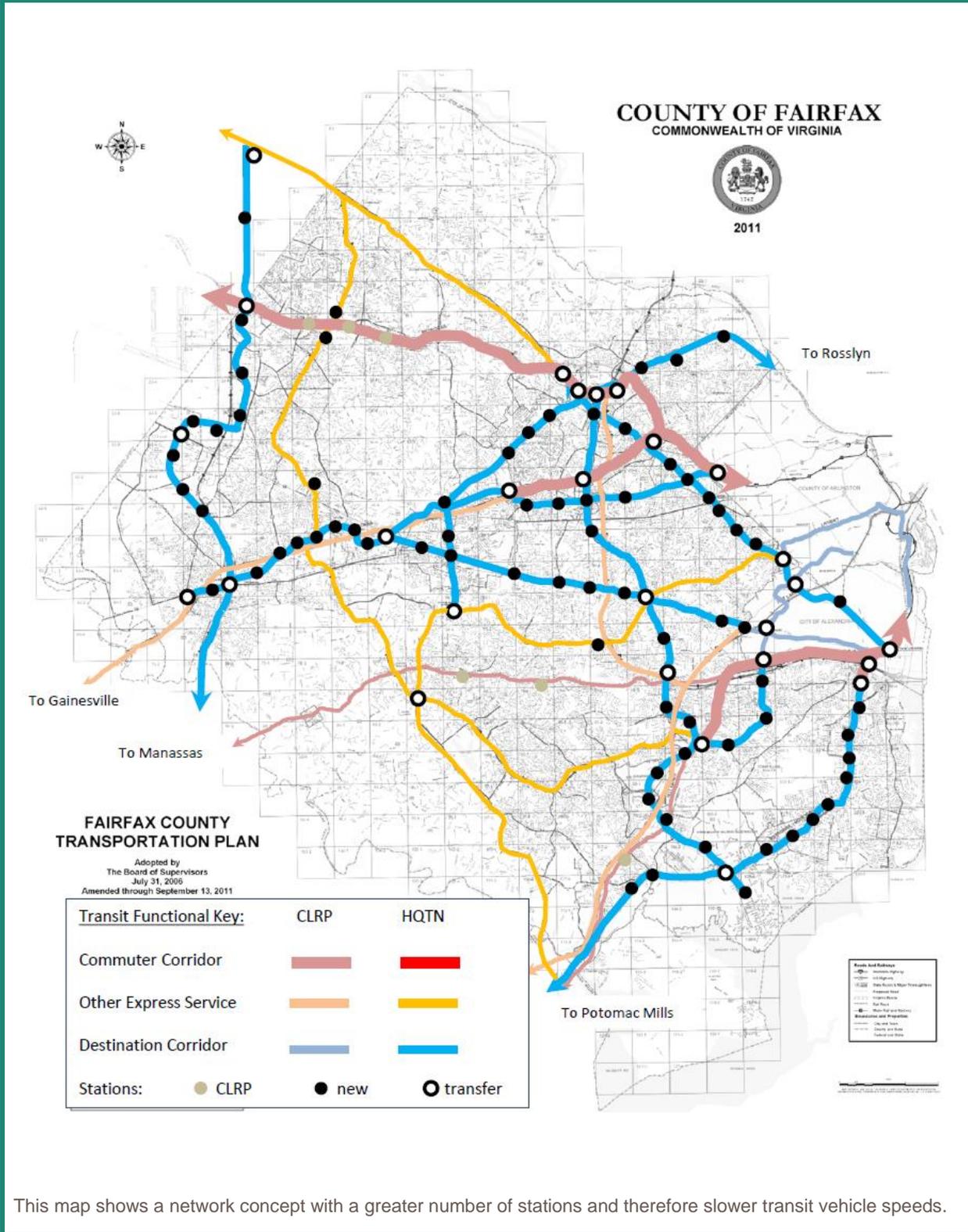
Exhibit 4-3 | Mobility Focused Network Concept



This map shows a network concept with higher speed transit lines and longer distances between stations.



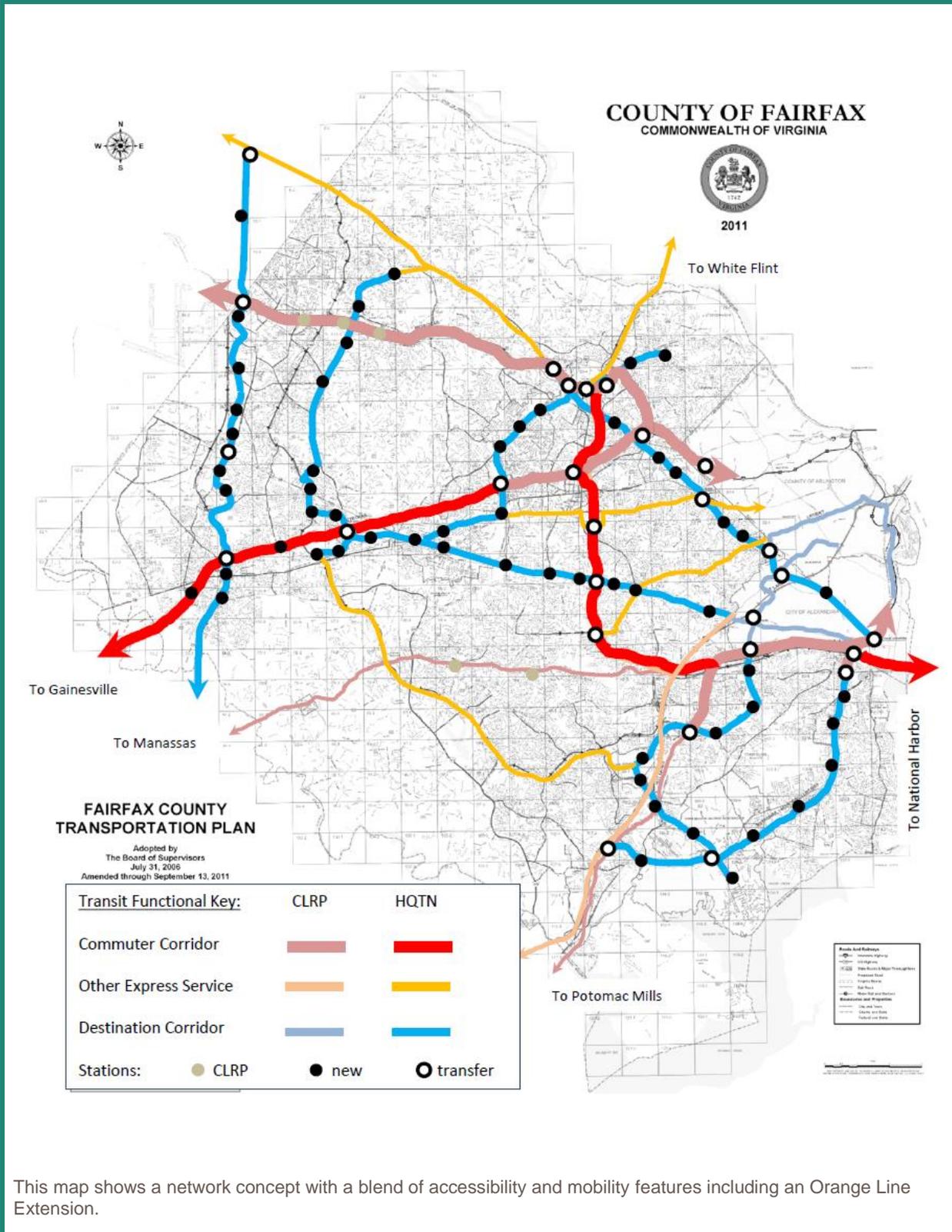
Exhibit 4-4 | Accessibility Focused Network Concept



This map shows a network concept with a greater number of stations and therefore slower transit vehicle speeds.



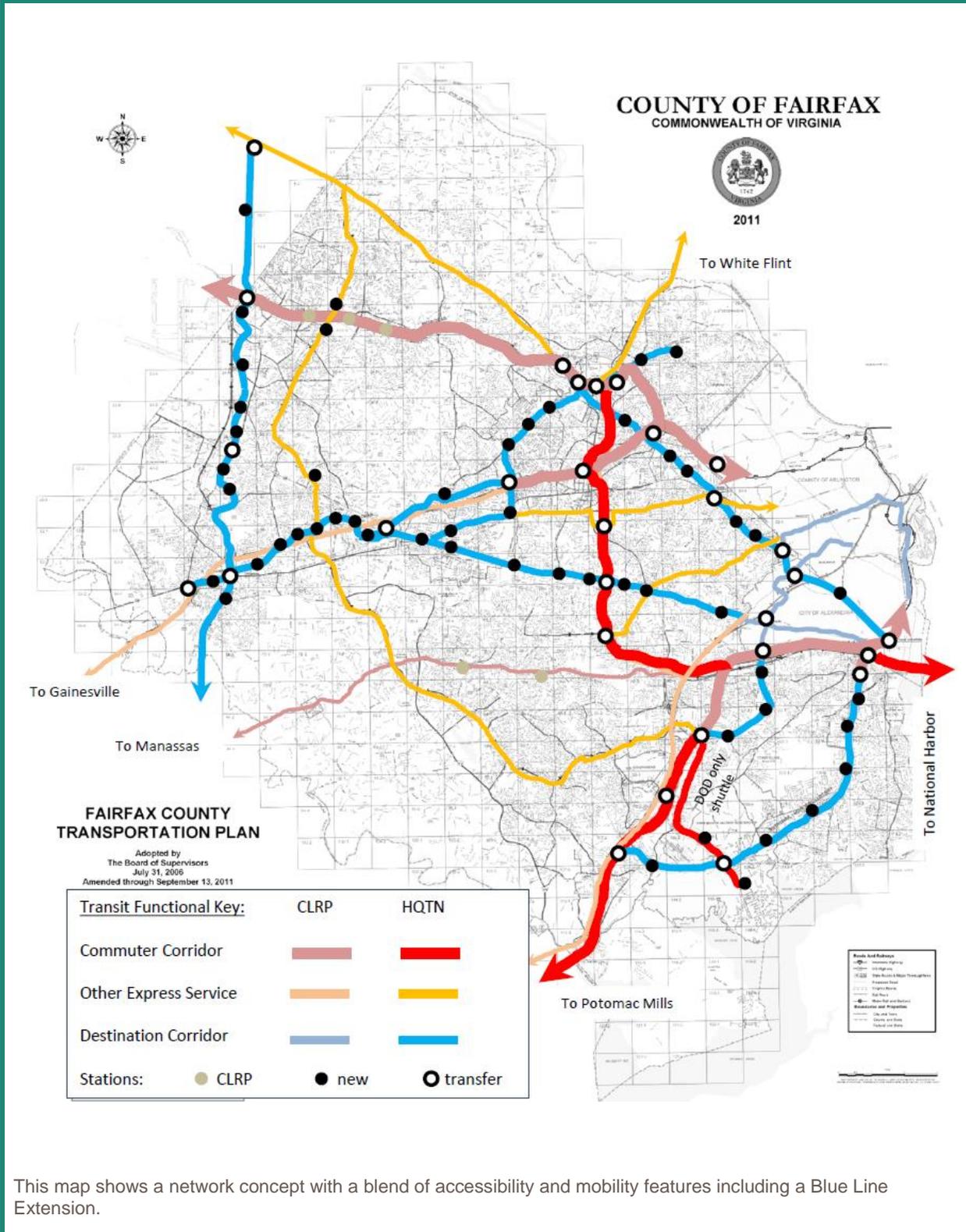
Exhibit 4-5 | Blended Concept With Orange Line Extension



This map shows a network concept with a blend of accessibility and mobility features including an Orange Line Extension.



Exhibit 4-6 | Blended Concept With Blue Line Extension



This map shows a network concept with a blend of accessibility and mobility features including a Blue Line Extension.



## Consideration of Transit Mode

High quality transit technologies span a wide range of transit guideways and vehicle types. The selection of a particular transit technology for any corridor depends first upon the travel market, corridor function, and land use context. **Exhibit 4-7** demonstrates the types of transit systems considered in the study. For the purpose of this study, a high quality transit system is defined as one that provides significant time savings to the user compared to auto travel along the same corridor, generally by providing a dedicated right-of-way so that the transit vehicle is not delayed by auto congestion. Metrorail and commuter rail services provide this type of travel, by definition, as they operate on dedicated right-of-way. LRT and BRT technologies typically operate in exclusive rights-of-way but may also operate in mixed traffic. Streetcars operate primarily in mixed traffic.

**Exhibit 4-7 | Comparison of Transit Technologies**

Transit Technology	Commuter rail	Heavy rail	Express Bus	Light rail transit (LRT)	Bus rapid transit (BRT)	Streetcar
Example	 Virginia Railway Express	 Metrorail	 Omni Ride	 The Tide (Hampton Roads)	 EMX (Eugene, OR)	 Portland Streetcar
Average operating speed	31-40 MPH	25 MPH	15 MPH (arterial) 25-50MPH(freeway)	15-25 MPH	12-20 MPH	8-12 MPH
Maximum operating speed	80 MPH	70 MPH	55 MPH	70 MPH	50 MPH	45 MPH
Typical station spacing	5 to 10 miles	1/2 to 5 miles	1 to 5 miles	1/2 to 2.0 miles	1/2 to 2.0 miles	1/10 – 1/4 miles
Typical capital cost per mile	\$5M - \$8M	\$60M - \$250M	Up to \$2M	\$50-\$150M	\$2M - \$10M	\$10M - \$30M
Typical peak hour person capacity in peak direction	1,500 – 8,000	11,500 - 23,000	300 – 8,000	4,000 - 18,000	2,000 - 12,000	1,500 - 7,500
Alignment access	Fully controlled for safety concerns (shares characteristics of freight rail)	Fully controlled for safety and high voltage power concerns (crossing must be grade-separated)	Based on roadway alignment (freeway or arterial lane)	May be either controlled or uncontrolled	May be either controlled or uncontrolled	Typically runs on street in mixed traffic
Typical Functions	Commuter	Commuter	Commuter	Commuter or destination	Commuter or destination	Destination or circulator

This table compares typical transit mode speeds, capacities, and other characteristics that may help define either commuter or destination corridors. Dark or light green shading is used to help identify modes that have generally similar operating characteristics and help demonstrate how the typical function of each mode is influenced by its operating characteristics.

## Measures of Effectiveness

**Exhibit 4-8** shows the degree to which all four systems achieve the study goals to connect, growth, and thrive, considering different measures of effectiveness. The two Blended Approach concepts represent different combinations of the bookends of the Mobility Focused and Accessibility Focused concepts.

Some of the results are straightforward:



- The Accessibility Focused concept has the greatest number of stations, so it scores the best in terms of the percentage of jobs and housing units accessible within ¼ mile or ½ mile of the transit network, and potential increase in property values; and
- The Mobility Focused concept has longer distances between stations and, therefore, higher speeds (regardless of mode) due to less time spent accelerating, decelerating, and stopped at stations for boardings and alightings, thereby achieving the highest speeds and greatest travel time savings per transit trip.

Some of the results are less intuitive:

- The total transit ridership is increased by adding more stations, thereby increasing accessibility:
  - Accessibility Focus: +80,900 trips
  - Blended – Orange Line Extension: +67,000 trips
  - Blended – Blue Line Extension: +66,300 trips
  - Mobility Focus: +55,300 trips
- The average trip length on the Mobility Focused transit network, however, is longer than that of the Accessibility Focused network, so the reduction in total Vehicle Hours of Travel (VHT) is actually very similar for all four networks:
  - Accessibility Focused: - 45,900 VHT
  - Blended – Orange Line Extension: - 42,600 VHT
  - Blended – Blue Line Extension: - 42,000 VHT
  - Mobility Focused: - 41,600 VHT

The study team developed two general planning principles during review of the alternative concepts related to person-throughput.

