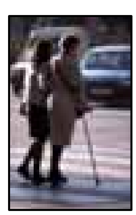
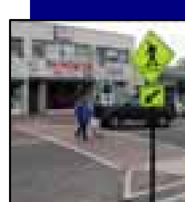
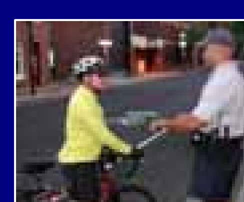
City of Alexandria

Pedestrian and Bicycle Mobility Plan

November 20, 2007

DRAFT



ACKNOWLEDGEMENTS

This Plan was prepared under the guidance of the Pedestrian and Bicycle Program within the City of Alexandria's Department of Transportation and Environmental Services. Guidance and support for the development of this Plan was also provided by a City Working Group and several Stakeholder Groups. This project was funded by a State Transportation Planning pilot grant from the Virginia Department of Transportation in partnership with the Northern Virginia Regional Commission.

Prepared for:

Pedestrian and Bicycle Program
Transportation & Environmental Services
City of Alexandria
301 King Street, Room 4100
Alexandria, VA 22314

Director: Rich Baier PE
Project Manager: Yon Lambert

Prepared by:

Toole Design Group, LLC
6525 Belcrest Road, Suite 400
Hyattsville, MD 20782
Phone: (301) 927-1900
www.tooledesign.com

November 20, 2007

The City of Alexandria would like to thank the following individuals for contributing to the development of this Plan:

CITY WORKING GROUP

Tom Culpepper, Department of Transportation & Environmental Services
Jim Maslanka, Department of Transportation & Environmental Services
Sandra Marks, Department of Transportation & Environmental Services
Donna Norfleet, Department of Transportation & Environmental Services
Valerie Peterson, Department of Planning & Zoning
Allison Anderson, Department of Planning & Zoning
Pat Mann, Department of Planning & Zoning
Steve Chozick, Department of Planning & Zoning
Laura Durham, Department of Recreation, Parks & Cultural Activities
Debbie Ludington, Department of Human Services/Aging & Adult Services

STAKEHOLDERS

Alexandria Commission on Persons with Disabilities
Chester Avery, Chair (focus group)
Chuck Benaugh, (focus group)
Ruth Soto, (focus group)
City Staff Contact- Mike Hatfield
Jennifer Keener Apple
Amanda Babcock
Joseph Delfico
Tamara Dunlap-Elkins
James Graham
Louise Harrison
Christine Marschall
Adam Osterman
Mary Parker
Tom Sachs
Tanisha Williams-Minor

Ad Hoc Transportation Task Force
Larry Robinson, chair
Joseph Bennett
George Foote
Poul Hertel
Eric Wagner
Lois Walker
Maria Wasowski

Alexandria Park & Recreation Commission
Judy Guse-Noritake, Chair
William Conkey
Henry Brooks
Ripley Forbes
Robert Moir
Lindsey Swanson
David Dexter
Kenneth Sharperson
Kay Vetter
Owen Jones

Pedestrian & Bicycle Citizens Group and BikeWalk Alexandria
Jerry King, chair
Sean Crumley
Pat Devine
Bruce Dwyer
Marianne Fowler
Eric Gilliland (Washington Area Bicyclist Association)
Larry Grossman
Scott Newsham
Steve Palinsar
Dick Leslie
Dave Levy
Ken Lyons
Ruth Reeder
Jeff Schanz
Irene Shanz
Amy Slack
Elizabeth Wright

Alexandria Traffic & Parking Board
Randy Cole
Thomas "Jay" Johnson, Jr.
Kevin Posey
Lawrence Ruggiero
Amy Slack
Patrick Warren
Converse West

Cover Page Photo Credits: City of Alexandria, Richard Nowitz/ACVA, Ernest E. Clark, Toole Design Group

TABLE OF CONTENTS

Executive Summary

Goal
The City of Alexandria is working to reduce dependence on private automobiles and provide citizens with transportation choices. One way to accomplish this goal is to improve access for persons with disabilities, pedestrians, and bicyclists. This Plan provides a blueprint for 10 years of on-the-ground safety, mobility and connectivity improvements. Implementation of this Plan will make walking and bicycling more attractive transportation choices in the City.

Planning Context and Focus
This detailed citywide study focused on 120 miles of heavily used roadways and the existing bikeways and trails network. It builds on the policy-level recommendations in the 2007-08 Transportation Master Plan. The recommendations in this Plan will be incorporated into small area plans, site plans and the City's Neighborhood Traffic Calming, Safe Routes to School and other capital improvement projects. This Plan furthers the goals of the Community Pathways initiative and the Spin City 2009 effort to become a bicycle-friendly community.

Public Involvement Opportunities
The first Public Meeting for this Plan was held in March 2007 and nearly 500 people completed an online survey and a paper survey on DASH buses. The project team met with key City-recognized committees including the Commission on Persons with Disabilities and the Traffic & Parking Board. City representatives also met with Civic Associations and Community Organizations. The Transportation Alternatives eNewsletter was used to distribute updates and a final Public Meeting will be held in December 2007.

Implementation and Funding
This plan includes more than 5,000 recommendations for specific improvements to enhance connectivity for pedestrians and bicyclists. The field data collection effort for this Plan was one of the most comprehensive efforts of its kind undertaken in the United States and resulted in a list of improvements totaling over $36 million – *not including* bridges or tunnels. The dollar figure is used for planning purposes only. The City expects many of the recommendations in this Plan to be implemented over time as part of regular maintenance or existing capital improvement programs. Some will be made using more than $4.5 million in existing grants set aside for pedestrian and bicycle improvements. Development proposals and associated streetscape projects also offer excellent opportunities for improvements.

The assessment was one of the most comprehensive efforts of its kind undertaken in the United States

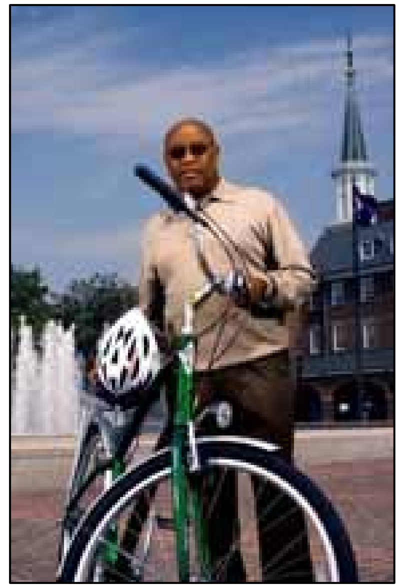
Terms and Language
Some of the terms used in this Plan may be unfamiliar to readers. A detailed description of pedestrian and bicycle facilities is provided in the appendix.

Maps and Graphics
The maps in this document are included in 8½ inch by 11 inch format. The full size versions of these maps are available on the City's website at http://www.alexride.org/bikeped.php.

Project Support and Implementation
This project is funded by a State Transportation Planning pilot grant from the Virginia Department of Transportation and the Northern Virginia Regional Commission.

OVERVIEW

Walking and bicycling are fundamental to the character and livability of Alexandria, Virginia. City residents and visitors have walked along the streets of Old Town for more than 350 years. Today, the King Street and Mount Vernon Avenue commercial areas thrive on pedestrian traffic. People access public transit, parks, neighborhood trails, and community centers throughout the City by walking and bicycling; students walk and bicycle to schools in all neighborhoods. With over one million visitors every year, the Mount Vernon Trail is one of the region's most popular multi-use trails, and thousands of pedestrians and bicyclists travel on Union Street on typical summer weekends. Alexandria is approximately five miles from the Potomac River to its boundary with Fairfax County, and three miles across from north to south; a perfect size for making trips by bicycle.



Mayor William D. Euille Photo Credit: Ernest E. Clark

The City of Alexandria Pedestrian and Bicycle Mobility Plan celebrates this history of walking and bicycling. It builds on the policy-level recommendations in the 2007 Comprehensive Transportation Master Plan and provides a blueprint for physical improvements to make walking and bicycling more attractive transportation choices in Alexandria. Most of the recommendations in this Plan will likely be implemented as a part of upcoming projects (e.g., roadway repaving, streetscape improvements, regular maintenance, corridor reconstruction, small area plans, site plans, private sector development, etc.). The recommendations can also be incorporated into existing City programs and initiatives, such as Safe Routes to School, Community Pathways and the Spin City 2009 effort to become a bicycle-friendly community.

This Plan includes more than five thousand recommendations for specific infrastructure improvements to enhance pedestrian and bicycle connectivity and mobility. These recommendations cover a wide range of physical improvements, from rebuilding existing sidewalks, to marking new bicycle lanes, to building new multi-use paths. A summary of this Plan's infrastructure improvement recommendations is included below.

Summary Pedestrian and Bicycle Recommendations

- 17.5 miles of new sidewalks and 11.8 miles of reconstructed sidewalks
- Removal of 274 sidewalk obstructions
- 645 new marked crosswalks and 672 re-striped crosswalks
- 251 new pedestrian countdown signals and 243 new pedestrian pushbutton signals
- 418 new accessible curb ramps and 464 reconstructed accessible curb ramps
- 148 bus stop improvements
- 13 new and 2 reconstructed pedestrian and bicycle overpasses/underpasses
- 10.1 miles of new shared-use paths and 3.54 miles of reconstructed shared-use paths
- Removal of 68 shared-use path surface obstructions and 10 clear width obstructions
- 16.3 roadway centerline miles of new bicycle lanes
- 3.7 roadway centerline miles of new climbing lanes for bicycles
- 16.4 roadway centerline miles of new shared lane markings for bicycles

- 12.31 miles of shared use pathways alongside roads

As noted, one of the ways that the recommendations in this Plan can be implemented is through the City's existing programs and internal funding mechanisms. For this reason, all of the recommendations in this Plan have been placed into one of the following five categories: Safe Routes to School, Access to Transit, Community Pathways, On-Road Bicycle Facilities, and Off-Road Facilities. These groupings were made based on the type and location of recommendations and their proximity to important community facilities such as schools and transit stops. By classifying recommendations by the City's existing programs, this Plan provides guidance on how each individual recommendation could potentially be funded and implemented over time.

City of Alexandria policeman directing children across the street. Photo Credit: City of Alexandria

A primary goal of this Plan is to provide a detailed roadmap to implementing the policy level recommendations in the 2007 Transportation Master Plan. Towards this end, this Plan also prioritizes all recommendations into short, medium, and long-term categories to enable the City to make informed and strategic decisions about how to effectively allocate resources over time. The prioritization of recommendations in this Plan accounts for a range of factors, including existing conditions, potential demand, safety, and public input.

The geographic areas where short-term priority projects congregate together provide a logical way to group recommendations. In many cases, clusters of projects can be accomplished under single contracts in order to ensure efficiency. Implementing clusters of projects is also particularly beneficial in enhancing overall connectivity in an area. Additionally, grouping short-term projects into clusters allows them to be easily included in the City's Capital Improvement Program (CIP) and Transportation Improvement Plan (TIP). Inclusion in the CIP and TIP is an important pre-requisite to the funding of infrastructure improvement projects.

The City of Alexandria is working to reduce dependence on private automobiles and provide Alexandrians with a variety of transportation choices. One way to accomplish this goal is to improve access for persons with disabilities, pedestrians, and bicyclists. By providing an extensive set of infrastructure improvement recommendations and grouping them together by the City's existing funding programs and relative priority, this Plan provides a blueprint for pedestrian and bicycle improvements. The implementation of these recommendations will result in safer conditions for pedestrians and bicyclists and make walking and bicycling more attractive transportation choices in Alexandria.

CHAPTER 1: INTRODUCTION

This Plan provides detailed recommendations for infrastructure improvements that will create more accessible and convenient conditions for pedestrians and bicyclists in Alexandria. The Plan focuses on specific "on the ground" infrastructure improvements that support the policy-level recommendations in the 2007 Comprehensive Transportation Master Plan. This chapter provides information on the general context for this Plan and an overview of the chapters that follow.

2007 Comprehensive Transportation Master Plan

One of the guiding principles of the Transportation Master Plan is that "Alexandria will lead the region in providing quality pedestrian and bicycle accommodations." This Plan includes specific recommendations to support the Transportation Master Plan's goal of making walking and bicycling more attractive transportation choices. The pedestrian and bicycle transportation goals of the Transportation Master Plan that are supported by this Plan are included in Figures 1 and 2.

This Plan includes recommendations for infrastructure, such as new sidewalks, crosswalks, pedestrian signals, accessible transit stops, bicycle lanes, and shared-use trails. While the focus of the Plan is on infrastructure, it is essential for the City to also have programs and policies that support pedestrian and bicycle activity. This includes education about how to use pedestrian and bicycle facilities more safely, encouragement for people to walk and bicycle more frequently, and enforcement of safer pedestrian, bicycle, and driver behavior.

The Transportation Master Plan includes detailed recommendations for programs and policies that support pedestrians and bicyclists. For example, the Transportation Master Plan recommends pedestrian and bicycle facilities as a part of all roadway reconstruction projects and major new development projects. This Plan supports the goals, objectives, actions and strategies in the Transportation Master Plan.

Figure 1: City of Alexandria Pedestrian Transportation Goals

PEDESTRIAN

Overall Goal: Walking will be the safest, most convenient and enjoyable way to get around in Alexandria.

Concept Goal #1. Engineering: The City will provide a continuous, connected and accessible network that enables pedestrians—particularly children and those with mobility impairments—to move safely and comfortably between places and destinations.

Concept Goal #2. Encouragement: The City will encourage mobility for all pedestrians by removing barriers to accessibility and promoting walking as a means of improving health and active lifestyles.

Concept Goal #3. Education: The City will develop Safe Routes to School Programs and awareness initiatives that address pedestrian safety, rights and responsibilities.

Concept Goal #4. Enforcement and Safety: The City will create a safe pedestrian environment through effective law enforcement, detailed crash analysis and implementation of safety countermeasures.

(Source: 2007 City of Alexandria Comprehensive Transportation Master Plan)

Federal and State Policies

This Plan is also consistent with Federal and State policies and regulations. Over the past 15 years, many policies and plans have been developed at the national and state levels to ensure that communities are designed to support walking and bicycling. Below is a description of the policies that are most relevant to this Plan.

Federal Policies

Federal transportation policies (through the Intermodal Surface Transportation Efficiency Act of 1990 as well as subsequent transportation bills) strongly support the inclusion of pedestrian and bicycle facilities in transportation projects, and have supplied a consistent source of funding for these activities for the past fifteen years.

The Federal Highway Administration (FHWA) Virginia Division Office established a Bicycle and Pedestrian Policy in 2001. This policy supports including pedestrian and bicycle facilities in all new and reconstructed federal-aid transportation projects except under specific circumstances.

This policy states that it will assist VDOT by sharing technologies, helping with planning activities, and promoting the safety aspects of walking and bicycling. The FHWA Division policy also states: "Bicycle and pedestrian facilities should be funded at the same federal-state ratio as the typical highway improvement," and "Federal participation will be withdrawn on any major project that severs an existing bicycle or pedestrian route, unless an alternate route exists or is provided."

Figure 2: City of Alexandria Bicycle Transportation Goals

BICYCLE

Overall Goal: Make bicycling an integral part of the transportation system in Alexandria.

Concept Goal #1. Engineering: The City will complete a connected system of primary and secondary bikeways with ample bicycle parking to serve all bicyclists' needs.
Concept Goal #2. Encouragement: The City will seek to increase bicycle usage and bicycle-transit connections through targeted outreach and encouragement.
Concept Goal #3. Education: The City will develop and implement targeted Safe Routes to School Programs as well as additional programs for adult cyclists and motorists.
Concept Goal #4. Enforcement and Safety: The City will create a safe bicycling environment through effective law enforcement and implementation of bicycle safety enhancements.

(Source: 2007 City of Alexandria Comprehensive Transportation Master Plan)

Americans with Disabilities Act (ADA)

People with disabilities are more likely to be pedestrians than other adults because some physical limitations can make driving difficult. For this reason, the U.S. Government established the Americans with Disabilities Act (ADA) in 1990. Its implementing regulations, issued by the Department of Justice (DOJ) in 1991, require that all new and altered facilities - including sidewalks, street crossings and related pedestrian facilities in the public right-of-way – be accessible to and usable by people with disabilities. The Americans with Disabilities Act Accessibility Guidelines (ADAAG) provide the necessary guidance for the design and construction of pedestrian facilities.

State Policies

As detailed below, this Plan is also consistent with State plans and policies spearheaded by the Virginia Department of Transportation and the Department of Conservation and Natural Resources.

Virginia Department of Transportation

On March 18, 2004 the Commonwealth Transportation Board adopted a new state policy for integrating pedestrian and bicycle accommodations into roadway projects (often termed “incidental” improvements – bikeways and sidewalks that are built as part of new roadway construction or roadway reconstruction). This policy essentially reverses previous VDOT policies which required a great deal of public and political support in order for bikeways and sidewalks to be *considered* for inclusion in transportation projects.

The new policy states that *“VDOT will initiate all highway construction projects with the presumption that the projects shall accommodate bicycling and walking.”* The policy provides a number of factors under which additional emphasis will be placed on the need for such facilities, essentially requiring bikeways and sidewalks whenever a roadway project occurs in an urban or suburban area. The policy provides several exemptions under which facilities are not required. This policy also pertains to operations and maintenance, including hazard elimination projects and signal installation.

Accessible street crossing. Photo Credit: Toole Design Group

The complete version of VDOT’s *Policy for Integrating Bicycle and Pedestrian Accommodations* can be found on the VDOT website at www.virginiadot.org in the Program section under Bicycling and Walking.

VDOT has also established standards for the physical layout of roadways through its Roadway Design Manual. The 2005 version of this manual has incorporated the VDOT Policy for Integrating Pedestrian and Bicycle Accommodations (see above). Several sections of the manual describe in detail how pedestrians and bicyclists should be included in roadway projects. It describes various methods of accommodating pedestrians and bicyclists and includes standards for sidewalks, buffers between sidewalks and roadways, curb ramps, and pedestrian tunnels, as well bicycle lanes, paved shoulders, wide outside lanes, and shared use paths.

Virginia Department of Conservation and Natural Resources

This Plan is also clearly in line with statewide recreation goals, as set forward in the recommendations of the Virginia Department of Conservation and Recreation’s (DCR) *2002 Virginia Outdoors Plan*. DCR identified the need to provide *“transportation alternatives, specifically trails for walking, hiking and cycling and to connect people with destinations.”*

Coordination with Transit

The pedestrian and bicycle infrastructure improvements recommended in this Plan will help the City achieve its goal for public transportation as outlined in the Transportation Master Plan: "Ensure that people can travel into, within, and out of the City of Alexandria by providing a mass transit system that combines different modes of travel into a seamless, comprehensive, and coordinated effort." Sidewalks, shared-use trails, and bikeways make it safer and easier for transit customers to reach buses and trains. Benches, shelters, and bicycle parking at transit stations and stops make access more convenient and comfortable. A functional non-motorized transportation infrastructure is critical to making the Alexandria transit system successful. This Plan supports the Transportation Master Plan's goal of a seamless, comprehensive and coordinated mass transit system.

A Note about the Graphics in this Document

This Plan provides a detailed set of location-specific infrastructure improvement recommendations throughout Alexandria. These recommendations are included within this Plan and also in Geographic Information Systems (GIS) databases. It is difficult to graphically display every single recommendation in this document because the quantity of information makes it difficult to discern distinct items on a citywide map. Therefore, the recommendation maps in this Plan necessarily present a generalized, and therefore less detailed, version of the full list of recommendations.

Figure 3: Sample Recommendation Map

A sample of just the sidewalk recommendations for a small area of the City is included in Figure 3 on this page. The GIS data includes a comprehensive accounting of all recommendations developed as part of this planning process. The City is incorporating this data into its site review and development process. It should continue to develop systems for utilizing the data in its GIS format. This process is discussed in detail in Chapter 6. Note that the maps in this document are included in 8½ inch by 11 inch format; however, the full size versions of these maps are available on the City's website at http://www.alexride.org/bikeped.php.

Plan Overview

Chapter 2 outlines the planning process for this Plan, including public involvement, field data collection and data analysis. Chapter 3 discusses existing conditions, with a focus on key factors that most directly impact the walking and bicycling environment in the City, such as conditions walking along and crossing roads. It also presents selected additional pertinent information such as existing and potential demand for pedestrian and bicycle facilities and locations with high numbers of reported pedestrian and bicycle crashes.

Chapter 4 presents recommendations for pedestrian and bicycle infrastructure improvements. It divides these recommendations into the City's existing programs and funding categories. Chapter 5 reorganizes the recommendations into short, medium and long-term priority categories to guide the City's efforts over time. It describes the methodology for prioritizing recommendations and outlines the short-term recommendations. It then presents a strategy for geographically organizing short-term recommendations into priority areas to facilitate implementation. Chapter 6 discusses strategies for most effectively utilizing the data generated through this planning process.

Bicyclists on the Mount Vernon Trail in Alexandria
Photo Credit: Richard Nowitz/ACVA

"THE CITY WILL BECOME BICYCLE-FRIENDLY BY MAKING ROUTINE ACCOMODATIONS FOR BICYCLISTS ON 'COMPLETE' STREETS AND PATHWAYS THAT ENABLE SAFE TRAVEL FOR ALL USERS"

"THE CITY WILL MAKE WALKING A PART OF PEOPLE'S EVERYDAY LIVES BY PROVIDING PLEASANT, SAFE AND ACCESSIBLE CONNECTIONS THAT ENCOURAGE AND REWARD THE CHOICE TO WALK"

2007 City of Alexandria Comprehensive Transportation Master Plan

CHAPTER 2: PLANNING PROCESS

This Plan has been developed through public outreach, detailed field data collection, and thorough data analysis. This chapter presents an overview of each of these elements of the planning process to provide context for the information to follow.

Public Outreach

Alexandria residents provided significant input throughout the planning process for this Plan. Public meetings were held to gather ideas for pedestrian and bicycle facility improvements and to obtain feedback on draft Plan recommendations. Nearly 40 people attended the first public meeting on March 22, 2007. At the meeting, participants were asked to provide feedback on specific locations in the City that need pedestrian and bicycle improvements. A second public meeting will be held in early December 2007 to review recommendations and provide additional feedback. This information will be incorporated into the final Plan to the extent possible (see Appendix C: Public Meeting Summaries for additional information).

Alexandria citizens identify pedestrian and bicycle infrastructure improvements at March 2007 public meeting. Photo Credit: Toole Design Group

A questionnaire distributed online and on the City's DASH transit buses was also utilized to gather further information from the public. The online questionnaire was available throughout March 2007 to give citizens an opportunity to provide input (see Appendix C: Questionnaire Summary).

Nearly 500 overall responses to the online and DASH transit bus questionnaires were received. Responses to the questionnaire informed the recommendations in this Plan and are highlighted in the following chapter. Additional information about the plan was distributed to residents through the City's Transportation Alternatives eNewsletter and the Pedestrian and Bicycle Program website.

A City working group provided feedback at key points in the planning process. The project team coordinated with various City departments, including the Transit, Maintenance, and Engineering Divisions of the Transportation and Environmental Services Department, Planning and Zoning, DASH, RPCA, and others. In addition, the project team met with key City-recognized committees, including the Ad Hoc Transportation Task Force, Commission on Persons with Disabilities, the Park and Recreation Commission, and the Traffic & Parking Board. City representatives also met with civic associations and community organizations, including the Del Ray Citizens Association (Traffic Committee), the Brookville-Seminary

Citizens Association and the Holmes Run Park Committee.

Field Data Collection

Extensive field work was conducted throughout Alexandria to document existing conditions for walking and bicycling and to identify opportunities to improve pedestrian and bicycle facilities. This analysis included pedestrian crossing conditions, on-road bicycling conditions, and potential locations for future greenways. The project team's pedestrian infrastructure assessment was one of the most comprehensive field data collection efforts of its kind undertaken in the United States. The map on the following page shows the areas where data were collected in the field. Measurements were collected on the following:

- 110.3 road centerline miles (220.6 counting both sides of the road)
- 147.3 miles of existing sidewalks
- 1,517 existing crosswalks
- 15 miles of multi-use trails
- 60.9 miles road evaluated for Bicycle Level of Service

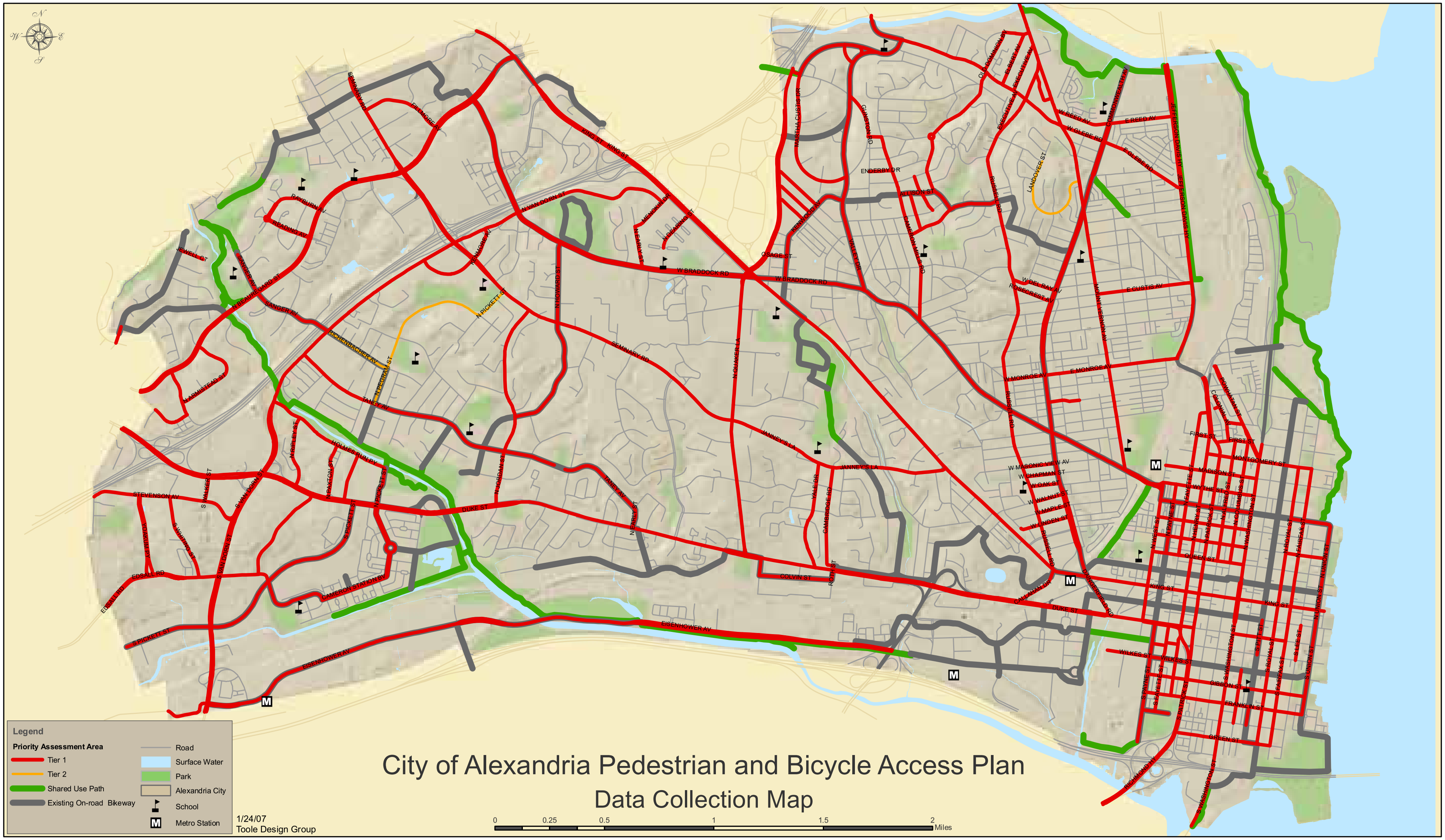
Utilizing a global positioning system (GPS), field data collectors gathered objective measurements of pedestrian and bicycle facilities throughout the City, including sidewalk width, surface type, surface condition, obstructions, and buffer type; crosswalk type, surface condition, and lanes crossed; crosswalk traffic control type and pedestrian signal type; curb ramp accessibility (general estimate); driveway crossing accessibility (general estimate); bus stop accessibility (general estimate); and many other factors (see Appendix E: Field Data Collection Items).

Objective field measurements were also taken to assign Bicycle Level of Service (Bicycle LOS) grades to a 70-mile on-road bicycle network and assess the conditions of 14 miles of multi-use trails. Bicycle LOS grades were calculated using a scientific model developed by the Florida Department of Transportation and used throughout the country on similar planning studies. The "A" (highest rating) through "F" (lowest rating) scale represents the comfort level that a typical bicyclist experiences riding on a roadway segment (see Appendix F: Bicycle Level of Service Model Description). Multi-use trail measurements included width, surface type, condition, and obstructions.

Field data collection efforts as part of the Pedestrian and Bicycle Mobility Plan.
Photo Credit: Toole Design Group

In addition to developing an inventory of the City's existing pedestrian and bicycle infrastructure, the project team also made preliminary recommendations for multi-use trail and on-road bicycle facility improvements. These recommendations were reviewed along

Figure 4: Data Collection Map



with other data sources to develop the final Plan recommendations.

Data Analysis

Once the field data collection was complete, the raw data was converted into Geographic Information Systems (GIS) database format for further review and analysis. Converting the data into GIS allowed the project team to better analyze large amounts of spatial information.

Several adjustments were made to improve the accuracy of the field data, including removing duplicate lines and points, changing infrastructure characteristics in the database that did not match other existing data, and filling in blank database entries. The cleaned GIS data was then used to generate a list of potential pedestrian facility recommendations. As noted, these include more than five thousand spot recommendations and recommendations along nearly one hundred eighty miles of sidewalks, roads and trails in Alexandria.

Bicyclist riding in an existing bicycle lane in Alexandria
Photo Credit: Toole Design Group

For bus stop recommendations, the GPS data gathered in the field was used to supplement a detailed bus stop inventory conducted by DASH in spring 2007. Measurements and preliminary recommendations for the multi-use trail and on-road bicycle facilities were made in the field by leaders of the project team.

The following chapter briefly discusses existing conditions for walking and bicycling in Alexandria. It focuses on attributes that play a key role in shaping the pedestrian and bicycle environment in the City.

CHAPTER 3: EXISTING CONDITIONS

Walking and bicycling are fundamental to the character and livability of Alexandria, Virginia. This chapter briefly discusses the range of pedestrian and bicycle environments in the City. It outlines key characteristics that impact the comfort of walking and bicycling in different areas of the City.

Pedestrians crossing Mount Vernon Avenue in an existing crosswalk. Photo Credit: City of Alexandria

Overview

The City of Alexandria has a full range of pedestrian and bicycle environments. The King Street and Mount Vernon Avenue commercial areas thrive on pedestrian traffic and thousands of pedestrians and bicyclists travel on Union Street on many weekends of the year. People access public transit, parks, neighborhood trails, and community centers throughout the City by walking and bicycling and students walk and bicycle to schools in all neighborhoods. With over one million visitors per year, the Mount Vernon Trail is one of the region's most popular multi-use trails.

Many areas of the City have pedestrian-friendly characteristics, such as well-connected sidewalk networks and on-street parking that serves as a barrier between motor vehicles and those on foot. There are also areas in the City, for example along stretches of Duke Street, where traffic volumes and speeds are high, the sidewalk network is more disconnected and roads are difficult to cross. Sidewalks do not exist in many West End developments. Curb ramps are missing from some crosswalks; crosswalks have worn away in some locations; a number of signalized intersections do not indicate when it is safe for pedestrians to cross. There are a number of bus stops without concrete pads or connections to local sidewalk networks to serve pedestrians with disabilities.

Likewise, the experience bicycling in Alexandria depends largely on location. There are many comfortable neighborhood streets, existing bike lanes, and bicycle parking facilities throughout the City. However, there are also barriers to bicycle travel. Multi-lane roadways such as Duke Street, Quaker Lane, and Van Dorn Street are difficult for bicyclists to travel along or cross. Fewer than three miles of City roadways have bicycle lanes.

Figures 5 through 8 on the following pages provide information on the reason people walk and bicycle in Alexandria and the issues that they face. This information was gathered from the public via the online survey. A detailed account of existing conditions for walking and bicycling in Alexandria is included in the data collection maps and public meeting notes included in the appendix of this Plan.

Figure 5: Percent of Respondents Walking for Specific Purposes at Least 1 Day Per Week

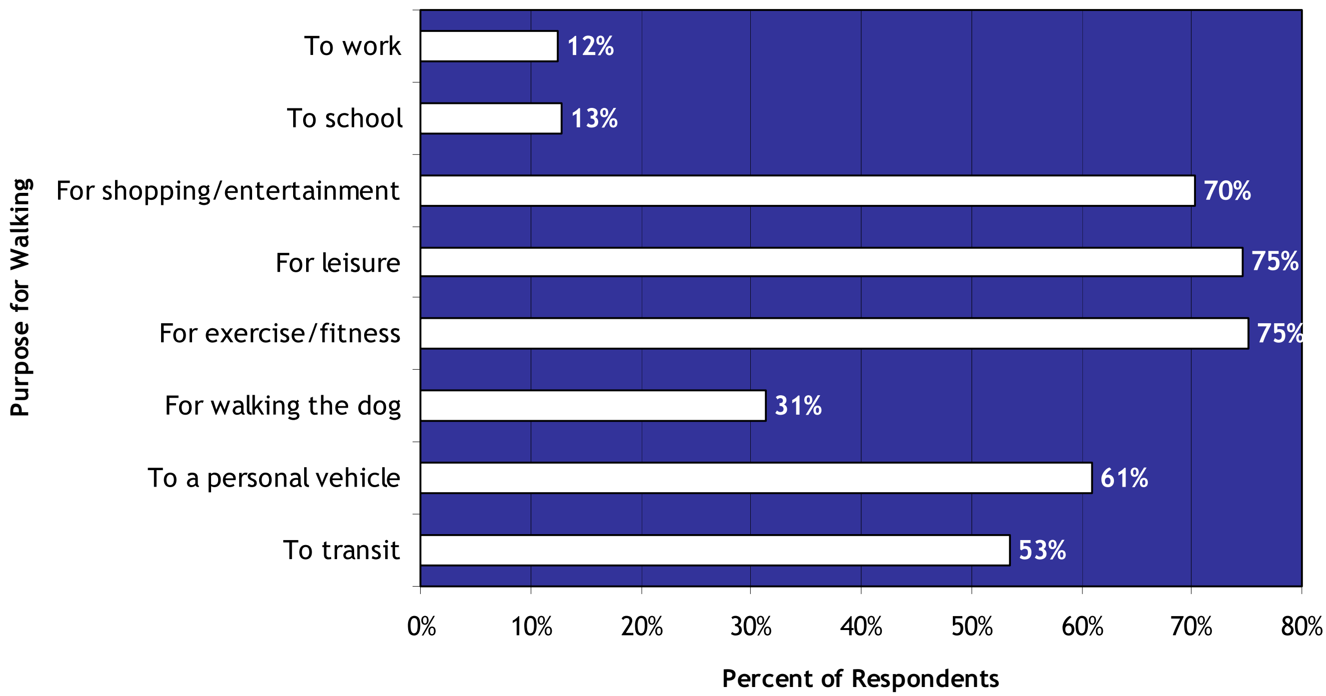


Figure 6: Most Critical Issues for Pedestrians

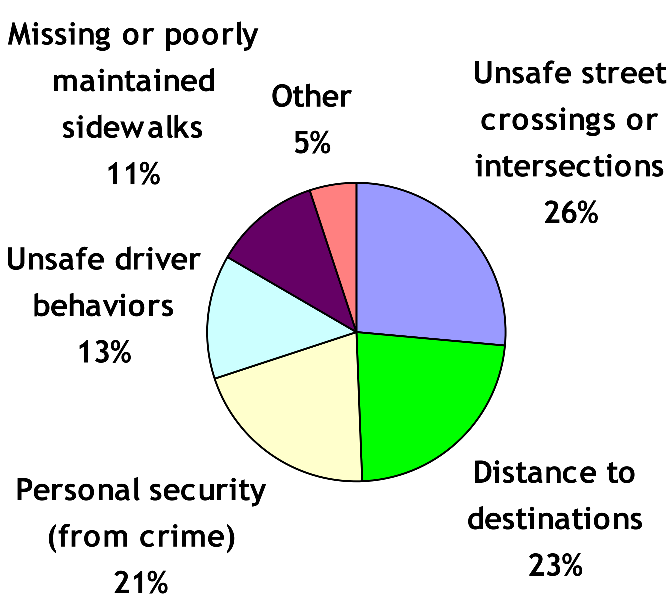


Figure 7: Percent of Respondents Bicycling for Specific Purposes at Least 1 Day Per Week

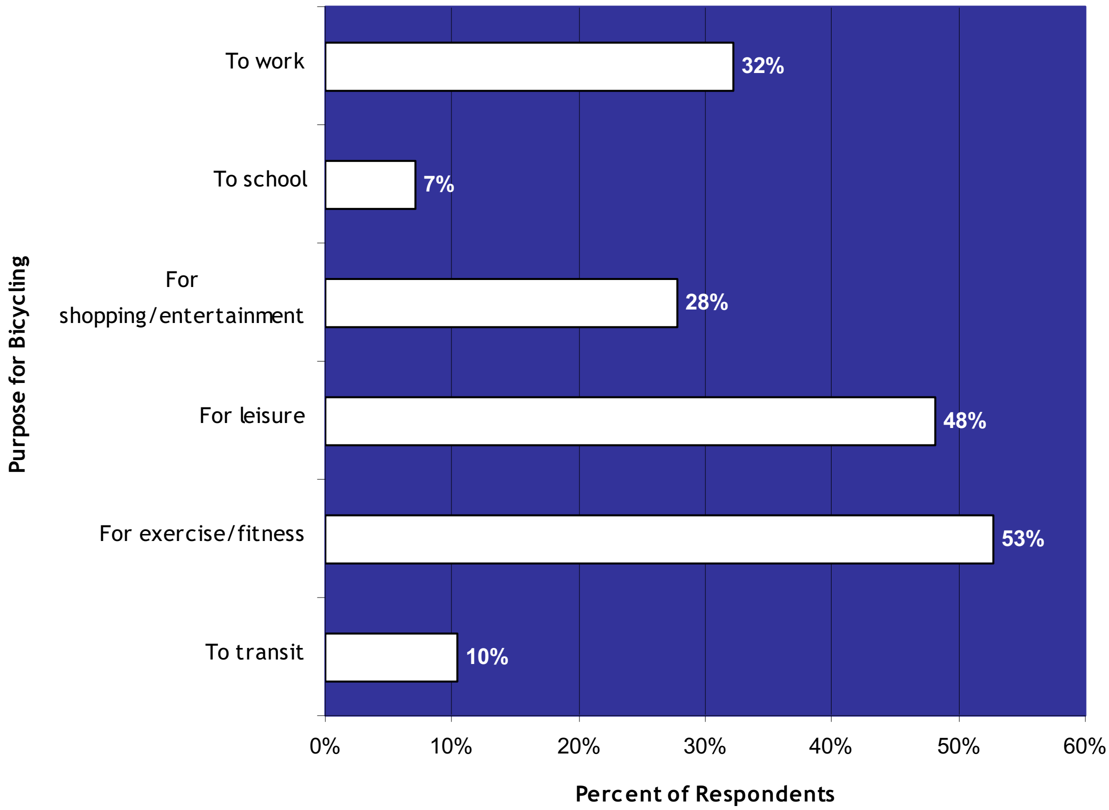
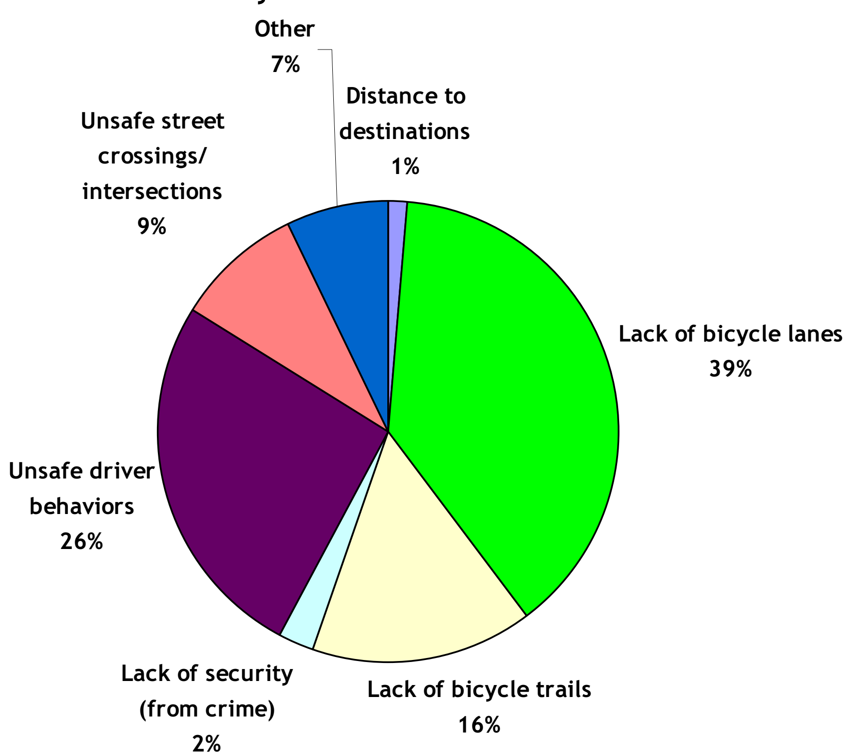


Figure 8: Most Critical Issues for Bicyclists in Alexandria



The maps on the pages that follow include some of the most critical information on existing conditions for pedestrians and bicyclists in Alexandria. They document conditions walking along roads and crossing roads in the City and the relative comfort of riding a bicycle on different roads. For these reasons, the data in these maps were used to prioritize recommendations in this Plan, as detailed in Chapter 6. The following maps are included in the pages that follow:

<u>Potential Pedestrian and Bicycle Activity</u>

Potential pedestrian and bicycle activity is an important aspect of existing conditions because it shows where non-motorized facility improvements have the potential to serve the greatest number of users. General estimates of potential pedestrian and bicycle activity were derived using a point system, as shown in Figures 9 and 10. The point system for estimating pedestrian and bicycle activity at each location is presented in the two sections below. A more detailed explanation is included in Appendix I.

Existing shared lane marking on Union Street
Photo Credit: City of Alexandria

Proximity to Trip Attractors

The presence of trip attractors was used as an indicator of potential pedestrian and bicycle activity. A pedestrian and bicycle potential score was developed based on proximity to locations in Alexandria that are likely to generate pedestrian and bicycle trips. A weighted score for each type of trip attractor was created under the assumption that certain facilities (such as Metrorail stops) would generate more pedestrian and bicycle activity than others (such as a park access point). The following trip attractors were accounted for in the prioritization model:

- Metrorail stations
- Bus stops
- Proposed BRT routes
- Schools
- Major park access points
- Recreation centers
- Commercial areas
- Existing and proposed multi-use trails
- Existing and proposed bicycle routes and facilities

A detailed discussion of trip attractors is included in Appendix I.
Population and Employment Density and Automobile Ownership

Population and employment forecasts for 2025 from the Metropolitan Washington Council of Governments (MWCOG) and household automobile ownership from the 2000 US Census were also used as an indicator of potential pedestrian and bicycle activity. Recommended project locations with greater future population and employment density were assigned more points. US Census block groups with lower automobile ownership were given more points. Population, employment, and automobile ownership data were divided into five categories, and points assigned for each category. A detailed discussion of these factors is included in Appendix I.

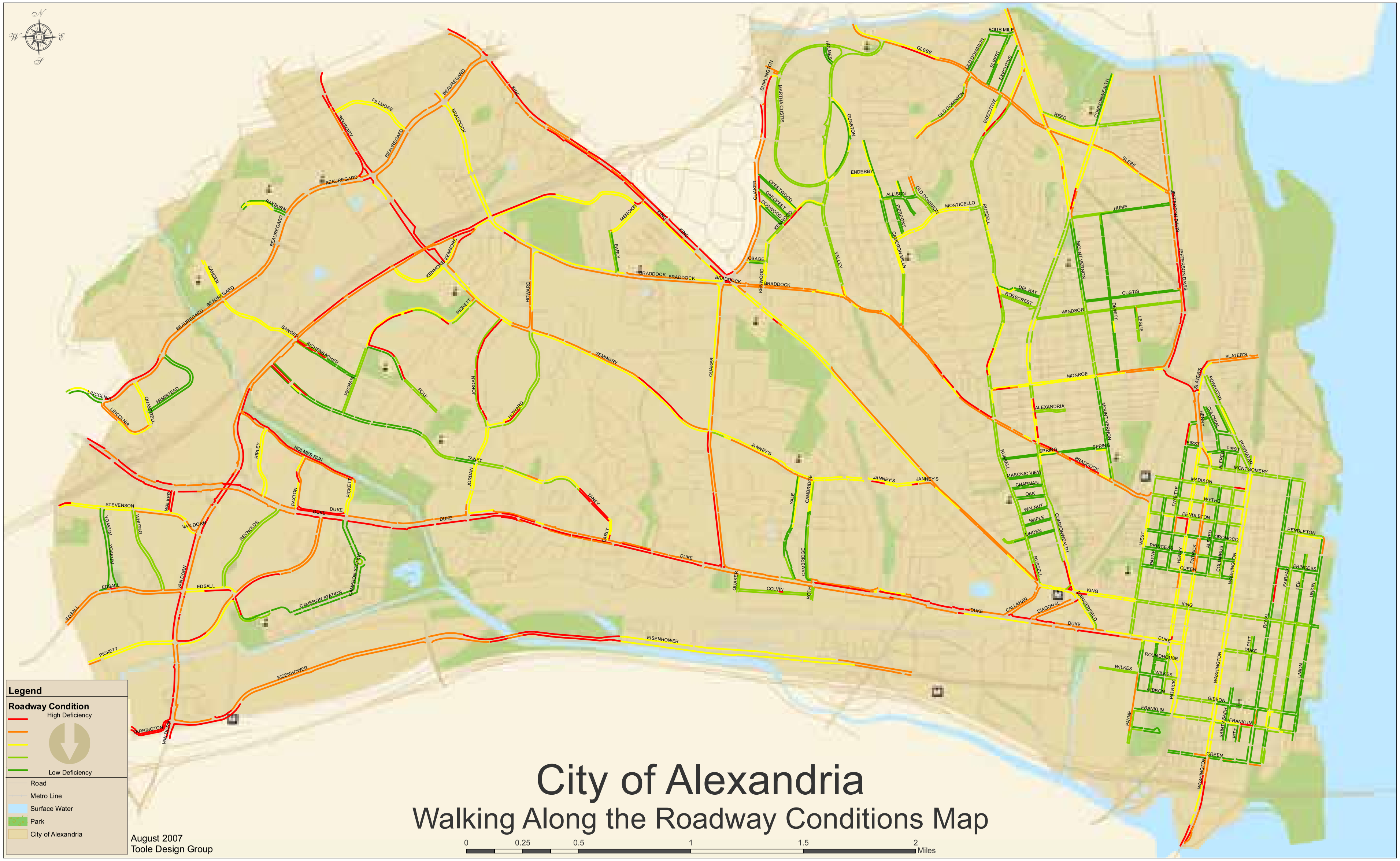
<u>Walking Along the Roadway</u>

Children crossing the street on Walk to School Day
Photo Credit: City of Alexandria

A pedestrian's experience walking along roads in Alexandria is a critical element of the existing pedestrian and bicycle environment. A point system was used to approximate pedestrian comfort walking along the roadway. The Walking Along the Roadway score that was developed accounts for the following factors: Presence, width and condition of sidewalk; Traffic volume and speed; High speed corridors; Presence of a buffer between the road and sidewalk; Presence of on-street parking. A more detailed explanation of the Walking Along the Roadway score is provided in the appendix. Figure 11 shows the Walking Along the Roadway scores for roads in Alexandria.

Figure 9: Potential Pedestrian Activity Map


City of Alexandria
Potential Bicycle Activity
Legend
Potential Bicycle Activity
High Potential
Low Potential
Surface Water
Road
Park
City of Alexandria
Draft
June 2007
Toole Design Group
0
0.25
0.5
1
1.5
2
Miles


City of Alexandria
Walking Along the Roadway Conditions Map
Legend
Roadway Condition
High Deficiency
Low Deficiency
Road
Metro Line
Surface Water
Park
City of Alexandria
August 2007
Toole Design Group
0
0.25
0.5
1
1.5
2
Miles

Crossing the Roadway

A pedestrian's experience crossing roads in Alexandria is also a critical element of the existing pedestrian environment. A point system was used to approximate the difficulty of street crossings for both pedestrians and bicyclists. The score is meant to reflect a person's experience crossing roads on foot in Alexandria. The score incorporates the following variables, and weighs each by its relative importance: Condition of crosswalk; Presence of crosswalk; Number of travel lanes crossed; Average Daily Traffic; Speed; High speed corridors; Presence of a median; Signal type; Presence of a signal. Figure 12 shows the Crossing the Roadway Conditions on roads in Alexandria.

Reported Crashes

Locations were there are a high number of pedestrian and bicycle crashes are also an important element of existing conditions for bicyclists and those on foot. Figures 13 and 14 show areas in the City that have a high number of pedestrian and bicycle crashes. These are referred to as crash "hot spots." GIS crash density analysis was used to identify these areas with higher concentrations of police-reported pedestrian and bicycle crashes. It is important to note that police-reported collisions provide an indication of safety problems, but most pedestrian and bicycle crashes are not reported to police[1]. Similarly, the presence of crashes does not necessarily reflect an engineering shortcoming.

Bicycle Level of Service Model (Bicycle LOS Model)

The *Bicycle Level of Service Model (Bicycle LOS Model)* provides another key indicator of existing conditions for bicyclists in Alexandria. The Bicycle LOS model is an evaluation of bicyclist perceived safety and comfort with respect to motor vehicle traffic while traveling in a roadway corridor. It identifies the quality of service for bicyclists that currently exists within the roadway environment. It is a framework that transportation professionals use to describe existing conditions (or suitability) for a mode of travel in a transportation system. The *Bicycle Level of Service Model* is based on the proven research documented in *Transportation Research Record 1578* published by the Transportation Research Board of the National Academy of Sciences. The Bicycle LOS score resulting from the final equation is pre-stratified into service categories "A", "B", "C", "D", "E", and F" ("A" is best, and "F" is worst). Figure 15 shows the Bicycle Level Service grades for roads in Alexandria.

The following chapter presents recommendations for infrastructure improvements throughout Alexandria to make walking and bicycling more comfortable and convenient. These recommendations represent a blueprint for implementing the pedestrian and bicycle policies and objectives outlined in the Transportation Master Plan.

[1] Stutts, J.C. and W.W. Hunter. "Police-reporting of Pedestrians and Bicyclists Treated in Hospital Emergency Rooms," Transportation Research Record No 1635, Transportation Research Board, 1998. P. 88-92. This study of a sample of cases collected at eight hospital emergency rooms in three states, showed that only 56 percent of the pedestrians and 48 percent of the bicyclists were successfully linked to cases reported on their respective state motor vehicle crash files. This study looked at only the most serious crashes (involving emergency room treatment). We can assume that less-severe crashes were accurately reported at an even lower rate.

Figure 12: Roadway Crossing Conditions Map

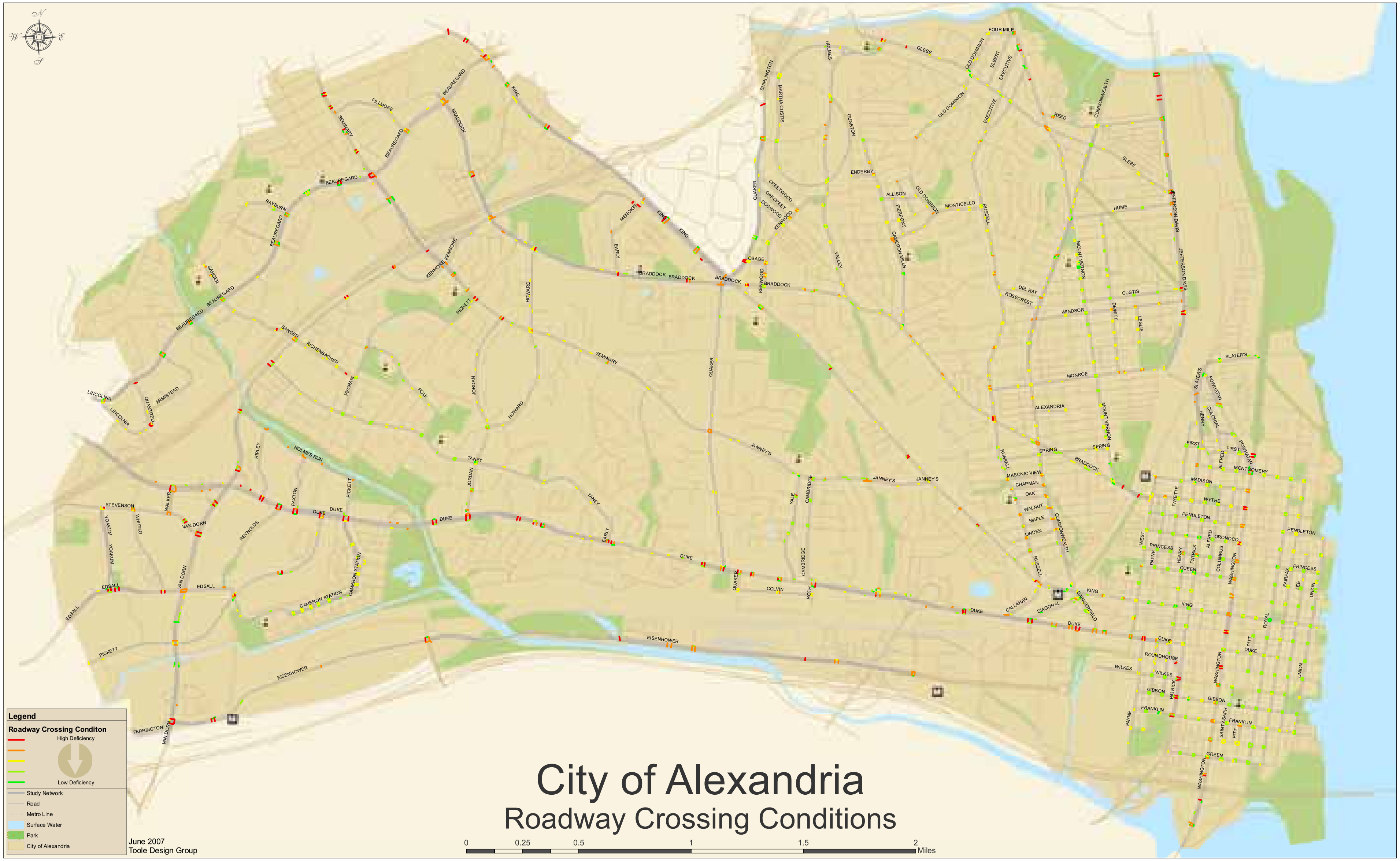


Figure 13: Pedestrian Crash Density Map

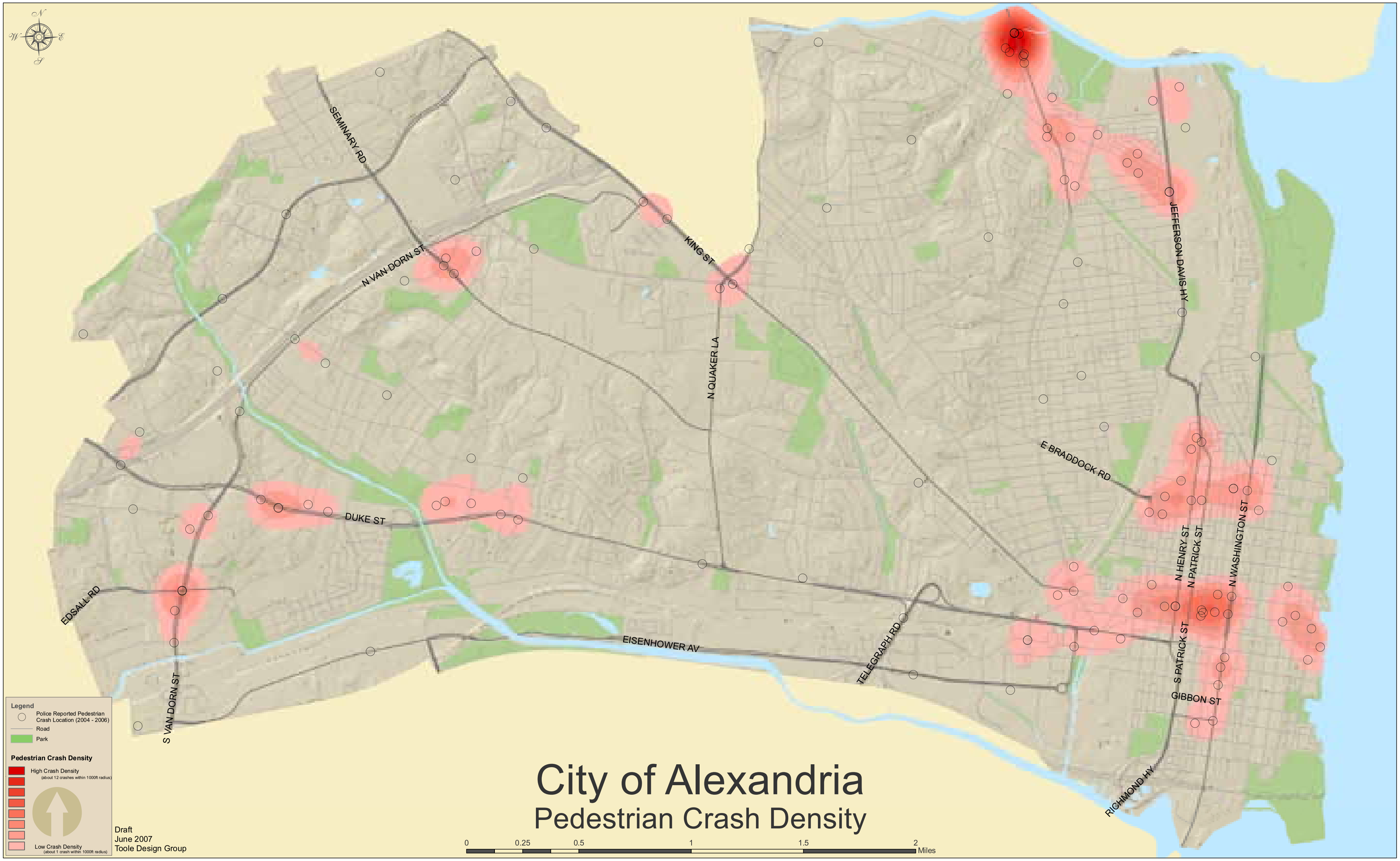


Figure 14: Bicycle Crash Density Map

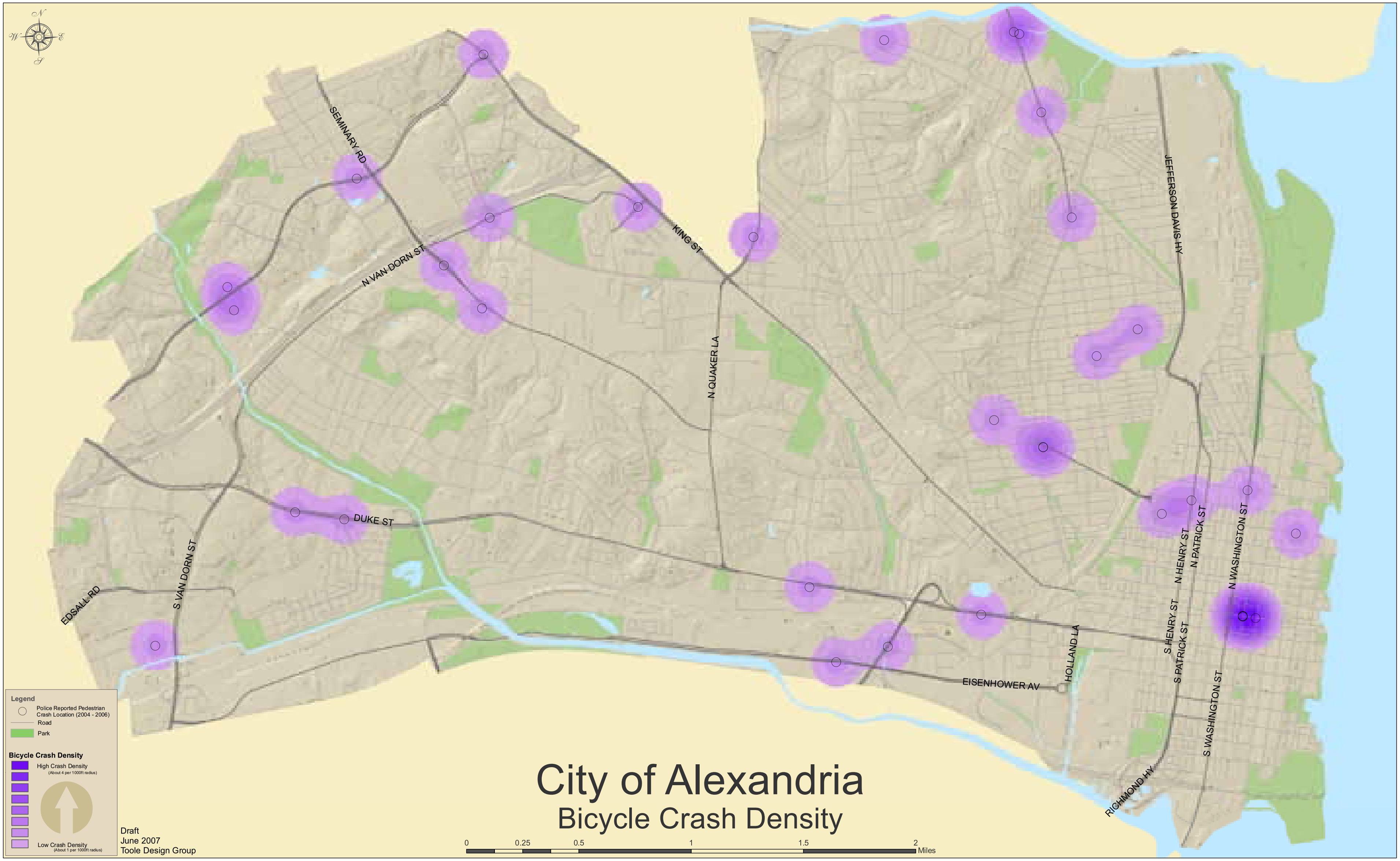
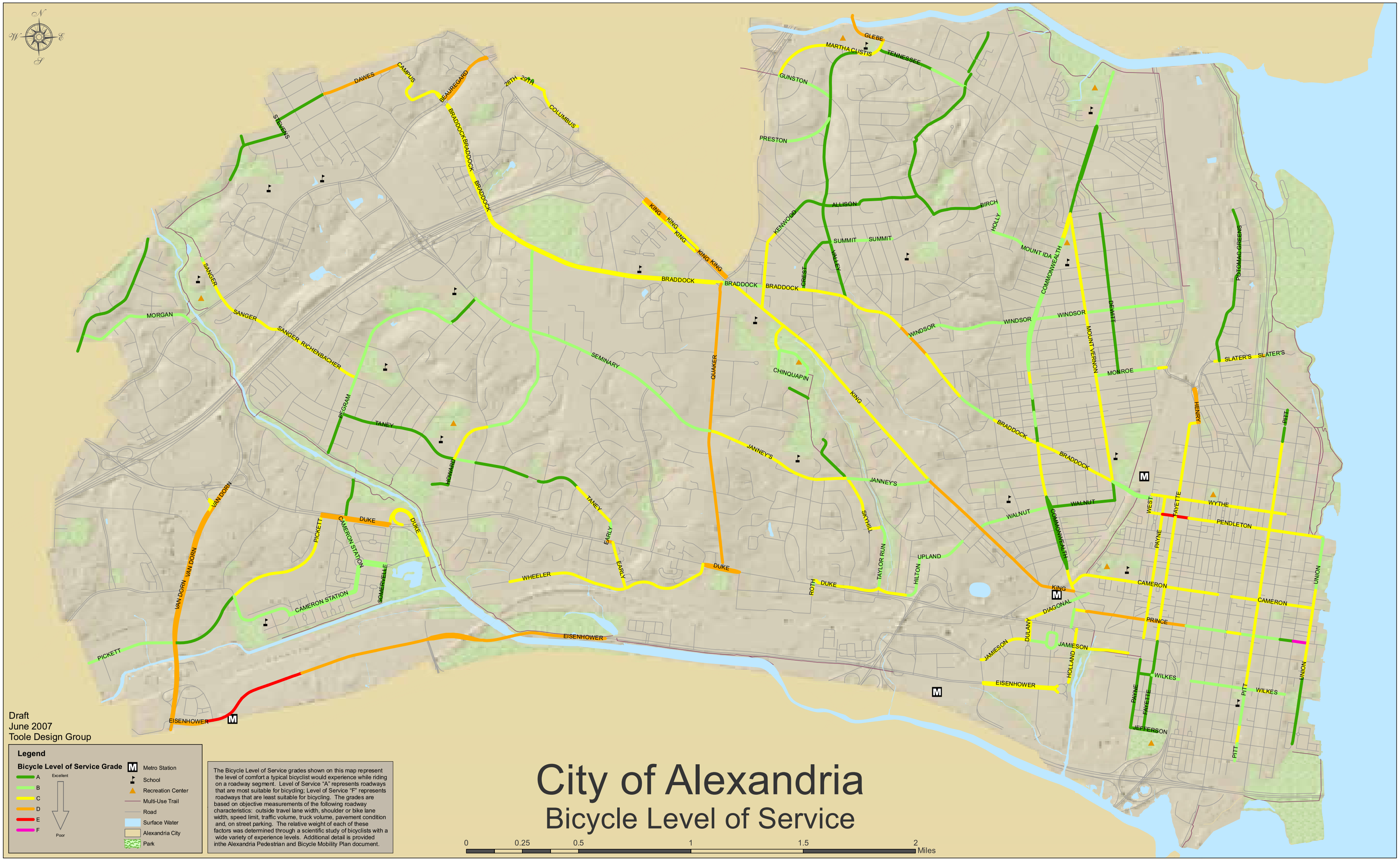


Figure 15: Bicycle Level of Service Map



CHAPTER 4: RECOMMENDATIONS

This chapter includes recommendations for infrastructure improvements that will make walking and bicycling in Alexandria more convenient and accessible. The recommendations in this section are aimed at creating an interconnected network of greenways, sidewalks, bikeways, and safe roadway crossings that encourages people to walk and bike for recreation and transportation. As previously noted, these recommendations are fully supported by the City of Alexandria's Comprehensive Transportation Master Plan.

Recommendations were generated through public input, field data collection, and data analysis. Note that these recommendations are only for the areas that the project team studied. Specific facility types that are recommended are outlined in Figure 16. Descriptions of these facility types are included in Appendix G. The recommendations presented in this chapter are grouped into the following existing City programs and initiatives: Safe Routes to School, Access to Transit, Community Pathways, On-Road Bikeways, and Off-Road Bikeways.

Figure 16: Facility Types

Facility Recommendations

Pedestrian Facilities
- Sidewalks
- Marked crosswalks
- Curb ramps
- Median crossing islands
- Curb extensions
- Raised crosswalks
- Pedestrian crosswalk signals

Bicycle Facilities
- Bicycle lanes
- Climbing lanes
- Shared lane markings
- Shared-use paths
- Sidepaths
- Bicycle boulevards
- Shared roadways
- Bridge facilities
- Bicycle turning pockets
- Bicycle boxes

Transit Access Facilities
- Concrete pads
- Benches
- Shelters

Pedestrian and Bicycle Facilities
- Shared-use paths (multi-use trails)
- Overpasses and underpasses
- Signalization improvements
- Warning signs

Plan Outcomes

This Plan includes comprehensive, citywide recommendations for pedestrian and bicycle facilities in Alexandria including:

Pedestrian Facilities
- 17.5 miles of new sidewalks
- 11.8 miles of reconstructed sidewalks
- Removal of 274 sidewalk clear width obstructions
- 645 new marked crosswalks
- 672 re-striped crosswalks
- 3 new median islands
- 251 existing signalized crossings with new pedestrian countdown signals
- 243 new accessible pedestrian pushbuttons
- 418 new accessible curb ramps
- 464 reconstructed curb ramps
- 579 reconstructed sidewalks at driveway crossings
- 148 bus stop improvements, including adding 117 benches and 31 shelters and benches
- Adding a full traffic signal or pedestrian activated signal at 2 mid-block intersections
- 13 new pedestrian and bicycle overpasses/underpasses

- 2 reconstructed pedestrian and bicycle overpass/underpasses

Shared-Use Path Facilities

- 10.1 miles of new shared-use paths
- 3.54 miles of reconstructed shared-use paths
- Removal of 68 shared-use path surface obstructions and 10 clear width obstructions

On-Road Bicycle Facilities

- 16.3 roadway centerline miles of new bicycle lanes
- 3.7 roadway centerline miles of new climbing lanes
- 16.4 roadway centerline miles of new shared lane markings
- 2.5 roadway centerline miles of bicycle boulevards (plus 3.9 miles of long-term bicycle boulevards)
- 7.3 roadway centerline miles of wide outside lanes
- 9.06 roadway centerline miles of shared roadway
- 12.31 miles of side paths
- .92 miles of pedestrian/bicycle priority streets

As detailed above, this Plan provides recommendations for infrastructure improvements throughout Alexandria. Some of the recommendations are made at a specific location or "point" in the City. Other recommendations were made along an entire stretch (referred to as a "line" recommendation) of road. The point and line recommendations in included in this Plan are outlined below.