To the extent that a dedicated transit corridor is being justified based on the efficient movement of people (or throughput), the corridor should carry at least 4,000 peak period, peak direction transit riders. The establishment of the 4,000 peak period, peak direction transit ridership as a planning threshold for exclusive transit right-of-way is based on guidance contained in the Transit Capacity and Quality of Service Manual (TCQSM), published by the Transportation Research Board in 2003. Exhibit 4-37 of the TCQSM suggests that minimum one-way peak hour passenger volumes for dedicated curb bus lanes on urban streets should be in the range of 1,200 to 1,600 passengers per hour. Converted to a four-hour PM peak period, with about 30% of the peak period demand occurring in the peak hour, this results in a 4,000 peak-period threshold for dedicated right-of-way.



### Exhibit 4-8 | Measures of Effectiveness for Initial Concepts

	Mobility Focused Concept	Blended Approach (Orange Line Ext)	Blended Approach (Blue Line Ext)	Access Focused Concept	Comments
<b>CONNECT</b>					
Increased County jobs/housing units with 1/2 mile of transit	331000	601000	578000	794000	Shorter station spacing in Access Focused concept increases number of jobs and housing units within walking distance of transit
Median # jobs accessible within 45 minutes by transit	256000	185000	176000	140000	Higher speeds in Mobility Focused concept increase number of regional jobs available within 45 minutes.
Reduction in average transit trip travel time (minutes)	17	15	14	12	Higher speeds in Mobility Focused concept attract longer trips with greater time savings
Average intersections within 1/2 mile of transit station	109	103	96	103	All four concepts serve similar areas as measured by number of intersections within 1/2 mile of stations
Increased regional daily transit ridership	Medium	Medium	Medium	High	Proximity of Access Focused concept is of greater value than speed associated with Mobility Focused concept in attracting transit riders
Connections between activity centers	High	High	High	High	All four concepts provide direct connections between activity centers.
Capital cost per weekday passenger	Medium/high	Medium	Medium	Low/Medium	Metrorail extensions have highest capital costs; high ridership levels needed to create cost effectiveness.
Operating agency efficiencies	High	Medium	Medium	Low/Medium	New LRT/BRT systems in Access Focused concept require greatest level of operability coordination
Complementarity with regional plans	Medium	Medium	Medium	Medium	All four concepts have some elements that would be new to local and regional plans.
<b>GROW</b>					
Increased potential land value in transit-oriented places	\$16B	\$22B	\$22B	\$26B	Total potential value increases with number of stations with only slightly diminishing returns per additional station
Areas most ready for redevelopment within 1/2 mile of transit	Low	Medium	Medium	High	Access Focused concept maximizes vacant land with sewer access and redevelopment areas within 1/2 mile of transit.
Service to planned mixed-use activity centers	Highest for designated centers	High	High	Highest in emerging centers	All four concepts are designed to connect the County's mixed-use centers
<b>THRIVE</b>					
Key destinations within 1/2 mile of transit	Low	Medium/high	Medium/high	High	Access Focused concept maximizes access to key community destinations such as retail centers and educational institutions
Proximity of disadvantaged populations to transit	High	Medium	Medium/high	Medium/high	All four concepts improve transit service to disadvantaged populations
Ease of use / quality of connections	High	Medium	Medium	Low	New LRT/BRT systems in Access Focused concept support areas without current Metrorail
Reduction in weekday PM peak period highway VHT	Medium	Medium	Medium	Medium	Access Focused concept results in higher modal shift for shorter trips so all concepts perform similarly
Potential to impact sensitive environmental resources	Low	Low	Low	Low	All four concepts rely primarily on use of existing transportation rights of way
Complementarity with Comprehensive Plan	High	High	Medium/high	Medium/high	All four concepts support County's future development concept

This table shows that each of the four initial transit network concepts fulfilled some objectives better than others, with green shading indicating higher levels of performance.



If the transit corridor carries at least 10,000 peak period, peak direction transit riders, the ridership may be sufficiently high enough to consider Metrorail technology. The Metrorail planning threshold of 10,000 peak period, peak direction riders was established by reviewing the validation year (2007) forecasts for all transit links in the MWCOG model. All segments of the Metrorail system have at least 10,000 riders, except for the final segments of the Blue and Green Line Metrorail stations in Prince George's County. No other transit facility in the region currently carries 10,000 riders; consequently, this threshold effectively separates the ridership level for Metrorail from today's lower capacity transit technologies.

Additional details on the measures of effectiveness for the initial transit concepts are provided in **Appendices A and F**.

### **Network Concepts Public Meeting**

The study team held a public meeting at two locations during November 2012 (at Stenwood Elementary School on November 13, and at Key Middle School on November 15) to present the initial alternative concepts and definitions and to solicit opinions on preferred transit concepts and modes.

The public meeting presentation described the performance of the different network concepts and posed four specific questions for the attendees to consider:

- What are the travel markets of greatest importance?
- Which transit functions best serve the County's needs?
- What transit technologies are best to serve those functions?
- What land use or policy changes could improve transportation system effectiveness?

About 40 people attended one of the two public meetings. Attendees recognized a wide range of travel markets both to, from, within, and through Fairfax County and noted that the transit functions and technologies needed to be matched to the more local (accessibility) or longer-distance (mobility) characteristics of each market.

### **Key Lessons for Next Steps**

The examination of alternative network concepts resulted in the following key findings, which informed subsequent study steps:

- Improving transit accessibility increases total ridership more than increasing transit mobility. However, since riders benefitting from the accessibility focused scenario are generally making shorter trips on transit than those benefitting from the mobility focused scenario, the effects on the reduction of vehicle miles of travel resulting from a shift from auto to transit are fairly similar for both concepts;
- Public reaction to the four scenarios resulted in a conclusion that both commuter and destination corridors are viewed as beneficial in appropriate contexts:
  - Commuter corridors are most appropriate where existing transportation facilities promote higher speeds, due to less abutting development (i.e., limited access facilities including I-66, I-95, I-495, Route 28, the Dulles Toll Road and CSX/VRE rail lines); and



- 
- Destination corridors are most appropriate where development densities and form create the potential for walkable transit-oriented development (TOD) nodes such as in the Dulles Suburban Center parallel to Route 28, the Richmond Highway corridor between Fort Belvoir and Huntington, the Route 7 corridor between Tysons and Bailey's Crossroads, and the Gallows Road corridor between Tysons and Merrifield.
  - General planning-level thresholds for peak-period, peak-direction ridership are:
    - 4,000 riders to justify fixed-guideway services on the basis of person-throughput along an arterial route (BRT or LRT), and
    - 10,000 riders to be considered a potential for Metrorail.
  - Certain corridors and centers appear to have appropriate TOD densities, but lack sufficient intensity or proximity to other centers in order to serve as anchors for continuous fixed guideway transit. These centers include Fairfax City/GMU, Annandale, Beltway South, Ravensworth, and Kingstowne.



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## CHAPTER FIVE: INITIAL PROPOSED NETWORK (2013)

The development of the recommended HQTN occurred in two distinct phases. The first phase, conducted primarily during 2012 and 2013, proposed an initial network. This network included recommendations for specific modes, alignments, and stations; however several of these corridors were under study by other agencies at the time. To facilitate interagency coordination, this initial proposed network was branded as the “Tested Transit Network” and the concepts for the corridors being studied by other agencies were framed as possibilities rather than firm recommendations.

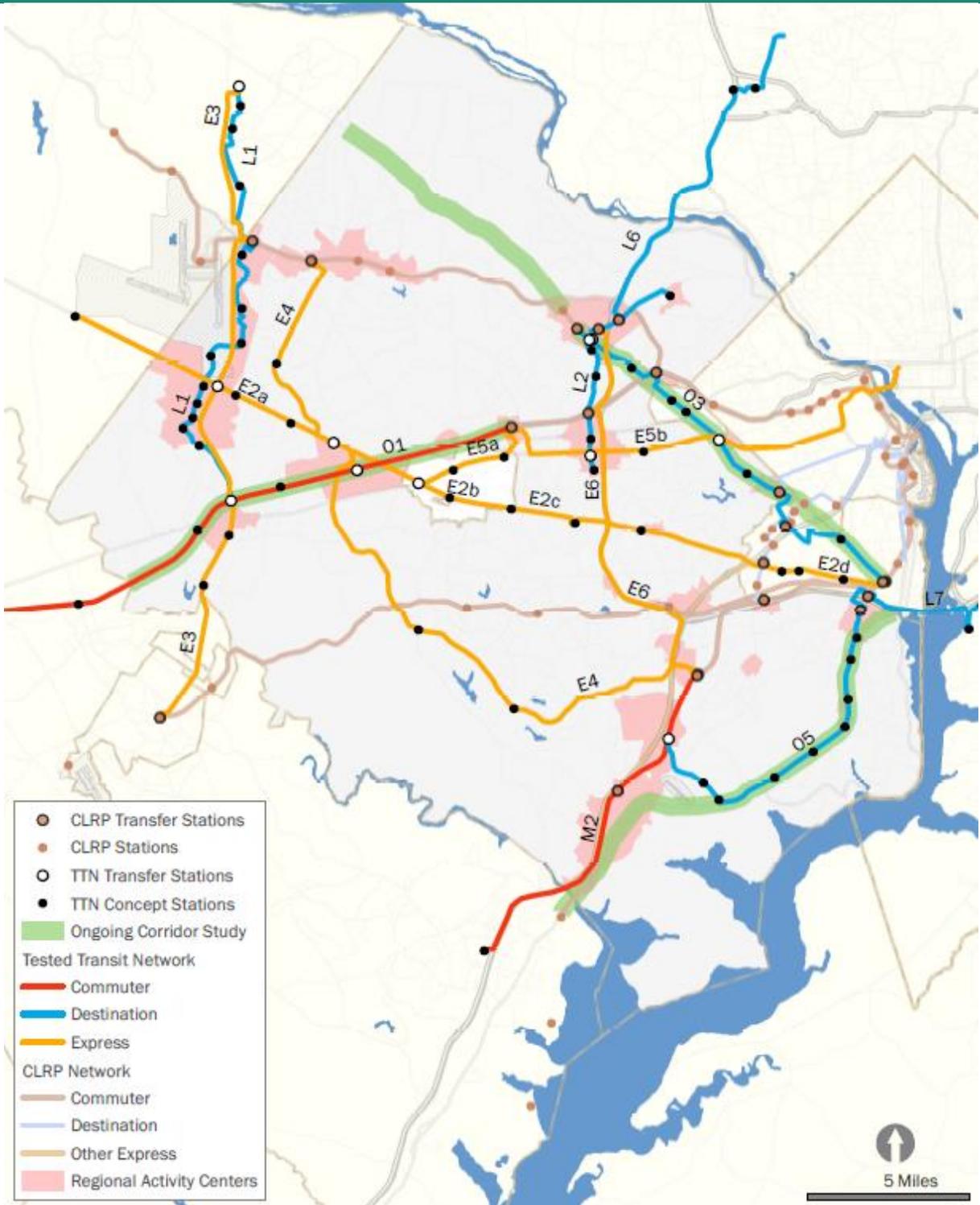
The most significant coordination occurred in the Richmond Highway corridor. The Virginia Department of Rail and Public Transportation (VDRPT) initiated a Multimodal Alternatives Analysis (AA) of the corridor in June 2013, at the same time as the CTNS initial proposed network was nearing completion. The CTNS effort was deferred while the AA study was conducted. The AA study was completed in January 2015, after which the CTNS effort resumed, incorporating the recommendations of the AA.

This chapter describes the initial proposed network, or Tested Transit Network, developed in the spring and summer of 2013. The contents of this chapter and the subsequent Chapter 6, discussing the 2016 Recommended Transit Network, are similar. Chapter 5 focuses on the considerations that informed the Tested Transit Network and the coordination that occurred with other studies between 2013 and 2015. Chapter 6 focuses on the recommendations that were presented in 2016 reflecting the benefit of that coordination.

**Exhibit 5-1** shows the elements of the Tested Transit Network presented to the public in July 2013 and **Exhibit 5-2** provides a tabular summary of the routes, in addition to the 2013 CLRP, that comprise the Tested Transit Network. Four routes are highlighted in green to indicate particular coordination with ongoing studies by other agencies along Route 7 west of Tysons, Route 7 east of Tysons, I-66, and Richmond Highway. The Tested Transit Network did not include any new transit line for Route 7 west of Tysons. For the other three routes, the Tested Transit Network included new services that were described as mode-neutral to recognize the coordination with other studies, although the performance measures were based on Metrorail in the I-66 corridor and LRT in the Route 7 (east of Tysons) and Richmond Highway corridors.



### Exhibit 5-1 | Tested Transit Network Elements



This map shows the location of the Tested Transit Network alignments and stations



### Exhibit 5-2 | Tested Transit Network Route Descriptions

Proposed High Quality Transit Network Concept Routes start with M, L, or E  
 Optional Routes in corridors under current study start with O

Route	Description	Mode	N/W terminus	S/E terminus	Length (miles)		Peak Headway (minutes)
					Within Fairfax County	Beyond Fairfax County	
O1	Orange Line Extension	TBD	Gainesville	Vienna Metrorail	12.9	6.6	6
M2	Blue Line Extension	Metrorail	Franconia/Springfield Metrorail	Potomac Mills	8.1	3.5	6
Subtotal					21.0	10.1	
L1	Route 28	LRT	Dulles Town Center	Centreville Metrorail	11.0	5.4	10
L2	Route 123/Gallows	LRT	McLean Metrorail	Fairfax Hospital	7.3	0.0	10
O3	Route 7	TBD	Greensboro Metrorail	King Street Metrorail	6.9	7.6	10
O5	Richmond Highway	TBD	Huntington Metrorail	Newington Metrorail	10.9	0.0	10
L6	American Legion Bridge	BRT / Express	White Flint Metrorail	McLean Metrorail	3.7	7.8	10
L7	Wilson Bridge	BRT / Express	Huntington Metrorail	Suitland Metrorail	0.6	11.5	10
Subtotal					40.4	32.3	
E2a	Route 50 - 236	Bus	South Riding	Fair Oaks Metrorail	5.4	2.8	10
E2b	Route 50 - 236	Bus	Fair Oaks Metrorail	Pickett Street	2.3	3.5	10
E2c	Route 50 - 236	Bus	Pickett Street	Landmark	7.5	0.8	10
E2d	Route 50 - 236	Bus	Landmark	King Street Metrorail	0.0	3.9	10
E3	Route 28	Bus	Dulles Town Center	Manassas VRE	11.5	10.1	10
E4	Route 286/289	Bus	Herndon/Monroe Metrorail	Franconia/Springfield Metrorail	25.0	0.0	10
E5a	Route 50 East	Bus	Kamp Washington	Vienna Metrorail	1.0	3.0	10
E5b	Route 50 East	Bus	Vienna Metrorail	Foggy Bottom Metrorail	8.0	6.1	10
E6	Tysons-Springfield	Bus	Tysons Corner Metrorail	Franconia/Springfield Metrorail	13.2	0.0	10
Subtotal					73.9	30.2	

This table describes the mode, extent, mileage, and service frequencies of the Tested Transit Network lines. Green shading indicates a corridor under study during summer 2013.

## Development of the Tested Transit Network

### Desire Lines and Travel Markets

The assessment of desire lines using the Sketch Level Model helped identify corridors where travel demand, development densities, and origin-destination patterns appeared to support high quality transit. **Exhibit 5-3** shows the identification of these five travel markets considering the context of the travel demand desire lines identified in Chapter 4 (see **Exhibit 4-1**).



Three of the five travel markets identified are regional in their significance and connect Fairfax County to the Washington, DC core in a radial fashion:

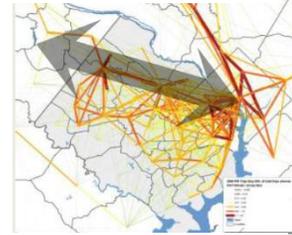
- The **Silver Line Market** connects Dulles Airport, Reston/Herndon, and Tysons to the DC core and serves Loudoun County to the west. This market is focused on activity centers that are designed to concentrate development density within a fairly narrow corridor, surrounded by lower density development to the north and south.
- The **Orange Line Market** connects Centreville, Fair Oaks, and Dunn Loring/Merrifield to the DC core and serves Prince William County to the west. This corridor contains multiple parallel routes and a wider band of moderate density development than the Metrorail Silver Line Market. New transit services parallel to the Metrorail Orange Line on Route 50 and Route 236 can provide additional coverage to connect additional activity centers both inside and outside the Beltway.
- The **Blue/Yellow Line Market** connects the activity centers of Lorton-South, Franconia-Springfield, Kingstowne, Fort Belvoir, Woodlawn, Hybla Valley, Beacon Hill, Penn Daw, and Huntington to the DC core and serves Prince William County to the south. This corridor is perhaps the most complex of the three regional, radial corridors. This is due to the bifurcation of the two primary alignment options along either the I-95/CSX Railroad corridor or the Richmond Highway corridor and the fact that its activity centers are generally smaller in area and have lower planned densities. Fort Belvoir creates a unique situation as it is a major employer, but has multiple nodes with secure perimeters.