Total Point Recommendations

- 2,137 obstructions
- 23 bicycle intersection improvements
- 597 driveway recommendations
- 255 bus stop recommendations
- 882 curb ramp improvements
- 1,320 crosswalk recommendations (counting each leg, or segment, separately)
- 632 signal recommendations (counting each leg, or segment, separately)

Total Point Recommendations: 5,846 (including all point recommendations)

Total Line Recommendations

- 79.2 miles of sidewalk recommendations (including long-term buffer recommendations)
- 61.8 miles of on-road bicycle recommendations
- 38.05 miles of off-road recommendations

Total Line Recommendations: 179.05 miles

Evaluation of Recommendations

The pedestrian and bicycle facility recommendations in this Plan are the result of a planning-level analysis. Each of these recommended improvements will require a more detailed project-level review. Additional traffic and transit analysis will be needed in some cases to determine the optimum design for specific locations. Like other public projects, neighborhood involvement will also be an important part of the evaluation and implementation process. Some locations shown on maps may be determined, after more detailed analysis, to require different or more costly improvements and therefore may become longer-term projects. However, for every project, the first assumption will be that the facilities, as shown in this Plan, will be implemented.

Existing directional bicycle route sign in Alexandria
Photo Credit: City of Alexandria

Program Recommendations

The facility recommendations described above were divided into five existing City of Alexandria programs to facilitate implementation. These programs include Safe Routes to School, Access to Transit, Community Pathways, On-Street Bikeways, and Off-Street Bikeways. The groupings were made based on the geographic criteria outlined below.

- *Safe Routes to School:* Recommendations within ¼ mile of a school
- *Access to Transit*: Recommendations with 1/16 mile of a bus stop, 1/8 mile of a future Bus Rapid Transit (BRT) stop, or ½ mile of Metrorail stop
- *Community Pathways:* Recommendations that will strengthen Alexandria's non-motorized transportation infrastructure, which were not included in the categories above
- *On-Street Bikeways:* Recommendations within the road
- *Off-Street Bikeways*: Recommendations outside of the road travelway

Recommendations were grouped by program to provide guidance on how individual improvements could potentially be implemented over time. It is important to note that in many cases, a single recommendation could potentially qualify for a number of different programs. For example, one intersection could be close to a school (and so could be included in the Safe Routes to School program) and also near a transit facility (and so could be included in the Access to Transit program).

Bus stop at the King Street Metrorail Station
Photo Credit: Toole Design Group

Decisions on how to fund specific improvements must be made on an individual basis. The information presented below is meant to inform this process. The estimated cost of implementing recommendations within each of the five programs is included in Table 1. Maps of these program area recommendations are included after each program area description.

Table 1: Estimated Pedestrian and Bicycle Mobility Plan Costs

Program	**Total**
Safe Routes to School	$4,324,820
Access to Transit	$12,333,352
Community Pathways	$1,306,848
On-Road Bicycle Facilities	$2,489,330
Off-Road Trails (not including bridges and tunnels)	$15,645,337
Total (All Programs)	**$36,099,688**

The programs included in Table 1 are described briefly in the pages that follow. A summarized list of the specific infrastructure improvements included within each of these program areas and an accompanying map is also provided in the pages that follow. Note that the program area maps show a generalized picture of the recommendations. For details on the specific recommendations, consult the maps in the appendix and the GIS data.

Safe Routes to Schools Program

The City's Safe Routes to Schools program takes a comprehensive approach to improving pedestrian and bicycle safety and encouraging more students to walk and bicycle to school. This plan focuses on specific pedestrian facility improvements within ¼-mile of all schools in the City. It is important to note that federal Safe Routes to School program eligibility criteria covers projects within a 2-mile radius of schools. Because this geography would cover nearly the entire City, a smaller area was chosen.

Walk to School Day event at Barrett Elementary School
Photo Credit: City of Alexandria

The physical infrastructure improvements detailed in Table 2 will complement education, enforcement, and encouragement efforts being done through partnerships between the City, school system, and other organizations. A map showing the type and location of these physical improvements is included on the following page.

Table 2: Safe Routes to Schools Recommendations

Recommendation Type	Number or Total Length of Recommendations
Bus Stop Improvement	0
Median Improvement	0
Stripe Crosswalk	144
Restripe Crosswalk	230
Curb Ramp Improvement	191
Driveway Improvement	192
Address Obstruction	723
Construct Sidewalk	3.94
Reconstruct Sidewalk	3.48
Improve Landscaping	0.09
Signal Improvement	159

Figure 17: Safe Routes to School Map

Access to Transit Program

It is critical for the City to provide safe and convenient facilities for customers to walk and bicycle to transit stops and stations. Therefore, the success of existing rail and bus systems, as well as future dedicated transit corridors as outlined in the Transportation Master Plan, in Alexandria depends on the non-motorized facility improvements recommended in this Plan.

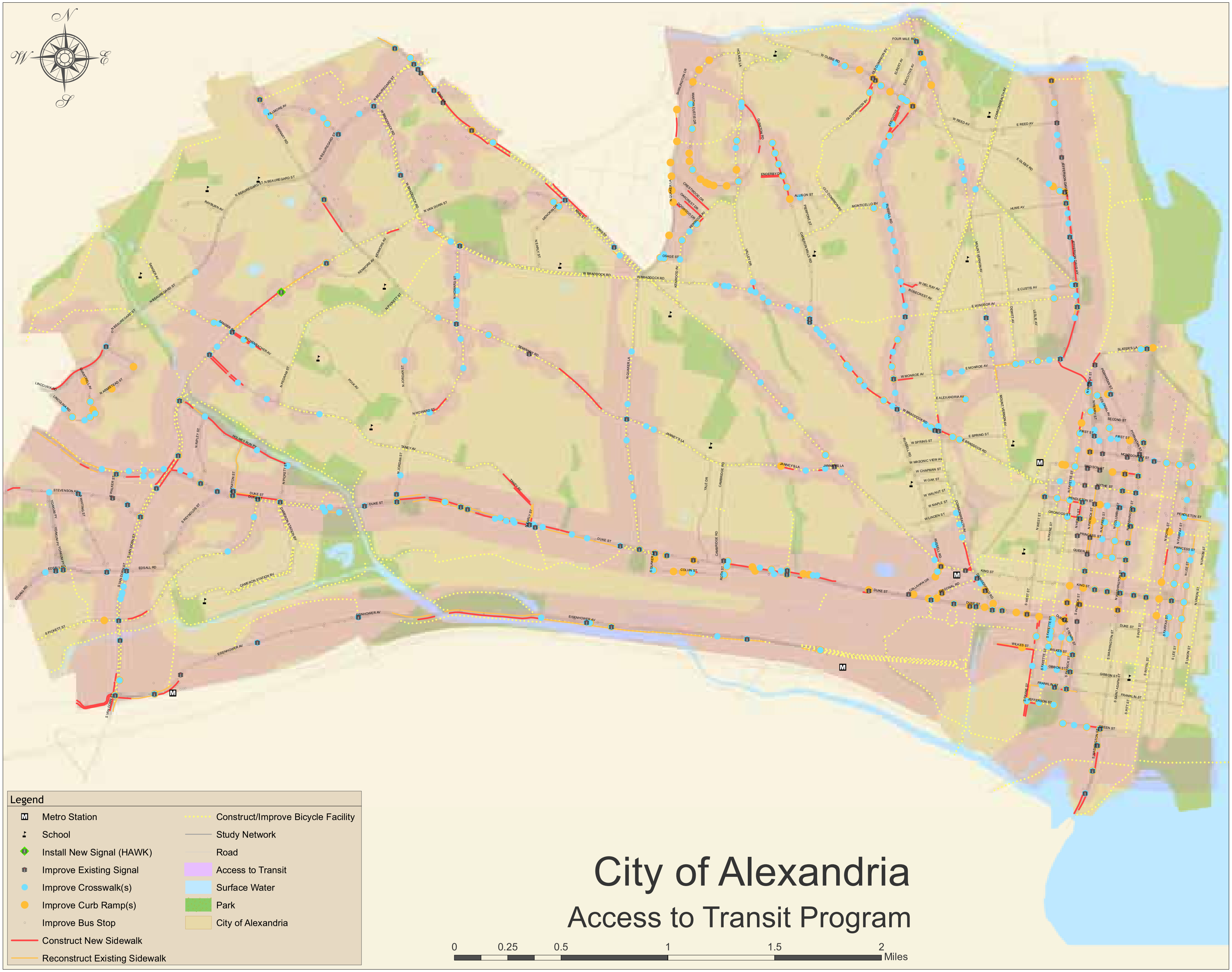
Access to Transit improvements include pedestrian facilities within 1/16-mile (330 feet) of all conventional bus stops, 1/8-mile (660 feet) of all future bus rapid transit routes, and ½-mile of all Metrorail Stations. Improvements to benches and shelters at bus stops are also included in this program. DASH and Metro bus boarding data were used to select high-use bus stops for these specific improvements. A map showing the type and location of the physical improvements outlined in Table 3 is included on the following page.

Existing bus stop in Alexandria
Photo Credit: Toole Design Group

Table 3: Access to Transit Recommendations

Recommendation Type	Number or Total Length of Recommendations
Bus Stop Improvement	255
Median Improvement	3
Stripe Crosswalk	372
Restripe Crosswalk	401
Curb Ramp Improvement	565
Driveway Improvement	292
Address Obstruction	1064
Construct Sidewalk	11.82
Reconstruct Sidewalk	7.9
Improve Landscaping	0.62
New Signal HAWK or Full	2
Signal Improvement	463

Figure 18: Access to Transit Map



Community Pathways Program

The Alexandria City Council passed a resolution creating the Community Pathways program in 2006 to focus on people, neighborhoods, parks, schools, recreation areas and trails. The program encompasses policy changes and initiatives that will strengthen Alexandria's non-motorized transportation infrastructure. Improving pedestrian safety is a major component of the Community Pathways program.

Existing multi-use path near Pendleton Street. Photo Credit: Toole Design Group

The recommendations for Community Pathways improvements in this Plan are for pedestrian facilities in neighborhood commercial centers and residential neighborhoods. They include non-motorized transportation improvements that were not already included in another program, but that are critical to the cohesion of Alexandria's neighborhoods. Note that all pathways in the City were not surveyed as part of this Plan and that many of the recommendations included in the other programs in this chapter (e.g. Safe Routes to School, Access to Transit, etc.) could also be implemented through the Community Pathways program.

A map showing the type and location of the physical improvements outlined in Table 4 is included on the following page.

Table 4: Community Pathways Recommendations

Recommendation Type	Number or Total Length of Recommendations
Bus Stop Improvement	0
Median Improvement	0
Stripe Crosswalk	129
Restripe Crosswalk	41
Curb Ramp Improvement	126
Driveway Improvement	95
Address Obstruction	350
Construct Sidewalk	1.8
Reconstruct Sidewalk	0.57
Improve Landscaping	0.04
Signal Improvement	8

Figure 19: Community Pathways Map

On-Street Bikeways Program

Existing bicycle lanes on Old Dominion Boulevard. Photo Credit: City of Alexandria

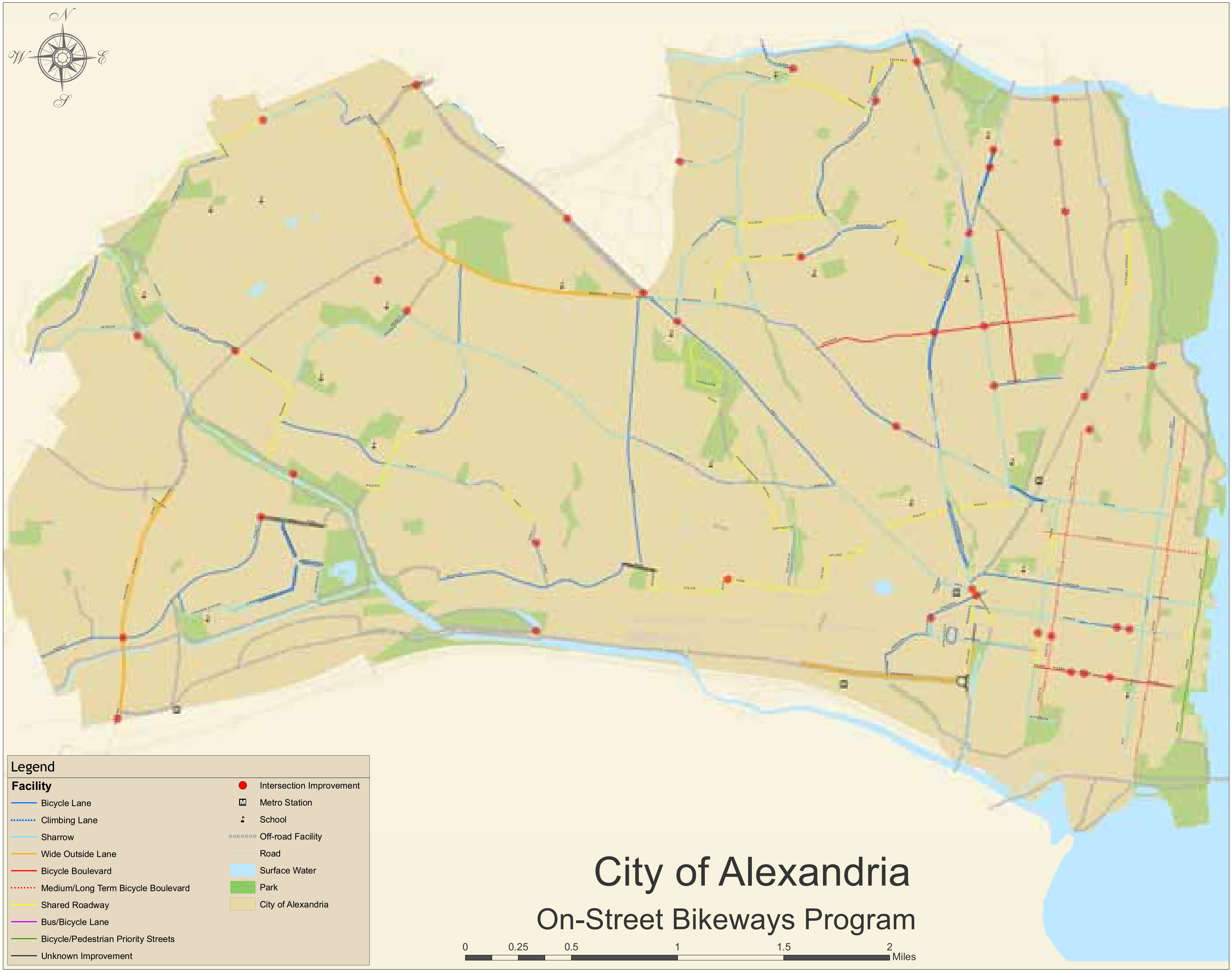
The On-Street Bikeways component of this Plan includes recommendations for more than 60 miles of new on-road bicycle facilities. New bicycle lanes, climbing lanes, shared lane markings, and other on-road facilities are essential for creating a continuous bikeway network that provides access to all destinations in the City. Because Alexandria is a built, urban environment, it is not possible to connect all activity centers with separated bicycle and pedestrian trails. On-road bicycle facilities are recommended to complete connections between trails and make connections to schools, parks, employment centers, transit hubs, and other destinations.

Roadway crossings are critical to the connectivity of the bicycle network. Recommended crossing improvements include new traffic signals, curb extensions, median crossing islands, bicycle turn pockets, and bicycle boxes. The facility types that are recommended for roadway segments and intersections are based on a variety of factors, including existing right-of-way, surrounding land uses, number of travel lanes, travel lane width, traffic volume and speed, traffic composition, presence of on-street parking, and pedestrian activity. Note that this Plan does not recommend the removal of any on-street parking. In many cases, on-road bicycle facilities can be created by narrowing or removing travel lanes in corridors with extra motor vehicle capacity. Often, these facilities can be added for a minimal cost as a part of a roadway repaving or reconstruction project. The on-street bicycle improvements outlined in Table 5 will help Alexandria achieve and surpass the goals of its Spin City 2009 initiative. A map showing the type and location of these physical improvements is included on the following page.

Table 5: On-Street Bikeway Recommendations

Recommendation Type	Total Length
Bicycle Lanes	14.895
Bike Boulevard	2.51
Bike Ped Priority Street	0.92
Climbing Lane	3.77
Sharrow	16.11
Shared Roadway	9.06
Long Term Bicycle Boulevard	3.9
Wide Outside Lanes	4.44
Unknown Improvement	0.795
Bicycle Intersection Improvement	31

Figure 20: On-Street Bikeways Map



Off-Street Trails Program

Off-street trails, or shared-use paths, are located in their own corridors, separated from motor vehicle traffic. These facilities provide a high-quality experience for pedestrians and bicyclists.

While this Plan recommends several new sections of off-street trails and several new pedestrian and bicycle bridge connections, most of the Off-Street Trails Program improvements include widening existing trails, removing clear width obstructions (e.g., potholes, root damage, overgrown trees and bushes, etc.), and repaving trail surfaces. The Off-Street Trails Program also includes sidepaths, which are wide sidewalks that are intended for shared pedestrian and bicycle use. A map showing the type and location of the physical improvements outlined in Table 6 is included on the following page.

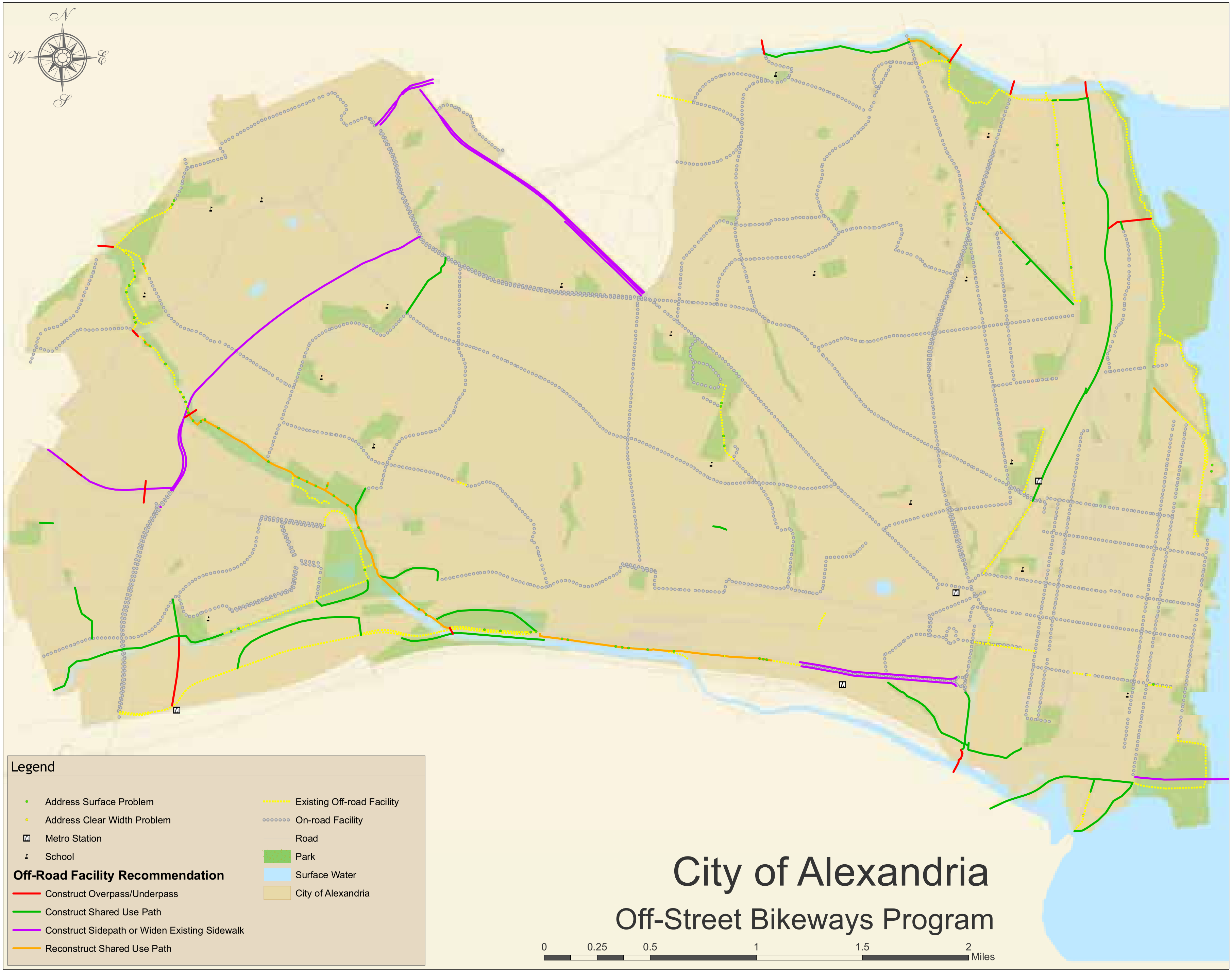
Multi-use trail stream crossing at Dora Kelley Park
Photo Credit: City of Alexandria

Table 6: Off-Street Trails Recommendations

Recommendation Type	Total Length
Construct Shared Use Path	10.11
Construct Sidepath or Widen Existing Sidewalk	8.105
Construct Overpass/Underpass	1.34
Reconstruct Shared Use Path	3.54
Reconstruct Overpass/Underpass	0.09

This chapter outlined the types and numbers of facility recommendations that have been made as a part of this planning process. It then divided these recommendations into groups based on five specific existing City of Alexandria programs. This was meant to provide guidance on how individual improvements could potentially be implemented over time. The following chapter takes the same comprehensive list of infrastructure recommendations and prioritizes them based on their relative importance. It then introduces a recommended timeline for implementation based on the prioritization methodology.

Figure 21: Off-Street Bikeways Map



CHAPTER 5: IMPLEMENTATION

This Plan provides a comprehensive list of pedestrian and bicycle infrastructure improvement recommendations throughout the City. This chapter introduces a strategy for prioritizing these improvements. By grouping the recommendations into short, medium, and long-term categories, this Plan enables the City to make informed and strategic decisions about how to effectively allocate resources over time. The prioritization of recommendations accounts for a range of factors, including existing conditions, potential demand, safety, and public input.

Bicyclists walking bikes along the sidewalk in Alexandria
Photo Credit: Richard Nowitz/ACVA

Pedestrian and Bicycle Program Funding

In the previous chapter, pedestrian and bicycle facility recommendations were classified into specific categories based on the City's existing pedestrian and bicycle programs. Other opportunities for implementing recommendations include upcoming improvement projects (e.g., roadway repaving, streetscape improvements, corridor reconstruction, etc.), road maintenance programs, site review, and redevelopment projects. The Transportation Master Plan includes a summary of funding sources available for the implementation of pedestrian and bicycle programs and infrastructure.

As noted, this chapter divides recommendations into short-term, medium-term, and long-term categories. These categories are described in detail below. Generalized cost estimates were developed for each type of facility improvement (see Appendix A: Generalized Cost Estimates). The estimated costs of all the recommendations in each program and phasing category are included in the appendix (see Appendix B: Estimated Pedestrian and Bicycle Mobility Plan Costs).

Most facility recommendations will be implemented through the program categories identified in this Plan. However, the City should also take advantage of implementation opportunities as they become available. For example, if the City is undertaking a roadway improvement project as part of its normal maintenance program, it may be advantageous to make a recommended roadway crossing improvement during that effort even if the recommended improvement has been identified through the Safe Routes to School program in this Plan. In this case, the City would improve road crossing conditions sooner and save the additional costs of retrofitting in the future. Therefore, the costs shown in this Plan are an approximation of the total cost of implementation.

The prioritization of recommendations in this Plan accounts for a range of factors, including existing conditions, potential demand, safety, and public input. The process for prioritizing recommendations is described below.

The costs shown in this Plan are an approximation of the total cost of implementation.

Prioritization of Recommendations

As part of the study process for this Plan, information was collected on 110 road centerline miles, 147 miles of existing sidewalks, and 15 miles of multi-use trails. A Bicycle Level of Service (BLOS) rating was developed for 60 miles of Alexandria's roads and more than 1,500 existing crosswalks were analyzed. Through this data collection and analysis process, the following recommendations were developed for specific locations in Alexandria:

- 2,137 obstruction recommendations
- 23 bicycle intersection recommendations
- 597 driveway recommendations
- 255 bus stop recommendations
- 822 curb ramp recommendations
- 1,320 crosswalk recommendations
- 632 traffic signal recommendations

In addition to the above recommendations, many recommendations were developed along roads and sidewalks, including the following:

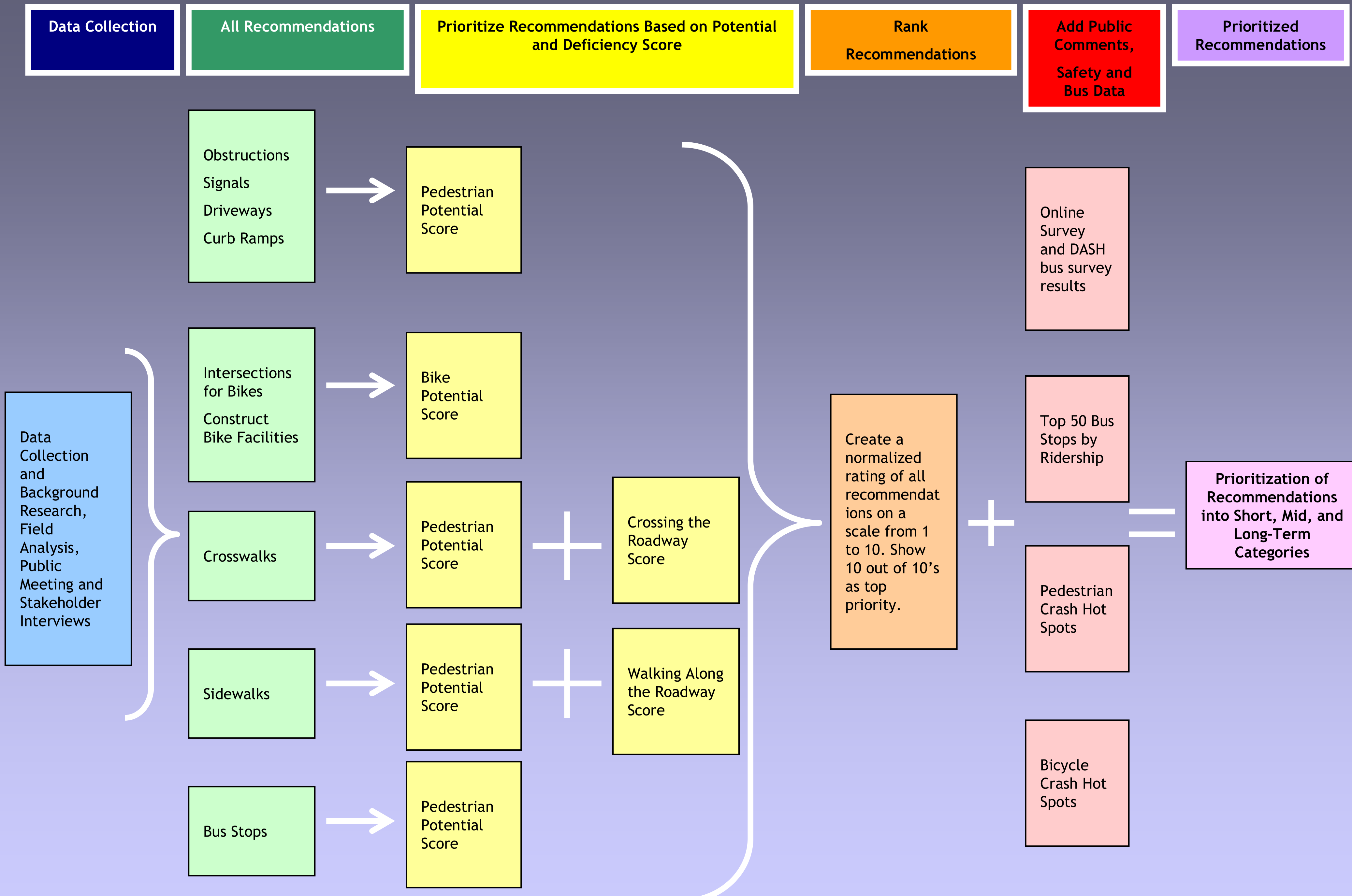
- 79 miles of sidewalk recommendations
- 62 miles of on-road bicycle recommendations
- 38 miles of off-road recommendations

A method was developed to prioritize these recommendations into short, medium and long-term categories. This prioritization strategy accounts for the potential demand for pedestrian and bicycle facilities, as well as other important variables, such as the location of pedestrian and bicycle crashes, bus ridership, and public input. Figure 22 on the following page shows graphically the methodology used for prioritizing recommendations. This methodology is described briefly on the following pages, and more extensively in Appendix I.

The first step in this process was to evaluate pedestrian and bicycle demand. This was accomplished by developing a pedestrian and bicycle potential score based on proximity to locations in Alexandria that are likely to generate pedestrian and bicycle trips. A weighted score for each type of trip attractor was created under the assumption that certain facilities (such as Metrorail stops) would generate more pedestrian and bicycle activity than others (such as a park access point). The following trip attractors were accounted for in the prioritization model:

- Metrorail stations
- Bus stops
- Proposed BRT routes
- Schools
- Major park access points
- Recreation centers

Figure 22: Prioritization Methodology



- Commercial areas
- Existing and proposed multi-use trails
- Existing and proposed bicycle routes and facilities

The model used the potential pedestrian and bicycle demand score to prioritize all recommendations, under the assumption that trip attractors are good indicators of places that people need to be able to access on foot and by bicycle, and that improvements in these areas should be prioritized over other areas. The pedestrian potential score was used to evaluate the following categories of pedestrian recommendations:

Bicyclist traveling the wrong way down the road
Photo Credit: Toole Design Group

- Obstructions
- Signals
- Driveways
- Curb ramps
- Crosswalks
  (in conjunction with the Crossing the Roadway score)
- Sidewalks (in conjunction with the Walking Along the Roadway score)
- Bus stops

The bicycle potential score was used to evaluate the following categories of bicycle recommendations:

- Intersections for bikes
- Construct bike facilities

A second level of analysis was utilized to evaluate and prioritize crosswalk and sidewalk recommendations. The "Crossing the Roadway" score described in Chapter 3 was developed to prioritize crosswalk recommendations as it is meant to reflect a person's experience crossing roads on foot in Alexandria. The score incorporates the following variables, and weighs each by its relative importance:

- Condition of crosswalk
- Presence of crosswalk
- Number of travel lanes crossed
- Average Daily Traffic
- Speed
- High speed corridors
- Presence of a median
- Signal type

- Presence of a signal

The “Crossing the Roadway” score was added to the “Pedestrian Potential” score to prioritize crosswalk recommendations. The relative importance of the two scores was assumed to be equal when they were added together.

Similarly, the “Walking Along the Roadway” score described in Chapter 3 was developed to prioritize sidewalk recommendations as it is meant to reflect the pedestrian experience walking along a road in Alexandria. The score incorporates the following variables:

- Presence, width and condition of sidewalk
- Traffic volume and speed
- High speed corridors
- Presence of a buffer between the road and sidewalk
- Presence of on-street parking

The “Walking Along the Roadway” score was added to the Pedestrian Potential score and their importance, relative to each other, was assumed to be equal.

The Pedestrian Potential, Bike Potential, Crossing the Roadway, and Walking Along the Roadway scores were used to prioritize all recommendations in this Plan. By attaching a numeric score to each recommendation, it was possible to evaluate the importance of each recommendation relative to each other. This was accomplished using the quantile method within GIS software to create ten categories with approximately the same number of recommendations in each. Recommendations with a score of one were considered to be the least important and recommendations with a score of ten are considered to be the most important.

As noted in Table 7 below, the score of each recommendation was used to assign it into the short, medium, or long-term category. Recommendations with a score of ten are considered to be short-term priorities, recommendations with a score of eight and nine are considered to be medium-term priorities, and recommendations with scores of one to seven are considered to be long-term priorities. The priority scores accounts for existing conditions, as well as potential demand for pedestrian and bicycle facility improvements.

Table 7: Priority Score and Phasing Categories

Priority Score	**Phasing Category**
10	Short-Term
8-9	Medium-Term
1-7	Long-Term

A final level of analysis was conducted to incorporate the following information into the priority scoring methodology.

Pedestrians walking along the sidewalk in Old Town. Photo Credit: Toole Design Group

- *Public input gathered through the online survey and the DASH bus survey*: Locations that were noted frequently by respondents to the online and DASH bus survey as needing pedestrian and/or bicycle improvements were incorporated into the prioritization strategy. If a particular location was noted three or more times, its prioritization score was automatically changed to a ten, automatically making it a short-term priority.

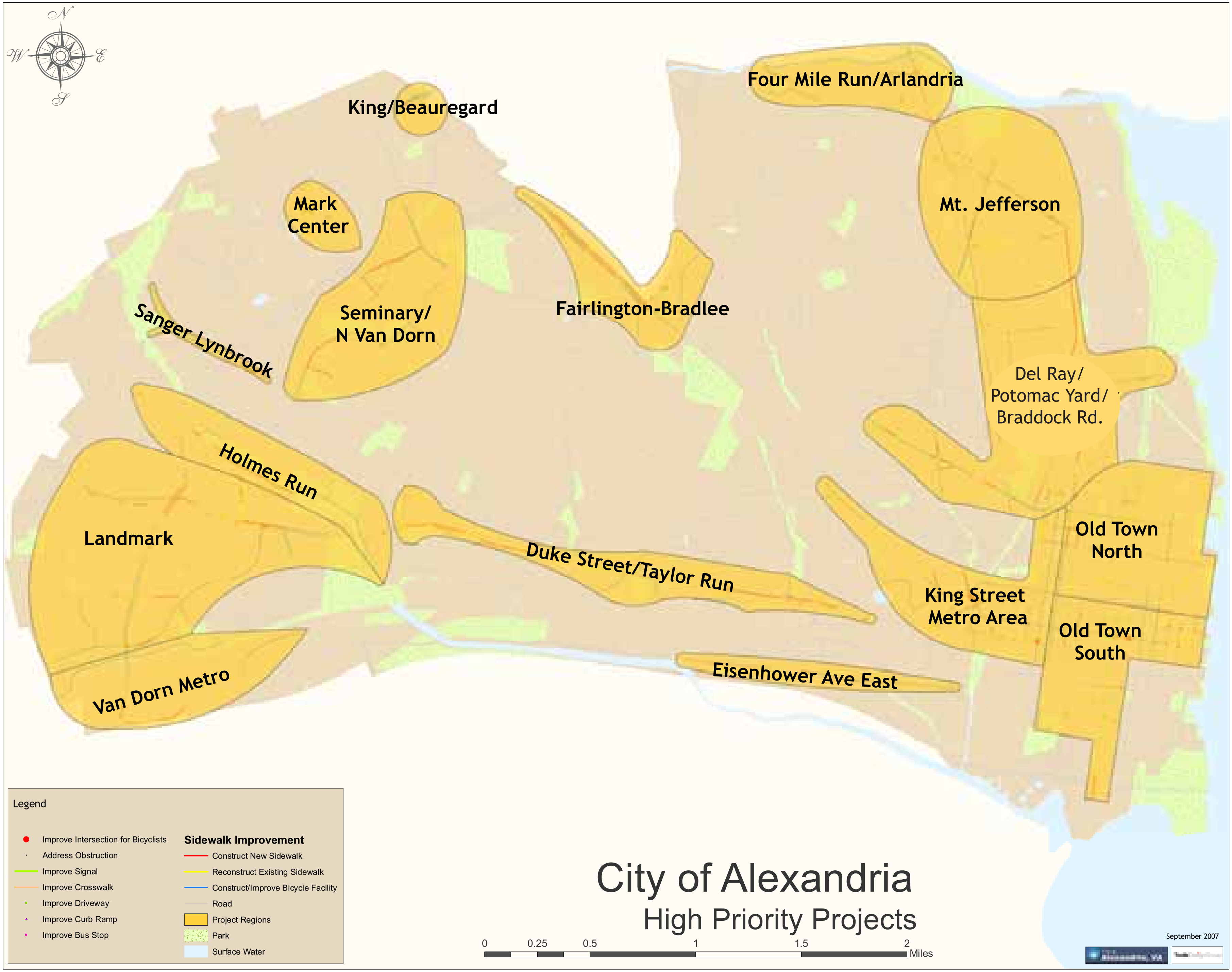
- *Pedestrian and bicycle crash hot spots:* Locations where there are a high number of pedestrian and bicycle crashes were considered to be a unique circumstance. The scores of recommendations within these crash "hot spot" areas were automatically changed to a ten, indicating that they should be considered short-term priorities.