Two of the five markets are subregional in their nature and do not connect directly to the DC core. However, they provide radial connectivity to Tysons and Dulles Airport, the two most significant destinations along the Metrorail Silver Line:

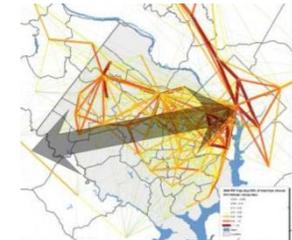
- The **Tysons Market** reflects the desire for connections to and from the Tysons Urban Center, which is the largest and most densely developed activity center in Fairfax County. The Metrorail Silver Line provides the regional connection through Tysons. The remaining Tysons market includes connections to:
  - The north towards Montgomery County;
  - The northeast towards McLean;

### Exhibit 5-3 | Travel Markets

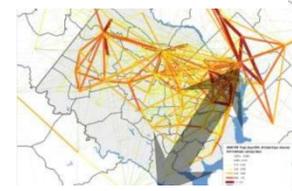
#### Silver Line Market



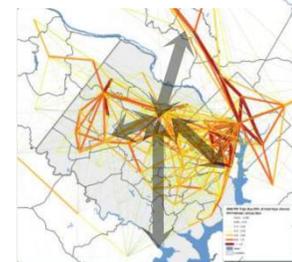
#### Orange Line Market



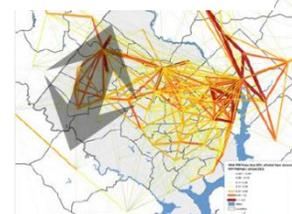
#### Blue/Yellow Line Market



#### Tysons Market



#### Route 28 Market



These maps show the five discrete travel markets indicated by the desire line analysis.



- The southeast towards Falls Church, Seven Corners, Baileys Crossroads, and Alexandria;
- The south towards Dunn Loring/Merrifield, Annandale, and Franconia-Springfield; and
- The southwest towards Vienna and George Mason University.
- The **Route 28 Market** connects Dulles Airport and Reston/Herndon to the Dulles Suburban Center, Centreville, and facilitates connections along Route 28 to both Loudoun County and Prince William County.

### Relationship to Concurrent Studies

**Exhibit 5-1** identifies the locations of the four concurrent corridor studies:

- The **VDOT Route 7 widening study**, from Tysons to Reston, considered both the potential for additional general purpose vehicle capacity and transit-priority treatments. The CTNS study had previously concluded that the land use patterns along Route 7 in this area were not supportive of fixed-guideway transit. If transit speeds were increased to the point where Route 7 would support fixed-guideway transit, it would not generate new riders, rather riders would shift from the Metrorail Silver Line to Route 7. The VDOT study ultimately reached the same conclusion;
- The **VDOT/DRPT Environmental Impact Statement (EIS)** from I-495 to Haymarket was labeled as “Route O1” in the Tested Transit Network but included in the network as a Metrorail extension. The EIS has continued forward under the “Transform 66” study brand to incorporate managed lanes and value pricing both inside and outside the Capital Beltway. The design outside the Capital Beltway will maintain the possibility for future Metrorail Orange Line Extension, as described in the Comprehensive Plan and the recommendations in this study;
- The Northern Virginia Transportation Commission (**NVTC**) **Route 7 Transit Alternatives Analysis (AA)**, from Tysons to Alexandria, as of 2013, was examining several alternative alignments and transit modes, with an eventual recommendation of BRT/LRT. Public meetings were held in fall 2015. The Recommended Transit Network described in Chapter 6 is consistent with the AA recommendation; and
- The **VDRPT Richmond Highway Multimodal Alternatives Analysis (AA)**, from Alexandria to Woodbridge, recommended a 3-mile long extension of the Metrorail Yellow Line to Hybla Valley and BRT for the full length of Richmond Highway, as described in greater detail in Chapter 6.

In addition to these key studies, coordination occurred with other transportation planning efforts. The way each of these studies influences the final recommended HQTN is discussed further in Chapter 6. These other efforts include:

- While the CTNS was underway, the work on the **City of Alexandria West End Transitway** occurred along Beauregard Street and Van Dorn Street. This route would link the Van Dorn Metrorail station to the Mark Center, with service continuing north to the Pentagon via two alternative routes;
- The **State of Maryland South Side Mobility Study** was also underway, studying transit connections across the Woodrow Wilson Bridge, between Virginia and Maryland. This study examined Metrorail, LRT/BRT, and express bus service alignments crossing the



Wilson Bridge. The study determined that transportation demand would support a more intensive transit solution than express bus, but that it would not support Metrorail. The Wilson Bridge was designed to accommodate fixed-guideway transit, with space reserved for future transit expansion. This study recognizes that any bus service that crosses the Wilson Bridge from the National Harbor would logically first connect to the Eisenhower Avenue Metrorail Station. The northward connection to Eisenhower Avenue is more viable than the southward connection to Huntington Metrorail due to the orientation of the existing Wilson Bridge ramps and express lanes into the Eisenhower Avenue area, the difficulty of crossing Cameron Run to the south, and the higher densities at Eisenhower Avenue; and

- **WMATA's Connect Greater Washington study** was underway and focused on addressing core capacity constraints associated with both capacity on the radial Metrorail lines approaching the DC core and station circulation issues within the core.

### **Corridor-Specific Considerations in the 2013 Network**

The following considerations informed recommendations for corridors that were not under study by other agencies. These remained essentially unchanged between the development of the Initial Proposed Concept in 2013 and the Recommended Concept in 2016. For those corridors that changed substantially between 2013 and 2016, a more detailed description of the corridor considerations is presented in the final section in Chapter 6 on interagency coordination.

#### **Route 28 Corridor (L1 and E3)**

The Tested Transit Network supports growth and connectivity along the Route 28 corridor with two different transit investments:

- Light Rail (Route L1) for local service located off Route 28 to areas east (north of the Udvar Hazy Museum to the Dulles area) and areas west (south of the Udvar Hazy Museum to Westfields and I-66); and
- Express bus service (Route E3), assumed in high occupancy vehicle (HOV) lanes along Route 28.

This dual investment increases both accessibility for development nodes in the Dulles Suburban Center and mobility for longer distance travel along the Route 28 corridor. The LRT alignment and stations are located parallel to Route 28 in order to serve existing and future potential station areas. These stops would be more frequent, and are spaced approximately at half-mile intervals. The Express Bus service would be oriented toward longer distance travel, and would have fewer stations in order to facilitate faster movement through the corridor. It would provide a more direct connection to the Innovation Metrorail Station and Centreville.

The assessment of alternatives included consideration of three alignments south of Route 50, two to the east and one to the west of Route 28. The potential for TOD is greater on the west side of Route 28, due to the greater amount of land zoned for mixed-use or industrial uses. One of the two western alignments (Lee Road) was selected in part due to its location between the higher noise contours associated with the Dulles Airport runways. Introducing residential development into the Lee Road portion of the corridor would be desirable for improving the jobs/housing balance both within the potential transit station areas, as well as throughout the



Dulles Suburban Center, but needs to be approached through the Fairfax Forward process to ensure compatibility with airport uses.

### **Merrifield/McLean (L2)**

The McLean and Merrifield activity centers are both close enough to Tysons and have sufficient development densities to warrant connection by fixed guideway transit. The Initial Proposed Concept envisioned a connection along Route 123 from McLean to Tysons, including a connection to the Metrorail Silver Line. The route would continue southward through Tysons via International Drive, including a connection with the L3 route along Route 7, and an extension south along Gallows Road to connect to the Dunn Loring Metrorail station and the Route 50 express bus service, before terminating at the Inova Fairfax Hospital at the southern end of the Merrifield activity center.

### **American Legion Bridge (L6)**

Many studies, including the Capital Beltway Corridor study of the 1990s and the ongoing WMATA Regional Transit System Plan, have noted the need to connect Tysons to either the Bethesda or White Flint activity centers in Montgomery County. This study confirmed the findings of prior studies, that regional circumferential transit service in the vicinity of the American Legion Bridge is challenging because of the long distance between Tysons and either Bethesda or White Flint, both 11 miles via the American Legion Bridge.

A Metrorail-type connection between Tysons Corner and White Flint was examined in the Transit Sketch Model Mobility-Focus Scenario and forecast to carry about 6,200 peak period, peak direction passengers. This fell short of the Metrorail threshold of 10,000, but above the dedicated right-of-way threshold of 4,000. Based on this finding, and coordination with the Montgomery County Planning Department, the alignment was included as BRT in the Tested Transit Network. Within Montgomery County, this service forms a logical extension of the Countywide Transit Corridors Functional Master Plan, adopted by Montgomery County in 2013. The section between Rock Spring Park and Tysons Corner would be almost exclusively along the Capital Beltway, taking advantage of the HOV lane. Within Fairfax County, this connection would function essentially as an express bus service as there are no logical intervening activity centers along the Capital Beltway between Tysons and the Potomac River.

### **Alternative Alignments Not Selected in Either 2013 or 2016 Networks**

The desire line analysis was conducted in conjunction with assessments of potential alternative corridor feasibility and desirability. These assessments explored conventional and innovative treatments using a combination of sketch-level analyses, further examination of the state of the practice in other jurisdictions, nationally and globally, coordination with the Technical Working Group (TWG) members on cross-jurisdictional interests, and qualitative judgment. This screening process yielded several conclusions:

- Powerline rights-of-way can have certain elements in common with transitway alignments. Powerline rights-of-way are often relatively direct, wide, and free of obstructions. The study team examined two potential alignments in powerline easements in Fairfax County (one connecting Manassas to Reston in the Dulles Suburban Corridor and the other connecting the South Run park and ride lot in Burke to the Capital Beltway at Braddock Road), but found that neither are practical. While the logistical and



institutional issues associated with powerline alignments in relatively flat, high-demand, corridors have been successfully addressed in regions, such as Chicago, Winnipeg, and Toronto, the Fairfax County powerline alignments showed low ridership potential and have significant topographic constraints.

- The Route 123 corridor through the town of Vienna has high ridership demand as a direct option for access to Tysons from the southwest, but operates within a significantly constrained ROW and functions as Vienna’s main street.
- Backlick Road connects the Annandale and Springfield activity centers and was considered as a potential connection between Tysons and Springfield, in conjunction with Gallows Road. The portion of Gallows Road north of Fairfax Hospital is incorporated into the recommended Gallows Road service (Route L2). To the south of Fairfax Hospital, however, the six miles of Gallows and Backlick Road connecting Merrifield to Springfield serve a limited number of activity centers (Annandale and the Beltway South Industrial Area) as well as the Backlick/Edsall commercial complex, which do not generate sufficient transit ridership that justifies a dedicated transit ROW.
- The **VDRPT SuperNova TDM study** recommended consideration of transit priority, such as BRT services on all four routes that connect Route 50 and the Dulles Toll Road approaching Reston/Herndon from the south; Route 28, Centreville Road, the Fairfax County Parkway and Reston Parkway. The Initial Proposed Concept introduced a fifth option, the Route 28 LRT line (Route L1), discussed above. The Proposed Concept finds the Fairfax County Parkway most appropriate for a supporting express bus (Route E4) in dedicated lanes due to the high level of access control. The forecast ridership on the routes examined in both the Transit Sketch Model and the MWCOG model are slightly below the 4,000 planning level threshold, but the potential for shared BRT/HOV as part of the planned widening of the Parkway to six lanes warrants this treatment in order to provide a good connection to the activity centers and the existing, planned, or proposed Metrorail lines (Metrorail Silver Line Phase 2, Metrorail Orange Line Extension, and Metrorail Blue Line) in each of the radial corridors. Sufficient demand does not appear to support designation of additional parallel routes for high quality transit in dedicated lanes along the candidate routes (Centreville Road, Fairfax County Parkway, and Reston Parkway). Access control along the Fairfax County Parkway provides the most compatible environment for this type of high speed express bus service.

### Measures of Effectiveness

**Exhibit 5-4** shows the degree to which the Tested Transit Network achieves the study goals to help Fairfax County Connect, Grow and Thrive through the implementation of a high quality transit system. The degree of system performance is compared against the baseline 2050 CLRP conditions described in Chapter 3. Each of the measures of effectiveness are described further in the following paragraphs.



### Exhibit 5-4 | Tested Transit Network Measures of Effectiveness

Goal	Achievement (compared to 2050 CLRP conditions)
<b>CONNECT</b>  <i>Provide more transportation choices for Fairfax County and regional connectivity</i>	<b>Allows average County resident to reach 190,000 more jobs within a 45 minute transit commute</b>
	<b>Increases Fairfax County transit trips by 90,000 per day, a 28% increase over base conditions.</b>
	<b>Introduces rail service to 14 previously unserved activity centers</b>
	<b>Cost per passenger consistent with recent New Starts approvals</b>
<b>GROW</b>  <i>Support local and regional economic development goals</i>	<b>Serves 27 new station areas within designated activity centers.</b>
	<b>Brings 120,000 new County households and 263,000 County jobs within ½ mile of high quality transit station</b>
<b>THRIVE</b>  <i>Strengthen quality of life by making transit-friendly, sustainable investments</i>	<b>Serves 28 new station areas with higher than average transit dependency.</b>
	<b>Reduces weekday peak period Vehicle Hours of Travel by 68,000</b>
	<b>Furthers Comprehensive Plan concepts for Enhanced Public Transportation Corridors</b>

This table shows how the Tested Transit Network helps achieve the study goals to Connect, Grow, and Thrive.

#### Connect: Accessibility

The Tested Transit Network improves the access via transit to regional job opportunities compared to the base condition. The Tested Transit Network allows the average County resident to reach approximately 190,000 more jobs in the region within a 45-minute transit commute.



**Connect: Transit Ridership**

**Exhibit 5-5** shows the performance of the Tested Transit Network for three scenarios; the 2007 model validation, the 2050 baseline conditions, and the 2050 Tested Transit Network.

<b>Exhibit 5-5   Tested Transit Network Ridership</b>			
<b>MEASURE OF EFFECTIVENESS</b>	<b>2007</b>	<b>2050 BASELINE</b>	<b>2050 TESTED TRANSIT NETWORK</b>
<b>Total regional weekday transit riders (000s)</b>	1,078	1,667	1,851
<b>Total Countywide weekday transit riders (000s)</b>	152	329	423
<b>Total Countywide transit mode share percentage</b>	3.9%	5.8%	7.2%
<b>Total Countywide Home-Based Work transit mode share percentage</b>	12.5%	15.2%	19.1%

This table shows how the Tested Transit Network increases the total number of transit riders and transit mode share.

**Connect: Serving Activity Centers**

The Proposed High Quality Transit Network Concept would introduce rail service to the following 14 activity centers where rail is not provided in the CLRP scenario (with the relevant route shown in parentheses):

- Beacon/Groveton (O5)
- Centreville (M1, L1)
- Dulles Suburban Center (L1)
- Fairfax Center (M1)
- Fort Belvoir (O5)
- Hybla Valley/Gum Springs (O5)
- I-95 Corridor (M2, O5)
- Lorton (M2)
- McLean (L2)
- Merrifield (L2)
- Penn Daw (O5)
- Seven Corners (O3)
- South County Center (O5)
- Woodlawn (O5)



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## Connect: Cost Effectiveness

Among the many measures of effectiveness (MOE's) used to evaluate the systemwide performance of the HQTN, cost-effectiveness is of particular interest. The effectiveness of any transit system is related to the level of resources devoted to making it effective, whether through higher speeds, more frequent station spacing, shorter operating headways, or other elements that effect system convenience, comfort, and reliability. However, competition exists at federal, state, regional, and local levels for scarce transportation system funding. It is important to demonstrate that the planned transit system, including its individual components, is expected to compete favorably for the limited implementation and operational funds.

The Federal Transit Administration (FTA) has established rules and regulations regarding the evaluation of cost-effectiveness for any transit project that is requesting federal funds. These rules, generally described as "New Starts" and outlined in Title 23 and Title 49 of the United States Code, are binding for projects seeking federal funding and provide a useful set of standards and practices. These standards are helpful even for smaller projects that will be implemented without federal dollars. These rules are detailed and specific regarding assumptions for elements such as horizon year, baseline conditions, amortization of capital and operating costs, and analysis tools. The New Starts process develops a single benefit-cost value of cost per rider for each project, which is measured against national standards to determine the level of cost-effectiveness. The details of the New Starts process are adjusted on a periodic basis, with the focus of major changes associated with the reauthorization cycles of the federal-aid surface transportation program. The reauthorization process typically runs on six-year cycles and was most recently adopted in December 2015 under the title, Fixing America's Surface Transportation Act, or the "FAST Act".

The quantitative rigor of the New Starts process is best applied when a single project is being added to the greater transportation system. They are not appropriate for evaluating the performance of an existing network or future transit services that will be phased in over a period of time and consider potential land use changes. The CTNS used an innovative approach to assess cost-effectiveness by using a planning-level metric examining capital costs against future year ridership and comparing that metric for the HQTN routes against the performance of other transit projects nationwide that were proceeding through the New Starts process and had therefore demonstrated sufficient cost-effectiveness.

Capital cost estimates for the assessment of the Proposed HQTN were developed using a sketch-level application of unit costs, as indicated in **Exhibit 5-6**. The unit costs were based on analysis of transit projects proposed or constructed in similar metropolitan environments across the United States since 2001.



**Exhibit 5-6 | Sketch Level Planning Cost Assumptions**

	SKETCH LEVEL PLANNING COSTS IN 2012 DOLLARS (MILLIONS)					
	Technology	Commuter rail	Heavy rail	LRT	BRT/busway	Bus/HOV lane
<b>Guideway (per mile)</b>	Elevated	\$0	\$200	\$100	\$60	\$60
	At-grade	\$0	\$100	\$50	\$15	\$1
	Below-grade	\$0	\$350	\$300	\$250	\$0
<b>Station (each)</b>	Elevated	\$0	\$80	\$3	\$3	\$3
	At-grade	\$80	\$50	\$0	\$0	\$0
	Below-grade	\$0	\$100	\$0	\$0	\$0

This table shows the unit capital costs assumed for transit line implementation.

In addition, an estimate of rolling stock costs were developed by considering the proposed transit technology, peak period headways, and round trip travel time for each of the lines in the Proposed HQTN Concept to identify the number of vehicles in service needed during the peak period. For each line, a 30% increase was added to provide a contingency factor in estimating fleet size. A proportional cost of a typical yard and shop was assumed based on the estimated fleet size for each line, with a unit cost of a yard and shop at \$30 million for 100 vehicles for BRT and LRT vehicles and \$50 million for 100 vehicles for Metrorail.

The total estimated capital cost for alignment, stations, rolling stock, and yard and shop for the Proposed HQTN Concept elements (beyond those included in the CLRP) is approximately \$7.6B. **Exhibit 5-7** provides a route by route assessment of each of the individual elements.



### Exhibit 5-7 | Tested Transit Network Cost Effectiveness

Route	Description	Mode	Mileage	Daily boardings - 2050 Initial	Daily - boardings 2050 Refined	Capital Cost (M)	2050 INITIAL LAND USE		2050 REFINED LAND USE	
							Annual weekday boardings	Capital Cost Per Weekday Passenger (CCPWP)	Annual weekday boardings	Capital Cost Per Weekday Passenger (CCPWP)
<b>E2</b>	Route 50 - 236	Express Bus	27.0	19000	20000	\$78	4673750	\$16.77	4891875	\$16.02
<b>E3</b>	Route 28	Express Bus	21.6	11000	11000	\$98	2680625	\$36.72	2653750	\$37.09
<b>E4</b>	Route 286/289	Express Bus	30.7	17000	16000	\$74	4128750	\$17.82	4071875	\$18.07
<b>E5</b>	Route 50 East	Express Bus	18.1	12000	12000	\$30	2890000	\$10.49	2879375	\$10.53
<b>E6</b>	I-495 (Franconia-Tysons)	Express Bus	13.3	6000	6000	\$4	1544375	\$2.50	1552500	\$2.49
<b>L1</b>	Route 28	LRT	16.4	41000	46000	\$926	10138750	\$91.29	11464375	\$80.74
<b>L2</b>	Route 123/Gallows	LRT	7.3	39000	42000	\$374	9874375	\$37.91	10470000	\$35.75
<b>L3</b>	Route 7	LRT	14.5	60000	61000	\$837	15090000	\$55.50	15291875	\$54.77
<b>L5</b>	Richmond Highway	LRT	10.9	45000	69000	\$647	11304375	\$57.21	17236875	\$37.52
<b>L6</b>	American Legion Bridge	BRT	11.5	42000	42000	\$210	10522500	\$19.94	10451875	\$20.07
<b>L7</b>	Wilson Bridge	BRT	12.2	10000	11000	\$249	2572500	\$96.94	2700000	\$92.36
<b>M1</b>	Orange Line Extension	Metrorail	19.4	106000	115000	\$2,568	26553125	\$96.73	28869375	\$88.97
<b>M2</b>	Blue Line Extension	Metrorail	11.6	58000	59000	\$1,541	14513125	\$106.21	14792500	\$104.20
<b>TOTALS</b>			214.5			\$7,638				

This table shows the Tested Transit Network capital cost, ridership, and cost-effectiveness



The assessment of transit route cost-effectiveness requires the consideration of both the capital and operating costs. The initial capital investment in a transit system is often the most newsworthy element of transit system affordability, as it is immediately understandable to a wide variety of audiences and typically requires the greatest assembly of both political and fiscal support. However, a transit option with a relatively low capital cost can be less cost-effective over time than an alternative investment with a higher capital cost but lower annual operating costs or longer system element lifespans. This is one of the characteristics of the “bus versus rail” discussions; in general rail investment elements, including alignments, stations, and rolling stock, have a higher capital cost that is offset by a longer lifespan. Where transit demand is high enough, the greater capacity provided by rail systems also creates cost-efficiencies in terms of system operator costs (i.e., an 8-car Metrorail train can carry over 800 passengers with one driver whereas a BRT vehicle may carry less than 100 passengers per driver).

For individual routes in an Alternatives Assessment, specific processes are typically followed that will facilitate a New Starts application by considering an implementation time horizon and capital and operating costs specific to that project. This process is more detailed than appropriate for a long-term network planning study, particularly given that system implementation will occur gradually over time, with a series of individual horizon years.

This study implicitly considers operating costs by examining the Capital Cost Per Weekday Passenger (CCPWP) and compares the range of CCPWP values against those calculated for current New Starts applications. This process incorporates operating costs by recognizing that higher capacity systems are considered by both federal and local funding partners as worthy investments even though the CCPWP may be significantly higher than lower capital-cost investments. The CCPWP is calculated by dividing the capital cost in current dollars by the estimated annual weekday passengers for the project horizon year.

**Exhibit 5-7** shows the CCPWP values for the routes in the Proposed HQTN Concept. The leftmost columns show the capital cost estimates and derivation of annual weekday riders for 2050. The rightmost columns show the resulting CCPWP values for both the 2050 Initial and 2050 Refined land use forecasts.

For comparison purposes, we evaluated the CCPWP for the FTA’s combined 2012 and 2013 New Starts capital investment program. For this two year period, the New Starts program encompasses 53 nationwide transit “guideway” projects. The primary objectives of New Starts projects are increasing mobility, reducing congestion, and lowering emission outputs. These projects consist of heavy commuter rail LRTBRT, streetcar, and infill stations.

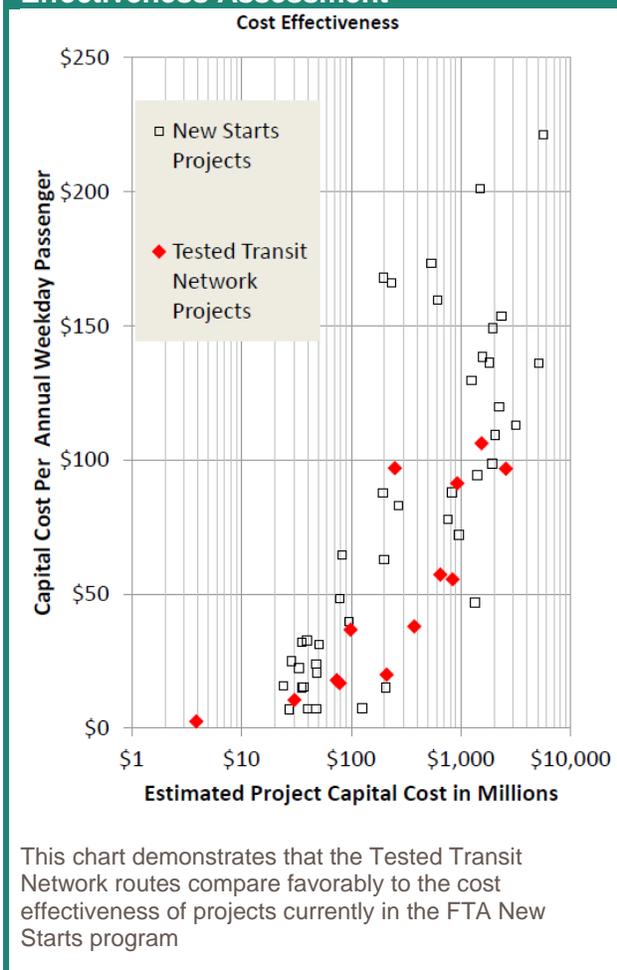
Within the 2012-2013 New Starts projects, the cost per passenger for heavy rail projects generally exceeds \$200; locally, for example, Phase 1 of the Metrorail Silver Line extension (11.7 miles) costs \$147 per weekday passenger. For light rail, the 2.9-mile Columbia River Crossing Project in Vancouver, Washington costs \$648 per passenger; conversely, the 1.9-mile Regional Connector Transit Corridor in Los Angeles costs just \$61 per passenger. In nearby Baltimore, the 14.5-mile Metrorail Red Line light rail project costs \$156 per passenger, while the proposed 16.3-mile Metrorail Purple Line in Montgomery and Prince George’s County, Maryland costs \$128. BRT is arguably the most cost effective transit mode, with the majority of New Starts BRT project costs under \$50 per passenger; the 8.6-mile Mesa Corridor BRT in El Paso, Texas costs \$9 per passenger, while the 15.7-mile E Street Corridor BRT in San Bernardino,



California costs \$137 per passenger. Infill stations on rail lines, such as Boston’s Assembly Square, can successfully increase daily weekday ridership (by 5,000 additional passengers) while remaining cost effective (\$50M).

For the purposes of comparing New Starts applications to the HQTN routes, the New Starts project CCPWP values are reduced by a factor of 30% to account for the difference between the New Starts horizon years (generally 2030 or 2035) and the higher levels of development in the Proposed Concept 2050 horizon year (also recognizing as described previously that the term 2050 is a label that combines current plan yield development within Fairfax County that would be expected to take beyond 2050 to absorb with 2030-2040 development extrapolation elsewhere in the region). So whereas the Metrorail Silver Line has a \$147 CCPWP considering a 2030 planning horizon, this study assigns it a \$112 CCPWP value for the purposes of considering year 2050 conditions for a better apples-to-apples comparison with the Proposed Concept routes.

**Exhibit 5-8 | Tested Transit Network Cost Effectiveness Assessment**

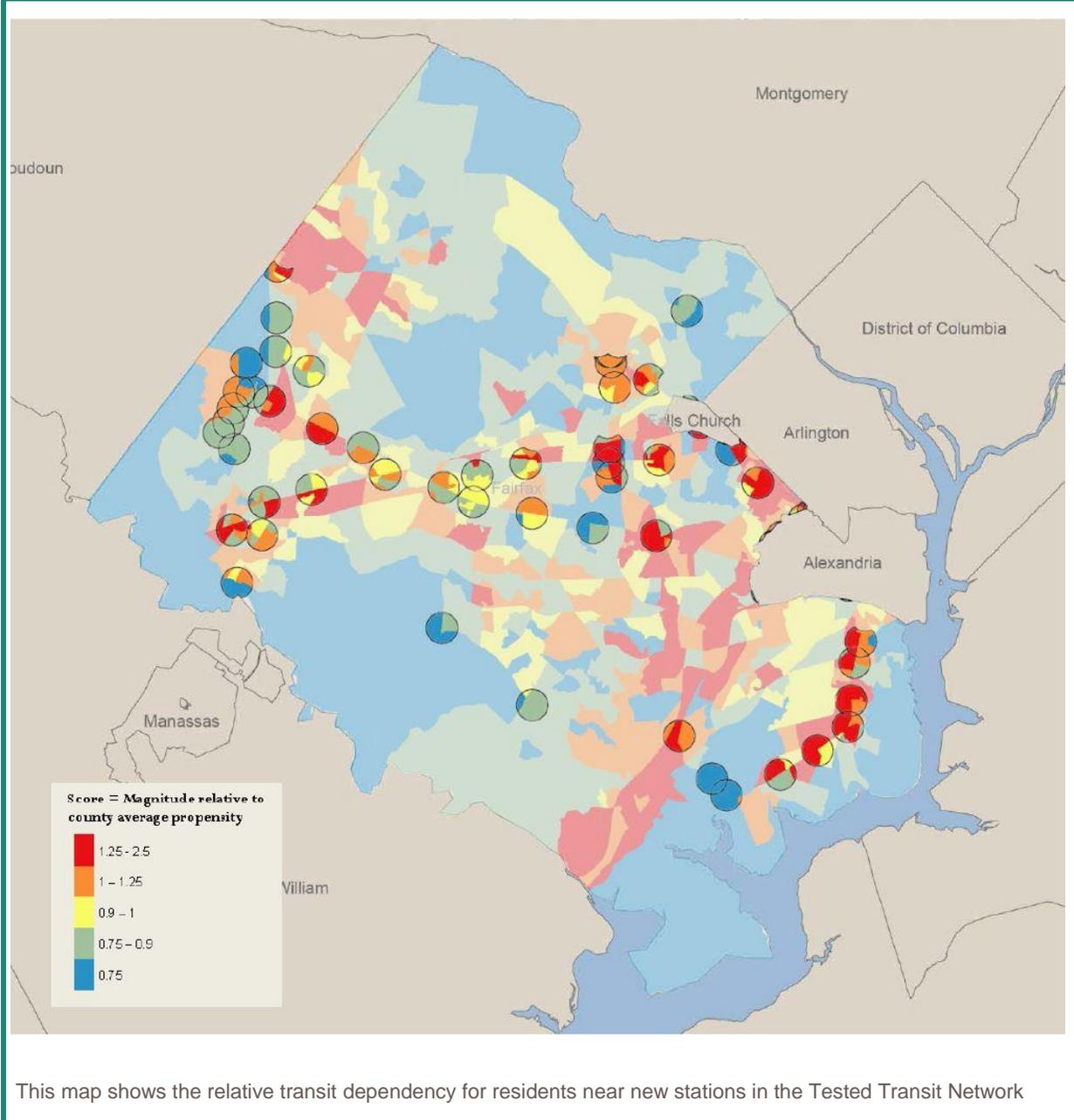


**Exhibit 5-8** shows a comparison of the estimated Capital Cost Per Weekday Passenger (CCPWP) values for the Proposed HQTN Concept routes, as compared to the current New Starts values. The information is shown on a log scale to facilitate comparison of projects less than \$100M with those costing well in excess of \$2B. The Proposed HQTN projects are generally comparable to, or more cost-effective than, those projects currently proceeding through the New Starts process.