- *Bus ridership:* Locations along bus routes in Alexandria that have high ridership were also considered to be particularly important. A list of the top fifty bus routes with the highest bus ridership was identified and recommendations in the vicinity of these routes were automatically changed to short-term priorities.

Using the methodology described above, all of the recommendations in this Plan were assigned a priority score and this score was used to determine whether the recommendation should be considered a short, medium, or long-term priority. The short-term projects in the Plan (those with a score of ten out of ten) are dispersed throughout the City. The areas where short-term priority projects congregate together provide a logical way to group recommendations. In many cases, clusters of projects can be accomplished under single contracts in order to ensure efficiency. Implementing clusters of projects is also particularly beneficial in enhancing overall connectivity in an area. Additionally, grouping short-term projects into clusters allows them to be easily included in the City's Capital Improvement Program (CIP) and Transportation Improvement Plan (TIP), which is an important pre-requisite to the funding of infrastructure improvement projects. Figure 23 on the following page shows short-term priority areas. The short-term priority areas are indicated below:

- Del Ray/Potomac Yard/Braddock Road
- Duke Street/Taylor Run
- Eisenhower Avenue East
- Fairlington/Bradlee
- Four Mile Run/Arlandia

Figure 23: Priority Areas Map



- Holmes Run
- King/Beauregard
- King Street Metro Area
- Landmark
- Mark Center
- Mt. Jefferson
- Old Town North
- Old Town South
- Sanger/Lynbrook
- Seminary N Van Dorn
- Van Dorn Metro

The estimated cost of implementing all short-term recommendations within these high priority areas is outlined in Table 8.

Table 8: Cost Estimates for Recommendations within the High Priority Project Areas

Project Area	**Total Cost**
Del Ray/Potomac Yard/Braddock Road	$ 1,323,464.39
Duke Street/Taylor Run	624894.28
Eisenhower Avenue East	864650.05
Farlington/Bradlee	$ 1,055,837.37
Four Mile Run/Arlandria	831692.63
Holmes Run	942739.6
King/Beauregard	$ 354,955.03
King Street Metro Area	645867.15
Landmark	1687875.23
Mark Center	110168.69
Mt. Jefferson	488976.43
Old Town North	897764.07
Old Town South	757774.29
Sanger/Lynbrook	64684.65
Seminary N Van Dorn	641238.45
Van Dorn Metro'	1033253.25
Total Cost	**$ 12,325,835.56**

A complete list of the short-term recommendations included in each of the high priority areas identified above is included in Appendix B. Also in the Appendix are cost estimates for completing these short-term recommendations. Table 9 outlines the total cost of implementing the short-term projects by program (e.g. Safe Routes to School, Access to Transit, etc.).

Table 9: Estimated Pedestrian and Bicycle Mobility Plan Costs

Program	Short-Term	Medium-Term	Long-Term	Total
Safe Routes to School	$1,680,074	$375,823	$2,268,923	$4,324,820
Access to Transit	$4,080,367	$1,944,613	$6,308,372	$12,333,352
Community Pathways	$120,597	$144,321	$1,041,930	$1,306,848
On-Road Bicycle Facilities	$820,599	$361,787	$1,306,944	$2,489,330
Off-Road Trails	$5,624,198	$5,372,642	$4,648,497	$15,645,337
Total (All Programs)	$12,325,836	$8,199,186	$15,574,666	$36,099,688

Performance Measures

The Transportation Master Plan includes lists of actions, strategies and performance measures to improve pedestrian and bicycle transportation in Alexandria. These will help the City benchmark its progress in implementing the Plan's recommendations. Key performance measures from the Transportation Master Plan are included in Figure 24 on the following page.

In order to track whether and to what extent it is meeting the performance measures in the Transportation Master Plan, the City should collect more data on pedestrian and bicycle activity. Pedestrian and bicycle counts can be used in annual reports, to demonstrate the positive effects of the pedestrian and bicycle program, and to justify further spending on pedestrian and bicycle transportation. The City should conduct pedestrian and bicycle counts on trails and streets, including both on and off-road facilities. It should conduct counts and behavioral observations before and after a pedestrian or bicycle facility is installed. Additionally, the City should conduct neighborhood travel diaries or surveys to learn more about the types of pedestrian and bicycle trips. New counting technology will enable the City to conduct these counts in a cost efficient and timely manner.

This Plan provides recommendations for thousands of infrastructure improvement projects throughout Alexandria. This chapter introduced a strategy for prioritizing these recommendations by grouping them into short, medium, and long-term categories. In doing so, this Plan enables the City to make informed and strategic decisions about how to effectively allocate resources over time. The following chapter provides a strategy for effectively utilizing the data developed as a part of this planning process.

Figure 24: City of Alexandria Pedestrian and Bicycle Performance Measures

Pedestrian

- The proportion of people walking to work in Alexandria shall increase from 3% to 5% by 2011.
- Working with the Alexandria City Public Schools, the City will establish a system for counting the number of children who walk to school, and the number shall increase 5% every year by 2011.
- The number and percentage of people who walk to access Alexandria's four Metrorail stops will increase (Of all survey respondents, 1,370 people (or 75%) walked to the Eisenhower Avenue station; 5,260 people (or 62%) walked to the King Street station; 2,700 people (or 61%) walked to the Braddock Road station; and 580 people (or 15%) walked to the Van Dorn Street station during the month of April 2005). Other modes of access include bus and connecting rail, drop-offs or drove and parked[1].
- The number of pedestrian-motor vehicle crashes (66 in 2004, 87 in 2005, and 36 through Oct. 1, 2006) will hold constant or decrease through 2011.
- The proposed sidewalk and shared-use path network will be 50% complete by 2011.
- Improved maintenance will result in a decrease in requests by 50% in 2011.
- Bi-annual special events in spring and fall will encourage active living and promotion walking as a means of transportation and recreation.
- More than 50% of elementary school children will receive pedestrian safety education by 2010.

Bicycle

- The proportion of people bicycling to work in Alexandria shall increase from 0.5% to 3% percent by 2011[1].
- Alexandria City Public Schools will begin counting the number of children bicycling to school, and this number shall increase 5% annually through 2011.
- The number of bicycle-motor vehicle crashes (13 in 2004, 17 in 2005 and 12 through Oct. 1, 2006) will hold constant or decrease through 2011.
- The proposed bikeway network will be 50% complete by 2011.
- The City will begin a log of maintenance requests related to its bikeways network, post the log online for public viewing, and seek to reduce its maintenance backlog by a number to be determined.
- The City will add at least 500 new bicycle parking racks by 2009. In all new development bicycle parking will be introduced at a rate of 1:10 (at least one bicycle parking space will exist for every 10 vehicular spaces).
- Bi-annual special events in spring and fall will encourage bicycle use.
- All city-sponsored special events and public recreational facilities will supply plentiful bicycle parking.
- More than 50% of elementary aged school children will receive bicycle safety education by 2010.

Baseline data for each of the pedestrian and bicycle performance measures should be established during 2008. The City will prepare an annual report to Council to summarize progress made on each of the performance measures.

(Source: City of Alexandria Comprehensive Transportation Master Plan)

CHAPTER 6: DATA UTILIZATION

One of the most important products of this planning effort is the extensive amount of data and thousands of detailed recommendations that have been generated. The large number of recommendations resulted from this Plan's objective of identifying physical improvements at specific locations throughout the City.

Existing bicycle parking in Alexandria
Photo Credit: Toole Design Group

The recommendations in this Plan should guide and inform the City's pedestrian and bicycle planning activities in the coming years. This can best occur if the City develops a focused and proactive strategy for using, managing and updating the data from this Plan in its original GIS format.

The program and priority maps in this document necessarily present a generalized, and therefore less detailed, version of the full set of recommendations. It is difficult to graphically display every single recommendation because the sheer quantity of information makes it difficult to discern distinct items on a citywide map. During implementation, it will be critical for the City to ensure that recommendations included in the GIS data guide its efforts. In order to do so, the City will need to develop procedural mechanisms for incorporating Plan recommendations from the GIS database into day-to-day activities so that this information can inform a range of initiatives across numerous City departments, from repaving roads to ongoing road maintenance.

GIS data should be made available to City staff in a format that allows them to search, query and export information. This could be helpful, for example, during the plan review process. The City's plan reviewer should consult the needs list in the GIS data to identify potential opportunities to implement recommendations from this

Plan. Additionally, GIS data could help to identify improvements recommended in this Plan that could be completed as a part of a routine repaving project. In order for this to work, the City will need to develop a sharable GIS platform available at every planner's work station. It will be critical for the City to develop a mechanism to ensure that the GIS information is updated regularly.

Until such a platform is available, the City should develop a series of hard-copy map books that City staff can reference as projects are considered and planned. The map books should provide all recommendations in this Plan across the entire City, at a scale that is legible. The map books should be organized into a series, with each set providing information on separate categories of recommendations. For example, one set of map books could provide information on all crosswalk and curb ramp recommendations. These map books should be kept in a location that is accessible by all City staff. A sample cover of such a map book is included as Figure 25 and a sample page is included as Figure 26.

The City should develop procedures for ensuring that City staff, including plan reviewers, public works staff and maintenance staff regularly reference the map books to inform their projects and programs. Completed projects should be noted on the hard copy maps and this information should be regularly entered back into GIS. If this is done regularly, the map books could provide a viable way to ensure that the GIS information developed as part of this planning process remains accurate over time.

By utilizing maps books in the short-term, while at the same time developing and instituting a long-term strategy for managing the GIS database developed as part of this planning process, the City can ensure that opportunities to implement the recommendations in this Plan are identified and incorporated in a timely manner.

Figure 25: Sample Map Book Cover

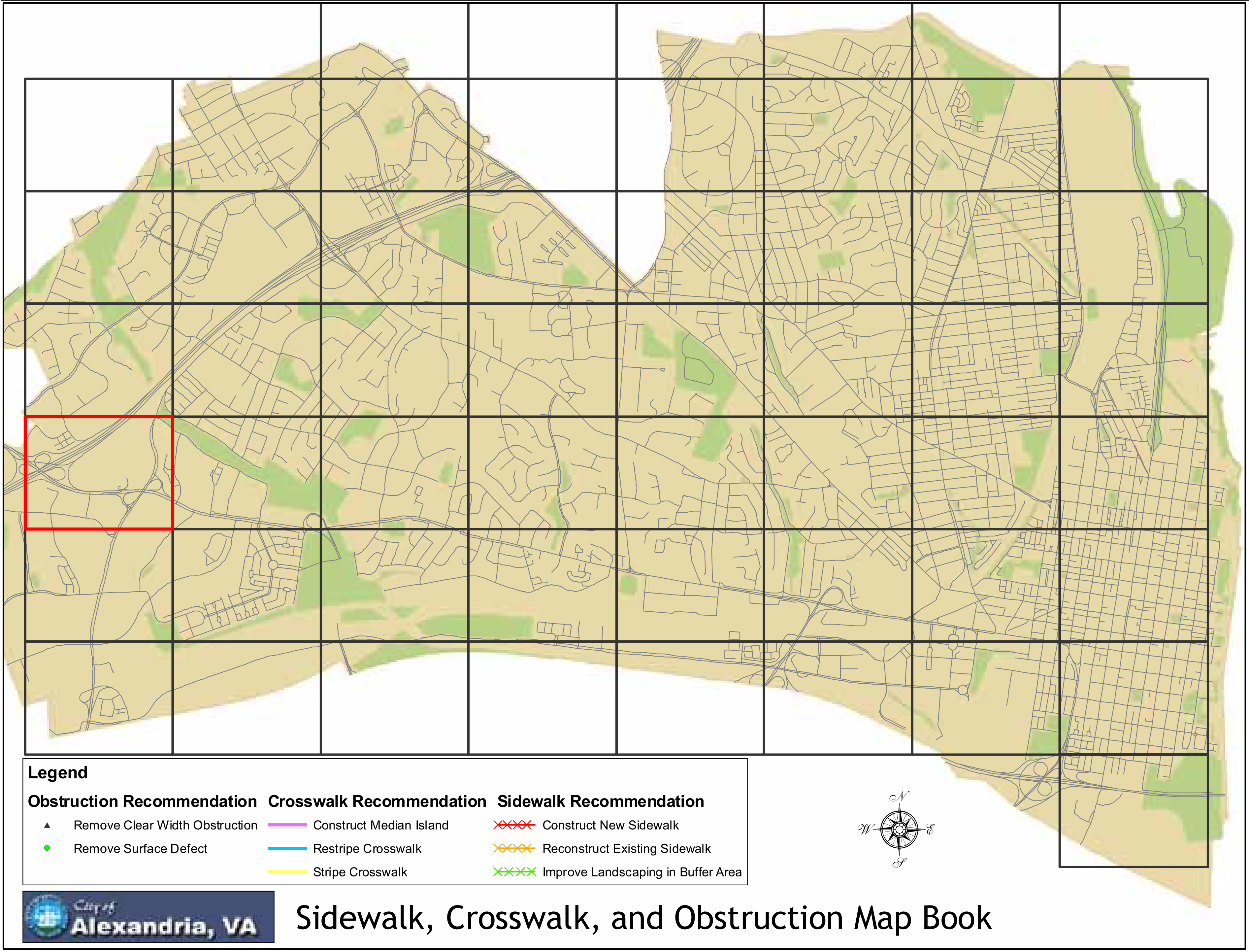


Figure 26: Sample Map Book Page

CHAPTER 7: CONCLUSION

Implementing the infrastructure improvement recommendations in this Plan will improve pedestrian and bicycle access and mobility in Alexandria. These physical improvements will make walking and bicycling in the City more comfortable and convenient. In doing so, these improvements will help the City meet the pedestrian and bicycle goals outlined in the Transportation Master Plan.

Pedestrians walking along the sidewalk in Old Town
Photo Credit: Toole Design Group

City of Alexandria Pedestrian and Bicycle Mobility Plan

APPENDIX

Appendix A: Generalized Cost Estimates

General (order of magnitude) cost estimates were developed for the main components of this plan. The estimated cost to implement this plan is approximately $36,100,000 (based on 2007 dollars). The Plan cost includes approximately $4,325,000 for Safe Routes to School, $12,333,000 for Transit Access, and $1,307,000 for Community Pathways, $2,489,000 for On-Road Bikeways, and $15,645,000 for Off-Road Trails. These cost estimates do not include high dollar projects such as bridges, tunnels, overpasses and underpasses.

The general costs were developed by calculating rough quantities and applying unit costs (based on 2007 City of Alexandria cost data). Costs were then translated into per mile or per facility costs, as explained in the spreadsheet associated with this appendix. For pedestrian and bicycle facilities that may be implemented with a larger project, the estimate represents the marginal cost required to develop the bicycle facility. For example, if bicycle lanes are added to a roadway during a repaving project, the estimate includes just the cost to implement the bicycle lanes (e.g., new pavement markings and bicycle related signs), but it does not include the new pavement.

Estimation of the costs involved several assumptions, including:

- Cost estimates assume that most pedestrian and bicycle facilities will be added as a component of an overall project to improve the roadway for all types of users; few roadway projects will be done for the exclusive purpose of adding pedestrian and bicycle facilities.
- Costs are based on 2007 dollars. They may change due to future economic conditions.
- Costs assume that facility projects will be implemented by contractors through a bidding process. They may vary if projects are done in-house.
- Facility costs include construction and design.
- All construction projects include a contingency, typically estimated at 25 percent of the construction cost.
- Design and construction costs may vary depending on the actual construction project size (e.g., project limits) and overall cost. Implementation will likely be more costly if pedestrian and bicycle improvements are done as many small projects compared to a smaller number of large projects.
- Regulatory and warning signs for bicycle lanes and on-street parking are included in the on-road bicycle facility costs. Pedestrian and bicycle wayfinding signs are also included in the on-road bicycle facilities category.
- Cost calculations assume that bicycle facility improvements are made on both sides of the street. Costs are generally over-estimated for the small portion of bicycle facility recommendations on one-way streets.
- Costs for roadway right-of-way acquisition are not included. These costs are not included in the estimates because specific projects are not yet defined.
- Costs for new multi-use trail construction include pavement, drainage, erosion and sediment control, and grading, but not right-of-way acquisition.
- During the early design stages of projects, maintenance of traffic, mobilization, potential utility impacts, drainage, and property acquisition costs can be based on a percentage of total project cost. These costs are not included in the estimates because specific projects are not yet defined and those project limits are unknown. While these costs are not included, they are a very small portion of overall costs

because most improvements recommended in the plan will be made as retrofit projects within the existing roadway curb-to-curb width.

- Costs for adding new pavement to create on-road bicycle facilities do not include curb and gutter, drainage, erosion and sediment control, and grading. These costs are not included in the estimates because specific projects are not yet defined and those project limits are unknown. While these costs are not included, they are a very small portion of overall costs because most bicycle facility improvements recommended in the plan will be made as retrofit projects within the existing roadway curb-to-curb width.

Background calculations for the general costs of this plan are contained in the Generalized Cost Estimates Spreadsheet, which is part of the Compendium of Supporting Materials available from the City.

Appendix B: Estimated Pedestrian and Bicycle Mobility Plan Costs

Project Recommendation Costs by Programmatic Category

Safe Routes To School							
	Top Priority (10 out of 10)		Medium Priority (8 and 9)		Low Priority (1 through 7)		Total Program Cost
Recommendation Type	**Number or Total Length**	**Total Cost**	**Number or Total Length**	**Total Cost**	**Number or Total Length**	**Total Cost**	
Bus Stop Improvement	0	$ -	0	$ -	0	$ -	
Median Improvement	0	$ -	0	$ -	0	$ -	
Stripe Crosswalk	16	$ 27,364.38	11	$ 14,148.25	117	$ 138,619.56	
Restripe Crosswalk	78	$ 121,109.02	36	$ 49,535.52	116	$ 172,109.30	
Curb Ramp Improvement	61	$ 73,200.00	32	$ 38,400.00	98	$ 117,600.00	
Driveway Improvement	49	$ 77,763.00	32	$ 50,784.00	111	$ 176,157.00	
Address Obstruction	144	$ 115,309.00	56	$ 74,012.00	523	$ 358,162.00	
Construct Sidewalk	1.93	$ 461,907.19	0.26	$ 62,261.85	1.75	$ 420,015.85	
Reconstruct Sidewalk	1.29	$ 341,861.53	0.26	$ 72,019.35	1.93	$ 537,869.21	
Improve Landscaping	0	$ -	0	$ -	0.09	$ 1,742.40	
Signal Improvement	80	$ 461,560.00	4	$ 14,662.00	75	$ 346,648.00	
Total Cost	**NA**	**$ 1,680,074.12**	**NA**	**$ 375,822.97**	**NA**	**$ 2,268,923.32**	**$ 4,324,820.41**

Access To Transit							
	Top Priority (10 out of 10)		Medium Priority (8 and 9)		Low Priority (1 through 7)		Total Program Cost
Recommendation Type	**Number or Total Length**	**Total Cost**	**Number or Total Length**	**Total Cost**	**Number or Total Length**	**Total Cost**	
Bus Stop Improvement	46	$ 175,100.00	47	$ 210,378.00	162	$ 694,962.00	
Median Improvement	3	$ 8,809.80	0	$ -	0	$ -	
Stripe Crosswalk	94	$ 170,145.19	57	$ 75,335.27	221	$ 296,347.58	
Restripe Crosswalk	145	$ 237,723.89	40	$ 67,212.51	216	$ 342,953.58	
Curb Ramp Improvement	198	$ 237,600.00	49	$ 58,800.00	318	$ 381,600.00	
Driveway Improvement	62	$ 98,394.00	21	$ 33,327.00	209	$ 331,683.00	
Address Obstruction	255	$ 289,124.00	184	$ 278,013.00	625	$ 619,683.00	
Construct Sidewalk	5.03	$ 1,205,933.88	2.63	$ 629,832.04	4.16	$ 996,740.80	
Reconstruct Sidewalk	1.9	$ 530,301.45	1.26	$ 352,333.52	4.74	$ 1,322,598.05	
Improve Landscaping	0.55	$ 9,804.96	0	$ -	0.07	$ 1,249.60	
New Signal HAWK or Full	0	$ -	0	$ -	2	$ 114,690.00	
Signal Improvement	209	$ 1,117,430.00	38	$ 239,382.00	216	$ 1,205,864.00	
Total Cost	**NA**	**$ 4,080,367.17**	**NA**	**$ 1,944,613.34**	**NA**	**$ 6,308,371.61**	**$ 12,333,352.12**

Community Pathways							
	Top Priority (10 out of 10)		Medium Priority (8 and 9)		Low Priority (1 through 7)		Total Program Cost
Recommendation Type	Number or Total Length	Total Cost	Number or Total Length	Total Cost	Number or Total Length	Total Cost	
Bus Stop Improvement	0	$ -	0	$ -	0	$ -	
Median Improvement	0	$ -	0	$ -	0	$ -	
Stripe Crosswalk	10	$ 14,614.31	1	$ 3,894.93	118	$ 131,728.53	
Restripe Crosswalk	15	$ 18,176.34	0	$ -	26	$ 41,612.50	
Curb Ramp Improvement	17	$ 20,400.00	0	$ -	109	$ 130,800.00	
Driveway Improvement	10	$ 15,870.00	5	$ 7,935.00	80	$ 126,960.00	
Address Obstruction	32	$ 15,808.00	11	$ 5,434.00	307	$ 165,872.00	
Construct Sidewalk	0.07	$ 16,152.62	0.53	$ 126,081.45	1.2	$ 286,744.80	
Reconstruct Sidewalk	0.07	$ 19,575.64	0	$ -	0.5	$ 141,302.03	
Improve Landscaping	0	$ -	0	$ -	0.04	$ 704.00	
Signal Improvement	0	$ -	1	$ 976.00	7	$ 16,206.00	
Total Cost	**NA**	**$ 120,596.91**	**NA**	**$ 144,321.38**	**NA**	**$ 1,041,929.86**	**$ 1,306,848.15**

On-Street Bikeways							
	Top Priority (10 out of 10)		Medium Priority (8 and 9)		Low Priority (1 through 7)		Total Program Cost
Recommendation Type	Number or Total Length	Total Cost	Number or Total Length	Total Cost	Number or Total Length	Total Cost	
Bicycle Lanes	5.26	$ 194,853.66	2.06	$ 55,192.93	7.575	$ 212,843.68	
Bike Boulevard	0.65	$ 18,200.00	0.61	$ 17,080.00	1.25	$ 35,000.00	
Bike Ped Priority Street	0.15	$ 4,200.00	0.23	$ 6,440.00	0.54	$ 15,120.00	
Climbing Lane	0.5	$ 9,963.34	0.07	$ 3,145.30	3.2	$ 86,000.68	
Sharrow	6.51	$ 54,996.48	3	$ 25,344.36	6.6	$ 55,756.80	
Shared Roadway	2.23	$ -	1.21	$ -	5.62	$ -	
Long Term Bicycle Boulevard	2.17	$ 60,760.00	1.16	$ 32,480.00	0.57	$ 15,960.00	
Wide Outside Lanes	1.155	$ 201,127.88	1.6	$ 164,099.94	1.685	$ 125,455.27	
Unknown Improvement	0.46	Further Study	0.125	Further Study	0.21	Further Study	
Bicycle Intersection Improvement	11	$ 276,498.00	2	$ 58,004.00	18	$ 760,808.00	
Total Cost	**NA**	**$ 820,599.36**	**NA**	**$ 361,786.53**	**NA**	**$ 1,306,944.43**	**$ 2,489,330.32**

Off-Street Trails							
	Top Priority (10 out of 10)		Medium Priority (8 and 9)		Low Priority (1 through 7)		Total Program Cost
Recommendation Type	Number or Total Length	Total Cost	Number or Total Length	Total Cost	Number or Total Length	Total Cost	
Construct Shared Use Path	3.36	$ 2,373,077.27	4.49	$ 3,171,165.80	2.26	$ 1,596,176.97	
Construct Sidepath or Widen Existing Sidewalk	2.935	$ 2,072,911.29	0.915	$ 646,239.80	4.255	$ 3,005,191.62	
Construct Overpass/Underpass	0.02	variable	0.44	variable	0.88	variable	
Reconstruct Shared Use Path	1.5	$ 1,178,209.50	1.98	$ 1,555,236.53	0.06	$ 47,128.38	
Reconstruct Overpass/Underpass	0	$ -	0.09	variable	0	$ -	
Total Cost	NA	$ 5,624,198.06	NA	$ 5,372,642.13	NA	$ 4,648,496.97	$ 15,645,337.16

Total	Top Priority		Medium Priority		Low Priority		Total Overall
	$ 12,325,835.62		$ 8,199,186.35		$ 15,574,666.19		$ 36,099,688.16

High Priority (10 out of 10) Recommendations and Costs By Project Area

Del Ray/Potomac Yard/Braddock Road		
Recommendation Type	**Number or Total Length**	**Total Cost**
Bicycle Facility Improvement*	3.8350	$ 558,947.12
Bicycle Intersection Improvement	2.0000	$ 82,196.00
Bus Stop Improvement	6	$ 8,400.00
Median Improvement	0	$ -
Stripe Crosswalk	15	$ 22,304.30
Restripe Crosswalk	27	$ 49,036.17
Curb Ramp Improvement	33	$ 39,600.00
Driveway Improvement	7	$ 11,109.00
Address Obstruction	41	$ 75,914.00
Construct Sidewalk	1.0780	$ 258,345.92
Reconstruct Sidewalk	0.0778	$ 21,725.88
Improve Landscaping	0.0475	$ 836.00
Signal Improvement	26	$ 195,050.00
Total Cost	**NA**	**$ 1,323,464.39**
Duke Street/Taylor Run		
Recommendation Type		
Bicycle Facility Improvement*	1.155	$ 8,865.11
Bus Stop Improvement	0	$ -
Median Improvement	0	$ -
Stripe Crosswalk	11	$ 22,304.30
Restripe Crosswalk	11	$ 22,104.56
Curb Ramp Improvement	14	$ 16,800.00
Driveway Improvement	5	$ 7,935.00
Address Obstruction	26	$ 50,374.00
Construct Sidewalk	1.0408	$ 249,430.84
Reconstruct Sidewalk	0.6125	$ 171,042.47
Improve Landscaping	0	$ -
Signal Improvement	10	$ 76,038.00
Total Cost	**NA**	**$ 624,894.28**
Eisenhower Avenue East		
Recommendation Type		
Bicycle Facility Improvement*	1.22	$ 861,850.05
Bus Stop Improvement	2	$ 2,800.00
Median Improvement	0	$ -
Stripe Crosswalk	0	$ -
Restripe Crosswalk	0	$ -
Curb Ramp Improvement	0	$ -
Driveway Improvement	0	$ -
Address Obstruction	0	$ -
Construct Sidewalk	0	$ -
Reconstruct Sidewalk	0	$ -
Improve Landscaping	0	$ -
Signal Improvement	0	$ -
Total Cost	**NA**	**$ 864,650.05**
Farlington/Bradlee		

Recommendation Type		
Bicycle Facility Improvement*	1.84	$ 641,644.59
Bicycle Intersection Improvement	1	Further Study
Bus Stop Improvement	0	$ -
Median Improvement	0	$ -
Stripe Crosswalk	14	$ 25,600.01
Restripe Crosswalk	8	$ 15,180.24
Curb Ramp Improvement	9	$ 10,800.00
Driveway Improvement	7	$ 11,109.00
Address Obstruction	21	$ 38,398.00
Construct Sidewalk	1.0778	$ 258,298.01
Reconstruct Sidewalk	0.0890	$ 24,853.52
Improve Landscaping	0	$ -
Signal Improvement	9	$ 29,954.00
Total Cost	**NA**	**$ 1,055,837.37**
Four Mile Run/Arlandria		
Recommendation Type		
Bicycle Facility Improvement*	1.92	$ 704,920.10
Bicycle Intersection Improvement	1	$ 53,894.00
Bus Stop Improvement	0	$ -
Median Improvement	3	$ 8,809.80
Stripe Crosswalk	5	$ 7,190.64
Restripe Crosswalk	1	$ 3,628.61
Curb Ramp Improvement	9	$ 10,800.00
Driveway Improvement	10	$ 15,870.00
Address Obstruction	13	$ 7,128.00
Construct Sidewalk	0.0188	$ 4,505.48
Reconstruct Sidewalk	0	$ -
Improve Landscaping	0	$ -
Signal Improvement	5	$ 14,946.00
Total Cost	**NA**	**$ 831,692.63**
Holmes Run		
Recommendation Type		
Bicycle Facility Improvement*	1.035	$ 783,395.10
Bus Stop Improvement	4	$ 6,800.00
Median Improvement	0	$ -
Stripe Crosswalk	1	$ 3,062.68
Restripe Crosswalk	1	$ 1,731.08
Curb Ramp Improvement	6	$ 7,200.00
Driveway Improvement	1	$ 1,587.00
Address Obstruction	0	$ -
Construct Sidewalk	0.4868	$ 116,663.08
Reconstruct Sidewalk	0.0366	$ 10,220.66
Improve Landscaping	0	$ -
Signal Improvement	1	$ 12,080.00
Total Cost	**NA**	**$ 942,739.60**
King/Beauregard		
Recommendation Type		
Bicycle Facility Improvement*	0.55	$ 354,955.03

Bus Stop Improvement	0	$ -
Median Improvement	0	$ -
Stripe Crosswalk	0	$ -
Restripe Crosswalk	0	$ -
Curb Ramp Improvement	0	$ -
Driveway Improvement	0	$ -
Address Obstruction	0	$ -
Construct Sidewalk	0	$ -
Reconstruct Sidewalk	0	$ -
Improve Landscaping	0	$ -
Signal Improvement	0	$ -
Total Cost	**NA**	**$ 354,955.03**
King Street Metro Area		
Recommendation Type		
Bicycle Facility Improvement*	3.56	$ 46,786.42
Bicycle Intersection Improvement	3	$ 51,004.00
Bus Stop Improvement	10	$ 61,600.00
Median Improvement	0	$ -
Stripe Crosswalk	13	$ 22,670.49
Restripe Crosswalk	26	$ 33,356.58
Curb Ramp Improvement	43	$ 51,600.00
Driveway Improvement	7	$ 11,109.00
Address Obstruction	59	$ 49,306.00
Construct Sidewalk	0.2793	$ 66,935.08
Reconstruct Sidewalk	0.2576	$ 71,935.58
Improve Landscaping	0	$ -
Signal Improvement	52	$ 179,564.00
Total Cost	**NA**	**$ 645,867.15**
Landmark		
Recommendation Type		
Bicycle Facility Improvement*	2.86	$ 708,823.47
Bicycle Intersection Improvement	2	$ 87,600.00
Bus Stop Improvement	16	$ 71,200.00
Median Improvement	0	$ -
Stripe Crosswalk	25	$ 52,498.33
Restripe Crosswalk	17	$ 40,314.19
Curb Ramp Improvement	21	$ 25,200.00
Driveway Improvement	15	$ 23,805.00
Address Obstruction	16	$ 9,316.00
Construct Sidewalk	0.9810	$ 235,099.60
Reconstruct Sidewalk	0.6069	$ 169,478.64
Improve Landscaping	0	$ -
Signal Improvement	30	$ 264,540.00
Total Cost	**NA**	**$ 1,687,875.23**
Mark Center		
Recommendation Type		
Bicycle Facility Improvement*	0	$ -
Bus Stop Improvement	5	$ 18,900.00
Median Improvement	0	$ -

Stripe Crosswalk	2	$ 3,661.90
Restripe Crosswalk	3	$ 10,020.29
Curb Ramp Improvement	3	$ 3,600.00
Driveway Improvement	2	$ 3,174.00
Address Obstruction	2	$ 988.00
Construct Sidewalk	0.1005	$ 24,085.13
Reconstruct Sidewalk	0.0303	$ 8,461.37
Improve Landscaping	0	$ -
Signal Improvement	3	$ 37,278.00
Total Cost	**NA**	**$ 110,168.69**
Mt. Jefferson		
Recommendation Type		
Bicycle Facility Improvement*	1.07	$ 14,871.63
Bus Stop Improvement	0	$ -
Median Improvement	0	$ -
Stripe Crosswalk	19	$ 32,124.85
Restripe Crosswalk	5	$ 8,655.40
Curb Ramp Improvement	21	$ 25,200.00
Driveway Improvement	42	$ 66,654.00
Address Obstruction	112	$ 61,159.00
Construct Sidewalk	0.3565	$ 85,436.29
Reconstruct Sidewalk	0.5793	$ 161,771.26
Improve Landscaping	0	$ -
Signal Improvement	15	$ 33,104.00
Total Cost	**NA**	**$ 488,976.43**
Old Town North		
Recommendation Type		
Bicycle Facility Improvement*	2.4	$ 55,682.00
Bus Stop Improvement	0	$ -
Median Improvement	0	$ -
Stripe Crosswalk	4	$ 7,357.09
Restripe Crosswalk	69	$ 93,178.71
Curb Ramp Improvement	36	$ 43,200.00
Driveway Improvement	6	$ 9,522.00
Address Obstruction	66	$ 85,512.00
Construct Sidewalk	0.2397	$ 57,444.82
Reconstruct Sidewalk	0.6055	$ 169,087.69
Improve Landscaping	0.4576	$ 8,053.76
Signal Improvement	76	$ 368,726.00
Total Cost	**NA**	**$ 897,764.07**
Old Town South		
Recommendation Type		
Bicycle Facility Improvement*	1.85	$ 43,841.17
Bicycle Intersection Improvement	2	$ 1,804.00
Bus Stop Improvement	2	$ 3,400.00
Median Improvement	0	$ -
Stripe Crosswalk	6	$ 6,458.26
Restripe Crosswalk	64	$ 88,218.50
Curb Ramp Improvement	74	$ 88,800.00

Driveway Improvement	15	$	23,805.00
Address Obstruction	53	$	22,460.00
Construct Sidewalk	0.1135	$	27,200.61
Reconstruct Sidewalk	0.2978	$	83,161.55
Improve Landscaping	0.0520	$	915.20
Signal Improvement	62	$	367,710.00
Total Cost	**NA**	**$**	**757,774.29**
Sanger/Lynbrook			
Recommendation Type			
Bicycle Facility Improvement*	0.46	$	14,464.03
Bus Stop Improvement	0	$	-
Median Improvement	0	$	-
Stripe Crosswalk	3	$	3,628.61
Restripe Crosswalk	0	$	-
Curb Ramp Improvement	2	$	2,400.00
Driveway Improvement	0	$	-
Address Obstruction	0	$	-
Construct Sidewalk	0.1844	$	44,192.01
Reconstruct Sidewalk	0	$	-
Improve Landscaping	0	$	-
Signal Improvement	0	$	-
Total Cost	**NA**	**$**	**64,684.65**
Seminary N Van Dorn			
Recommendation Type			
Bicycle Facility Improvement*	1.72	$	405,212.08
Bus Stop Improvement	1	$	2,000.00
Median Improvement	0	$	-
Stripe Crosswalk	2	$	3,262.42
Restripe Crosswalk	6	$	11,584.92
Curb Ramp Improvement	5	$	6,000.00
Driveway Improvement	4	$	6,348.00
Address Obstruction	22	$	19,686.00
Construct Sidewalk	0.7809	$	187,145.03
Reconstruct Sidewalk	0	$	-
Improve Landscaping	0	$	-
Signal Improvement	0	$	-
Total Cost	**NA**	**$**	**641,238.45**
Van Dorn Metro'			
Recommendation Type			
Bicycle Facility Improvement*	1.46	$	964,041.46
Bus Stop Improvement	0	$	-
Median Improvement	0	$	-
Stripe Crosswalk	0	$	-
Restripe Crosswalk	0	$	-
Curb Ramp Improvement	0	$	-
Driveway Improvement	0	$	-
Address Obstruction	0	$	-
Construct Sidewalk	0.2888	$	69,211.79
Reconstruct Sidewalk	0	$	-

Improve Landscaping	0	$ -
Signal Improvement	0	$ -
Total Cost	**NA**	**$ 1,033,253.25**

Overall Cost for High Priority (10 out of 10) Recommendations	**NA**	**$ 12,325,835.56**

Appendix C: Public Meeting Summaries

Public input was an important part of the process of developing this plan. This appendix includes summaries the two public meetings held during the planning process. The first public meeting was intended to provide background information about the project and to solicit input from the public on maps and comment sheets. The second public meeting was intended to present the initial recommendations from the draft plan and gather public feedback on the draft recommendations.

First Public Meeting—March 22, 2007

The first public meeting for the City of Alexandria Pedestrian and Bicycle Mobility Plan was held at City Hall on March 22, 2007. Most of the meeting was an open house, providing citizens with approximately two hours to provide suggestions for the Plan. Informal remarks were given by Councilman Rob Krupicka, Lieutenant Paul Story (Alexandria Police Department), Yon Lambert (City Pedestrian and Bicycle Program Coordinator), and Bob Schneider (project consultant with Toole Design Group). 28 citizens signed-in for the meeting.

Citizen comments were provided on maps, on comment cards, and through conversations with City and consulting team staff. All comments will be considered as the draft plan recommendations are developed.

The comments listed below were submitted on the comment cards:

- For pedestrian safety, snow removal on sidewalks needs to be improved. I walk a lot in Old Town and Parker-Gray, and snow and ice removal is poor in many places. The problem exists not only in residential blocks but also on major commercial streets such as sections of King Street and Washington Street. This can be a huge obstacle for pedestrians.
- The lowest-hanging fruit in terms of improvements in Alexandria are completing missing sidewalks and curb cuts. This is more useful than countdown pedestrian signals.
- I would bike in Alexandria more if there were more bike racks at my destination—especially in Old Town.
- Are plans in place to eliminate the grade crossing at Eisenhower Avenue with trail extension on south side of Eisenhower Avenue to across from the animal shelter? The trail could be "dipped" under the bridge at that point to connect with the existing trail [on the south side of Eisenhower Avenue] toward Cameron Station.
- The sidewalk on Pegram to Pickett is in need of great repair. There are many children that walk from the valley to Hammond, and it is essentially a one-person sidewalk, but the kids clump in groups. Not only does the sidewalk slope toward the street, but on garbage day, the kids walk in the street to go around the trash. Very dangerous area! Thanks!
- Repair work is badly needed on the Holmes Run Trail between Beatley Bridge and Latham Street. Tree roots have caused upheaval of the trail. Bicyclists and joggers often use grass instead of the trail. We are promised trail improvements after the planned sewer renovation, but we need some fixes now.
- In Del Ray and Old Town all intersections should be 4-way stop signs, no 2-way. It is a

hazard to pedestrians and it [this suggested change] would slow traffic.

- High priority should be given to get whatever it takes (bridge?) to connect the Fairfax County Lake Barcroft Trail along Holmes Run (at the County line near N. Chambliss)

The following comments summarize feedback provided on the maps:

- Improve lighting on trails
- Improve lighting near Metro stations
- Connect the Holmes Run trail to new trails in Fairfax County
- Improve the Holmes Run trail tunnel under I-395 and Van Dorn Street
- Construct sidewalks to fill gaps on residential streets
- Install better signage to identify the Mount Vernon Trail through Old Town
- Complete sidewalks on both sides of all arterial streets
- Ask First Baptist Church to allow pedestrian and bicycle access through their roads and parking lots to make connections between existing trails and roads in the Taylor Run area
- Trim hedges on residential streets to improve driver sight distance of pedestrians
- Add pedestrian signals to all signalized intersections
- Stripe more bike lanes throughout the City, especially in Old Town
- Provide trail connections to Eisenhower Avenue Metro area from the east and from the west
- Provide better bicycle connections through in the Eisenhower Avenue corridor near the Eisenhower Avenue Metro station
- Make improvements to major corridors for pedestrian and bicycle access (e.g., King Street, Seminary Road/Janney's Lane, Van Dorn Street, Duke Street)
- Provide better pedestrian crossings across Duke Street near Landmark Mall
- Provide better pedestrian crossings of Van Dorn Street
- Provide pedestrian and bicycle connections across the railroad tracks to connect Cameron Station to the Van Dorn Street Metro area and to connect the Duke Street Corridor to Eisenhower Avenue
- Provide concrete landing pads, benches, and shelters for bus passengers at all bus stops in west Alexandria—some riders must currently wait in the street
- Mid-block crossings need to be made much safer in west Alexandria—signals are spread far apart, and intersections have multiple turning lanes, so pedestrians often choose to cross mid-block rather than at intersections (e.g., Van Dorn Street)
- Make King Street into a pedestrian mall (at least start with several blocks at the east end; or at least in the summer months)
- Improve the Mount Vernon Trail connection into Old Town from the south
- Provide pedestrian and bicycle connections across the railroad tracks north of the Braddock Road metro station near the Monroe Street Bridge and the Potomac Yards area
- Fix tree root damage on multi-use trails
- Provide better pedestrian and bicycle access through difficult intersections, such as King Street & Braddock Road & Quaker Lane and the interchange of Duke Street & Telegraph Road
- Improve bicycle access in the Duke Street corridor
- Provide longer pedestrian crossing intervals at wide signalized intersections
- Remove overgrown shrubs, utility poles, and other obstructions in sidewalks
    - Reduce motor vehicle speeds on all streets, particularly arterial roadways

- Construct more curb ramps for strollers, bicycles, and people with disabilities
- Construct a multi-use trail in Fort Ward Park
- Add curb extensions to Commonwealth Avenue intersections
- Improve maintenance of Eisenhower Avenue and Holmes Run Trails
- Paint and enhance roadway crossings along trolley trail that runs parallel to Fairfax Street north of Oronoco Bay Park
- Complete a trail through the entire length of the Mount Jefferson Park Greenway—avoid drainage issues and privacy issues for trail users being able to see into adjacent houses
- Pedestrian crossings, including signals and push-buttons near the Eisenhower Avenue Metro Station should be improved
- Improve wayfinding signage to help trail users find trail access points and reach destinations from the trails

Second Public Meeting (To Be Held in early December 2007)

Appendix D: Questionnaire Summary

Questionnaires were used to gather public feedback on pedestrian and bicycle issues in Alexandria. Similar questions were distributed using two different methods in order to gather input from a wide cross-section of potential respondents. One questionnaire was posted online on the City's pedestrian and bicycle transportation web page between March 1, 2007 and May 11, 2007. Hard copies of a second questionnaire were made available on all DASH buses between March 1, 2007 and March 30, 2007. Over 470 responses were collected during the questionnaire period.

This appendix includes the questionnaire form and a summary of responses for each survey.

Online Questionnaire Form

Welcome! Thank you for participating in our short survey for the *City of Alexandria Pedestrian and Bicycle Mobility Plan*.

Your input is critical to help the City promote access for persons with disabilities, pedestrians, and bicyclists throughout Alexandria.

This survey should take no more than 10 minutes to complete and will be available online from March 1 through March 31, 2007. Information collected from the survey will be confidential and used solely for developing the Pedestrian and Bicycle Mobility *Plan*. For more information on the Plan please visit the project Website: http://www.alexride.org/bikeped_study.php.

If your primary language is not English or you have a disability that makes it difficult to take this survey online, please call the City of Alexandria at 703-739-9415 for the opportunity to take the survey by phone.

Click **Next** to begin!

1. If you walk/travel as a pedestrian in the City of Alexandria, please tell us why and how often for each purpose.
Frequently (5 or more days/week); Occasionally (1-4 days per week); Rarely (less than once a week); Never

- ❑ I walk to the bus or Metro station
- ❑ I walk to my car
- ❑ I walk the dog
- ❑ I walk for exercise or personal fitness
- ❑ I walk for leisure
- ❑ I walk to reach destinations for running errands, shopping, or entertainment
- ❑ I walk to school
- ❑ I walk to work

Next
Previous

2. What is most important to you when walking in Alexandria?

- ❑ Distance to destinations
- ❑ Personal security (from crime)
- ❑ Missing or poorly maintained sidewalks
- ❑ Unsafe driver behaviors
- ❑ Unsafe street crossings or intersections
- ❑ Other

If you selected "other" above, please specify ___________

3. What makes it hard for you to walk in Alexandria? Please select your top 3 choices.

Choice #1; Choice #2; Choice #3

- ❑ Drivers not stopping for pedestrians in crosswalks
- ❑ Drivers running red lights
- ❑ Fast vehicle speeds
- ❑ Heavy traffic
- ❑ I have mobility limitations (poor health, use of wheelchair or other walking aid)
- ❑ Lack of facilities for people with disabilities (such as curb ramps)
- ❑ Wide Intersections
- ❑ Not enough time given to cross intersections
- ❑ No sidewalks or missing sidewalks
- ❑ Places I need to go are not within walking distance
- ❑ Poor/inadequate lighting
- ❑ Cracked or broken sidewalks
- ❑ Sidewalks are too close to the road
- ❑ Narrow sidewalks
- ❑ Unattractive/unappealing streets (no trees, large parking lots along sidewalk, buildings without windows to the street)

- ❑ Walking on bridges or overpasses
- ❑ Weather/climate
- ❑ Worries about personal security (from crime)
- ❑ I don't find anything difficult or unpleasant about walking in Alexandria
- ❑ Other

If you selected "other" above, please specify ___________

4. Which of the following changes would encourage you to walk more often? (Please choose top 3)

Choice #1; Choice #2; Choice #3

- ❑ Better education on pedestrian safety
- ❑ Better lighting in areas where you walk
- ❑ Fewer motor vehicles on streets
- ❑ Increased enforcement of laws applying to motorists
- ❑ Increased enforcement of laws applying to pedestrians
- ❑ More comfortable places to wait at bus stops
- ❑ More destinations within walking distance
- ❑ More frequent transit service
- ❑ More pedestrian facilities (such as sidewalks, crosswalks, etc.)
- ❑ More programs and events for pedestrians
- ❑ Safer driver behavior
- ❑ Other
- ❑ Nothing

If you selected "other" above, please specify ___________

5. Which types of locations in Alexandria need the most improvements (such as new sidewalks or safer crossings) to improve your pedestrian experience? Please rate each type of location according to need.

No improvements needed; Some improvements needed; Many improvements needed; Don't know

- ❑ Near bus stops
- ❑ Near highway interchanges (example: I-395; I-495 Beltway)
- ❑ Near Metro and VRE stations
- ❑ Near parks and other recreation destinations
- ❑ Near retail/shopping centers
- ❑ Near schools
- ❑ Near service providers (example: hospitals or clinics)
- ❑ Near tourist destinations
- ❑ On bridges or overpasses
- ❑ On major street corridors (example: Van Dorn Street; Mount Vernon Avenue)
- ❑ On neighborhood streets
- ❑ Other

If you selected "other" above, please specify ___________

6. Please list any **specific destinations** in Alexandria (such as the name of a school, park, shopping area, medical service, bus stop or Metro station) that need improvements to make pedestrian travel safer and more comfortable.

- ❑ ________________
- ❑ ________________
- ❑ ________________

7. Please list any specific **streets** or **intersections** in Alexandria that need improvements for pedestrians.

- ❑ ____
- ❑ ____
- ❑ ____

8. How many bicycles do you have in your household?

- ❑ 0
- ❑ 1

- ❑ 2
- ❑ 3
- ❑ 4
- ❑ 5+

9. If you bicycle in the City of Alexandria, please tell us why and how often for each purpose.
Frequently (5 or more days/week); Occasionally (1-4 days per week); Rarely (less than once a week); Never

- ❑ I bicycle to the bus or Metro station
- ❑ I bicycle for exercise or personal fitness
- ❑ I bicycle for leisure
- ❑ I bicycle to reach destinations for running errands, shopping, or entertainment
- ❑ I bicycle to school
- ❑ I bicycle to work

10. What is the most critical issue that people face as bicyclists in Alexandria?

- ❑ Destinations that are too far away
- ❑ Lack of bicycle lanes on roadways
- ❑ Lack of bicycle trails away from roadways
- ❑ Lack of personal security (from crime)
- ❑ Unsafe driver behaviors
- ❑ Unsafe street crossings or intersections
- ❑ Other

If you selected "other" above, please specify ___________

11. On which bicycle facility do you prefer to ride? (Choose One)

- ❑ Paved shoulders
- ❑ Greenways/off-road trails
- ❑ Vehicle travel lanes (sharing travel lanes with motor vehicle traffic)
- ❑ Designated bicycle lanes
- ❑ Wide vehicle travel lanes (enough space for motorists to pass bicycles to the left in the same lane)

12. Which of the following factors make it unpleasant for you to bicycle or prevent you from bicycling more often in Alexandria? (Please choose top 3)

Choice #1; Choice #2; Choice #3

- ❑ Crossing busy roads
- ❑ Drainage grates
- ❑ Heavy traffic
- ❑ High-speed traffic
- ❑ Hills
- ❑ Lack of bicycle facilities (such as bike lanes, wide travel lanes, paved shoulders, greenway trails, etc.)
- ❑ Loose gravel/debris
- ❑ Narrow roads
- ❑ Other travel modes are safer or more comfortable
- ❑ Pavement quality
- ❑ Personal safety (from crime)
- ❑ Physical ability
- ❑ Poor lighting (along routes/trails or at roadway crossings)
- ❑ Travel time and/or distance
- ❑ Other
- ❑ Nothing

If you selected "other" above, please specify ___________

13. Which of the following changes would encourage you to bike more often? (Please choose top 3)

Choice #1; Choice #2; Choice #3

- ❑ A new City bicycle map
- ❑ Better education on bicycle safety
- ❑ Fewer cars on streets
- ❑ Showers/changing facilities at your place of work
  - ❑ Increased enforcement of laws applying to bicyclists

- ❑ Increased enforcement of laws applying to motorists
- ❑ More bicycle lanes and trails
- ❑ More bicycle racks for parking
- ❑ More bicycle racks on buses
- ❑ More destinations within bicycling distance
- ❑ More programs and events for new cyclists
- ❑ Other
- ❑ Nothing

If you selected "other" above, please specify ___________

14. Which areas of Alexandria need the most improvements (such as new bicycle trails or bicycle lanes) to improve your bicycling experience? Please rate each area according to need.

    No improvements needed*; *Some improvements needed*; *Substantial improvements needed*; *Don't know

- ❑ Near bus stops
- ❑ Near highway interchanges (example: I-395; I-495 Beltway)
- ❑ Near Metro and VRE stations
- ❑ Near parks and other recreation destinations
- ❑ Near retail/shopping centers
- ❑ Near schools
- ❑ Near service providers (example: hospitals or clinics)
- ❑ Near tourist destinations
- ❑ On bridges or overpasses
- ❑ On major street corridors (example: Van Dorn Street; Mount Vernon Avenue)
- ❑ On neighborhood streets
- ❑ Other

If you selected "other" above, please specify ___________

15. If bicycle-on-bus service were provided on DASH buses, how frequently would you use it?

Frequently (5 or more days/week); Occasionally (1-4 days per week); Rarely (less than once a week); Never

16. Please list any **specific destinations** in Alexandria (such as the name of a school, park, shopping area, medical service, bus stop or Metro station) that need improvements to make bicycle travel safer and more comfortable.

- ❑ ________________
- ❑ ________________
- ❑ ________________

17. Please list any specific **streets** or **intersections** in Alexandria that need improvements for bicyclists.

- ❑ ____
- ❑ ____
- ❑ ____

18. Please check all that apply:

- ❑ I live in the City of Alexandria
- ❑ I work in the City of Alexandria
- ❑ I do not live or work in the City of Alexandria
- ❑ I walk/bicycle regularly in the City of Alexandria

19. What is your zip code?

22202
22206
22301
22302
22303
22304
22305

22310
22311
22312
22313
22314
22320
Other

If you selected “other” above, please specify ___________

20. Age:
- ❑ Under 10 years
- ❑ 10-15
- ❑ 16-19
- ❑ 20-29
- ❑ 30-39
- ❑ 40-49
- ❑ 50-59
- ❑ 60-69
- ❑ 70 or older

21. Gender
- ❑ Female
- ❑ Male

22. Do you have a disability or mobility limitation?
- ❑ Yes
- ❑ No

(Optional) If yes, please list the type(s) of disability or mobility limitation(s) that you have_________.

23. (Optional) Please provide any additional comments below related to pedestrian or bicycle facilities in the City of Alexandria

24. (Optional) Would you like to receive updates and information on Alexandria transportation programs by e-mail? If yes, please provide your e-mail address below. ________________________________

Thank you!
Your input will be considered as a part of the City of Alexandria *Pedestrian and Bicycle Mobility Plan*.

Please visit the project website (http://www.alexride.org/bikeped_study.php) for upcoming meetings, contact information, and updates on the progress of the City of Alexandria *Pedestrian and Bicycle Mobility Plan*.

Online Questionnaire Summary

Included below are the destinations, roads, and intersections that were cited three or more times by respondents to the online survey.

Question 6: Please list any specific destinations in Alexandria (such as the name of a school, park, shopping area, medical service, bus stop or Metro station) that need improvements to make pedestrian travel safer and more comfortable.

Destinations with three or more responses on the survey:

- Alexandria Hospital (INOVA)
- Andrew Adkins Housing Project
- Braddock Road
- Braddock Metro
- Bradleee Shopping Center
- Del Ray neighborhood
- Duke Street
- Eisenhower Metro
- Fox Chase Shopping Center
- King Street
- King Street Metro
- TC Williams High School
- King/Commonwealth intersection
- Hammond Middle School
- Hoffman Center
- Holmes Run Trail
- Landmark Mall
- Mount Vernon Avenue
- Route 1
- Slaters Lane
- Pickett Road
- Polk Elementary School
- Potomac Yard
- Van Dorn Street
- Van Dorn Metro

Question 7: Please list any specific streets or intersections in Alexandria that need improvements for pedestrians.

Intersections with three or more responses:

- Braddock/Commonwealth intersection
- Braddock/West intersection
- Braddock/Russell intersection
- Braddock/King intersection
- Braddock Metro
- Commonwealth/Mt. Vernon intersection
- Duke/Telegraph intersection
- Duke/Landmark Mall intersection
- Glebe/Mt. Vernon intersection
- King/Union intersection
- King/Russell intersection
- King/Janney's intersection
- King Street Metro
    - Monroe at Bridge

- Braddock/Mt. Vernon intersection
- Mt. Vernon/Del Ray intersection
- Pegram/Pickett intersection
- Pegram/Polk intersection
- Quaker/King intersection
- Beauregard/Seminary intersection
- Slaters/Washington intersection
- Van Dorn/Edsall intersection
- West/Wyeth intersection

Question 16: Please list any specific destinations in Alexandria (such as the name of a school, park, shopping area, medical service, bus stop or Metro station) that need improvements to make bicycle travel safer and more comfortable.

Destinations with three or more responses:

- Arlandia area
- Braddock Road Metro
- Bradlee Shopping Center
- Duke Street
- Fox Chase Shopping Center
- 4-Mile Run Trail
- Hammond Middle School
- Holmes Run Trail
- King Street Metro
- King Street
- Landmark Mall
- Mount Vernon Trail
- Old Town
- Polk Elementary School
- Potomac Yard
- Route 1
- TC Williams High School
- Van Dorn Metro

Questions 17: Please list any specific streets or intersections in Alexandria that need improvements for bicyclists.

Specific intersections with 3 or more responses:

- Braddock/West intersection
- Braddock Road Metro
- King/Commonwealth intersection
- King/Braddock intersection
- King/Quaker intersection
- Mt Vernon/Glebe intersection
- Mt Vernon/Commonwealth intersection
- Route 1/Slaters intersection
- Route 1/Monroe intersection

City of Alexandria *Pedestrian and Bicycle Mobility Plan* Transit Rider Survey

The City of Alexandria and DASH are working together to gather information for the *City of Alexandria Pedestrian and Bicycle Mobility Plan*.

Your input is critical to help the City and DASH promote access for persons with disabilities, pedestrians, and bicyclists throughout the City of Alexandria.

This survey should take no more than 10 minutes to complete and will be available on DASH buses from March 1 through March 31, 2007. Completed surveys can be dropped in the box on this bus.

If your primary language is not English or you have a disability that makes it difficult to take this survey on the bus, please call the City of Alexandria at 703-838-4966 for the opportunity to take the survey by phone. The survey is also available on the project Website: http://www.alexride.org/bikeped_study.php..

When done, please return your completed survey to the box at the front of the bus.

1. What is most important to you when walking in Alexandria? (Please check one option below.)
   _____Distance to destinations
   _____Personal security (from crime)
   _____Missing or poorly maintained sidewalks
   _____Unsafe driver behaviors
   _____Unsafe street crossings or intersections
   _____Other

If you selected "other" above, please specify ____

2. What makes it hard for you to walk **to your bus stop** in Alexandria? (Please select your top 3 choices by marking a "1", "2", or "3" in front of three options below.)
   _____Drivers not stopping for pedestrians in crosswalks
   _____Fast vehicle speeds/Heavy traffic
   _____No facilities for people with disabilities (example: curb ramps)
   _____Wide Intersections
   _____No sidewalks or missing sidewalks
   _____Poor/inadequate lighting
   _____Cracked or broken sidewalks
   _____Narrow sidewalks
   _____Weather/climate
   _____Worries about personal security (from crime)
   _____I don't find anything difficult or unpleasant about walking to the bus stop
   _____Other

If you selected "other" above, please specify ____

3. Which types of locations in Alexandria need the most work to make walking easier (such as new sidewalks or safer crossings)? (Please check one of the boxes after each option.)

Locations	No improvement needed	Some improvements needed	Many improvements needed	Don't know
On bridges or overpasses				
Near Metro and VRE stations				
Near parks and other recreation destinations				
Near retail/shopping centers				
Near schools				

Near service providers (example: hospitals, clinics)
Near tourist destinations
Near bus stops
On major street corridors (example: Van Dorn Street, King Street)
On neighborhood streets
Other

If you selected "other" above, please specify ____

4. Please list any **specific destinations** in Alexandria (such as the name of a street, intersection, school, park, shopping area, medical service, bus stop or Metro station) that need improvements to make pedestrian travel safer and more comfortable.
   a) ____
   b) ____
   c) ____

If you do not ride a bicycle, you may skip Question 5 and 6.

5. Which of the following changes would encourage you to bicycle more often? (Please select your top 3 choices by marking a "1", "2", and "3" in front of the options below.)
_____A new City bicycle map
_____Better education on bicycle safety
_____Fewer cars on streets
_____Showers/changing facilities at your place of work
_____Increased enforcement of laws applying to motorists
_____More bicycle lanes and trails
_____More bicycle racks for parking
_____Bicycle racks on buses
_____Other
_____Nothing

If you selected "other" above, please specify ____________________________________

6. If bicycle-on-bus service were provided on DASH buses, how often would you use it? (Please check one option below.)
_____Frequently (5 or more days per week)
_____Occasionally (1 to 4 days per week)
_____Rarely (less than 1 day per week)
_____Never

7. Please check all that apply:
_____I live in the City of Alexandria
_____I work in the City of Alexandria
_____I do not live or work in Alexandria
_____I walk/bicycle regularly in Alexandria

8. What is your zip code?_______________

9. Age (Please check one option below.)
_____Under 10 years
_____10-15
_____16-19
_____20-29
_____30-39
_____40-49
_____50-59
_____60-69
_____70 or older

10. Gender (Please check one option below.)
_____Female
_____Male

11. Do you have a disability or mobility limitation? (Please check one option below.)
_____Yes
_____No

(Optional) If yes, please list the type(s) of disability or mobility limitation(s) that you have: ____

12. (Optional) Would you like to receive updates and information on Alexandria transportation programs by e-mail? If yes, please provide your e-mail address:

____

13. (Optional) Please provide any additional comments related to pedestrian or bicycle facilities in the City of Alexandria in the space below.

Thank you!
Information collected from the survey will be confidential and used solely for developing the *Pedestrian and Bicycle Mobility Plan*.

Please visit the project website (http://www.alexride.org/bikeped_study.php) for upcoming meetings, contact information, and updates on the progress of the *City of Alexandria Pedestrian and Bicycle Mobility Plan*.

Please return your completed survey to the box on this bus.

Included below are the destinations that were cited three or more times by respondents to the DASH bus survey.

Question 4: Please list any specific destinations in Alexandria (such as the name of a street, intersection, school, park, shopping area, medical service, bus stop or Metro station) that need improvements to make pedestrian travel safer and more comfortable.

Destinations with three or more responses on the survey:

- Braddock Road
- Braddock Metro
- Bradlee Shopping Center
- Commonwealth Avenue
- Duke Street
- Glebe Road
- Janney's Lane
- Jefferson Davis Highway
- King Street
- King/Braddock
- King Street Metro intersection
- Landmark Mall
- Martha Custis Road
- Mount Vernon
- Route 1
- Russell Road
- Seminary Lane
- Slater's Lane
- Van Dorn Street

Appendix E: Field Data Collection Items

A large amount of detailed information was collected to assess the existing pedestrian and bicycle infrastructure in Alexandria. The pedestrian field data collection effort focused on approximately 100 roadway centerline miles in priority assessment areas. Below are the criteria that were used to select priority assessment areas:

- Locations with high levels of pedestrian and bicycle activity, including areas with high numbers of persons with disabilities. These include locations near parks, schools, retail, multi-use trails, institutional locations (e.g., libraries and post offices), etc.
- Proximity to transit (e.g., heavily-used bus stops, rail stations, locations frequently served by paratransit).
- Pedestrian and bicycle facility safety (e.g., locations of pedestrian and bicycle crash concentrations; access barriers identified through inventory).
- Roadways that are: 1) scheduled to be repaved in the near future, 2) not part of an area that will undergo large-scale redevelopment during the next five years, and/or 3) in parts of the City where there is more potential for redevelopment of individual properties.
- Socioeconomic equity and geographic distribution.
- Public priorities for pedestrian and bicycle data collection.

Bicycle field data was collected on 70 miles of roadways in the City's bikeway network. The information was used to calculate Bicycle Level of Service model grades on roadway segments in the system. Shared-use path observations were made on approximately 14 miles of existing trails.

Below is a list of the field data collected during each inventory. Note that the level of detail varied for each data collection item. Some facility characteristics were measured, while others were summarized through visual observations.

Field Data Collection Items

<u>Pedestrian Facility Inventory</u>

- Sidewalk typical width/Sidewalk typical clear width (approximate width, nearest foot)
- Sidewalk clear width obstructions (identified points where obstructions existed and listed the type of obstruction)
- Buffer width between sidewalk and roadway (approximate width, nearest foot)
- Sidewalk surface type
- Sidewalk surface condition (general rating)
- Driveway crossings (surface type and general ADA accessibility—general visual assessment)
- Curb ramps (compliant vs. non-compliant with ADA—general visual assessment)
- Curb radius (Less than 15 feet, 15-25 feet, More than 25 feet—general visual assessment)
- Type of buffer (e.g., street trees, grass, landscaping)
- On-street parking type (parallel, straight-in, diagonal)
- Bicycle rack locations

- Bus stop accessibility (ADA compliance—general visual assessment)
- Bus stop characteristics (sign, bench, shelter, etc.)
- Roadway crosswalk type (standard, high-visibility, brick, etc.)
- Roadway crosswalk condition (general rating)
- Roadway crossing length (number of lanes to cross)
- Roadway crossing traffic control type (stop; yield; conventional, countdown, audible ped signal; uncontrolled)
- Presence of push buttons at signalized crossings
- Presence of other crossing facilities (median islands, curb extensions, raised crosswalks)

<u>Bicycle Level of Service Inventory</u>

- Outside travel lane width (measured to nearest ½ foot)
- Posted speed limit
- Percentage of on-street parking (25% increments)
- Pavement condition (5=best, 1=worst rating scale)
- Roadway shoulder width (measured to nearest ½ foot)
- Bicycle lane width (measured to nearest ½ foot)
- Traffic volume (ADT) (from VDOT traffic data—estimates were made where data was not available)
- Percentage of heavy vehicles (from VDOT traffic data—estimates were made where data was not available)

<u>Shared-Use Path Inventory</u>

- Shared-use path typical width (measured to nearest ½ foot)
- Shared-use path surface type
- Shared-use path surface condition (general rating)
- Shared-use path clear width obstructions (identified points where obstructions existed and listed the type of obstruction)
- Shared-use path surface maintenance problems (identified points where maintenance problems existed and listed the type of maintenance problem)

Appendix F: Bicycle Level of Service Model Summary

Prepared by

Toole Design Group
Washington DC-Baltimore

for the

City of Alexandria Pedestrian and Bicycle Mobility Plan

February 2007

Background

Level of Service (LOS) is a framework that transportation professionals use to describe existing conditions (or suitability) for a mode of travel in a transportation system. The traffic planning and engineering discipline has used LOS models for motor vehicles for several decades. Motor vehicle LOS is based on average speed and travel time for motorists traveling in a particular roadway corridor. In the 1990s, new thinking and research contributed to the development of methodologies for assessing levels of service for other travel modes, including bicycling, walking, and transit. Specific methodologies for bicycle level of service have been developed and used by a number of cities, counties, and states around the U.S. since the mid-1990s. This Plan adopts the Bicycle Level of Service (Bicycle LOS) Model assessment method.

When considering level of service in a multi-modal context, it is important to note that LOS measures for motor vehicles and bicycles are based on different criteria and are calculated on different inputs. Motor vehicle LOS is primarily a measure of speed, travel time, and intersection delay. Bicycle LOS is a more complex calculation, which represents the level of comfort a bicyclist experiences in relation to motor vehicle traffic.

Bicycle Level of Service Model

The *Bicycle Level of Service Model (Bicycle LOS Model)* is an evaluation of bicyclist perceived safety and comfort with respect to motor vehicle traffic while traveling in a roadway corridor. It identifies the quality of service for bicyclists that currently exists within the roadway environment.

The statistically calibrated mathematical equation entitled the *Bicycle LOS Model*[1] *(Version 2.0)* is used for the evaluation of bicycling conditions in shared roadway environments. It uses the same measurable traffic and roadway factors that transportation planners and engineers use for other travel modes. With statistical precision, the *Model* clearly reflects the effect on bicycling suitability or “compatibility” due to factors such as roadway width, bike lane widths and striping combinations, traffic volume, pavement surface condition, motor vehicle speed and type, and on-street parking.

The *Bicycle Level of Service Model* is based on the proven research documented in *Transportation Research Record 1578* published by the Transportation Research Board of the National Academy of Sciences. It was developed with a background of over 150,000 miles of evaluated urban, suburban, and rural roads and streets across North America. Many urban planning agencies and state highway departments are using this established method of evaluating their roadway networks. The Virginia Department of Transportation is using the *Bicycle LOS Model* in both the Richmond and Northern Virginia regions. The model has also been applied in Anchorage AK, Baltimore MD, Birmingham AL, Buffalo NY, Gainesville FL, Houston TX, Lexington KY, Philadelphia PA, Sacramento CA, Springfield MA, Tampa FL, Washington, DC, Winston-Salem, NC, and by the Delaware Department of Transportation (DelDOT), Florida Department of Transportation (FDOT), New York State Department of Transportation (NYDOT), Maryland Department of Transportation (MDOT) and many others.

[1] Landis, Bruce W. et.al. “Real-Time Human Perceptions: Toward a Bicycle Level of Service” *Transportation Research Record 1578*, Transportation Research Board, Washington, DC 1997.

Widespread application of the original form of the *Bicycle LOS Model* has provided several refinements. Application of the *Bicycle LOS Model* in the metropolitan area of Philadelphia resulted in the final definition of the three effective width cases for evaluating roadways with on-street parking. Application of the *Bicycle LOS Model* in the rural areas surrounding the greater Buffalo region resulted in refinements to the "low traffic volume roadway width adjustment". A 1997 statistical enhancement to the *Model* (during statewide application in Delaware) resulted in better quantification of the effects of high speed truck traffic [see the $SP_t(1+10.38HV)^2$ term]. As a result, *Version 2.0* has the highest correlation coefficient (R^2 = 0.77) of any form of the *Bicycle LOS Model*.