**Grow: Increase Access to Transit**

In the 2050 Initial forecasts, Fairfax County (including Fairfax City and Falls Church City) has a total population of 1,457,569 people in 568,510 households and 1,202,218 jobs. In the baseline condition, about 16% of the County’s population and 26% of the County’s jobs are within a half mile of high quality transit. The 52 new stations in the Tested Transit Network bring another 120,000 households and 263,000 jobs within a half mile of a HQTN station, resulting in more than a third of Fairfax County residents and roughly half the jobs within walking distance of high quality transit.

### Exhibit 5-9 | Transit Dependent Populations



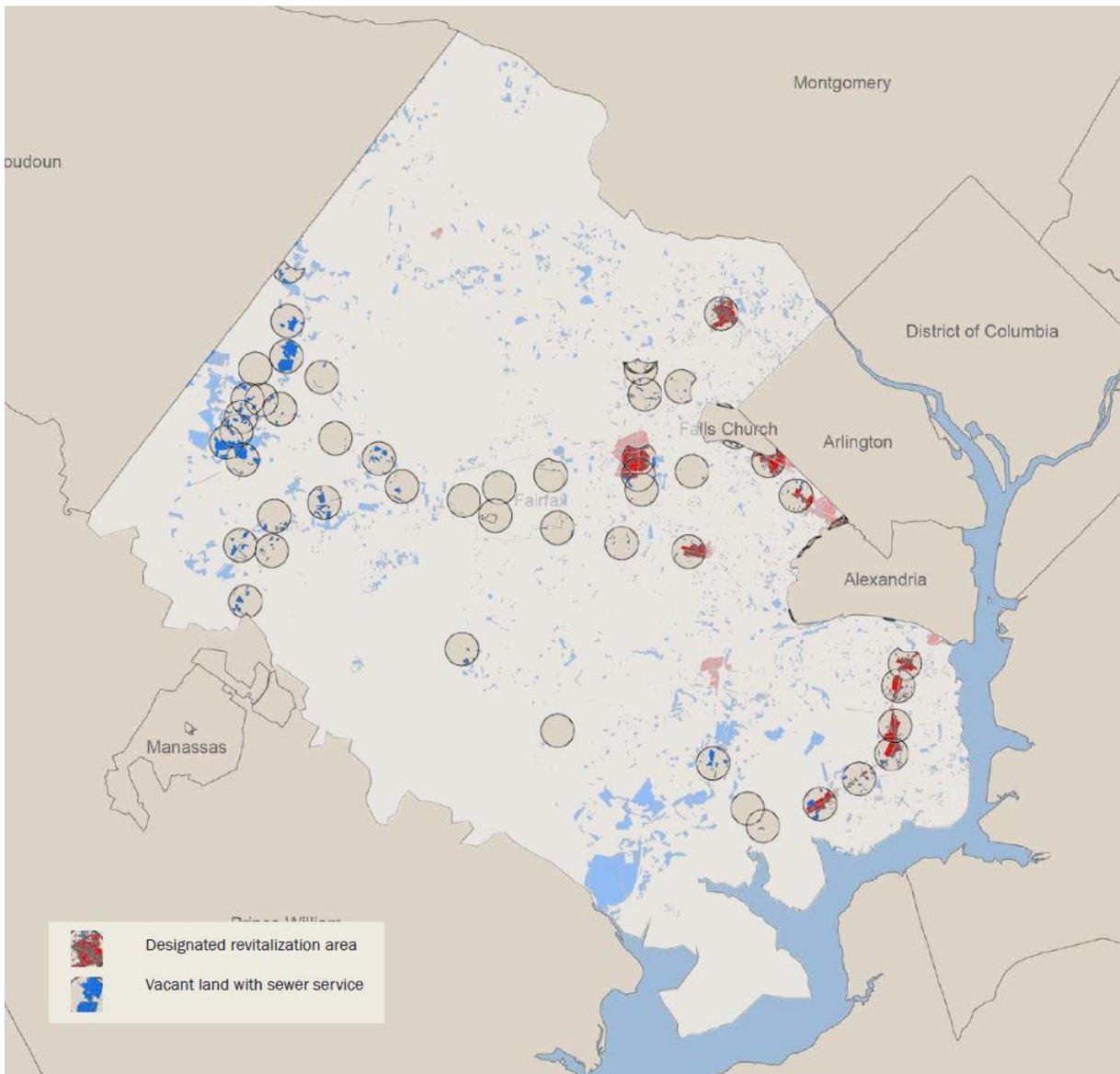
### Thrive: Serving Transit Dependent Riders

The Proposed HQTN Concept provides improved transit service to areas of the County where populations are most likely to be transit-dependent. The assessment of transit propensity based on demographic variables was conducted using a methodology outlined in the Transit Cooperative Research Program's (TCRP) Report 28, *Transit Markets of the Future*. This process identifies areas with high densities of populations likely to take transit. The background colors in **Exhibit 5-9** show each block group in the County by magnitude of transit propensity relative to the Countywide average, organized into quintiles.



The areas where transit-dependent populations are highest are generally in the eastern part of the County along Richmond Highway and I-95, as well as in Reston/Herndon, and along the Route 50 and I-66 corridors. The Tested Transit Network provides new HQTN transit stations with higher than average transit propensity based on the TCRP Report 28 approach.

### Exhibit 5-10 | Guiding Development Patterns



This map shows the relationship of new stations in the Tested Transit Network to the County's desired development areas



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### Thrive: Reducing Vehicle Hours of Travel

The Tested Transit Network reduces the reliance on auto travel, resulting in increased transit ridership and reduced auto travel. The Transit Sketch Model estimates that the change from the 2050 baseline conditions to the Tested Transit Network would incent approximately 99,000 peak period motorized vehicle trips to shift from auto to transit across the region (from a base of approximately 7.2 million trips). These auto trips had an average trip length of 41 minutes, thereby resulting in a savings of 68,000 vehicle hours of travel (VHT) on a typical weekday peak period. These savings might be realized if the Proposed Concept is implemented with sufficient supporting TDM mechanisms so that the additional highway capacity created by the mode shift is not made available for other trips to either shift mode or create longer origin-destination pairs. Without such TDM mechanisms, however, latent demand for making longer trips within the same travel time budget could be realized. In summary, the HQTN provides increased opportunity to reduce reliance on vehicle travel, but no transit system should be developed primarily as a rationale for significantly reducing congestion in a thriving economic area such as the Washington DC region.

### Thrive: Furthering the Comprehensive Plan

The Tested Transit Network provides new transit stations to areas of the County where investment is either targeted by policy or expected to occur due to market forces. Fairfax County has designated certain geographic areas of the County as Revitalization Areas, shown in red in **Exhibit 5-10**.

The Tested Transit Network includes LRT/BRT corridors along Richmond Highway, Route 7 through Seven Corners and Baileys Crossroads, and connecting McLean to Merrifield.

Other areas of the County are prime development sites because they contain vacant parcels within the County's sewer envelope, identified in blue in **Exhibit 5-10**. The Proposed Route 28 corridor serves the largest concentration of these sites in the Dulles Suburban Center.

### Proposed Concept Public Meeting

The study team held a public meeting on July 10, 2013 at the Fairfax County Government Center to present a status report on the proposed concepts and performance of the Tested Transit Network.

The public meeting materials summarized the elements of the Tested Transit Network and its performance and stressed the continuing coordination with ongoing studies. About 50 people attended the public meeting. Common comments included interest in particular route proposals, costs and funding, coordination with ongoing studies, and continuing outreach to those constituents unable to attend the public meeting.



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## Key Lessons for Next Steps

The primary lessons learned from the Initial Proposed Concept was the need to conduct further coordination with ongoing studies, particularly in the Richmond Highway Corridor. Additional key lessons included:

- Changes to land use policies, such as examined in the refined land use scenario, can improve transit ridership and cost-effectiveness without substantially exacerbating congestion; and
- Because latent demand is multimodal, supporting policies such as parking management, value pricing, or TDM programs and services is essential to helping promote modal shift. These policies are presented as part of the discussion of the Recommended Transit Network in Chapter 6.

## Subsequent Coordination Regarding Richmond Highway

Continuing coordination occurred on all active projects highlighted in **Exhibits 5-1** and **5-2**. The greatest focus of coordination occurred in the Richmond Highway corridor. The assessment of transit service in the Richmond Highway Corridor focused on three primary elements. First, the transit function and technology appropriate for the corridor is an element of substantial interest among stakeholders, with a strong community interest in establishing support for an extension of the Metrorail Yellow Line from the Huntington Metrorail Station. A related element of interest is the potential for higher land use densities in the several activity centers along the corridor, both to help develop transit riders for higher quality and capacity technologies such as Metrorail, as well as to help establish market interest in meeting County policies to reinvest in, and revitalize the Corridor. The study team coordinated with the Fort Belvoir master planning efforts to ensure that the transit forecasts reflected not only the expansion plans associated with the current BRAC implementation efforts, but also reasonable assumptions for additional development both at Fort Belvoir and Fort Belvoir North. Finally, the southern terminus of a high quality transitway in the Richmond Highway corridor could extend to Woodbridge in Prince William County, to Lorton, or to Newington.

In all three cases, the nature, density, and extent of land uses in the Richmond Highway Corridor were crucial to the assessment of transit service feasibility and desirability. The Richmond Highway Corridor is anchored at the north end by Metrorail, which supports TOD, extending from the Washington D.C. core through both Arlington and Alexandria along the CSX/VRE/Metrorail corridors. Within Fairfax County the Richmond Highway Corridor has some of the County's oldest highway-oriented commercial activity centers and is a focus for redevelopment and revitalization. The corridor includes one of the County's largest employment sites in Fort Belvoir. The communities in the corridor also have a relatively high propensity for transit use based on socioeconomic considerations.

The CTNS study team recognized at the study outset that while several studies over the past three decades had concluded that the Richmond Highway Corridor may best be suited for a BRT solution, the land use potential in the Corridor could warrant a higher capacity transit solution. The study team decided to revisit the current Comprehensive Plan forecasts for growth and instead considered the potential for greater levels of development density in the



activity centers between Fort Belvoir and Huntington. The Tested Transit Network included both the results of the “Initial Land Use” based on the Comprehensive Plan and the “Refined Land Use” that included substantial additional development in the designated activity centers in the Richmond Highway Corridor with a net increase of about 45,000 additional residents and 25,000 additional jobs. The increased land use was instrumental in improving transit utilization; the L5 Corridor attracted 45,000 daily riders in the Initial Land Use scenario and 69,000 daily riders in the Refined Land Use scenario.

The CTNS study team found that the Metrorail Blue Line market described in Chapter 4 consists of two distinct transit submarkets along the I-95 Corridor and the Richmond Highway Corridor. The Tested Transit Network analyses found that an LRT solution that connected the Huntington Metrorail Station to a future Newington Metrorail Station via Fort Belvoir was cost-effective. It also found that the ridership varied substantially by different segments of the Corridor. Between Huntington and Hybla Valley the LRT line would generate over 10,000 peak period, peak direction riders, suggestive of Metrorail level ridership based on the planning-level threshold described previously. Between Hybla Valley and Fort Belvoir the LRT line would generate between 2,000 and 4,000 peak period, peak direction riders. To the south of Fort Belvoir the ridership dropped below 2,000 peak period, peak direction riders with ridership higher if the route terminated at the Newington Metrorail Station than continuing southward toward Lorton or Woodbridge.



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## CHAPTER SIX: RECOMMENDED NETWORK (2016)

The study team developed the Recommended Transit Network through coordination with ongoing studies, examination of several corridors in greater detail, and additional public and stakeholder outreach. This chapter summarizes the Recommended Transit Network and describes the additional technical analyses and outreach efforts that informed the recommendations. Chapter 7 provides more detailed review of individual network alignments and station locations for those fixed-guideway elements of the Recommended Transit Network which are not already in the regional CLRP or under current study.

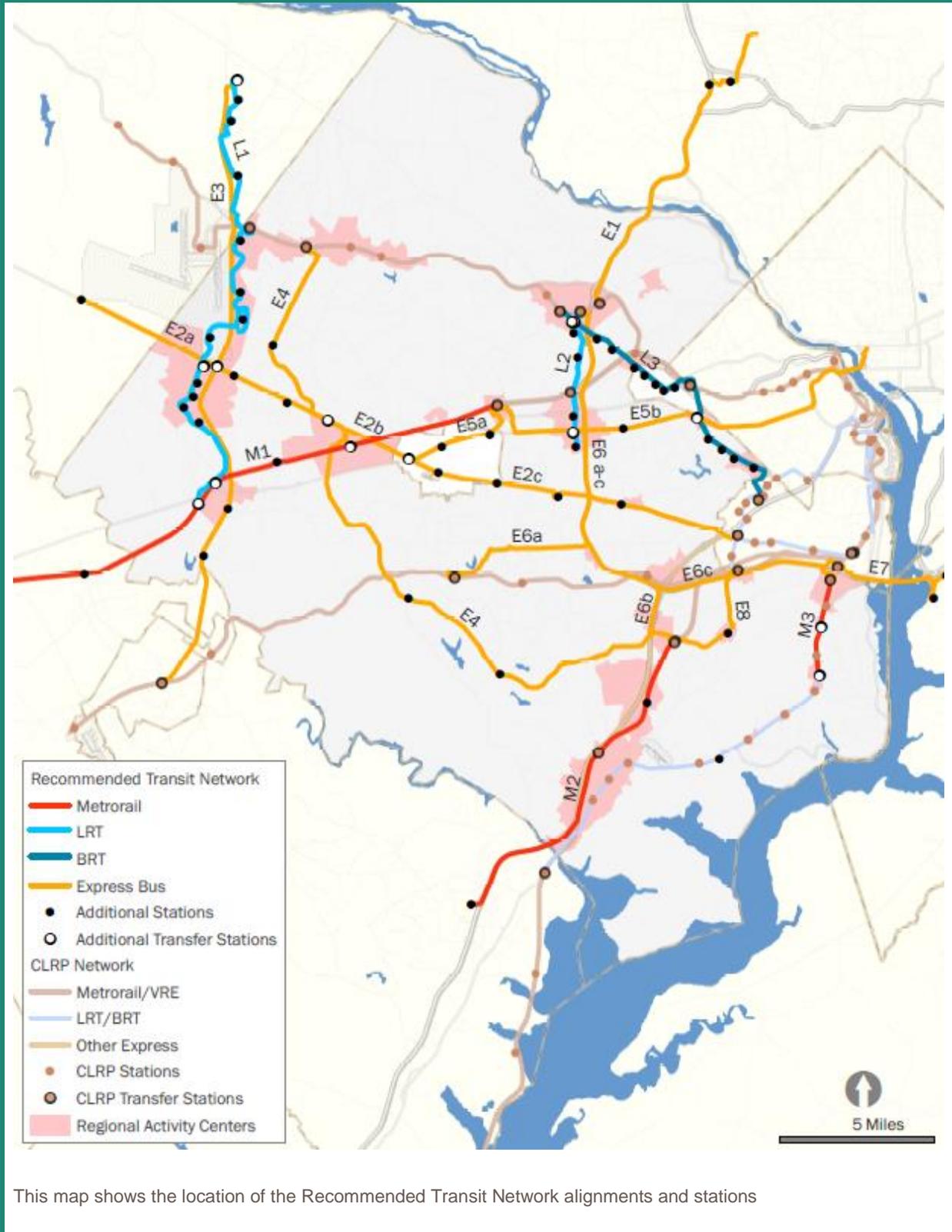
**Exhibit 6-1** presents the Recommended Transit Network and **Exhibit 6-2** describes the 14 individual routes (including segments/variations for routes E2 and E6). Overall, the Recommended Transit Network includes the following elements in addition to the 2015 regional CLRP:

- 34 new Metrorail route miles with 11 new Metrorail stations, of which 24 miles and 8 stations are in Fairfax County, and
- 33 new LRT/BRT miles with 32 new LRT/BRT stations, of which 24 miles and 24 stations are in Fairfax County.

These Metrorail and LRT/BRT stations are supported by 143 miles and 26 stations of new express bus services, of which 97 miles and 13 stations are in Fairfax County.