Version 2.0 of the *Bicycle Level of Service Model (Bicycle LOS Model)* will be employed to evaluate collector and arterial roadways in the City of Alexandria. Its form is shown below:

Bicycle LOS = $a_1 \ln (Vol_{15}/L_n) + a_2 SP_t(1+10.38HV)^2 + a_3(1/PR_5)^2 + a_4(W_e)^2 + C$

Where:

Vol_{15} = Volume of directional traffic in 15 minute time period

$$Vol_{15} = (ADT \times D \times K_d) / (4 \times PHF)$$

where:

ADT	=	Average Daily Traffic on the segment or link
D	=	Directional Factor (assumed = 0.565)
K_d	=	Peak to Daily Factor (assumed = 0.1)
PHF	=	Peak Hour Factor (assumed = 1.0)

L_n = Total number of directional *through* lanes

SP_t = Effective speed limit

$$SP_t = 1.1199 \ln(SP_p - 20) + 0.8103$$

where:

SP_p = Posted speed limit (a surrogate for average running speed)

HV = percentage of heavy vehicles (as defined in the 1994 Highway Capacity Manual)

PR_5 = FHWA's five point pavement surface condition rating

W_e = Average effective width of outside through lane:

where:

$W_e = W_v - (10\text{ ft} \times \%\ OSPA)$	and $W_l = 0$
$W_e = W_v + W_l (1 - 2 \times \%\ OSPA)$	and $W_l > 0$ & $W_{ps} = 0$
$W_e = W_v + W_l - 2 (10 \times \%\ OSPA)$	and $W_l > 0$ & $W_{ps} > 0$ and a bike lane exists

where:

W_t	=	total width of outside lane (and shoulder) pavement
OSPA	=	percentage of segment with occupied on-street parking
W_l	=	width of paving between the outside lane stripe and the edge of pavement
W_{ps}	=	width of pavement striped for on-street parking
W_v	=	Effective width as a function of traffic volume

and:

$W_v = W_t$	if ADT > 4,000veh/day
$W_v = W_t (2-0.00025 \times ADT)$	if ADT $\leq$ 4,000veh/day, and if the street/ road is undivided and unstriped

a_1: 0.507 a_2: 0.199 a_3: 7.066 a_4: - 0.005 C: 0.760

(a_1 - a_4) are coefficients established by the multi-variate regression analysis.

The Bicycle LOS score resulting from the final equation is pre-stratified into service categories "A", "B", "C", "D", "E", and F" ("A" is best, and "F" is worst), according to the ranges shown in Table 1, reflecting users' perception of the road segments level of service for bicycle travel. This stratification is in accordance with the linear scale established during the referenced research (i.e., the research project bicycle participants' aggregate response to roadway and traffic stimuli). The *Model* is particularly responsive to the factors that are statistically significant. An example of its sensitivity to various roadway and traffic conditions is shown on the following page.

Bicycle Level-of-Service Categories

LEVEL-OF-SERVICE	Bicycle LOS Score
A	≤ 1.5
B	> 1.5 and ≤ 2.5
C	> 2.5 and ≤ 3.5
D	> 3.5 and ≤ 4.5
E	> 4.5 and ≤ 5.5
F	> 5.5

The Model represents the comfort level of a hypothetical "typical" bicyclist[2]. Some bicyclists may feel more comfortable and others may feel less comfortable than the Bicycle LOS grade for a roadway. A poor Bicycle LOS grade does not mean that bikes should be prohibited on a roadway. It suggests to a transportation planner that the road may need a variety of improvements (i.e., provide a bicycle lane, increase shoulder width, repave, slow motor vehicle traffic, etc.) to help more bicyclists feel comfortable using the corridor.

Application

The *Bicycle LOS Model* is used by planners, engineers, and designers throughout the US and Canada in a variety of planning and design applications. Applications include:

1) Conducting a benefits comparison among proposed bikeway/roadway cross-sections
2) Identifying roadway restriping or reconfiguration opportunities to improve bicycling conditions
3) Prioritizing and programming roadway corridors for bicycle improvements
4) Creating bicycle suitability maps
5) Documenting improvements in corridor or system-wide bicycling conditions over time

[2] The Bicycle Level of Service Model was developed using the perceptions of a diverse group of bicyclists. These cyclists represented a wide range of ages and experience levels. Each of the cyclists rated their own level of comfort as they rode on roadway segments with a wide variety of traffic conditions and street layouts. Their responses were combined using statistical modeling techniques to determine which measurable traffic and roadway characteristics had significant relationships to the comfort levels reported by all of the bicyclists. A quantitative model was developed from these data to predict, with the greatest possible accuracy, how a diverse set of bicyclists would feel on a roadway with any given combination of traffic and roadway characteristics. Therefore, a "typical" bicyclist is a bicyclist that is most closely represented by the wide range of ages and experience levels present in the original Bicycle Level of Service experiment. In general, it is expected that more experienced cyclists would independently rate roadways higher than a "typical" cyclist because they are more likely to be comfortable riding in more difficult conditions.

Bicycle LOS Model Sensitivity Analysis

Bicycle LOS = $a_1 \ln (Vol_{15}/Ln) + a_2 SP_t (1+10.38HV)^2 + a_3 (1/PR_5)^2 + a_4 (W_e)^2 + C$

where:	a_1: 0.507	a_2: 0.199	a_3: 7.066	a_4: -0.005	C: 0.760
T-statistics:	(5.689)	(3.844)	(4.902)	(-9.844)	

Baseline inputs:

ADT	=	12,000 vpd	% HV	=	1	L	=	2 lanes
SP_p	=	40 mph	W_e	=	12 ft	PR_5	=	4 (good pavement)

	BLOS	% Change
Baseline BLOS Score (Bicycle LOS)	3.98	N/A

Lane Width and Lane striping changes

W_t	=	12 ft - - (baseline average) - - - - - -	3.98 - - - - - -	no change
W_t	=	10 ft	4.20	6% increase
W_t	=	11 ft	4.09	3% increase
W_t	=	13 ft	3.85	3% reduction
W_t	=	14 ft	3.72	7% reduction
W_t	=	15 ft (W_l = 3 ft)	3.57 (3.08)	10% (23%) reduction
W_t	=	16 ft (W_l = 4 ft)	3.42 (2.70)	14% (32%) reduction
W_t	=	17 ft (W_l = 5 ft)	3.25 (2.28)	18% (43%) reduction

Traffic Volume (ADT) variations

ADT	=	1,000	Very Low	2.75	31% decrease
ADT	=	5,000	Low	3.54	11% decrease
ADT	=	12,000	Average - (baseline average) - -	3.98 - - - - - -	no change
ADT	=	15,000	High	4.09	3% increase
ADT	=	25,000	Very High	4.35	9% increase

Pavement Surface conditions

PR_5	=	2	Poor	5.30	33% increase
PR_5	=	3	Fair	4.32	9% reduction
PR_5	=	4	Good - - - (baseline average) - -	3.98 - - - - -	no change
PR_5	=	5	Very Good	3.82	4% reduction

Heavy Vehicles in percentages

HV	=	0	No Volume	3.80	5% decrease
HV	=	1 - - -	Very Low - (baseline average) - -	3.98 - - - - - -	no change
HV	=	2	Low	4.18	5% increase
HV	=	5	Moderate	4.88	23% increase[a]
HV	=	10	High	6.42	61% increase[a]
HV	=	15	Very High	8.39	111% increase[a]

[a] Outside the variable's range (see Reference *(1)*)

Appendix G: Pedestrian and Bicycle Facility Descriptions

Developing a continuous, accessible system of pedestrian and bicycle facilities throughout Alexandria is central to creating safer conditions for pedestrians and bicyclists and making walking and bicycling more attractive transportation choices in the community. This chapter describes the specific pedestrian and bicycle facilities recommended in the City.

Pedestrian Facilities

All City residents are pedestrians at one time or another. This includes employees walking to work, students walking to school, neighbors walking to parks, and wheelchair users traveling to bus stops and rail stations. It also includes owners walking dogs, shoppers walking through parking lots to store entrances, and people who drive and park in Old Town, Mount Vernon Avenue, Duke Street, or other commercial areas and walk to local establishments. Pedestrians include people of all ages, incomes, and abilities. The facilities described below will increase the number of safe, continuous, and accessible pedestrian facilities on roadways and pathways in Alexandria.

Pedestrian facility design is critical for pedestrian safety and comfort. The City should follow the guidelines and requirements of the Americans with Disabilities Act Accessibility Guidelines (ADAAG)[3] and the AASHTO Pedestrian Guide[4] when implementing the recommendations of this plan. The sections below describe pedestrian facilities that will improve conditions for walking along the roadway, crossing the roadway, accessing transit stops, and sharing space safely with bicycles.

---

[3] ADA Accessibility Guidelines for Buildings and Facilities. United States Access Board, 2002. http://www.access-board.gov/adaag/html/adaag.htm

[4] AASHTO *Guide for the Planning, Design, and Operation of Pedestrian Facilities*. American Association of State Highway and Transportation Officials, 2004.

Example Pedestrian Facility Design Resources

ADA Accessibility Guidelines for Buildings and Facilities. United States Access Board, 2002. http://www.access-board.gov/adaag/html/adaag.htm.

AASHTO *Guide for the Planning, Design, and Operation of Pedestrian Facilities*. American Association of State Highway and Transportation Officials, 2004.

Pedestrian and Transit-Friendly Design: A Primer for Smart Growth. R. Ewing for Smart Growth Network in Florida, 1999. http://www.epa.gov/smartgrowth/pdf/ptfd_primer.pdf.

Designing Sidewalks and Trails for Access, Part I of II: Review of Existing Guidelines and Practices. US Department of Transportation, Federal Highway Administration., 1999, http://www.fhwa.dot.gov/environment/bikeped/Access-1.htm.

Accessible Rights-of-Way: A Design Guide. US Access Board, 1999, http://www.access-board.gov/prowac/guide/PROWGuide.htm.

PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System, US Department of Transportation, Federal Highway Administration, Authors: D.L. Harkey and C.V. Zegeer, September 2004, http://www.walkinginfo.org/pedsafe/.

Pedestrian Facilities Planning and Design Handbook. Florida Department of Transportation, 1999, http://www.dot.state.fl.us/safety/ped_bike/ped_bike_standards.htm#Florida%20Ped%20Handbook.

Facilities for Pedestrian Travel along the Roadway

Pedestrians are safer and feel more comfortable when they have high-quality facilities for walking along the roadway. Pedestrian facilities should be continuous, be accessible to all pedestrians (including those with disabilities), have a surface wide enough to accommodate existing and future pedestrian activity, be separated from the roadway by a buffer (such as parked cars, trees, or landscaping), have adequate lighting, include appropriate street furniture, and not be obstructed by poles, bushes, utility boxes or other immovable objects.

Sidewalk in Alexandria
Photo Credit: City of Alexandria

Sidewalks

Sidewalks are the central element of the pedestrian transportation system. There should be a continuous, connected system of sidewalks on both sides of all roadways in Alexandria (where pedestrians are permitted). The City should ensure that its sidewalks and other pedestrian pathways have appropriate width, surface, separation from motor vehicle traffic, lighting and signs.

Width
Sidewalks should be wide enough to accommodate expected levels of pedestrian traffic. Narrow sidewalks that cannot accommodate the volume of foot traffic may encourage pedestrians to walk in the roadway increasing the potential for conflict with motor vehicles.

At a minimum, it is desirable to provide a sidewalk clear width (i.e., lateral space available for pedestrian travel for the length of a corridor) at least wide enough to accommodate two

This sidewalk is wide enough to allow large numbers of pedestrians to pass comfortably.
Photo Credit: Toole Design Group

This sidewalk is not wide enough for all three children to walk side-by-side.
Photo Credit: Toole Design Group

people walking side-by-side (5 feet)[5]. In addition, ADA guidelines specify a minimum passing area width of 5 feet at least every 200 feet. In areas with high pedestrian volumes (often areas near transit stops and stations) and/or where street furniture (e.g. pay phones, trash cans, etc.), utilities, and street trees may function as obstacles, additional sidewalk width will be necessary to provide this minimum clear width.

Surface
The full clear width of a sidewalk should be paved with a smooth, stable and slip-resistant material to accommodate wheelchairs, bicycles, and strollers. Additionally, grade changes and conflicts with vehicles should be kept to a minimum, including curb cuts for driveways. More details can be found in the ADAAG.

[5] *Pedestrian and Transit-Friendly Design: A Primer for Smart Growth*. Ewing for Smart Growth Network in Florida, 1999. http://www.epa.gov/smartgrowth/pdf/ptfd_primer.pdf

Sidewalks should be smooth, stable and slip-resistant to allow all pedestrians, including people with disabilities to travel safely.
Photo Credit: Toole Design Group

Sidewalks with surface defects, such as gaps, cracks, joints, or heaved pavement can be a hazard to pedestrians.
Photo Credit: Toole Design Group

Buffer

For the safety and comfort of pedestrians, it is desirable to provide a buffer area between the sidewalk and roadway (i.e., sidewalks should not be located against the curb, directly adjacent to the lanes of moving traffic). Some form of buffer should be included to protect pedestrians from noise, pollution, wind and errant vehicles. Landscaping, such as a simple grass strip, shrubs, and/or trees can be used. A tree-lined buffer has the added benefits of improving roadway aesthetics, providing shade, and improving pedestrians' perceptions of safety with respect to motor vehicle traffic[6,7]. On-street parking can also serve as a buffer between moving vehicles and pedestrians while simultaneously slowing vehicular traffic.

Buffer space between the sidewalk and moving vehicles makes pedestrians feel safer. Photo Credit: Toole Design Group

The pedestrian on this sidewalk is very close to vehicles in the outside travel lane. Photo Credit: Toole Design Group

[6] *Pedestrian and Transit-Friendly Design: A Primer for Smart Growth*. Ewing for the Smart Growth Network in Florida, 1999. http://www.epa.gov/smartgrowth/pdf/ptfd_primer.pdf

[7] Landis, B.W., V.R. Vattikuti, R. M. Ottenberg, D.S. McLeod, M. Guttenplan. "Modeling the Roadside Walking Environment: Pedestrian Level of Service," Transportation Research Record 1773, Transportation Research Board, National Academy of Sciences, 2001.

Obstructions
Sidewalks must have a minimum clear width of 36 inches and clear height of 80 inches to meet pedestrian accessibility requirements. There are many locations in Alexandria where immovable objects block this clear width. Examples of these obstructions include: trees, utility poles, light poles, traffic signal poles, hydrants, raised utility hole covers, water meters, guardrail, mailboxes, pipes, signs, steps, and guy wires.

Additional Considerations
There are several other factors that the City should consider when evaluating sidewalks, including:

- Ample lighting is required to ensure the safety and security of pedestrians (see recommendations for lighting in the Improvements to Pedestrian Roadway Crossings section below).

- Directional signage and wayfinding should be installed around major pedestrian attractors (e.g., heavily-used transit stops, major parks, tourist destinations, commercial corridors) to direct pedestrians to local points of interest. This signage should be sized and oriented appropriately for pedestrians.

Obstructions in the sidewalk network.
Photo Credit: Toole Design Group

Improvements to Pedestrian Roadway Crossings

Improving the safety and convenience of roadway crossings is essential for making Alexandria more walkable. Nationally, nearly 75% of all police-reported pedestrian crashes involve pedestrians crossing roadway travel lanes[8]. Many of the pedestrian crashes reported in Alexandria between 2004 and 2006 were in roadway corridors with multiple travel lanes in each direction, high actual traffic speeds (85th percentile speed of 35 m.p.h. or higher) and high traffic volumes (10,000 ADT or higher) (e.g., Mount Vernon Avenue (north end), Duke Street, Van Dorn Street, Quaker Lane, etc.). Roadway crossing improvements may help prevent future pedestrian crashes in these and other roadway corridors.

This plan recommends a number of engineering solutions at specific locations to improve difficult pedestrian crossings, including constructing median islands, reconstructing curb ramps, reducing turning radii, and adding pedestrian countdown signals. These treatments,

[8] Zegeer, C.V., et al. Pedestrian and Bicycle Crash Types of the Early 1990s, Federal Highway Administration, FHWA-RD-95-163, p. 22, June 1996.

when combined with education and enforcement programs, can make crossings more convenient and help reduce pedestrian crashes.

Using a Combination of Treatments to Make Crossings Safer

The goal of the recommended improvements is to help pedestrians cross roadways safely. This often requires using a combination of safety treatments, particularly on multi-lane roads with high speeds and traffic volumes. Marked crosswalks are one tool that is commonly used to improve pedestrian crossings. However, in many cases, marked crosswalks alone are not sufficient to increase pedestrian safety. Additional treatments should be used to supplement marked crosswalks. FHWA guidelines state, "In most cases, marked crosswalks are best used in combination with other treatments (e.g., curb extensions, raised crossing islands, traffic signals, roadway narrowing, enhanced overhead lighting, traffic calming measures etc.)."[9] Therefore, combinations of several types of safety treatments are recommended to improve crossings in Alexandria.

Types of Pedestrian Crossing Improvements

Specific types of recommended roadway crossing improvements are described below. These infrastructure improvements generally address roadway markings and geometry, curb ramps, traffic signals, signs, and lighting. The types of improvements listed below are appropriate for controlled (traffic signals, stop signs, etc.) or uncontrolled locations unless otherwise indicated.

Roadway Markings and Geometry

Each roadway crossing improvement recommended in this plan will require detailed engineering analysis to determine the feasibility and design of each of the potential treatments described below before the improvements are made.

<u>Marked Crosswalks</u>
Legally, crosswalks exist where two streets intersect whether or not they are denoted with markings[10]. High-visibility crosswalks are recommended at many of the 45 pedestrian crossing improvement locations in Alexandria to alert motorists to locations where they should expect pedestrians and to show pedestrians preferred crossing locations. This may involve striping new crosswalks where they do not currently exist, restriping crosswalks that have worn away, or restriping crosswalks that need to be moved to a more appropriate location. Colored crosswalks and stamped crosswalks are decorative in nature; they are not considered standard crosswalks in the City of Alexandria.

While the City of Alexandria has used a variety of crosswalk types, including standard parallel line markings and colored crosswalks (with stamped asphalt or pavers), high-visibility crosswalk markings are recommended for key crossing locations. The high-visibility crosswalks are similar to standard crosswalks, but they also have thick white bars parallel to

[9] Zegeer, C. V., J. R. Stewart, H. H. Huang, and P. A. Lagerwey. Safety Effects of Marked Versus Unmarked Crosswalks, Federal Highway Administration, FHWA-RD-01-075, Feburary 2002.
[10] The Code of Virginia, 46.2-100 states: "'Crosswalk' means that part of a roadway at an intersection included within the connections of the lateral lines of the sidewalks on opposite sides of the highway measured from the curbs or, in the absence of curbs, from the edges of the traversable roadway; or any portion of a roadway at an intersection or elsewhere distinctly indicated for pedestrian crossing by lines or other markings on the surface."

the direction of travel. This may help make drivers more aware of pedestrians crossing in critical locations.

A majority of the key locations for pedestrian crossing improvements in Alexandria are controlled intersections (intersections with stop signs or traffic signals). Crosswalks should be marked across most street approaches at these intersections.

Pedestrian crossings should be designed to maximize pedestrian safety. The MUTCD states that: "Crosswalk lines should not be used indiscriminately. An engineering study should be performed before they are installed at locations away from traffic signals or STOP signs." A recent national research project completed by the Federal Highway Administration provides specific guidance on the installation of crosswalks and other safety measures at uncontrolled locations[11]. The results of this study clearly indicate the safety value of enhanced pedestrian crossing measures at midblock crossings and other uncontrolled locations (such as T-intersections). Safety measures that are recommended include crossing islands, raised crossings, and other traffic calming techniques, as well as additional warning signs and signal treatments in some locations.

Where crosswalks are recommended, it is critical to consider additional pedestrian crossing treatments that may needed to supplement the crosswalk. Marked crosswalks alone (i.e., without traffic-calming treatments, traffic signals and pedestrian signals when warranted, or other substantial crossing improvement) are insufficient and should not be used under the following conditions:

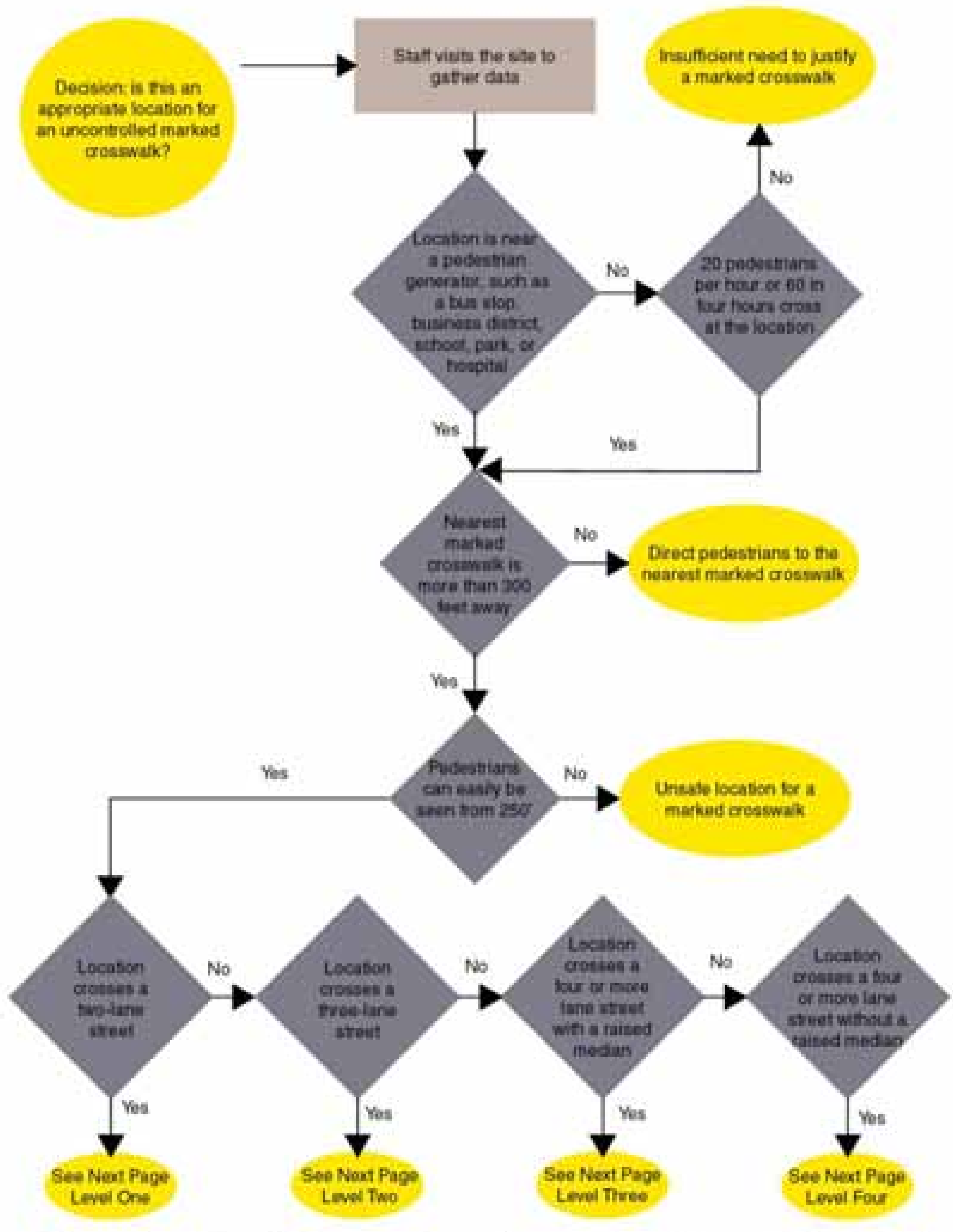
- Where the speed limit exceeds 40 miles per hour,
- On a roadway with four or more lanes without a raised median or crossing island that has (or will soon have) an Average Daily Traffic count (ADT) of 12,000 or greater, or
- On a roadway with four or more lanes with a raised median or crossing island that has (or soon will have) an ADT of 15,000 or greater.

Pedestrians crossing the street in a marked crosswalk. Photo Credit: Toole Design Group.

As the City of Alexandria evaluates uncontrolled crossings in the future, it should use the decision tree shown in Figure X to determine appropriate safety treatments based on vehicular speeds, volumes, and number of travel lanes.

[11] Zegeer, C. V., J. R. Stewart, H. H. Huang, and P. A. Lagerwey. Safety Effects of Marked Versus Unmarked Crosswalks, Federal Highway Administration, FHWA-RD-01-075, Feburary 2002.

Evaluating Locations for Uncontrolled Marked Crosswalks



Source: Based on Safety Effects of Marked Versus Unmarked Crosswalks, Federal Highway Administration, 2002

Evaluating Locations for Uncontrolled Marked Crosswalks

Engineering Treatments for Uncontrolled Marked Crosswalks

Level 1: 2 Lane Street

NUMBER OF CARS (ADT)	POSTED SPEED 30 mph or less	35 mph	40 mph or more
Up to 12,000 cars per day	High visibility crosswalk markings	High visibility crosswalk markings	High visibility crosswalk markings plus an engineering treatment (see below)
12,000-15000	High visibility crosswalk markings	High visibility crosswalk markings	Pedestrian signal or grade separated crossing
15,000 cars or more per day	High visibility crosswalk markings	High visibility crosswalk markings plus an engineering treatment (see below)	Pedestrian signal or grade separated crossing

Level 3: 4 or more Lanes with a Raised Median

NUMBER OF CARS (ADT)	POSTED SPEED 30 mph or less	35 mph	40 mph or more
9,000 cars or fewer per day	High visibility crosswalk markings	High visibility crosswalk markings	High visibility crosswalk markings plus an engineering treatment (see below)
9,000-12,000	High visibility crosswalk markings	High visibility crosswalk markings plus an engineering treatment (see below)	Pedestrian signal or grade separated crossing
12,000-15,000	High visibility crosswalk markings plus an engineering treatment (see below)	High visibility crosswalk markings plus an engineering treatment (see below)	Pedestrian signal or grade separated crossing
15,000 or more	Pedestrian signal or grade separated crossing	Pedestrian signal or grade separated crossing	Pedestrian signal or grade separated crossing

Level 2: 3 Lane Street

NUMBER OF CARS (ADT)	POSTED SPEED 30 mph or less	35 mph	40 mph or more
9,000 cars or fewer per day	High visibility crosswalk markings	High visibility crosswalk markings	High visibility crosswalk markings plus an engineering treatment (see below)
9,000-12,000	High visibility crosswalk markings	High visibility crosswalk markings plus an engineering treatment (see below)	High visibility crosswalk markings plus an engineering treatment (see below)
12,000-15,000	High visibility crosswalk markings plus an engineering treatment (see below)	High visibility crosswalk markings plus an engineering treatment (see below)	Pedestrian signal or grade separated crossing
15,000 or more	High visibility crosswalk markings plus an engineering treatment (see below)	Pedestrian signal or grade separated crossing	Pedestrian signal or grade separated crossing

Level 4: 4 or more Lanes without a Raised Median

NUMBER OF CARS (ADT)	POSTED SPEED 30 mph or less	35 mph	40 mph or more
9,000 cars or fewer per day	High visibility crosswalk markings	High visibility crosswalk markings plus an engineering treatment (see below)	Pedestrian signal or grade separated crossing
9,000-12,000	High visibility crosswalk markings plus an engineering treatment (see below)	High visibility crosswalk markings plus an engineering treatment (see below)	Pedestrian signal or grade separated crossing
12,000-15,000	Pedestrian signal or grade separated crossing	Pedestrian signal or grade separated crossing	Pedestrian signal or grade separated crossing
15,000 or more	Pedestrian signal or grade separated crossing	Pedestrian signal or grade separated crossing	Pedestrian signal or grade separated crossing

Engineering Treatments

Road Diet (removal of one or more motor vehicle travel lanes)
Median Crossing Islands
Curb Extensions
Advance Stop Lines
In-Roadway Warning Lights
Pedestrian Signals
Grade Separated Crossing (should not be used in conjunction with high visibility crosswalk markings)

Engineering Treatments for
Uncontrolled Marked Crosswalks

Median islands

Median islands (or pedestrian crossing islands) allow pedestrians to cross one direction of motor vehicle traffic at a time. Studies show that they reduce pedestrian crashes[7]. Median islands (or raised median strips) should be installed to help improve pedestrian safety and comfort at a majority of the locations recommended for crossing improvements. They are likely to be a long-term improvement on roadways where significant geometric changes are needed to provide enough space for the median island.

Accessible median crossing islands provide a refuge for people crossing the street
Photo Credit: Toole Design Group

Space for median islands can be created by removing existing travel lanes on roadways that have excess vehicle capacity. Removing travel lanes may involve removing through-travel lanes or replacing a center-turn lane with raised median islands or a median strip. In some corridors, removing travel lanes can also create extra roadway space for bicycle lanes. There are several roadways in Alexandria where lanes could be removed in the long-term as a part of corridor reconstruction projects. These streets include:

- King Street between Quaker Lane and Janney's Lane
- Sanger Avenue between Beauregard Street and Van Dorn Street
- Pickett Street between Cameron Station Boulevard and Duke Street
- Howard Street between Seminary Road and Braddock Road
- West Glebe Road between Martha Custis Drive and South Glebe Road
- Braddock Road between High Street and Russell Road
- Slaters Lane between Potomac Greens Drive and the George Washington Memorial Parkway

Removing travel lanes often requires tradeoffs between travel modes within a roadway corridor. Engineering analysis should be conducted to evaluate the impact of removing travel lanes on all modes, including transit, motor vehicle, bicycle, and pedestrian transportation before lanes are removed.

Curb extensions
Curb extensions shorten pedestrian crossing distance and increase the visibility of pedestrians at roadway crossings. By narrowing the curb-to-curb width of a roadway, curb extensions may also help reduce motor vehicle speeds and improve pedestrian safety. Curb extensions are appropriate for locations that have on-street parking. They may be complemented by in-roadway pedestrian crossing signs, high-visibility pedestrian warning signs, and improved lighting. Curb extensions have already been installed in Alexandria on King Street, Diagonal Street, Mount Vernon Avenue, and Russell Road. Space for additional on-street parking and new curb extensions can also be created by removing travel lanes (see discussion above).

Curb extensions reduce pedestrian crossing distance
Photo Credit: Toole Design Group

Curb radius reduction
Wide curb radii allow motorists to make high-speed turning movements. Reducing the curb radii at the corners of an intersection helps slow turning vehicles, improves sight distance between pedestrians and motorists, and shortens the crossing distance for pedestrians. Surrounding land uses and the traffic composition on the roadway are important to evaluate when considering this treatment. If a curb radius is too small, trucks and buses may drive over the curb and endanger pedestrians. Several intersections in Alexandria have wide curb radii that should be reduced. The City should also look for opportunities to reduce curb radii as a part of all roadway projects that involve geometric improvements at intersections.

Reducing curb radii slows turning motor vehicles
Photo Credit: Toole Design Group

Raised pedestrian crossings

Raised pedestrian crossings (raised crosswalks) provide a continuous route for pedestrians at the same level as the sidewalk. Approaching vehicles must slow down to go over raised crosswalks comfortably. This encourages motorists to yield and makes crossing the street safer for pedestrians. Pedestrians are also positioned slightly higher than the road surface, which makes them more visible to approaching motorists. Pavement markings on the slope of the raised crosswalk can improve the visibility of the raised crosswalk to motorists. Raised crossings eliminate the grade separation between the sidewalk and road surface, making the crossing more comfortable. However, pedestrians should continue to cross with caution at these locations. This treatment is appropriate for low-speed locations, such as low-volume neighborhood residential streets and shopping center parking lots.

Raised pedestrian crosswalk
Photo Credit: Toole Design Group

Curb ramps

Accessible curb ramps should be provided at every marked crosswalk in Alexandria. Two types of curb ramp improvements are recommended in the City: 1) constructing new curb ramps at crosswalks where they do not exist and 2) retrofitting existing curb ramps to make them comply with Americans with Disabilities Act (ADA).

Accessible curb ramp
Photo Credit: Toole Design Group

All curb ramps in Alexandria must meet the requirements of the Americans with Disabilities Act Accessibility Guidelines for Buildings and Facilities (ADAAG) (the ADAAG rules are available at http://www.access-board.gov/adaag/html/adaag.htm). Accessible curb ramps will be provided when roads are resurfaced or reconstructed. Though it is not requirement, it is recommended that the City provide a curb ramp for each crosswalk extending from a corner rather than a single curb ramp pointing into the center of the intersection.

Traffic Signals

Signalized intersections stop opposing traffic, allowing pedestrians to cross busy roadways. At most signalized intersections, motor vehicles are still allowed to turn across crosswalks. Though drivers are required to yield to pedestrians at these locations, pedestrian collisions occur. Fast-turning traffic also increases pedestrian discomfort at these intersections, so it is important to make other geometric improvements (such as reducing turning radii or adding median islands) when signalized intersections are installed or upgraded. Traffic signal improvements include installing pedestrian countdown signals, providing leading pedestrian interval phasing, restricting right-turn-on-red, and installing pedestrian activated traffic signals (see Figure R4).

<u>Pedestrian countdown signal heads</u>

Pedestrian countdown signal heads are beneficial at intersections with high pedestrian crossing volumes and/or long crossing distances because they indicate the number of seconds remaining for pedestrians to complete crossing the street. It is the policy of the City of Alexandria to provide Accessible Pedestrian Signals (APS) at such locations as may be necessary to meet the mobility needs of persons with disabilities.

APS's are traffic signals that provide information in nonvisual format (such as audible tones, verbal messages, and/or vibrating surfaces). The primary purpose of these signals is to assist pedestrians with visual disabilities in safely crossing streets at complex locations. Pedestrians who have visual disabilities typically initiate their crossing at signalized intersections when they hear the vehicular traffic in front of them stop and the traffic alongside of them begin to move.

Pedestrian countdown signal head
Photo Credit: Toole Design Group

Factors that limit accessibility for pedestrians with visual disabilities include: wide streets, intersections with complex geometry, roundabouts or traffic circles, right-turn-on-red (which masks the beginning of the through phase), continuous right-turn movements, complex signal phasing, traffic-actuated signals, exclusive pedestrian phasing where all vehicular traffic is stopped and pedestrians are allowed to cross diagonally, and increasingly quiet cars. Further, periods of low traffic volume make it difficult for pedestrians who have visual disabilities to discern signal phase changes.

APS's provide audible and/or vibrotactile information to help pedestrians with visual disabilities identify when the "WALK" phase occurs. The push buttons should be placed in convenient locations. Pedestrian actuation should be avoided when pedestrian crossings are frequent. Instead, locations with frequent pedestrian crossings should have an automatic walk cycle in order to reduce pedestrian delay. APS's are currently being tested at the intersection of East Glebe Road and Route 1 in the City of Alexandria.

Leading pedestrian interval

At signalized intersections with high pedestrian crossing volumes, the signals can be programmed to allow pedestrians to begin crossing 2 to 4 seconds before the vehicle traffic on the parallel street is given a green light. This low-cost treatment gives pedestrians enough time to cross to the middle of the street so that turning vehicles can see them, be aware of them, and yield to them before they receive a green light. It is also possible to use the LPI only during certain times of the day, such as between 7 a.m. and 7 p.m., whenever the highest numbers of pedestrians are typically present. A study of a three-second leading pedestrian interval (LPI) found that the LPI decreased conflicts between turning motor vehicles and increased the percentage of motorists that yielded to pedestrians in the crosswalk[12].

A leading pedestrian interval allows pedestrians to begin crossing before the vehicle traffic on the parallel street is given a green light. Photo Credit: Toole Design Group

Traffic signals with LPI have a longer all red phase, which may tempt drivers to take advantage of the extra time and run red lights. This type of behavior should be prevented through education and strict enforcement. Because the LPI has not been used in the City before, this treatment could be tested as a temporary treatment at test intersections. When considering the treatment, the following intersections should be evaluated: Mount Vernon Avenue & Russell Road, Mount Vernon Avenue & 4-Mile Road, King Street & Washington Street, Mount Vernon Avenue & Glebe Road, Duke Street & Cameron Station Boulevard, and Braddock Road & King Street, for 3 to 6 months to see how well it works for all modes.

[12] Van Houten, R., R. A. Retting, C. M. Farmer, J. Van Houten, and J. E. L. Malenfant. "Field Evaluation of a Leading Pedestrian Interval Signal Phase at Three Urban Intersections," Transportation Research Record 1734, 2000.

LED signs could also be tested for effectiveness at reducing conflicts between pedestrians and turning vehicles. The high-visibility LED signs could display the words, "TURNING VEHICLES MUST YIELD TO PEDESTRIANS", or a similar message. These signs could be used as an alternative or a complement to the LPI.

<u>Right-Turn-On-Red restriction</u>
Motorists are required by law to stop at red lights before making a permissive right-turn-on-red. Though the City of Alexandria currently uses two signs that state, "TURNING TRAFFIC MUST YIELD TO PEDESTRIANS" and "NO TURN ON RED WHEN PEDESTRIANS ARE PRESENT", motorists often roll through the stop (especially at intersections with wide turning radii) and focus only on the traffic approaching from their left. This may prevent them from seeing pedestrians crossing from their right. In addition, drivers often pull into the crosswalk to wait for a gap in traffic, blocking the path of pedestrians and putting them at risk of being struck by the vehicle[13].

No Turn on Red When Pedestrians are Present signs provide a clear message to drivers in locations with high pedestrian volumes.
Photo Credit: Toole Design Group

To address this problem, the City should require drivers to wait for the green light to turn right at intersections with high pedestrian volumes. "NO RIGHT TURN ON RED" signs should be used to provide a clearer message to drivers in locations with high pedestrian volumes. The existing signs can be kept to continue reminding drivers of their responsibility to yield to pedestrians when turning during a green light phase. It may be desirable for the City to test the right turn restriction at three to five intersections for 3 to 6 months and evaluate its impacts on all travel modes. The City could also experiment with applying the restriction only during certain times of day with more pedestrian activity, such as 7 a.m. to 7 p.m.

---

[13] Zegeer, C.V., Seiderman, C., Lagerwey, P., Cynecki, M., Ronkin, M. and Schneider, R. Pedestrian Facilities Users Guide: Providing Safety and Mobility, Federal Highway Administration, FHWA-RD-01-102, March 2002.

Pedestrian-activated traffic signal (mid-block)
At busy mid-block pedestrian crossings, pedestrian-activated traffic signals should be considered for regulating vehicular traffic. Extensive guidance and standards for pedestrian signal warrants are provided in the MUTCD (Section 4C). These signals are appropriate in locations with heavy pedestrian crossing activity and police-reported crashes. The City should conduct a detailed review of each intersection recommended for this type of traffic signal.

New High-Intensity Activated Crosswalk (HAWK) Signals should also be considered at mid-block locations where pedestrian-activated traffic signals are recommended in Alexandria. These signals allow the traffic light to stay green for roadway traffic until a pedestrian pushes the button. When the button is pushed, the traffic light turns to yellow and red like a typical traffic signal. When traffic receives the red light, the pedestrian signal provides the WALK indication to the pedestrian. After the pedestrian begins to cross and the flashing DON'T WALK indication starts, drivers are given a flashing red signal that allows the drivers to proceed as soon as the pedestrian clears the crosswalk and conditions are safe. The City of Alexandria should consult the MUTCD to help determine appropriate locations for this treatment. In locations where the HAWK signal is used, the City could do a study of driver expectations and conduct an educational campaign to help motorists and pedestrians understand how they should behave at this type of signal.

HAWK signals allow the traffic light to stay green for roadway traffic until a pedestrian pushes the button.
Photo Credit: Toole Design Group

Accessible pedestrian signals
As noted, it is the policy of the City of Alexandria to provide Accessible Pedestrian Signals (APS) at such locations as may be necessary to meet the mobility needs of persons with disabilities. These signals provide audible and/or vibrotactile information to help pedestrians with visual disabilities identify when the "WALK" phase occurs. The push buttons should be placed in convenient locations.

Pedestrian actuation should be avoided when pedestrian crossings are frequent. Instead, locations with frequent pedestrian crossings should have an automatic walk cycle in order to reduce pedestrian delay. Crossings with an automatic walk cycle may also be candidates for audible signals. Specific crossings should be evaluated by the city to determine if audible signals are needed to assist pedestrians with visual disabilities.

Signs

Driver awareness of pedestrians at crossings can be enhanced by pedestrian warning signs and by clear sight lines to pedestrians in and approaching crosswalks. Crosswalks can be enhanced by new high-visibility pedestrian warning signs and in-roadway pedestrian crossing warning signs. Sight-distance improvements for pedestrians should also be made as a part of all roadway reconstruction projects. These treatments are described below.

High-visibility pedestrian warning signs can increase driver awareness of pedestrians, especially in areas where pedestrians may not be expected.

<u>High-visibility pedestrian warning signs</u>

High-visibility pedestrian warning signs are recommended at several important pedestrian crossing locations in Alexandria. These signs can increase driver awareness of pedestrians, especially in areas where pedestrians may not be expected. A fluorescent yellow/green color is approved in the national Manual on Uniform Traffic Control Devices and can be used on these signs (the W11-2 Pedestrian Crossing Sign). According to the MUTCD, these signs "should only be used at locations where the crossing activity is unexpected or at locations not readily apparent." These signs will be most effective when combined with other treatments, such as marked crosswalks, curb extensions, median islands, etc. Flashing lights can also be used, in appropriate situations, to grab the attention of drivers. The City can also experiment with using pedestrian and bicycle crossing warning signs at shared-use path crossings. Signs should be used judiciously—too many signs can cause visual clutter and lead to non-compliance.

<u>In-roadway pedestrian crossing warning signs</u>

In-roadway pedestrian crossing signs are bright yellow signs placed in the middle of the road at marked crosswalks[14,15,16]. These signs are included in Section 2B.12 of the Manual on Uniform Traffic Control Devices (MUTCD). They remind drivers of their responsibility to yield to pedestrians in the crosswalk by stating, "STATE LAW—YIELD TO PEDESTRIANS IN CROSSWALK." These signs are already being used at pedestrian crossings on Mount Vernon Avenue in Alexandria. In-roadway pedestrian crossing signs may also be more effective when accompanied by other facilities, such as high-visibility crosswalks and curb extensions. In-roadway pedestrian crossing signs should not be used at signalized intersections (per MUTCD).

In-roadway pedestrian crossing signs are bright yellow signs placed in the middle of the road at marked crosswalks.
Photo Credit: Toole Design Group

<u>Sight-distance improvements</u>
Sight-distance obstructions can increase the risk of pedestrians being struck by vehicles at roadway crossings. Several of the locations recommended for pedestrian crossing improvements in Alexandria have landscaping, light poles, bus stop shelters, and other features obstructing the line of sight between drivers and pedestrians. While these features can make a street more attractive and serve other valuable functions, they should be placed in locations that do not obscure drivers' views of pedestrians.

The City should evaluate sight-distance obstructions as a part of all roadway projects. It should make physical changes to address them, as appropriate.

Lighting

Improving roadway lighting, especially at pedestrian crossings, has been shown to reduce nighttime pedestrian crashes. Pedestrians are adversely affected by low-light conditions: two-thirds of pedestrian fatalities occur between dusk and dawn. Roadway lighting should illuminate all pedestrian crosswalks (standard street lamps should be provided at each end of the crosswalk). Street lights placed on high poles that only illuminate part of an intersection are not adequate. Pedestrian lighting should also be provided along sidewalk segments, especially when there are dark areas on long blocks between intersection lights. Better lighting will also help improve the personal security of pedestrians walking in Alexandria at night. Pedestrian lighting should be designed in accordance with the City of Alexandria

[14] City of Madison, Wisconsin Department of Transportation, Traffic Engineering Division, "Year 2 Field Evaluation of Experimental 'In-Street' Yield to Pedestrian Signs," Submitted to FHWA 1999.
[15] H.F. Huang, C.V. Zegeer, R. Nassi, and B. Fairfax. "The Effects of Innovative Pedestrian Signs at Unsignalized Locations: A Tale of Three Treatments," FHWA, FHWA-RD-00-098, 2001, available online at: www.tfhrc.gov/safety/pedbike/pubs/00-098.pdf
[16] Ercolano, J. "Pedestrian Crossing Devices," Case Study #28 in PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System, FHWA, FHWA-SA-04-003, September 2004.

lighting specifications and be included as a part of all developments and roadway reconstruction projects.

Preferred pedestrian-scale lighting is characterized by shorter light poles (i.e. 16-foot tall posts), lower levels of illumination (except at crossings), shorter spacing between lamp posts, and lamps that produce a better color definition and "white light" to areas with higher pedestrian volumes.

Transit Access Improvements

Pedestrian safety and access is vital to the success of bus and rail transit in Alexandria. To access a transit stop or station, most people travel at least a short distance by foot, wheelchair, or other assistive device. Adequate sidewalks, pathways, and roadway crossing treatments in the area around transit access points are critical for the safety and convenience of transit customers.

Concrete pads, benches, shelters and lighting improve safety and convenience of transit customers.
Photo Credit: Toole Design Group

Sidewalk connections to bus stops roadway crossing improvements near transit stops and stations are included in the recommendations discussed above. This section describes concrete pad, bench, shelter and lighting facility improvements for transit stops.

<u>Concrete Pads</u>
A level landing area of at least eight feet in length and five feet in depth must be provided at all bus stops to meet ADA accessibility requirements. Many bus stops in the City have landing areas, but there are several that need new pads installed. When these pads are installed, they should include an accessible connection to the sidewalk system.

<u>Benches and Shelters</u>
Benches and shelters should be provided at appropriate bus stop locations to make it more comfortable for pedestrians to wait for the bus. New benches and shelters are recommended at bus stops that are currently used by a large number of pedestrians or have the potential to serve many pedestrians in the future. DASH and Metro bus boarding data were used to select high-use bus stops for bench and shelter improvements.

<u>Transit Stop Lighting</u>
Lighting should be improved transit stops and stations to increase the comfort and security of customers waiting for the bus or train. Lighting should be evaluated by the City and DASH

and improved, where needed. This evaluation should focus on transit stops and stations that have high levels of use or have problems with crime.

Shared-Use Pedestrian and Bicycle Facility Types

Several types of recommended pedestrian facilities are shared with bicyclists, in-line skaters, and other non-motorized users. These shared-use path, sidepath, and grade separation facilities are described below.

It will be critical for the City to retrofit and design new shared-use paths, sidepaths, and grade-separated facilities so that conflicts between pedestrians and bicyclists and other users are minimized. The city should apply the FHWA Shared Use Path Level of Service methodology[17] to congested shared-use path segments to identify sections that are congested and should be widened. Special attention should be given to trail sections with high use by both pedestrians and bicyclists, since these two types of trail users have different speeds and characteristics.

Specific shared facilities recommended in Alexandria include new shared-use paths, sidepaths, and grade-separated facilities.

<u>Shared-Use Paths</u>
Shared-use paths (also referred to as multi-use trails) are an important component of Alexandria's pedestrian and bicycle transportation system. Shared-use paths are usually paved and should be a minimum of 10-feet wide. Minimum width may be reduced to eight feet where physical or right-of-way constraints are severe. Path widths of 12, 14, and even 16 feet are appropriate in high-use urban situations and areas with a significant mix of pedestrian and bicycle traffic.

Holmes Run Trail
Photo Credit: City of Alexandria

[17] The FHWA Shared Use Path Level of Service methodology determines the level of comfort on a trail from a bicyclist's perspective. The model uses trail width, total number of users, and percentage of different user types to estimate the amount of delay that bicyclists will experience in passing other trail users.

Alexandria also has several unpaved shared-use paths. These paths provide excellent places for walkers, hikers, runners, and mountain bicyclists to explore. It is important for the City to maintain sufficient width and surface quality on these pathways.

Existing conditions of shared-use paths in Alexandria, including surface type, surface condition, width, and maintenance needs (e.g., overgrown bushes, drainage problems, fallen trees, surface defects, etc.) were evaluated in the field.

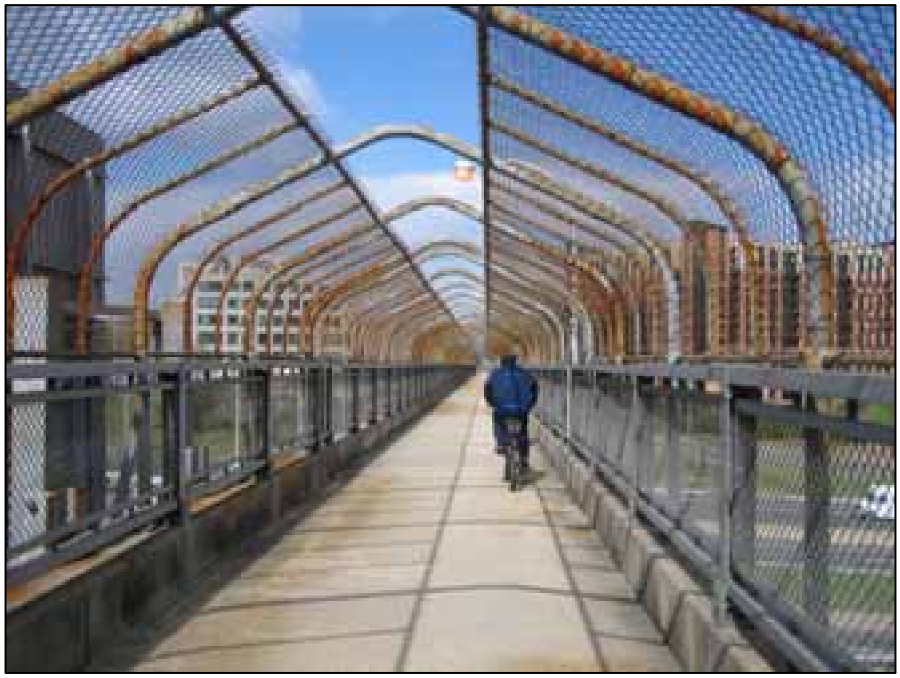
Sidepaths

Sidepaths are wide sidewalks that are intended for shared pedestrian and bicycle use. Ideally, sidepaths are provided on both sides of the roadway and bicyclists use the paths as one-way facilities (traveling in the same direction as adjacent motor vehicle traffic). Due to right-of-way and budget constraints, sidepaths are often provided only on one side of the roadway. These facilities are only used in a few locations, sidepaths should be designed to reduce conflicts between pedestrians and bicyclists. Sidepaths can function well if some of the following key design features can be achieved:

Sidepaths are wide sidewalks that are intended for shared pedestrian and bicycle use.
Photo Credit: City of Alexandria

- Sufficient width is available to build a facility with at least a five-foot buffer between the outside travel lane and edge of pathway (a 42-inch vertical barrier also acceptable).
- The path can be located in an area where conflicts with crossing roadways and driveways (which may or may not be signalized) can be minimized. Paths work particularly well where they are parallel to expressways and railroad rights-of-way because they are limited access in nature. However, paths parallel to expressways must be designed carefully – grade separation is preferred at freeway interchanges.
- Crossings of free flow ramps can be avoided, minimized, or made sufficiently safe.
- Conflicts between pedestrians and bicyclists are minimized by having adequate width, clear space at the side of the path, and sight distance at locations where pedestrians cross or enter the facility.

Overpasses and Underpasses



Overpasses and underpasses separate pedestrian and bicycle traffic from motor vehicle traffic
Photo Credit: Toole Design Group

Overpasses and underpasses separate pedestrian and bicycle traffic from motor vehicle traffic, allowing pedestrians and bicyclists to cross busy streets without potential conflicts. Because they are expensive to construct, they should be reserved for locations where there is a high demand for pedestrian and bicycle crossings and the danger of crossing the roadway is high (the bridge over I-395 between Alexandria and Shirlington at Gunston Road is a good example). Ideally, overpasses and underpasses should take advantage of the topography at a site—grade separations are less expensive to construct and more likely to be used if they can help pedestrians and bicyclists avoid going up and down slopes, ramps, and steps. If overpass ramps add significant distance to the route of a pedestrian or bicyclist, they are less likely to use the facility, and they may choose to risk crossing at grade. Adequate width (for users to pass each other comfortably), lighting, and surveillance should also be provided to increase security of these crossings.

Roadways Designated for Non-Motorized Use

There are several roadways in Alexandria, for example Union Street and King Street, which have very high levels of pedestrian and bicycle activity, especially on weekends and during the summer. These roadways are open to motor vehicle traffic at all times. This can cause potential conflicts between motorized and non-motorized users. The City has in the past closed portions of roadways to motorized traffic at certain times that regularly experience high pedestrian and bicycle use. For example the City has previously closed King Street from Fairfax Street to Union Street to motor vehicles on weekends.

The City may wish to consider limiting access to motor vehicles on streets with high pedestrian and bicycle activity. As it explores this possibility, it will be essential to gather input from local residents and businesses. Impacts on traffic flow and parking should be evaluated. In order to allow access to businesses and homes, it may be possible to close streets to through motor vehicle traffic, but still allow cars and trucks to park on the closed streets. Parking permits for local employees and residents could be considered as a part of this solution. Union Street is an example of a street where motor vehicle access could potentially be limited, but not eliminated entirely, to improve pedestrian and bicycle mobility.

Bicycle Facility Types

This plan presents recommendations for more than 60 miles of bikeways to connect activity destinations throughout the City of Alexandria. These bikeways will also connect to the bicycle systems in Fairfax and Arlington Counties and across the Woodrow Wilson Bridge into Maryland. The Bicycle Facility Network includes locations throughout the City where specific improvements have either already been made or are proposed in the future to accommodate bicycles. Almost all Bicycle Facility Network segments will have some type of visible cue (i.e. a bike lane, a bike route sign, a pavement marking, a trail, etc.) to indicate that special accommodations have been made for bicyclists. While the network will provide primary routes for bicycling, it is important to note that, by law, bicyclists are permitted to use *all* roadways in Alexandria (except limited access freeways or where bicycles are otherwise prohibited). Therefore, the Bicycle Facility Network will serve as a core system of major routes that can be used to safely access all parts of the City and other parts of the transportation system. The completed Bicycle Facility Network will connect all parts of the city.

The Bicycle Facility Network includes the following types of improvements:

Facilities for network segments:
- Bicycle lanes
- Climbing lanes
- Shared lane markings
- Shared-use paths
- Bicycle boulevards
- Shared roadways
- Bridge facilities

Facilities for roadway crossings:
- Signalized intersections (adding traffic signals)
- Pedestrian crosswalk signals (with appropriate elements to facilitate bicycle crossings)
- Bicycle boxes
- Curb extensions
- Median crossing islands
- Overpasses and underpasses
- Warning signs

Portions of the Bicycle Facility Network identified as "early action" are recommended to be implemented in the next three years. Other segments of the network will require a longer period to implement due to their higher complexity.

A Network to Meet the Needs of Different Types of Bicyclists
The recommended Bicycle Facility Network includes a variety of facility improvements that respond to the many different issues faced by bicyclists. Some parts of the Network are located along independent corridors that are separated from roadways. Other parts of the network will require motorists and bicyclists to coexist in the same right-of-way. Even among

"on-road" bikeways, there are a variety of different design treatments that will be used, depending on whether the roadway is a quiet neighborhood street versus a busy arterial street.

There are important reasons for providing a mix of bicycle facility types:

- Alexandria is a built environment with a finite number of corridors that can accommodate shared-use paths. Consequently, bicyclists need access to the roadway system in order to create an interconnected system and to be able to reach all desired destinations.
- Different types of bicycle facilities are appropriate in different situations, depending on surrounding land use characteristics, available right-of-way space, traffic volume, traffic speed and composition, on-street parking, roadway grade, etc.
- Depending upon an individual bicyclist's level of experience, some types of bikeways are preferred over others. For example, new bicyclists tend to prefer off-road shared-use paths and quiet neighborhood streets. More experienced bicyclists usually prefer on-road bicycle facilities such as bike lanes, wide curb lanes, paved shoulders, etc. Sometimes, more experienced bicyclists avoid using trails because they are crowded with other users.

For these reasons, the Bicycle Facility Network is composed of a variety of different facility types that can realistically be implemented and will appeal to bicyclists with varying levels of experience.

Facilities for Network Segments

The Bicycle Facility Network includes a variety of on- and off-road bicycle facilities. On-road bicycle facilities serve several purposes, including designating roadway space for bicyclists, channelizing motor vehicles and bicyclists, making bicyclist movements more predictable, indicating the proper direction for bicyclists to travel on the roadway, and indicating the optimal location on the street for riding at mid-block locations and when approaching intersections. Off-road bicycle facilities, including multi-purpose trails, provide a space for bicyclists to be physically separated from roadway traffic. The specific type of facility that is recommended on each segment of the network depends on a wide range of factors, including:

- Surrounding land uses and connectivity to destinations
- Existing right-of-way space
- Number of travel lanes
- Travel lane width
- Traffic volume
- Traffic speed
- Traffic composition (presence of buses and large trucks)
- Presence of on-street parking
- Pedestrian activity

Bicycle facilities recommended for on-road and off-road segments in the Bicycle Facility Network are described below. These facilities should be designed according to the standards in the AASHTO *Guide for the Development of Bicycle Facilities*[18].

[18] American Association of State Highway and Transportation Officials. *Guide for the Development of Bicycle Facilities*, 1999.

On-Road Bicycle Facilities

The Recommended On-Road Bicycle Facilities Map shows specific locations where bicycle lanes, climbing lanes, shared lane markings, wide outside lanes, paved shoulders should be installed in the Bicycle Facility Network (see Figure R12). The individual facility components of the Bicycle Facility Network are described below.

A bicycle lane is a portion of the roadway that has been designated for the preferential use of bicyclists.
Photo Credit: Toole Design Group

<u>Bicycle Lanes</u>

A bicycle lane is a portion of the roadway that has been designated by striping, signing[19], and/or pavement markings for the preferential use of bicyclists. The minimum width for a bicycle lane next to parked cars is five feet (four feet if next to a curb). Bicycle lanes include a bicycle pavement marking with an arrow to indicate that bicyclists should ride in the same direction as adjacent motor vehicle traffic. These facilities are recommended for arterial roadways in Alexandria. Bicycle lanes can provide the following benefits:

- Increase the comfort of bicyclists on roadways
- Increase the amount of lateral separation between motor vehicles and bicycles
- Indicate the appropriate location to ride on the roadway with respect to moving traffic and parked cars, both at mid-block locations and approaching intersections
- Increase the capacity of roadways that carry mixed bicycle and motor vehicle traffic
- Increase predictability of bicyclist and motorist movements
- Increase drivers' awareness of bicyclists while driving and when opening doors from an on-street parking space

When on-street parking exists, bicycle lanes should be designed so that bicyclists are encouraged to ride far enough away from parked cars so that they are not at risk of being struck by opening doors. Further, bicycle lanes should not be placed between parked cars and the curb, for the following reasons:

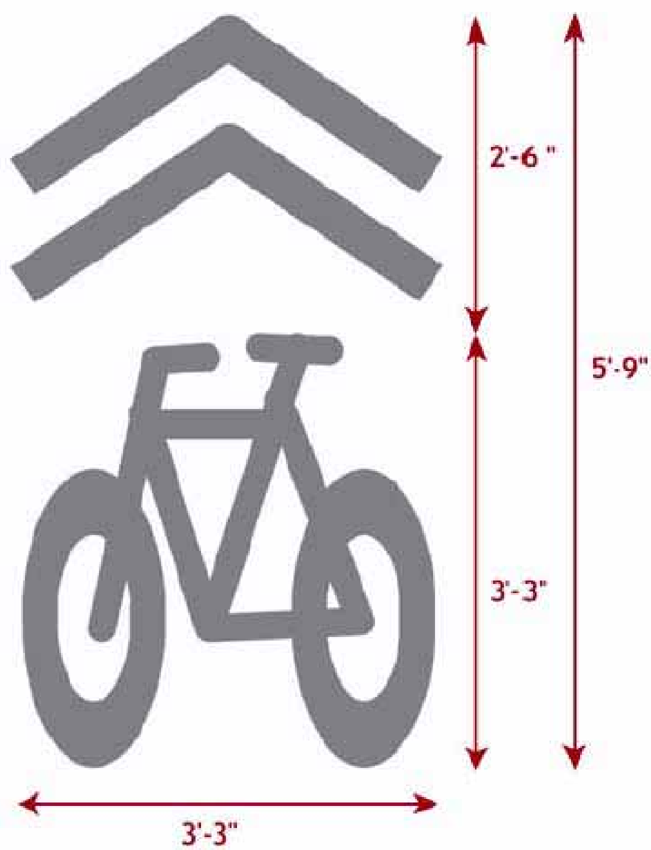
[19] The National Committee on Uniform Traffic Control Devices (NCUTCD) voted unanimously, at the January 20th, 2006 committee meeting, to allow jurisdictions the flexibility to designate bicycle lanes without bicycle lane signs (R3-17) – striping will be sufficient to designate bicycle lanes.

- Motor vehicles entering the arterial roadway from a side street must cross through bicycle traffic to view arterial roadway traffic around the parked cars. This takes driver attention away from bicyclists and blocks bicyclists.
- Drivers of motor vehicles crossing or turning from or to the road with bicycle lanes are primarily focused on motor vehicle traffic on the roadway. Bicyclists in the bike lanes are not in their primary line of sight.
- To make a left turn, bicyclists must merge into the travel lanes from behind a line of parked cars, creating a situation with poor sight lines between motorists and bicyclists. If parking is fully-utilized, this may not even be possible.
- Motor vehicle passengers are not accustomed to looking for bicyclists when they open their doors on the right side of the vehicle.
- If the facility is a two-way bicycle pathway, bicyclists are encouraged to ride in the opposite direction of adjacent motor vehicle traffic, making them vulnerable to motor vehicle drivers who only look to their left when turning right from a side street.
- Roadway space is not used efficiently. Roadways with on-street parking require some space for car doors to open safely. When one line of cars is moved away from the curb to make room for the bicycle facility, several feet of shy distance (e.g., lateral space) are needed on both sides of that line of parked cars, rather than just on the drivers' side. Overall, more roadway space is needed for car doors to open, so less space can be used for other purposes.

Shared Lane Markings

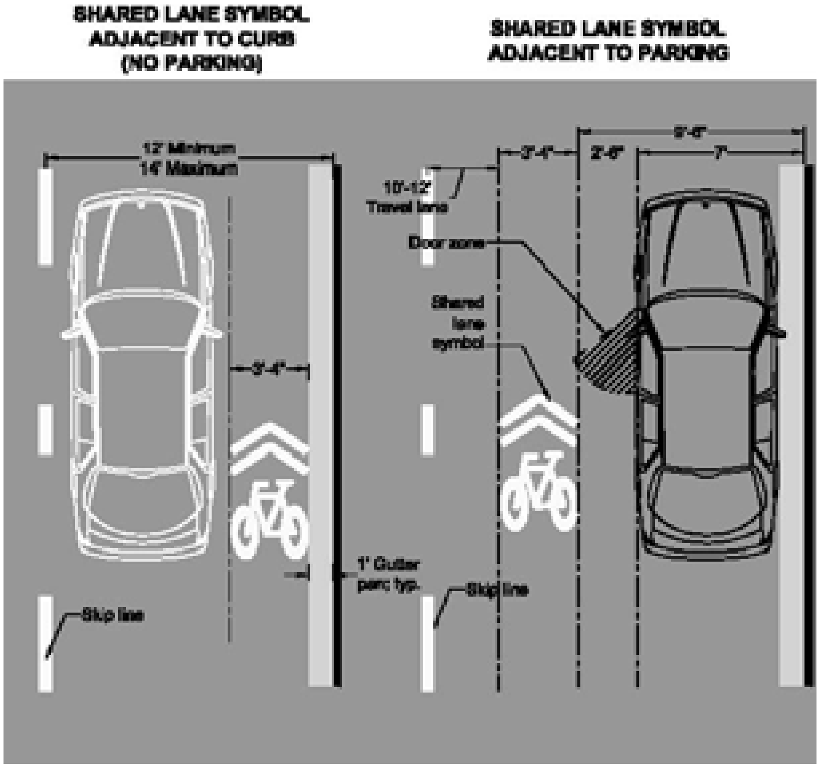
Shared lane markings are bicycle symbols that are placed within a vehicular travel lane of the roadway. Unlike bicycle lanes, they do not designate a particular part of the roadway for the use of bicyclists. The bicycle symbols used in shared lane markings include chevrons pointing in the direction of motor vehicle traffic to indicate that bicyclists should also ride in this direction. Shared lane markings have the following benefits:

- Provide a visible cue to bicyclists and motorists that bicycles are expected and welcomed on the roadway
- Indicate the most appropriate location to ride on the roadway with respect to moving traffic and parked cars
- Can be used on roadways where there is not enough space for standard width bicycle lanes
- Connect gaps between other bicycle facilities, such as a narrow section of roadway between road segments with bicycle lanes



Shared lane markings are bicycle symbols that are placed within a vehicular travel lane of the roadway.

Shared lane markings will be used most commonly on arterial roadways. However, the city may experiment with and develop a protocol for using these markings on non-arterial roadways.



Shared lane markings indicate the most appropriate location to ride on the roadway with respect to moving traffic and parked cars.

Shared lane markings indicate the most appropriate location to ride on the roadway with respect to moving traffic and parked cars.

<u>Climbing Lanes</u>
Climbing lanes are a hybrid bicycle facility that includes a five-foot bicycle lane on one side of the roadway (typically in the uphill direction) and a shared lane marking on the other side of the roadway. This allows slower-moving, uphill bicyclists to have a designated bicycle lane space and allows motor vehicles to pass more easily. It also allows faster-moving, downhill bicyclists to have a shared-lane marking, which alerts motorists to expect faster-moving bicyclists in the travel lane, further from parked cars. The bicycle lane and shared lane markings also indicate the proper direction for bicyclists to travel on either side of the street. This type of facility is particularly applicable in Alexandria in locations with steep grades.

Bicycle Boulevards

Bicycle boulevards are non-arterial streets that are designed to allow bicyclists to travel at a consistent, comfortable speed along low-traffic roadways and to cross arterials conveniently and safely. This is achieved by introducing treatments that allow bicyclists to travel along the bicycle boulevard with minimal stopping while discouraging motor vehicle traffic. Traffic calming and traffic management treatments such as traffic circles, chicanes, and diverters are used to discourage motor vehicles from speeding and using the bicycle boulevard as a cut-through. Quick-response traffic signals, median islands, or other crossing treatments are provided to facilitate bicycle crossings of arterial roadways.

Bicycle boulevards allow bicyclists to travel along the road with minimal stopping while discouraging motor vehicle traffic.
Photo Credit: Toole Design Group

The city should look to other jurisdictions for examples of bicycle boulevard marking and signing. There is currently no national consensus or best practice for identifying bicycle boulevards. Some jurisdictions utilize signs only, markings only, or a combination of each. It is recommended that a prototype design be developed and evaluated along a two- to three-block section of roadway in Alexandria.

Shared Roadways

Shared roadways are regular streets without any designated bicycle facilities. Many local streets with low traffic volumes and low speeds are already good places for bicyclists to ride because they are quiet streets. Roadway striping and markings are not necessary to make these streets comfortable for most bicyclists to use. Many of Alexandria's arterial roadways are also currently shared roadways, but appropriate facilities described above should be added to the arterial roadways to make them more comfortable for bicycling.

Wide Outside Lanes

Wide outside travel lanes are typically designed to be 13- to 15-feet wide. This width allows most motor vehicles to pass cyclists within the travel lane, which is not possible in more typical 10- to 12-foot wide travel lanes. Wide outside travel lanes on arterial roadways are generally acceptable for experienced cyclists, but less-experienced bicyclists may not feel comfortable on this type of facility. These travel lanes do not provide the benefit of having a striped area that is exclusively for the use of bicyclists, a feature that bicyclists with all levels of riding experience have reported as desirable[20]. Wide outside lanes also do not have markings to indicate where bicyclists should be positioned when passing through an intersection with a right-turn lane.

Bus/Bike Only Roadways
As Alexandria develops its transit system over the next 10 years, there may be some roadways that are designated for buses only (possibly during peak travel times). If bus-only roadways are planned, the City should work with transit agencies to ensure that the roads are also open to bicycles. It is preferable to have wide outside lanes on these roadways to create safe bus and bicycle passing opportunities.

Shared Bus/Bike Lanes
Exclusive bus lanes are likely to be added to City roadways as Bus Rapid Transit corridors are developed. In appropriate locations, these lanes can create car- and truck-free space for both transit vehicles and bicycles. If bus/bike-only lanes are developed, it is desirable for the lanes to be wide enough for buses and bicyclists to pass each other comfortably in the lane. The locations and design of shared bus/bike-only lanes will need to be evaluated on a case-by-case basis.

If bus-only roadways are planned, the City should work with transit agencies to ensure that the roads are also open to bicycles.
Photo Credit: Toole Design Group

Off-Road Bicycle Facilities

Shared-use paths, sidepaths, and grade-separated facilities are all important components of the recommended Bicycle Facility Network. Detailed descriptions and recommended locations for these facilities are included in the Pedestrian Facility Recommendations section above. Additional descriptions of their application for bicycle transportation are provided below. All of these facilities require bicyclists to share space with pedestrians. Bicyclists must use caution when riding near pedestrians on these facilities, including yielding the right-of-way to pedestrians, giving pedestrians sufficient space when passing, providing audible warnings to pedestrians before passing.

Shared-Use Paths
Shared-use paths can provide a high-quality bicycling experience because they are separated from motor vehicle traffic and often provide access through parks and adjacent to water bodies. They should be designed with adequate width to accommodate existing and future levels of pedestrian and bicycle traffic safely.

[20] Landis, Bruce W. et.al. "Real-Time Human Perceptions: Toward a Bicycle Level of Service" *Transportation Research Record 1578*, Transportation Research Board, Washington, DC 1997.

Sidepaths

Sidepaths are essentially shared-use paths that are located on the side of a roadway. Ideally, sidepaths are provided on both sides of a roadway and bicyclists use them as one-way facilities (traveling in the same direction as adjacent motor vehicle traffic on the roadway). However, sidepaths are often located only on one side of a road and are intended to provide two-way bicycle and pedestrian travel. Sometimes this type of facility is the only option in a narrow roadway corridor. Special attention will be required in the design process to improve bicycle safety on sidepaths, since these facilities can create potential conflicts with motorists at roadway and driveway crossings.

Sidepaths are shared-use paths that are located on the side of the roadway. Photo Credit: Toole Design Group

Overpasses and Underpasses

Overpasses and underpasses can provide important linkages to increase the connectivity of the Bicycle Facility Network in the future. In addition to allowing bicyclists to cross busy streets without potential conflicts, they can help avoid long and sometimes hilly detour routes around railroad and highway corridors.