### Exhibit 6-1 | Recommended Transit Network Elements



This map shows the location of the Recommended Transit Network alignments and stations



## Exhibit 6-2 | Recommended Transit Network Route Descriptions

Route	Description	Mode	N/W terminus	S/E terminus	Peak Headway
M1	Orange Line Extension	Metrorail	Gainesville	Vienna Metrorail	6
M2	Blue Line Extension	Metrorail	Franconia/Springfield Metrorail	Potomac Mills	6
M3	Yellow Line Extension	Metrorail	Huntington Metrorail	Hybla Valley	6
L1	Route 28	LRT	Dulles Town Center	Stone Road Metrorail	10
L2	Route 123/Gallows	LRT	Tysons Corner Metrorail	Fairfax Hospital	10
L3	Route 7	BRT	Greensboro Metrorail	Mark Center	10
E1	American Legion Bridge	Bus	White Flint Metrorail	Tysons 123 Metrorail	10
E2a	Route 50 - 236	Bus	South Riding	Fair Oaks Metrorail	10
E2b	Route 50 - 236	Bus	Fair Oaks Metrorail	Pickett Street	10
E2c	Route 50 - 236	Bus	Pickett Street	Landmark	10
E3	Route 28	Bus	Dulles Town Center	Manassas VRE	10
E4	Route 286/289	Bus	Herndon/Monroe Metrorail	Franconia/Springfield Metrorail	10
E5a	Route 50 East	Bus	Kamp Washington	Vienna Metrorail	10
E5b	Route 50 East	Bus	Vienna Metrorail	Foggy Bottom Metrorail	10
E6a	Tysons-Springfield	Bus	Tysons Corner Metrorail	Burke VRE (Connector Route 495)	10
E6b	Tysons-Springfield	Bus	Tysons Corner Metrorail	Franconia/Springfield Metrorail	10
E6c	Tysons-Springfield	Bus	Tysons Corner Metrorail	Huntington Metrorail	10
E7	Wilson Bridge	Bus	Huntington Metrorail	Suitland Metrorail	10
E8	Van Dorn Street	Bus	Van Dorn Street Metrorail	Franconia/Springfield Metrorail	10

This table describes the mode, extent, mileage, and service frequencies of the Recommended Transit Network lines

### Corridor-Specific Considerations

The recommendations for the specific corridors described below evolved during the course of the study. The following sections of the report describe the pertinent changes within each of these corridors. Additional details on each corridor are provided in **Appendix A**.

#### METRO RAIL EXTENSION TIMEFRAME

The Orange Line and Blue Line Metrorail extensions both appear cost-effective in 2050. However, it is expected that continued expansion of express bus and commuter rail services will have greater cost-effectiveness than Metrorail extensions for the purposes of mobility in each corridor. Both Metrorail extensions should be included in the County's long-range plans, but implementation should only be pursued in conjunction with an examination of land use plans in both Fairfax and Prince William Counties.

#### Orange Line Extension (Metrorail Corridor M1)

The Orange Line extension from the Vienna Metrorail Station to Prince William County is already in the Comprehensive Plan and is retained in the HQTN. The primary change to the Orange Line Corridor relates to the coordination with the Transform 66 project. The Transform



66 project has been designed to date with HOT lanes that will not preclude the ability to extend Metrorail in the median in the future.

The key elements of the HQTN that affect the Metrorail Orange Line Corridor include connections to the Route 28 Corridor (Route L1). In the Tested Transit Network the Route L1 southern terminus was envisioned at a new Orange Line (Route M1) Centreville Metrorail Station in a redesigned I-66/Route 28 interchange. During the review of the Transform 66 design possibilities, a number of Route 28 interchange possibilities were examined that complicated rail station design options within the interchange. The proposed concept for the Route L1 connection therefore was adjusted to move the Orange Line Centreville Metrorail Station to be adjacent to the Trinity Center development. The Route L1 connection was also extended to the Stone Road Metrorail Station to improve direct access to Route L1 from the planned park and ride facility outside of the Centreville activity center.

### **Blue Line Extension (Metrorail Corridor M2)**

The primary change to the Metrorail Blue Line Extension between the Tested Transit Network and the Recommended Transit Network was the elimination of the connection to Fort Belvoir via a fixed-guideway route along of the Newington Metrorail Station.

### **Richmond Highway Corridor (BRT in CLRP, Metrorail Corridor M3)**

The state's Richmond Highway Alternatives Analysis (AA) reflects the high level of ridership in the northern portion of the Corridor and the interest of the citizens in extending Metrorail service into the Corridor. The AA process recommended a multimodal solution consisting of:

- BRT service from Huntington to Woodbridge which was added to the region's CLRP in November 2015 and
- a Metrorail Yellow Line Extension from Huntington to Hybla Valley.

As with the CTNS efforts described in Chapter 5, both of the AA modal recommendations would benefit from increased land use intensity in the Comprehensive Plan.

The AA recommendations were incorporated into the Recommended Transit Network. Based upon continuing coordination with Fort Belvoir staff, the Recommended Transit Network also includes a planned BRT station at Belvoir Road to serve Pence Gate, a more direct walk-access connection to the Fort Belvoir Community Hospital and supporting employment areas than provided by the Accotink Station location.

Additional information on the Richmond Highway AA is available at the [study website](#).

### **Gallows Road (LRT/BRT Corridor L2)**

High quality transit connections are desirable to connect Tysons with the nearby McLean and Dunn-Loring/Merrifield business centers. Travel demand forecasts indicate that land use density and ridership would be sufficient to support a LRT or BRT investment on its own right of way. The Tysons and Merrifield business centers both have a significant amount of rail-supportive density as shown in Exhibit 3 of the Executive Summary.

The Tested Transit Network included a connection along Route 123 from McLean to Tysons, including a connection to the Metrorail Silver Line. The route would continue southward through



Tysons via International Drive, including a connection with the L3 route along Route 7, and an extension southward along Gallows Road to connect to the Dunn Loring Metrorail Station and the Route 50 express bus service, before terminating at the Inova Fairfax Hospital at the southern end of the Merrifield activity center.

BRT or LRT connecting Tysons to Merrifield/INOVA along Gallows Road and to McLean along Route 123 would carry up to 7,300 peak period, peak direction riders, another indication of sufficient ridership (above 4,000) to support fixed-guideway transit (BRT or LRT) but below levels needed to support Metrorail (above 10,000).

A 7.3 mile LRT between Merrifield and McLean was estimated to have a capital cost of about \$375M based on sketch-level unit cost estimates, resulting in a Capital Cost Per Weekday Passenger of about \$50, commensurate with current New Starts LRT systems. The capital cost for the portion between Tysons Corner Metrorail and Merrifield is about \$240M and the capital cost for the portion between Tysons Corner Metrorail and McLean is about \$135M. If the route were implemented as BRT, the capital costs would be different.

During the development of the Recommended Transit Network the relative merits of the portion between McLean and Tysons was reconsidered. This segment would have accounted for only 3,500 of the 45,000 peak period transit riders but would represent more than a third of the estimated capital cost. The challenges associated with including an at-grade fixed-guideway connection along Route 123 from the McLean Metrorail Station, underneath the Dulles Connector Road bridge, to McLean would be challenging. Therefore, the decision was made to drop the connection to McLean from the Recommended Transit Network.

The Gallows Road concept would most likely include transit in the median. Several alternative configurations of travel lanes and median/buffer widths were examined. The current recommendation would support a four-lane roadway (adding transit to the current section rather than the additional two traffic lanes recommended in the Comprehensive Plan). The full transitway concept would generally result in 200' of width from building edge to building edge within centers like the Merrifield CBC, and 165' of width from building-edge to building-edge between activity centers. This concept would incorporate stations within the typical section.

Options to reduce property impacts would include selective narrowing of the roadway median (from which left turn bays are "cut out", so narrowing the median might require prohibiting left turns to some minor side streets), or narrowing the planting strip and sidewalk. A minimal approach would result in a 134' right-of-way within activity centers and a 112' right-of-way between activity centers, but would need to be wider at station locations.

A full BRT/LRT implementation would likely be decades away (the horizon year for this master plan analysis was 2050), so establishing the full transitway building-to-building planned width for the purposes of considering development approvals would minimize active property takings/impacts for those properties that redevelop prior to transitway implementation.



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### Route 7 (LRT/BRT Corridor L3)

The CTNS study team coordinated with the Envision Route 7 project throughout the development of the L3 Corridor recommendations. At the time of the Tested Transit Network proposal described in Chapter 5, the Envision Route 7 study was just beginning (the introductory meeting for the Envision Route 7 study was also held in July 2013). The Tested Transit Network concept held true to the initial Route 7 study mission to connect Tysons to Alexandria while essentially following Route 7. Through multi-agency coordination, three basic shifts in the Route 7 high quality transit network concept occurred:

- The eastern terminus was shifted to the Mark Center based on the lower density development along King Street (Route 7) within Alexandria,
- The alignment was shifted in the Falls Church and Seven Corners area to facilitate a direct connection to the East Falls Church Metrorail Station, and
- Sufficient assessment of costs and benefits was developed so that as of spring 2016 the AA locally preferred alternative is a BRT mode rather than an LRT mode.

The provision of a direct connection to the East Falls Church Metrorail Station is consistent with the 2015 Comprehensive Plan amendment to strengthen the Seven Corners Community Business Center, including a redesign of the existing Seven Corners interchange and a new street grid connections to improve multimodal circulation and connectivity. Additional details on the Route 7 AA are available at the [study website](#).

### Van Dorn Street (Express Bus Corridor E8)

Transit service along Van Dorn Street between Kingstowne and the Van Dorn Metro Station would provide important service to this area of Fairfax County. The primary community concern in this corridor is reducing congestion. Transit demand under a variety of conditions was tested in this study.

During the development of the Initial Proposed Concept in 2013, an extension of Alexandria's West End Transitway was examined with the Comprehensive Plan potential development and a 2050 horizon year. The forecast volumes in the Initial Proposed Concept model runs using the MWCOG model were limited to approximately 900 peak period, peak direction riders at the peak load point south of the Capital Beltway, well below the 4,000 planning threshold. This number of riders is not indicative of the need for BRT, particularly given the primary constituent interest in justifying the BRT based on person-throughput and congestion reduction. The transitway had an estimated capital cost of \$80M and an estimated Capital Cost Per Weekday Passenger of about \$100, high for a BRT system.

Sensitivity tests were conducted to examine a substantially higher level of development in Kingstowne at about 97 activity units (AU) per acre, an amount about four times the density of current Plan recommendations, equivalent to the extending the recently proposed Parcel M and N development density throughout the Community Business Center (CBC), and roughly equivalent to Beacon Hill densities considered in the Richmond Highway Corridor studies. The primary challenges facing transitway implementation are related to Kingstowne's land use and transportation network context. The Kingstowne CBC is too far from any other activity centers to establish a true BRT corridor, and not dense enough to generate the high levels of transit ridership needed to justify dedicated right-of-way from a person-throughput perspective.



However, given the congestion in this corridor, options for either a reversible express-bus lane (or HOV facility) should be studied as they may help address design and operational concerns associated with a bi-directional transit-only facility.

### **Measures of Effectiveness**

**Exhibit 6-3** shows the degree to which the Recommended HQTN achieves the study goals to help Fairfax County Connect, Growth, and Thrive through the implementation of a HQTN system. System performance is compared against a refined baseline set of conditions including the 2050 Final Land Use scenario and updated CLRP conditions described in Chapter 3. As described in Chapter 3, there are several differences between both baseline conditions generally described as reflecting the CLRP and the proposed conditions with the additional HQTN transit lines that complicate comparison of the effectiveness of the Tested Transit Network described in Chapter 5 and the Proposed HQTN described in these paragraphs. Most notably, the CLRP network was changed to add the Richmond Highway BRT, the baseline land use was updated with a substantial increase in housing units, and the HQTN additions were shifted (again, most notably to shift the Richmond Highway BRT to the CLRP and to add the Metrorail Yellow Line extension to Hybla Valley). The combination of these effects generally improve the baseline conditions substantially so that the overall effectiveness of the Proposed HQTN is at roughly the same (or improved) levels as that of the Tested Transit Network, but the changes measured against the baseline are not as great due to the improvement in the baseline conditions.



### Exhibit 6-3 | Recommended Transit Network Measures of Effectiveness

Goal	Achievement (compared to 2050 CLRP conditions)
<b>CONNECT</b> <i>Provide more transportation choices for Fairfax County and regional connectivity</i>	<b>Allows average County resident to reach 90,000 more jobs within a 45 minute transit commute</b>
	<b>Increases Fairfax County transit trips by 65,000 per day, a 16% increase over base conditions.</b>
	<b>Introduces rail service to 7 previously unserved activity centers</b>
	<b>Cost per passenger consistent with recent New Starts approvals</b>
<b>GROW</b> <i>Support local and regional economic development goals</i>	<b>Serves 27 new station areas within designated activity centers.</b>
	<b>Brings 103,000 additional County households and 270,000 County jobs within ½ mile of high quality transit station</b>
<b>THRIVE</b> <i>Strengthen quality of life by making transit-friendly, sustainable investments</i>	<b>Serves 33 new station areas with higher than average transit dependency.</b>
	<b>Reduces weekday peak period Vehicle Hours of Travel by 40,000</b>
	<b>Furtheres Comprehensive Plan concepts for Enhanced Public Transportation Corridors</b>

This table shows how the Recommended Transit Network helps achieve the study goals to Connect, Grow, and Thrive

#### Connect: Accessibility

The Recommended HQTN improves the access to transit to regional job opportunities compared to the base condition. The Recommended HQTN allows the average County resident to reach approximately 90,000 more jobs in the region within a 45-minute transit commute.



**Connect: Transit Ridership**

Exhibit 6-4 shows the performance of the Recommended HQTN for three scenarios; the 2007 model validation, the 2050 baseline conditions, and the 2050 Recommended HQTN.

Exhibit 6-4   Recommended Transit Network Ridership			
MEASURE OF EFFECTIVENESS	2007	2050 BASELINE	2050 RECOMMENDED TRANSIT NETWORK
Total regional weekday transit riders (000s)	1,078	1,883	1,952
Total Countywide weekday transit riders (000s)	152	413	477
Total Countywide mode share percentage	3.9%	7.1%	8.2%
Total Countywide Home-Based Work mode share percentage	12.5%	18.5%	21.6%

This table shows how the Recommended Transit Network increases the total number of transit riders and transit mode share

**Connect: Serving Activity Centers**

The Recommended Transit Network would introduce rail service to the following seven activity centers where rail is not provided in the CLRP scenario (with the relevant route shown in parentheses):

- Beacon Hill (M3)
- Centreville (M1, L1)
- Dulles Suburban Corridor (L1)
- Fairfax Center (M1)
- Hybla Valley/Gum Springs (M3)
- I-95 Corridor (M2)
- Merrifield (L2)

The number of activity centers served in the Recommended Network is lower than that noted in the Tested Transit Network due to the conversion of the Route 7 and Richmond Highway LRT services to BRT.

**Connect: Cost Effectiveness**



**Exhibit 6-5** shows the capital cost estimates and cost-effectiveness for the Recommended Transit Network based on the same approaches described for the Tested Transit Network in Chapter 5. **Exhibit 6-5** includes available cost estimates from the Envision Route 7 BRT (Route L3) and Richmond Highway Alternatives Analysis (Route M3).

The total estimated capital cost for the Recommended Transit Network is \$8.1B, or about \$0.5B more than the Tested Transit Network. The most significant changes between the Tested Transit Network and the Recommended Transit Network includes:

- The addition of the Metrorail Yellow Line Extension (M3) from Huntington to Hybla Valley increased costs by about \$1.4B;
- The extension of the Route 28 LRT/BRT (L1) from Centreville to Stone Road increased costs by about \$0.1B;
- The truncation of the Gallows Road LRT/BRT (L2) northern terminus at the Tysons Corner Metrorail Station reduced costs by about \$0.1B; and
- The changes to the Route 7 LRT/BRT (L3), including the connection to the East Falls Church Metrorail Station, locating the eastern terminus at Mark Center rather than King Street Metrorail, and assuming BRT rather than LRT reduced costs by about \$0.6B.

**Exhibit 6-6** shows the CCPWP values for the routes in the Recommended Transit Network using the same approach described in Chapter 5 for the Tested Transit Network. The patterns in the two network are generally consistent; the cost-effectiveness of the Recommended Transit Network routes remain comparable to the New Starts projects described in Chapter 5.



**Exhibit 6-5 | Recommended Transit Network Cost Effectiveness**

Route	Description	Mode	Mileage	Daily - boardings 2050 Final	Capital Cost (M)	COST EFFECTIVENESS	
						Annual weekday boardings	Capital Cost Per Weekday Passenger (CCPWP)
E1	American Legion Bridge	Express bus	11.5	42000	\$58	10390000	\$5.63
E2	Route 50 - 236	Express bus	24.2	18000	\$78	4583125	\$16.96
E3	Route 28	Express bus	21.0	7000	\$35	1755625	\$20.16
E4	Route 286/289	Express bus	25.0	13000	\$72	3251875	\$22.28
E5	Route 50 East	Express bus	18.3	11000	\$31	2730625	\$11.33
E6	I-495 (Franconia-Tysons)	Express bus	27.6	8000	\$41	1916875	\$21.13
E7	Wilson Bridge	Express bus	11.5	11000	\$61	2766250	\$22.10
E8	Van Dorn - Kingstowne	Express bus	4.4	4000	\$7	1055625	\$7.04
L1	Route 28	LRT	17.8	51000	\$1,032	12708125	\$81.22
L2	Route 123/Gallows	LRT	4.8	30000	\$248	7508125	\$33.07
L3	Route 7	BRT	10.8	112000	\$266	27890000	\$9.54
M1	Orange Line Extension	Metrorail	19.5	91000	\$2,965	22764375	\$130.23
M2	Blue Line Extension	Metrorail	11.6	87000	\$1,711	21710625	\$78.82
M3	Yellow Line Extension	Metrorail	3.1	67000	\$1,461	16686875	\$87.55
<b>TOTALS</b>			211.1		\$8,068		

This table shows the Recommended Transit Network capital cost, ridership, and cost-effectiveness.



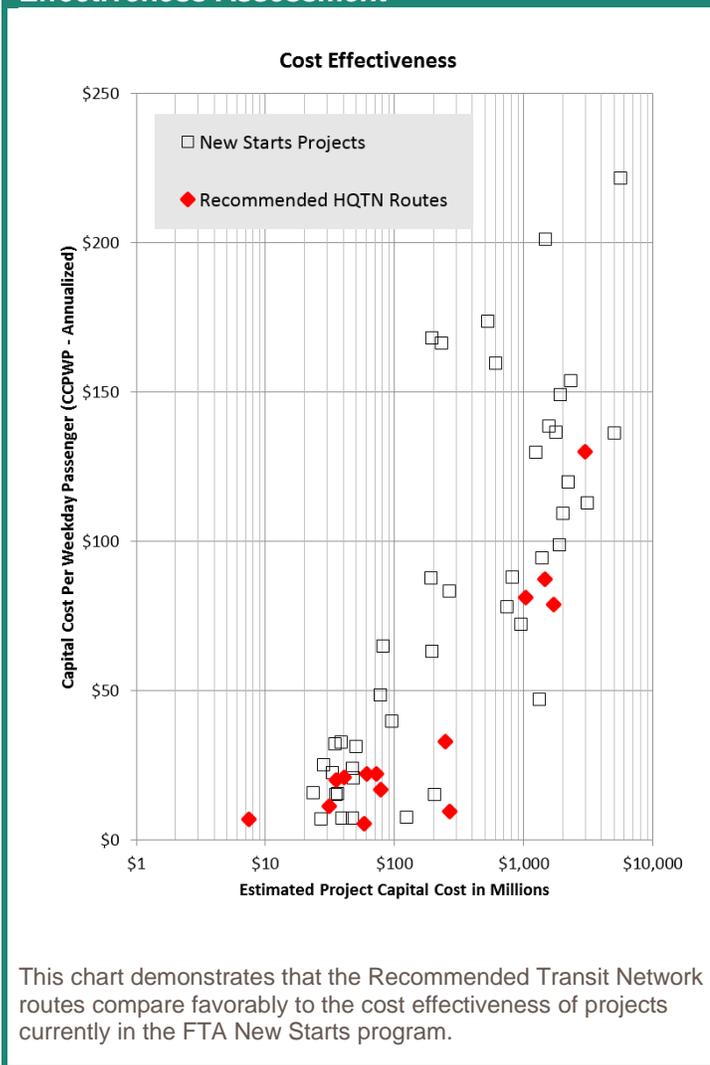
### Thrive: Serving Transit Dependent Riders

The areas where transit-dependent populations are highest are generally in the eastern part of the County as well as in Reston/Herndon, and along the Route 50 and I-66 corridors. The Recommended Transit Network provides HQTN transit stations with higher than average transit propensity in these areas, particularly in the Richmond Highway Corridor (now included in the CLRP but shown in **Exhibit 6-7**) and the Route 7 Corridor.

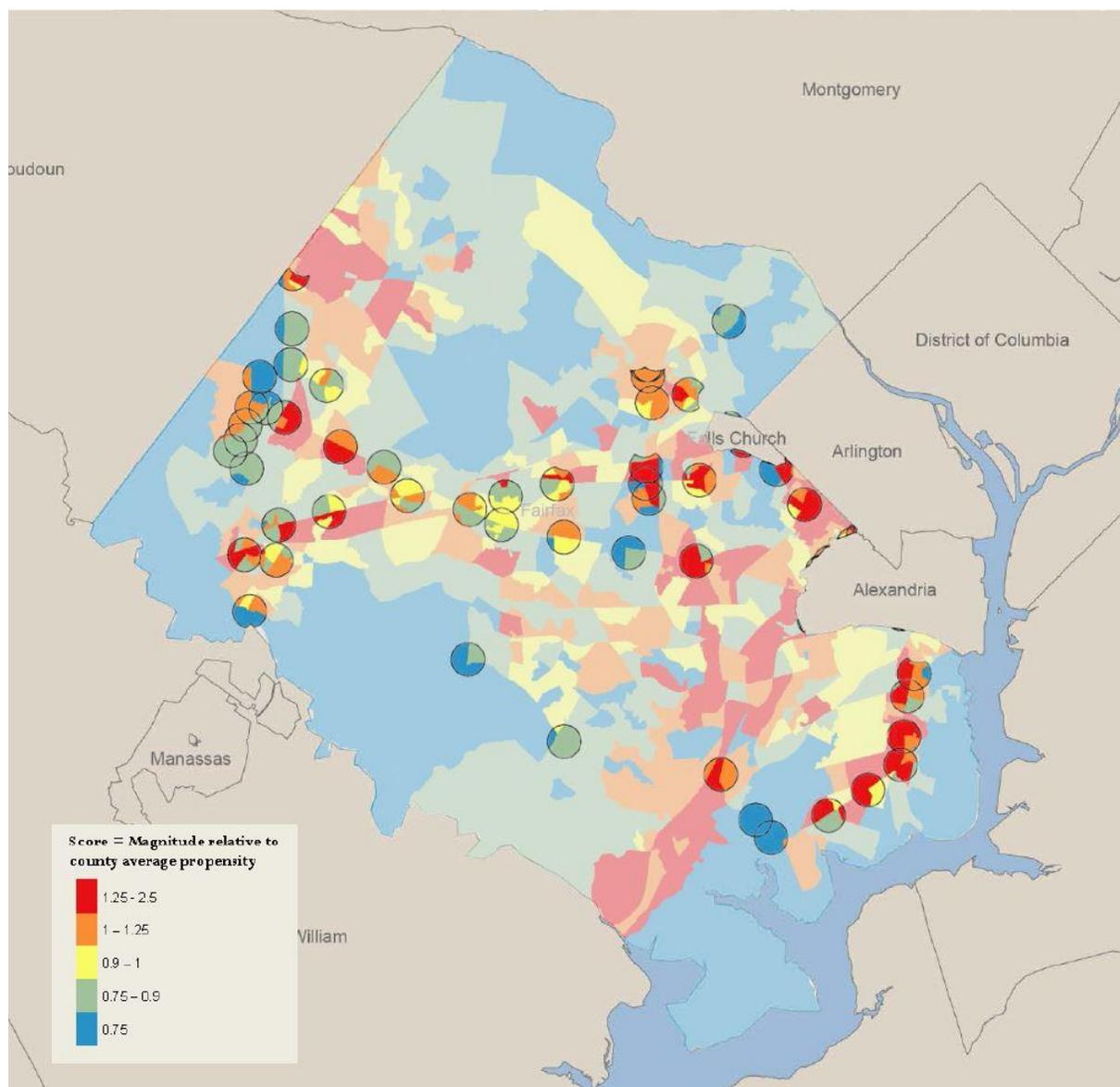
### Thrive: Reducing Vehicle Hours of Travel

The Proposed HQTN reduces reliance on auto travel. As noted in Chapter 5, the assessment of reduced vehicle hours of travel is based on an assessment of potential travel time savings that can be realized due to the effectiveness of the HQTN of serving trips by transit without the effect of latent demand increasing other auto trip lengths. Through this process, the HQTN can be estimated to reduce vehicle hours of travel by 40,000 on a typical weekday peak period. These savings can be realized through the development of supporting TDM mechanisms to minimize the likelihood that the additional roadway capacity associated with HQTN mode shift is used up by longer vehicle trips.

### Exhibit 6-6 | Recommended Transit Network Cost Effectiveness Assessment



### Exhibit 6-7 | Transit Dependent Populations



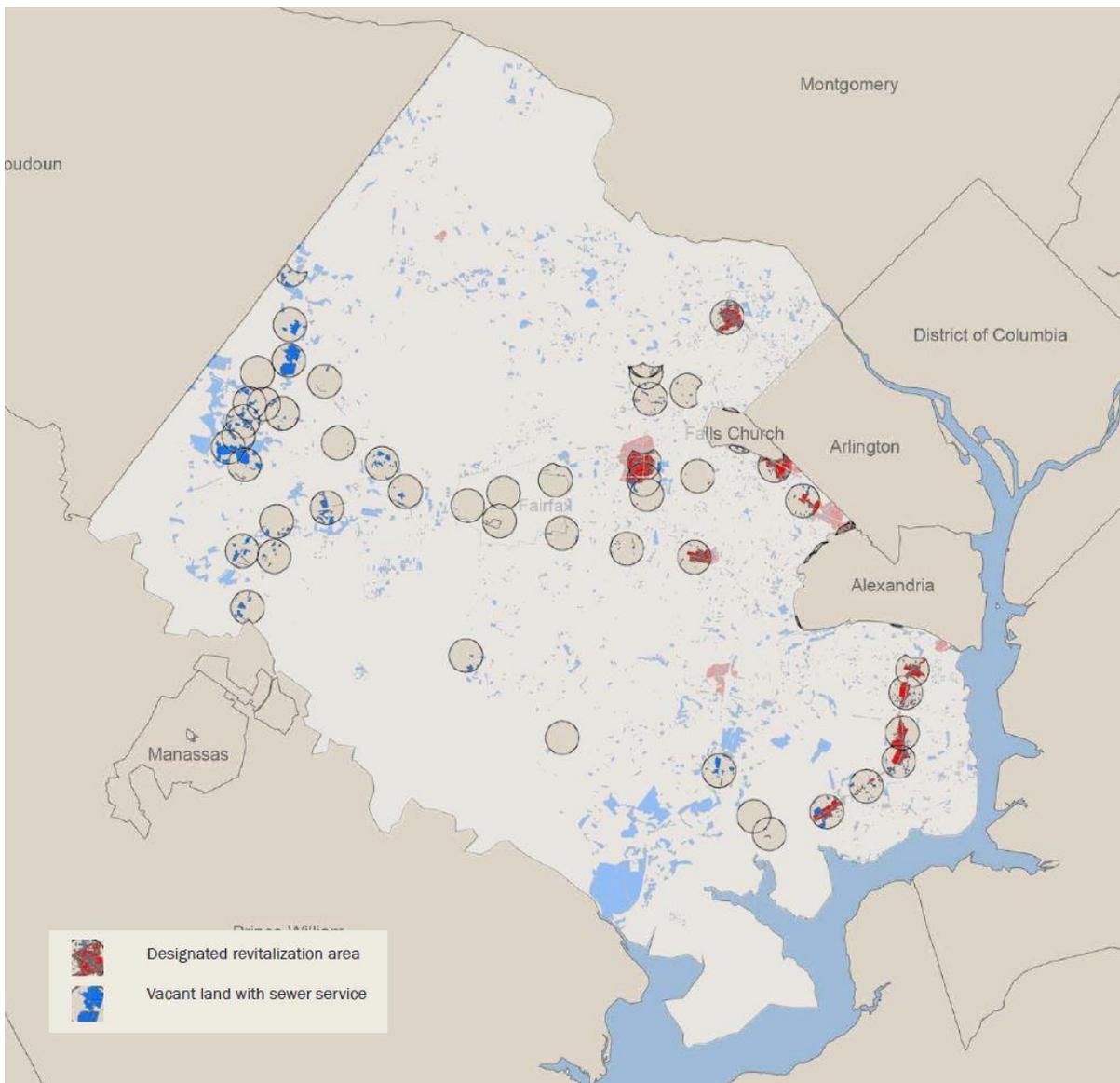
This map shows the relative transit dependency for residents near new stations in the Recommended Transit Network.

### Grow: Furthering the Comprehensive Plan

As noted in Chapter 5, the Recommended Transit Network provides new transit stations to areas of the County where investment is either targeted by policy or expected to occur due to market forces. Fairfax County has designated certain geographic areas of the County as Revitalization Areas, shown in red in **Exhibit 6-8**.

The Recommended Transit Network includes LRT/BRT corridors along Richmond Highway, Route 7 through Seven Corners and Baileys Crossroads, and connecting Tysons to Merrifield.

### Exhibit 6-8 | Guiding Development Patterns



This map shows the relationship of new stations in the Recommended Transit Network to the County's desired development areas.

Other areas of the County are prime development sites because they contain vacant parcels within the County's sewer envelope, identified in blue in **Exhibit 6-8**. The Proposed Route 28 Corridor serves the large concentration of these sites in the Dulles Suburban Center.



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## **Public Outreach**

The study team held a series of public meetings at three locations during February 2016 (at the Government Center on February 16, at George Marshall High School on February 23 and at Mount Eagle Elementary School on February 25) to present the Recommended Transit Network.

The [public meeting presentation](#) described the recommended transit network elements and network performance. About 45 people attended one of the three meetings. Public comments included an interest in greater supporting detail on transportation system elements and costs, continued coordination on implementation, particularly regarding the Transform 66 project and next steps for study acceptance and plan amendments.

## **Transit Network Implementation**

The completion of the CTNS is only the first step in the improvement of transit system performance. Subsequent steps include incorporation of the Recommended Transit Network into the Comprehensive Plan, seeking opportunities to strengthen supporting policies, preserving alignment and station right-of-way, and moving projects from planning into design and construction.

### **Amending the Comprehensive Plan**

Elements of the HQTN can be incorporated into the Comprehensive Plan through two approaches. First, some elements such as the adjustment of a specific alignment or station, could be adopted through a process similar to the adoption of the 2015 transportation map changes. Second, elements that reflect a substantive change to the transportation network could be accommodated in a Countywide amendment to the Transportation Plan Map.

### **Strengthening Supporting Policies**

The County should continue to pursue the strengthening of four specific types of supporting policies to facilitate HQTN implementation and enhance HQTN performance.

- The success of new high-quality transit services depends in large part on the success of those services that are already built. The County should help the region develop broader public and elected official support for transit system funding at all levels, including deferred maintenance and the addition of projects to address Metrorail's core capacity needs within the regional CLRP. The County should support the establishment of a reliable source of continued regional funding for transit services.
- Supporting feeder bus, park and ride (beyond existing or TDP/CLRP spaces), and circulator systems will provide broader access to commuter services and increased coverage within larger activity centers. Park and ride lots are most valuable in locations that can connect lower density residential communities with feeder or express bus services to access activity centers. Circulator systems are most valuable where activity centers have significant development potential not directly served by an HQTN station, such as Reston Town Center and Fair Oaks (as well as expansion of existing services in Springfield and Tysons Corner).
- Land use plans and policies can help encourage the density, diversity, and design of TOD places, particularly in destination corridors where BRT/LRT will connect multiple

activity centers in a single corridor. In the Route 28 Corridor and the Richmond Highway Corridor, additional development density and diversity was considered to maximize efficient use of developable properties, increase total transit ridership, and reduce vehicle miles of travel.

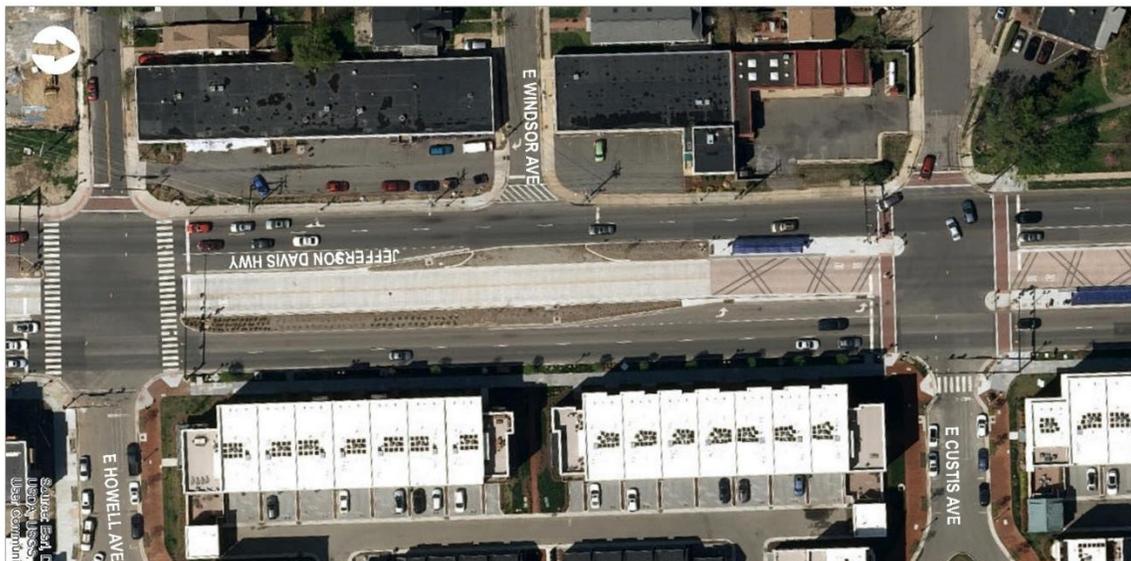
- The increased transit ridership associated with the Proposed HQTN Concept will create additional roadway capacity. Some of that increased capacity will be utilized by other auto travelers, so that both vehicle hours of travel (at free flow speeds) and delay will be higher than today's levels. Progressive parking management policies and value pricing techniques can help further reduce vehicular travel demand and delays.

### Preserving Right of Way

Establishing comprehensive plan guidance for transit alignments and station locations facilitates the preservation of desired right-of-way over time as redevelopment occurs, reducing the likelihood of adverse property impacts in the future and helping establish effective TOD.

Several alternative configurations of travel lanes and median/buffer widths were examined to accommodate the Gallows Road (L2) median transitway concept. The full transitway concept would generally result in 200' of width from building edge to building edge within centers like Tysons and 165' of width from building-edge to building-edge between centers. This concept would incorporate far-side stations within the typical section, allowing the use of near-side space to serve as left-turn lanes, a consistent typical section such as found in the Metroway implementation along Jefferson Davis Highway (Route 1) in Alexandria, as shown in **Exhibit 6-9**, with about 80' of space between the centerline and the building edge.

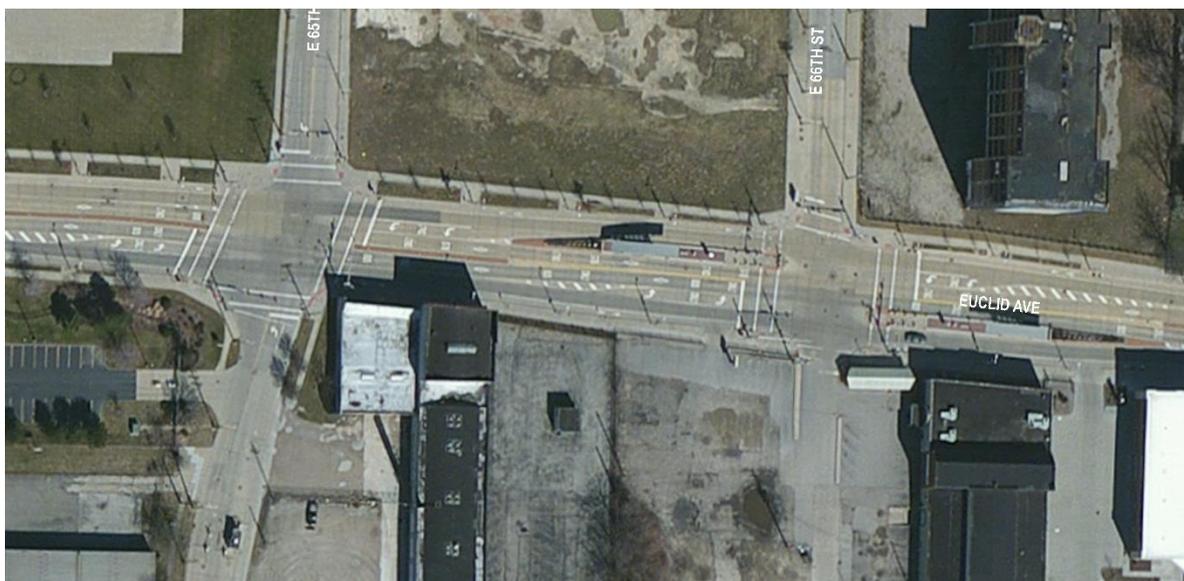
#### Exhibit 6-9 | Full Transitway Concept Example



The Metroway BRT in Alexandria demonstrates a Full Transitway Concept with a 160' right-of-way. *Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community.*

Options to reduce property impacts would include selective narrowing of the roadway median (from which left turn bays are “cut out”, so narrowing the median might require prohibiting left turns at some minor side streets), or narrowing the planting strip and sidewalk. A minimal approach would result in a 134’ right-of-way within centers and a 112’ right-of-way between centers, but would need to be wider at station locations. **Exhibit 6-10** shows an example of a transitway that has been retrofit into a minimal approach, in this case the Health Line in Cleveland, Ohio. In this particular segment there is no “typical” section, as the transitway design has been carefully threaded through several closely spaced intersections. The typical section has been minimized, yet there are several undesirable design elements, including narrow sidewalks, offset locations of the BRT alignment on either side of intersections causing the bus to weave or “slalom” through the intersection, a lack of separation between the transitway and the adjacent roadway, a lack of pedestrian median refuges for several crosswalks, and reduced system “legibility” for users of any mode.

### Exhibit 6-10 | Minimal Transitway Concept Example



The Health Line BRT in Cleveland provides an example of a minimal transitway concept in a variable right-of-way. Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community.

**Exhibit 6-11** shows conceptually a range of typical section elements from a variety of sources that were considered in developing recommended right-of-way widths for Gallows Road. The recommended rights of way for the full transitway concepts are shown in the first four lines, with dimensions guided by the VDRPT *Multimodal System Design Guidelines*. Several alternative sections were also considered and checked, primarily to address two concerns that the DRPT guidance would result in too wide a footprint; design elements that could be reduced or eliminated in design to minimize property impacts or capital costs, and comparison against other design guidance. This process also led to the selection of preferred “full” right-of-way widths rounded to the nearest five feet as it is likely that the state of the practice in preferred design



elements and standard widths will continue to evolve over the next decade or two so that any specific elements incorporated in this report are likely to be at least a foot or two different at such time as these projects enter detailed design.



**Exhibit 6-11 | Potential Typical Section Alternatives for Transitway Design**

	Half-Section Dimensions (both sides of street)										Full Section Width	
	Pedestrian Realm			Roadway				Transitway		Subtotal	Total	As Applied for Full (Rounded) and Minimal Concepts
	Setback	Sidewalk	Panel	C&G	Parking	Bicycle	Travel	Median	Travel			
<b>DRPT Guidelines (8/27/13)</b>												
Inside Activity Centers - 4 lanes	5	10	8	0.5	8	5	24	16	13	89.5	179	<b>180</b>
Outside Activity Centers - 4 lanes	5	10	8	0.5	0	5	24	16	13	81.5	163	<b>165</b>
Inside Activity Centers - 6 lanes	5	10	8	0.5	8	5	36	16	13	101.5	203	<b>200</b>
Outside Activity Centers - 6 lanes	5	10	8	0.5	0	5	36	16	13	93.5	187	<b>185</b>
<b>Adjusted to "slalom" with one median reduced to 3' monolithic or painted (10/21/13)</b>												
Inside Activity Centers - 4 lanes	5	10	8	0.5	8	5	24	9.5	13	83	166	
Outside Activity Centers - 4 lanes	5	10	8	0.5	0	5	24	9.5	13	75	150	
Inside Activity Centers - 6 lanes	5	10	8	0.5	8	5	36	9.5	13	95	190	
Outside Activity Centers - 6 lanes	5	10	8	0.5	0	5	36	9.5	13	87	174	
<b>Minimum footprint - no median (9/22/15)</b>												
Inside Activity Centers - 4 lanes	10			0.5	0	6	22	3	13	54.5	109	
Outside Activity Centers - 4 lanes	10			0.5	0	6	22	3	13	54.5	109	
Inside Activity Centers - 6 lanes	10			0.5	0	6	33	3	13	65.5	131	
Outside Activity Centers - 6 lanes	10			0.5	0	6	33	3	13	65.5	131	
<b>Comparison to 9/21/15 coordination notes with Chris Wells/Adam Lind</b>												
Inside Activity Centers - 4 lanes	0	5	5	2	0	6	22	3	13	56	112	<b>112</b>
Outside Activity Centers - 4 lanes	0	5	5	2	0	6	22	3	13	56	112	<b>112</b>
Inside Activity Centers - 6 lanes	0	5	5	2	0	6	33	3	13	67	134	<b>134</b>
Outside Activity Centers - 6 lanes	0	5	5	2	0	6	33	3	13	67	134	<b>134</b>
<b>Tysons Urban Design Guidelines for Pedestrian Realm (10/5/15 comparison)</b>												
Boulevard (L2 on Route 123) - 8 lanes	33			2	0	6	44	3	13	101	202	
Avenue Max (L2 on Gallows/International) - 6 lanes	28			2	0	6	33	3	13	85	170	
Avenue Min (L2 on Gallows/International) - 6 lanes	20			2	0	6	33	3	13	77	154	
<b>Tysons Plan (9/2015 draft) curb-to-curb dimensions (10/5/15 review)</b>												
Boulevard (L2 on Route 123) - 8 lanes	33			0	8	5	44	3	13	106	212	
Avenue Max (L2 on Gallows/International) - 6 lanes	28			0	8	5	22	3	13	79	158	
Avenue Min (L2 on Gallows/International) - 6 lanes	20			0	8	5	22	3	13	71	142	

This table shows a range of typical section elements considered for full and minimal transitway concepts.



Since a full LRT or BRT would likely be decades away, establishing a full transitway concept with a 165' or 200' building-to-building width would minimize active property takings/impacts for those properties that redevelop prior to transitway implementation. When preliminary engineering begins, those properties that have redeveloped will have been protected. A general planning tenet is to select slightly conservative (i.e. wider) dimensions early in the planning process for the sake of contingency planning as right-of-way is protected during development review. It is easier to adapt to a public facility design space that is ten feet wider than needed, than it is to adapt the same design to space that is ten feet narrower than needed.

**Exhibit 6-12** shows how preservation of right-of-way facilitates quality design in a phased implementation approach. The first figure shows a typical suburban setting with buildings set back from the sidewalk and served by parking in front of the buildings. The second figures shows an overlay of the full right-of-way for a planned transitway. In the third figure, redevelopment on the left side of the street occurs before the transitway is completed, and the buildings are designed to be oriented not towards the existing street but rather towards the eventual sidewalk. In the final figure, the transitway is built to match that new building line.

### Establishing Implementation Priorities

The HQTN is designed to meet the needs of the County several decades in the future. Individual transit routes and services should be phased in over time, with triggers identified not by horizon year, but by economic development readiness. In general, the priority for implementation should follow the following guidelines:

**Exhibit 6-12 | Phased Implementation Concepts**

These graphics show how right-of-way preservation can guide public and private sector design.



- The highest priority projects are the two BRT projects already in the alternatives analysis process; the Richmond Highway phased BRT implementation and Envision Route 7.
- The express bus network can be implemented as piecemeal design and operations projects. Three projects in particular should be considered for near term study:
  - Express bus services on the Fairfax County Parkway in conjunction with the long term corridor study that the County is undertaking;
  - The implementation of HOV lanes to support express bus services along Route 28 should be incorporated into project planning as this corridor improvement has scored well in the recent HB 2 assessments; and
  - The examination of transit-supportive designs, such as a reversible bus lane, along Van Dorn Street should be considered in conjunction with additional study of the Franconia Road intersection, a project that scored highly in the recent HB 2313 assessments.
- The next priority fixed-guideway project should be the Gallows Road LRT/BRT to support Tysons development. As has proven to be the case with Route 7 and Richmond Highway, the County needs to consider the timeframe for alternatives analysis or its equivalent process under federal regulations at time of implementation. Should the Gallows Road project be initiated in the immediate future, it is more likely that development absorbed within the implementation analysis timeframe would support BRT and less likely that it would support LRT.
- The next priority project should be the Route 28 Corridor, with timing to be considered as part of the Fairfax Forward land use planning efforts.
- The extension of Metrorail services is the longest-range set of projects in the HQTN and should not be initiated until WMATA has addressed core capacity concerns through projects that have yet to be funded in the CLRP. Fairfax County will need to complete strategic land use plans for the Metrorail Yellow Line Corridor and coordinate with Prince William County on similar plans for Metrorail Stations on the Orange and Blue Lines.

### **Coordinating Among Implementers and Operators**

The implementation of the HQTN requires further study and collaboration among local, regional, state, and federal agencies who will be responsible for implementing and operating system elements. The coordination steps include the following:

- Synthesis of emerging guidance on transit project and mode selection and design from federal, regional, and statewide sources such as the Federal surface transportation program (known as the FAST Act), emerging WMATA guidance on project density and ridership thresholds, and the DRPT Multimodal System Design Guidelines.
- Identification of appropriate stand-alone projects with defined project sponsors and champions, recognizing the interjurisdictional nature of the HQTN and the evolutionary nature of transportation system technologies (ranging from transit vehicle to emerging ridesharing service providers), institutional frameworks for decision making, and project funding and permitting requirements.



- 
- Completion of alternatives analyses and other environmental studies needed to confirm, or refine, mode selection and detailed design elements. These studies will incorporate more detailed assessments of elements such as project life-cycle costs reflecting detailed operations and maintenance needed to maintain a state of good repair and local community benefits and impacts that are necessary to move from systems planning to project implementation.



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## CHAPTER SEVEN: KEY LOCATOR MAPS

The following pages show route alignment and station reference maps for the following HQTN routes that are not the subject of ongoing study:

- L1 = Route 28 Corridor LRT/BRT
- L2 = Gallows Road LRT/BRT
- M1 = Orange Line Metrorail Extension
- M2 = Blue Line Metrorail Extension

For each of these routes, a key locator map identifies the full route and subsequent pages indicate the location of the proposed alignments, stations, and elements of the right-of-way to be protected. Where the alignments follow existing roadway alignments, the right-of-way widths generally retain the existing roadway centerline, unless otherwise noted. Callout boxes describe location-specific characteristics of the alignment.

There are two ongoing studies with their own recommendations for the following HQTN routes that are the subject of current study:

- Envision Route 7 (Route L3)
- Richmond Highway (Route M3 and the Richmond Highway BRT line in the CLRP) via the Embark Richmond Highway land use and Richmond Highway AA transportation planning initiatives.

Note: Due to technical limitations associated with developing the referenced Locator Maps in a web-accessible format, they will be made available in PDF upon request from FCDOT.