Roadways Designated for Non-Motorized Use

Limiting motor vehicles access on certain roadways could potentially improve bicycle conditions in the City. Bicyclists would still need to use caution near pedestrians and at roadway intersections. For example, limiting motor vehicle access on Union Street could potentially improve access to the Mount Vernon Trail through Alexandria. This would be likely to increase the trail's popularity in the region. This City could consider making Union Street a priority street for pedestrians and bicyclists by allowing local motor vehicle traffic, while discouraging through traffic.

Use of Sidewalks for Bicycling

While bicycling on sidewalks is allowed in the City of Alexandria, bicyclists should use extreme caution on these facilities. They should not travel faster than the design speed of the sidewalk (which is often the speed of a typical jogger). Bicyclists should always yield to pedestrians, ride very cautiously near pedestrians, and use audible cues to alert pedestrians of their presence on sidewalks. Bicyclists should ride in the same direction as adjacent motor vehicle traffic and be aware of potential conflicts with motor vehicles at intersections. However, sidewalks may be useful for bicycling for a number of reasons:

- Bicycle access is needed but bicycle volumes and/or pedestrian volumes are expected to be low.
- Right-of-way is constrained or there are traffic safety concerns (high speeds, high volumes, lots of trucks)—a sidewalk may be the best option in this type of location for many bicyclists, especially if they are traveling up a steep hill.

Bicyclists should use extreme caution when bicycling on sidewalks. Photo Credit: Toole Design Group

Sidewalks that are expected to be used by bicyclists should be designed to accommodate separated, one-way bicycling on each side of the road so that bicyclists can safely and easily transition to and from the road at each end of the segment. Sidewalk bike routes should not result in bicyclists riding opposed to motor vehicle traffic when they re-enter the street. In addition, sidewalks that are expected to serve bicycle travel should be a minimum width of six feet for one-way bicycle travel and a minimum of eight feet if two-way bicycle travel is likely.

Further Study Required

There are several roadways in the Bicycle Facility Network that have poor conditions for bicycling, but do not have straightforward opportunities to include bicycle facilities by striping narrower lanes, removing lanes, adding shoulders, or making other physical improvements due to right-of-way constraints and traffic volumes. Some of these roadways represent critical connections between major destinations in the Bicycle Facility Network. In order to make recommendations on how to improve these roadways for bicyclists, the city will need to conduct additional, detailed studies that are beyond the scope of this plan.

Transitions Between Different Bicycle Facility Types

Due to existing roadway conditions, surrounding land uses, available right-of-way, and other characteristics, it is often necessary to use different bicycle facilities to provide bicycle access within the same bikeway corridor. It is important for the city of Alexandria to provide transitions between different facilities. These transitions can be made safer and more understandable for bicyclists and motorists with appropriate treatments, such as spot directional signs, warning signs, pavement markings, curb cuts, etc. An example of a transition treatment could be shared lane markings and appropriate warning signs on a facility where a bicycle lane ends and the roadway continues. Transitions should be provided as a part of the bicycle facility design process.

Facilities for Bicycle Roadway Crossings

Roadway crossings are critical to the safety and continuity of the Bicycle Facility Network. Alexandria has a number of multi-lane streets that carry high-speed, high-volume traffic, such as Duke Street, Van Dorn Street, King Street, and Jefferson Davis Highway. Many other arterial streets are also challenging to cross, particularly during peak travel periods. In order to make it possible for bicyclists to travel throughout the City, there must be safe places to cross these major streets. The section below describes the types of treatments that are recommended to help bicyclists cross these roadways. Selection of the appropriate roadway crossing treatment depends on a number of factors:

- Roadway width
- Motor vehicle traffic volumes
- Motor vehicle speed
- Sight-distance
- On-street parking
- Presence of traffic signals at the intersection or at nearby intersections
- Presence of a signed bicycle route or bicycle boulevard

An appropriate combination of physical improvements should be recommended for each crossing location in the Bicycle Facility Network. These crossing improvements include traffic signals, geometric improvements, signs, and markings. Many of the crossing improvements that serve pedestrians will also benefit bicyclists. Therefore, many of the roadway crossing facility improvements for bicyclists are described in the Pedestrian Facility Recommendations section above. This section focuses on crossing facilities that are more specific to bicyclists.

Bike boxes are installed to allow bicyclists to move in front of cars waiting at an intersection. Photo Credit: Toole Design Group

Specific types of recommended crossing improvements for bicyclists include bicycle boxes at intersections, bicycle lane pockets at intersections, bicycle-oriented traffic signal timing, and automatic bicycle detection at signalized intersections. These facilities are described below and shown on the Recommended Bicycle Crossing Improvements Map (see Figure R13).

<u>Bike Box at Intersection</u>

Bike boxes are installed to allow bicyclists to move in front of cars waiting at an intersection to increase their visibility and reduce conflicts with turning vehicles. They are typically used at intersections where bicyclists need to turn left and/or many vehicles turn right. During a red signal phase, bicyclists are able to better position themselves for a left turn by moving left across the bike box.

Through bicycle lane on intersection approach

When adequate width is available at intersections with right-turn lanes, a bicycle lane should be provided to the left side of the right-turn lane. It is beneficial to have this designated lane for bicyclists to show them the appropriate positioning for traveling straight through the intersection and to remind right-turning drivers that they should yield to through-bicyclists before entering the right-turn lane. Bicycle lane pockets can be provided at intersections even when a street does not have continuous bicycle lanes. In some cases, bicycle lanes are dropped to provide dedicated turning lanes. Clear markings and/or signage should be provided prior to the turn lane to indicate appropriate merging behavior to bicyclists and drivers.

Left-turn bicycle lane pocket on intersection approach

Left-turn bicycle lane pockets are either provided as the only lane where legal left-turns are permitted or on the right side of a motor vehicle left-turn lane. At unsignalized intersection approaches, left-turn pockets can be provided to allow bicyclists to wait in a designated space for a gap in traffic before turning left. These pockets are particularly beneficial on roadways with relatively high traffic volumes and significant bicycle turning movements. Locations with raised medians provide good opportunities to add these pockets. At signalized intersection approaches, left-turn bicycle lane pockets can be also be added, where appropriate.

Left-turn pockets can be provided to allow bicyclists to wait in a designated space for a gap in traffic before turning left. Photo Credit: Toole Design Group

Bicycle-oriented traffic signal timing

Traffic signal timing should consider all modes including bicycling. Therefore, all traffic signals should facilitate safe bicycle crossings. This includes providing a minimum green time and a minimum yellow time to ensure that bicyclists are able to clear intersections, per the AASHTO *Guide for the Development of Bicycle Facilities*. This is particularly important on signed bicycle routes because less-experienced riders are expected to use them. It is important to ensure that signal timing for bicycle crossings also facilitates safe pedestrian crossings.

Automated bicycle detection at signalized intersections
At some signalized intersections, the traffic on the minor street approach is not given a green light until a sensor (typically an inductive loop) detects a vehicle. The City should ensure that all sensors at actuated traffic signals can detect bicycles. In the future, the City should explore new automated detection technologies such as infrared or video sensors that can tell the difference between bicycles and motor vehicles. Automated bicycle detection systems can also be designed to collect intersection bicycle counts.

Bicycle Parking Facilities

Racks and lockers should be provided at key destinations in Alexandria so that bicyclists have secure places to park their bicycles. This section describes bicycle parking facilities. Specific sites for racks and lockers are shown on the Recommended Bicycle Parking Facilities (see Figure R14).

Bicycle Racks
Bicycle racks typically provide short-term (a few hours) bicycle parking in locations that are convenient to stores, parks, bus stops, and transit stations. Though bike racks are currently provided at several locations in Alexandria, there are many destinations that do not have racks available. [Citizens may request racks through the Bicycle Rack Request Program]. The City of Alexandria will coordinate with WMATA, DASH, retail businesses, schools, and other organizations in the City to identify additional locations where bicycle racks can be provided. Bicycle racks should be installed according to City of Alexandria specifications.

U-shaped bicycle racks can provide short-term bicycle parking at train stations, bus stops, stores, parks, schools, and other locations. Photo Credit: Toole Design Group.

Bicycle Lockers
Bicycle lockers are usually used for longer-term bicycle parking (entire day or several days) and provide greater protection for bicycles. Currently, there are several lockers available at Metro rail stations in Alexandria. It will be important to coordinate with WMATA to evaluate the potential demand for bike parking near these transit stations and future Smart Stations to determine if more bike lockers should be provided. Bike lockers could also potentially be installed at some schools and parks in Alexandria.

Justification for Key Pedestrian and Bicycle Facility Design and Policy Recommendations

This section describes the reasoning behind several important pedestrian and bicycle facility design and policy concepts in the Plan. While this part of the appendix does not address all issues in the Plan, it provides background information and research for many of the pedestrian and bicycle facility and policy questions that are commonly raised in communities.

Sidewalks on Both Sides of Roadways
Sidewalks should be provided on both sides of all arterial, collector, and local streets (with the exception of short cul-de-sacs or dead-end streets.

Justification

All streets should have some type of walking space out of the vehicular travelway. When a sidewalk is provided on only one side of the street, pedestrians traveling on the opposite side may not cross to the sidewalk, and may instead elect to walk in the roadway. This creates an uncomfortable and potentially hazardous situation. If pedestrians do cross, they increase their exposure to vehicular traffic. Though it may be appropriate for some streets in developing areas to temporarily have a pedestrian walkway only on one side, sidewalks on both sides are necessary for pedestrian-compatible roadways. A research study of pedestrians' perceptions of walking along different types of roadway segments found that sidewalk presence has a significant positive effect on pedestrians' feelings of safety and security while walking along roadways (1). Further, an analysis of 47 pedestrian crash sites and 94 comparison sites found that the absence of sidewalks was associated with a significantly higher likelihood of pedestrian crashes (2).

Decisions on whether to provide a sidewalk should not be based on existing pedestrian volumes because they are not a reliable indication of pedestrian demand. Individuals tend to walk more in locations where continuous connections are provided. A lack of pedestrian activity in a location with discontinuous sidewalks is not necessarily an indication of a lack of pedestrian demand.

1. Landis, B.W., V.R. Vattikuti, R. M. Ottenberg, D.S. McLeod, M. Guttenplan. "Modeling the Roadside Walking Environment: Pedestrian Level of Service," *Transportation Research Record 1773*, Transportation Research Board, National Academy of Sciences, 2001.

2. McMahon, P.J., C.V. Zegeer, C. Duncan, R.L. Knoblauch, J.R. Stewart, and A.J. Khattak. *An Analysis of Factors Contributing to "Walking Along Roadway" Crashes: Research Study and Guidelines for Sidewalks and Walkways*, Federal Highway Administration, FHWA-RD-01-101, February 2002.

Minimum Sidewalk Width
Sidewalks should have a minimum width of five feet.

Justification

A five-foot sidewalk width is very important, as it enables two people to walk side by side, which is not possible on 4-foot wide sidewalks. Many other jurisdictions have increased their minimum sidewalk width to 5 feet. In addition, new rules that will be issued by the U.S. Access Board in the near future will require that 4-foot sidewalks provide a 5-foot passing area (a wider area where two wheelchairs can pass) every 200 feet (1). This makes constructing continuous 5-foot sidewalks much more practical than sidewalks of varying width. Additional sidewalk width is particularly important for locations with higher volumes of pedestrian activity, such as near schools, shopping centers, parks, and other pedestrian attractors. In these locations, it would be beneficial to require sidewalks that are 6-feet wide (or wider).

1. ADA Accessibility Guidelines for Buildings and Facilities. United States Access Board, 2002. Available Online: http://www.access-board.gov/adaag/html/adaag.htm.

Sidewalk Buffers
The buffer space between the sidewalk and the curb and gutter (or edge of pavement) should be maximized within the available right-of-way. Street trees should be provided in appropriate locations in this buffer area.

Justification

Pedestrians feel more comfortable when there is a greater buffer between the sidewalk and the street, particularly when the roadway serves high volumes of traffic. A scientific study of the real-time perceptions of pedestrians walking along roadway segments identified buffer width as a significant factor in a pedestrian's comfort level. The study also showed that on-street parking and street trees also act as buffers between roadway traffic and the sidewalk and increase pedestrian comfort (1).

1. Landis, B.W., V.R. Vattikuti, R. M. Ottenberg, D.S. McLeod, M. Guttenplan. "Modeling the Roadside Walking Environment: Pedestrian Level of Service," *Transportation Research Record 1773*, Transportation Research Board, National Academy of Sciences, 2001.

Raised Median Islands
Raised medians or pedestrian refuge islands should be provided, where practical, at crosswalks on streets with more than three lanes, especially on streets with high volumes of traffic. Median widths of 6 to 10 feet are recommended. Medians should be made accessible through the provision of level cut-throughs or curb ramps.

Justification

Raised medians have been shown to significantly reduce the incidence of pedestrian crashes, particularly at multi-lane sites. Medians make it easier for pedestrians to cross the street by reducing the width of roadway that pedestrians must cross at one time. Raised medians may provide a place for landscaping and change the character of the street, possibly reducing the speeds of vehicles. Medians and channelizing islands also reduce the rate of motor vehicle crashes and have particular benefits for older drivers.

Research suggests that raised medians are more effective than painted medians at reducing pedestrian crashes. Zegeer et al. found that raised medians and crossing islands correspond with a significantly lower crash rate on multi-lane roads with both marked and unmarked crosswalks, but that painted medians did not correspond with a reduction in pedestrian crash rates compared with multi-lane roads without medians (1). Bowman and Vecellio also found that locations with raised medians correspond with lower pedestrian crash frequencies compared to locations on undivided arterial streets (2). Research in Australia described by Peter Cairney found that locations with raised medians had lower pedestrian crash frequencies than locations without, but that narrow medians have higher crash frequencies than wider ones (3).

1. Zegeer, C., Stewart J., Huang, H. and Lagerwey, P. “Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Locations- Executive Summary and Recommended Guidelines.” Report No. FWHA-RD-01-075, Federal Highway Administration, Washington, DC, March 2002.
2. Bowman, B.L., and R.L. Vecellio. “Effect of Urban and Suburban Median Types on Both Vehicular and Pedestrian Safety. “ *Transportation Research Record* 1445 (1994): 169-179.
3. Cairney, Peter. “Pedestrian Safety in Australia.” FHWA-RD-99-093. Federal Highway Administration, Washington DC, December 1999.

In-Street Pedestrian Crossing Signs
In-Street Pedestrian crossing signs (*MUTCD* sign R1-6) may be placed in the roadway at crosswalks to remind motorists of their responsibility to yield to pedestrians within the crosswalk. The *MUTCD* specifies that these signs may not be used at signalized locations.

Justification

In-street pedestrian crossing signs often increase the incidence of drivers yielding to pedestrians in the crosswalk by reminding motorists that it is their legal responsibility (1, 2, and 3).

1. City of Madison, Wisconsin Department of Transportation, Traffic Engineering Division, “Year 2 Field Evaluation of Experimental ‘In-Street’ Yield to Pedestrian Signs,” Submitted to FHWA 1999.
2. H.F. Huang, C.V. Zegeer, R. Nassi, and B. Fairfax. “The Effects of Innovative Pedestrian Signs at Unsignalized Locations: A Tale of Three Treatments,” FHWA, FHWA-RD-00-098, 2001, available online at: www.tfhrc.gov/safety/pedbike/pubs/00-098.pdf
3. Ercolano, J. “Pedestrian Crossing Devices,” Case Study #28 in *PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System*, FHWA, FHWA-SA-04-003, September 2004.

Leading Pedestrian Interval—Pedestrian Signal Timing
At signalized intersections with high pedestrian crossing volumes, the signals can be programmed to allow pedestrians to begin crossing 2 to 4 seconds before the vehicle traffic on the parallel street is given a green light.

Justification

This is a low-cost treatment. It gives pedestrians enough time to cross to the middle of the street so that turning vehicles can see them, be aware of them, and yield to them before they receive a green light. Because the LPI is operated by the traffic signal controller, it is also possible to use the LPI only during certain times of the day, such as between 7 a.m. and 7 p.m., whenever the highest numbers of pedestrians are typically present. A study of a three-second leading pedestrian interval (LPI) found that the LPI decreased conflicts between turning motor vehicles and increased the percentage of motorists that yielded to pedestrians in the crosswalk (1).

Traffic signals with LPI have a longer all red phase, which may tempt drivers to take advantage of the extra time and run red lights. This type of behavior should be prevented through education and strict enforcement (2).

1. Van Houten, R., R. A. Retting, C. M. Farmer, J. Van Houten, and J. E. L. Malenfant. “Field Evaluation of a Leading Pedestrian Interval Signal Phase at Three Urban Intersections,” Transportation Research Record 1734, 2000.
2. Zegeer, C.V., Seiderman, C., Lagerwey, P., Cynecki, M., Ronkin, M. and Schneider, R. Pedestrian Facilities Users Guide: Providing Safety and Mobility, Federal Highway Administration, FHWA-RD-01-102, March 2002.

Traffic Calming

Traffic calming is the practice of slowing traffic speeds by reducing the design speed of roadways. This is done by making various physical changes to the roadway, including adding raised median islands, curb extensions, and raised crosswalks; adding chicanes; narrowing travel lanes; etc. Traffic calming is appropriate on neighborhood streets that should have low traffic speeds.

Justification

Numerous studies have shown that traffic calming has many benefits, including reductions in the number and severity of collisions, reductions in vehicular speeds, reductions in noise levels, and improvements in the comfort of pedestrians and bicycles (1, 2, 3, and 4). Since traffic speed is correlated with the severity of pedestrian crashes, the reduction of speeds help improve pedestrian safety. It is estimated that 85% of pedestrians who are struck at 40 mph are killed, 45% at 30 mph, and only 5% at 20 mph (5).

[Some of the recommended roadway treatments may also help decrease motor vehicle speeds. Lower vehicle speeds will reduce the severity of injuries when crashes occur. When hit by a vehicle traveling at 40 miles per hour, a pedestrian has an 85% chance of being killed; at 30 miles per hour, the likelihood decreases to 45%; and at 20 miles per hour the pedestrian fatality rate is only 5%[21].]

1. Institute of Transportation Engineers, Traffic Calming: State of the Practice, August 1999.
2. Zegeer, C.V., J.Stuart, and H. Huang, Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Crossing Locations, Federal Highway Administration, Washington, DC, 1999.

[21] Zegeer, C.V., et al. Pedestrian Facilities Users Guide: Providing Safety and Mobility, Federal Highway Administration, FHWA-RD-01-102, p. 13, March 2002.

3. City of Cambridge, MA, Preliminary Results: Effects of Columbia Street Traffic Calming Project on Driver Behavior, April 2000.
4. Zein, S.R., Geddes, E., Memsing, S., Johnson, M., “Safety Benefits of Traffic Calming,” Transportation Research Record, Volume 1578 pp. 3-10, 1997.
5. Ashton, S.J. and Mackay, G.M., “Some characteristics of the population who suffer trauma as pedestrians when hit by cars.” Proceedings of the 4th International IRCOBI Conference on the Biomechanics of Truma, Goeteborg, Sweden, 5-7 September, 1979.

Travel Lane Widths
Roadway travel lane widths should not be excessively wide. Local and collector roadways should generally be striped with 10-foot travel lanes. Arterial roadways should have 10- or 11-foot lanes, depending on traffic volume and use by heavy trucks.

Justification

According to AASHTO’s *Guide for Achieving Flexibility in Highway Design* (2004), the normal range of design lane width is between 9 and 12 feet (1). This guide states:

“In urban areas and along rural routes that pass through urban settings, narrower lane widths may be appropriate. For such locations, space is limited and lower speeds may be desired. Narrower lane widths for urban streets lessen pedestrian crossing distances, enable the provision for on-street parking and transit stops, and enable the development of left-turn lanes for safety.”

Narrowing existing travel lanes can provide extra space for shoulders and bicycle lanes. Striped shoulders and bicycle lane space improves the safety and comfort of bicyclists. A study of the real-time perceptions of bicyclists riding on a wide variety of roadway segments found that the width of the shoulder or bicycle lane had a significant influence on bicyclists’ feeling of comfort and safety. Wider shoulders increase the comfort levels of bicyclists riding along roadway segments (2). A similar result was found in a Federal Highway Administration study that asked bicyclists to rate the suitability of different roadways for bicycling from video clips (3). Wider shoulders and bicycle lanes are preferred by bicyclists. In some situations narrower motor vehicle lanes and wider shoulders and bicycle lanes may have a desired traffic calming effect, slowing typical motor vehicle traffic by several miles per hour.

According to the AASHTO *Policy On Geometric Design of Highways and Streets* (2004), minor thoroughfares (collector roadways) can be designed with 10-foot motor vehicle travel lanes. Ten-foot travel lanes are already used on many roadways in the City of Alexandria. Wider widths should be considered in rural areas if the roadway has high traffic volumes or speeds and considered in urban areas if the roadway carries a large amount of truck traffic (p. 425, 433).

Major thoroughfares (arterial roadways) are commonly designed with 11-foot travel lanes. However, in urban areas, some major thoroughfares can have narrower lanes. The AASHTO guide states, “Lane widths of 3.0 m [10 ft] may be used in highly restricted areas having little or no truck traffic” (p. 472) (4).

1. American Association of State Highway Transportation Officials. *A Guide for Achieving Flexibility in Highway Design*, 2004. Order from:

https://bookstore.transportation.org/publications/bookstore.nsf/Categorized?OpenForm&cat=Design/Operations/Planning
2. Landis, Bruce W. et.al. "Real-Time Human Perceptions: Toward a Bicycle Level of Service," *Transportation Research Record 1578*, Transportation Research Board, Washington, DC 1997.
3. Harkey, D.L., D.W. Reinfurt, M. Knuiman, J.R. Steward, and A. Sorton. *Development of the Bicycle Compatibility Index: A Level of Service Concept*, Federal Highway Administration, FHWA-RD-98-072, December 1998.
4. American Association of State Highway Transportation Officials. *Policy On Geometric Design of Highways and Streets, Fifth Edition*, 2004. Order from: https://bookstore.transportation.org/publications/bookstore.nsf/Categorized?OpenForm&cat=Design/Operations/Planning

Bicycle Lanes
Bicycle lanes should be provided, where practical, on collector and arterial roadways in Alexandria.

Justification

National research has shown that bicyclists feel more comfortable and motor vehicles give bicyclists more lateral space when a shoulder or bike lane stripe is provided (Landis, et al. 1996; Harkey, et al. 1998; Hunter, et al. 1999; City of Cambridge, MA 2005) (1,2,3,4). Bike lanes help bicyclists navigate through complex intersections with turn lanes and other features that might otherwise deter bicyclists. This research is supported by policies in the AASHTO Bicycle Guide (1999)(5), which states:

"Bike lanes are intended to delineate the right of way assigned to bicyclists and motorists and to provide for more predictable movements by each. Bike lanes also help to increase the total capacities of highways carrying mixed bicycle and motor vehicle traffic…[Bike lanes may be provided] by reducing the width of vehicular lanes or prohibiting parking…" (p. 8)

1. Landis, Bruce W.; Venkat R. Vattikuti; and Michael T. Brannick. "Real-Time Human Perceptions: Towards a Bicycle Level of Service," *Transportation Research Record 1578*, 1996. Available Online: http://www.dot.state.fl.us/planning/systems/sm/los/pdfs/BLOS_TRBscanned.pdf
2. Harkey, D.L.; D.W. Reinfurt; M. Knuiman; and A. Sorton. *Development of the Bicycle Compatibility Index: A Level of Service Concept: Final Report*, Report No. FHWA-RD-98-072, Federal Highway Administration, Washington, DC, August 1998. Available Online: http://www.hsrc.unc.edu/research/pedbike/98095/.
3. Hunter, William W.; J. Richard Stewart; Jane C. Stutts; Herman H. Huang; and Wayne E. Pein. *A Comparitave Analysis of Bicycle Lanes Versus Wide Curb Lanes: Final Report*, Federal Highway Administration, FHWA-RD-99-034, December 1999. Available Online: http://www.walkinginfo.org/pdf/r&d/widelanes_final.pdf.
4. City of Cambridge, MA. "Safety Benefits of Bike Lanes." Available Online: http://www.cambridgema.gov/~CDD/et/bike/bike_safety.html.
5. American Association of State Highway and Transportation Officials. *Guide for the Development of Bicycle Facilities*, 1999.

Pedestrian and Bicycle Accommodations on Roadway Bridges, Underpasses, and Interchanges

Pedestrians and bicycles should be accommodated on roadway bridges, underpasses, and interchanges in Alexandria (unless prohibited by law). New bridges should be constructed with bicycle lanes and wide sidewalks. Bridge replacement projects on controlled access freeways where pedestrians and bicyclists are prohibited by law will generally *not* include facilities to accommodate bicyclists and pedestrians. In cases, however, where a bridge replacement project on a controlled access freeway impacts a non-controlled access roadway (i.e. a new overpass over an arterial roadway), the project should include the necessary access for pedestrians and bicycles on the non-limited access roadway, including such elements as: bicycle lanes, sidewalks, and pedestrian/bicycle crossing improvements to associated ramps and intersections.

Justification

The current Federal law for pedestrian and bicycle accommodation on bridges was established in the Transportation Equity Act for the 21st Century (TEA-21) and re-affirmed by the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU). This law states:

"In any case where a highway bridge deck is being replaced or rehabilitated with Federal financial participation, and bicyclists are permitted on facilities at or near each end of such bridge, and the safe accommodation of bicyclists can be provided at reasonable cost as part of such replacement or rehabilitation, then such bridge shall be so replaced or rehabilitated as to provide such safe accommodations." (23 U.S.C. Section 217)(1).

1. Federal Highway Administration. "Bicycle and Pedestrian Legislation in Title 23 United States Code." Available Online: www.fhwa.dot.gov/environment/bikeped/sec217.htm.

Appendix H: Existing Conditions and Preliminary Recommendations Maps

The full size versions of all of the maps included in this Plan are available on the City's website at http://www.alexride.org/bikeped.php.

Appendix I: Prioritization of Recommended Improvements

This appendix describes the method used to prioritize the pedestrian and bicycle facility recommendations during the planning process. The prioritization process resulted in maps of early-action, short-term, medium-term, or long-term projects. A variety of factors were considered when prioritizing the plan recommendations. These factors included:

- ***Existing conditions:*** Potential to improve conditions for pedestrians and bicyclists where there are missing facilities, facilities that are in poor condition, or barriers to walking and bicycling (e.g., pedestrian deficiencies or low bicycle level of service grades identified through existing data and field inventories).
- ***Existing and future demand:*** Potential for pedestrian and bicycle activity at a location based on objective land use and socioeconomic characteristics.
- ***Reported crashes:*** Potential to improve conditions in locations with high numbers of reported crashes.
- ***Bus Riderhsip***
- ***Public input:*** Potential to address problems that were mentioned frequently by citizens in survey responses and e-mails and at stakeholder meetings and public meetings.

Each of the individual factors is described in more detail below.

Reported Crashes

Higher priority is given to pedestrian and bicycle recommendations that improve conditions in locations with greater numbers of reported pedestrian-vehicle and bicycle-vehicle collisions. GIS crash density analysis was used to identify areas with higher concentrations of police-reported pedestrian and bicycle crashes (see Figure H1: Pedestrian Crash Density and Figure H2: Bicycle Crash Density). Police-reported collisions provide an indication of safety problems, but most pedestrian and bicycle crashes are not reported to police[22]. Recommended facilities were given priority rankings based on the average crash density per mile within a 1000 foot radius of their location.

It is also important to consider locations that have unsafe or uncomfortable characteristics for walking and bicycling, even if they have not experienced reported crashes. There are streets in Alexandria that have missing or narrow sidewalks, non-ADA-compliant curb ramps, missing pedestrian signals, narrow travel lanes that are difficult for bicyclists to share with motor vehicles, difficult roadway crossings, or other challenges. Locations with challenging pedestrian and bicycle conditions have been given higher priority for improvements.

A point system was used to approximate pedestrian comfort walking along the roadway. Recommended pedestrian projects that are intended to improve conditions for walking along

[22] Stutts, J.C. and W.W. Hunter. "Police-reporting of Pedestrians and Bicyclists Treated in Hospital Emergency Rooms," Transportation Research Record No 1635, Transportation Research Board, 1998. P. 88-92. This study of a sample of cases collected at eight hospital emergency rooms in three states, showed that only 56 percent of the pedestrians and 48 percent of the bicyclists were successfully linked to cases reported on their respective state motor vehicle crash files. This study looked at only the most serious crashes (involving emergency room treatment). We can assume that less-severe crashes were accurately reported at an even lower rate.

a roadway segment (e.g., adding a sidewalk) received points according to the table below. Projects that received more points were given a higher priority (see Figure H3: Walking Along the Roadway Conditions).

Pedestrian Walking along the Roadway Deficiency		Points
Sidewalk Presence		
	Missing sidewalk on roadway with less than 1,500 ADT	10
	Missing sidewalk on roadway with more than 1,500 ADT	20
Sidewalk Clear Width		
	Under 5' wide	2
	Under 4' wide	5
Sidewalk Condition		
	Fair	2
	Poor	5
Buffer		
	No separation between street and sidewalk but there is on-street parking	2
	No separation between street and sidewalk and there is no on-street parking	5
Traffic Volume (ADT)		
	Less than 1,500	1
	1,500 – 4,999	2
	5,000 – 9,999	3
	10,000 – 14,999	4
	15,000 – 19,999	5
	20,000 – 24,999	6
	25,000 or more	7
Motor Vehicle Speed Category of Parallel Street[23]		
	Medium-speed	6
	High-speed	10

The Bicycle Level of Service model was used to estimate the level of comfort that a typical bicyclist feels while riding along roadway segments in Alexandria. This model's grading system is based on measurements of outside travel lane width, presence of a bicycle lane or shoulder, traffic volume, speed limit, heavy truck traffic, on-street parking, and pavement condition (a detailed description of the Bicycle Level of Service Model is provided in Appendix X). Higher priority was given to recommended bicycle facilities on roadway segments that have lower Bicycle Level of Service grades, or poorer conditions for bicycling (see Figure H4: Bicycle Level of Service).

A point system was also used to approximate the difficulty of street crossings for both pedestrians and bicyclists. Recommended pedestrian and bicycle roadway crossing improvement projects received points according to the table below. Projects that received more points were given a higher priority. Motor vehicle volume, posted speed limit, number of travel lanes crossed, and presence of a raised median crossing island were identified as significant factors associated with higher risk of pedestrian crashes at uncontrolled marked

[23] Motor vehicle speed categories were based on the City's roadway functional classification system. The high-speed category included expressway, arterial, primary collector, and major collector roadways. Medium-speed roadways included all residential collectors. The low-speed category included local roadways. Several exceptions were made: all arterial roadways in the Old Town area, Commonwealth Avenue, and Monroe Street (west of US 1) were classified as medium speed rather than high speed.

crosswalk locations in a FHWA study[24]. Traffic signals and stop signs for opposing traffic allow pedestrians and bicyclists to cross at locations where motor vehicle traffic is stopped. These locations are typically easier to cross than uncontrolled locations.

Pedestrian and Bicycle Crossing Deficiency		**Points**
Marked Crosswalk Presence		
	Missing crosswalk	3
Marked Crosswalk Condition		
	Fair	1
	Poor	2
Curb Ramp Characteristics (each end of the crosswalk counted separately and summed)		
	No truncated domes, but otherwise ADA compliant	1
	Not ADA compliant because of slope or surface problem	2
	Missing	3
Number of Travel and Turning Lanes at Crossing		
	2	2
	3	4
	4	6
	5	8
	6 or more	12
Presence of a Raised Median Crossing Island		
	Median crossing island present at crosswalk	-5
Traffic Volume (ADT)		
	Less than 1,500	1
	1,500 – 4,999	2
	5,000 – 9,999	3
	10,000 – 14,999	4
	15,000 – 19,999	5
	20,000 – 24,999	6
	25,000 or more	7
Motor Vehicle Speed Category of Perpendicular Street[25]		
	Medium-speed	6
	High-speed	10
Intersection with 3-way or 4-way stop signs (stop control in all directions)		
	All crossings	-5
Intersection with Traffic Signals for Opposing Traffic		
	Signalized intersection that doesn't have pedestrian signals at the crosswalk	-5
	Traditional pedestrian signals at the crosswalk	-10
	Countdown pedestrian signals at the crosswalk	-15

A map was developed to show which projects have the highest priority for addressing challenging pedestrian and bicycle roadway crossings (see Figure H5: Roadway Crossing Conditions).

[24] Zegeer, C., J. Stewart, H. Huang, and P. Lagerwey. "Safety Effects of Marked vs. Unmarked Crosswalks at Uncontrolled Locations- Executive Summary and Recommended Guidelines." Report No. FHWA-RD-01-075, Federal Highway Administration, Washington, D.C., February 2002

[25] Motor vehicle speed categories were based on the City's roadway functional classification system. The high-speed category included expressway, arterial, primary collector, and major collector roadways. Medium-speed roadways included all residential collectors. The low-speed category included local roadways. Several exceptions were made: all arterial roadways in the Old Town area, Commonwealth Avenue, and Monroe Street (west of US 1) were classified as medium speed rather than high speed.

Existing and Future Demand

Existing and future demand is important to consider because it shows where non-motorized facility improvements have the potential to serve the greatest number of users. General estimates of existing and future pedestrian and bicycle activity in different parts of Alexandria were derived using a point system. This "sketch plan" method is similar to methods applied in Portland, OR[26] and Washington, DC[27].

The existing and future pedestrian and bicycle demand at each recommended project location was estimated from the pedestrian and bicycle trip attractors, anticipated growth in population and employment density, and rates of household automobile ownership near that location. The point system for estimating pedestrian and bicycle activity at each location is presented in the two sections below.

Proximity to Trip Attractors

Recommended project locations received more points for being close to pedestrian and bicycle trip attractors. Buffer zones of one-eighth, one-fourth, and one-half mile (straight-line distance, not network distance) were drawn around each attractor. Project locations received points for falling within each of these buffer areas according to the table below. Note that projects completely within commercial areas and on trails and bicycle routes were given a greater number of points than projects in buffer areas around them (see "no buffer" column)[28].

Trip Attractor	No buffer	1/8 mile	1/4 mile	1/2 mile
Metro Station		15	10	5
Bus Stop (DASH or Metro)		5	3	
Proposed Bus Rapid Transit Route		10	5	
Proposed Smart Station		5	3	
School (public, private, and college)		5	3	
Major Park Access Point		3	1	
Recreation Center		3	1	
Commercial Area	30	15	3	
Existing or Proposed Paved Multi-Use Trail	15	3	1	
Existing or Proposed Gravel Trail	5	3	1	
Existing or Proposed Bicycle Route (Bicycle Projects only)	*15*	*5*	*3*	*1*

It is likely that bicyclists will travel further to and from trip attractor destinations than pedestrians. Yet, the greatest concentrations of bicyclists will still be located close to the attractors, so it is fair to use the same buffer distances for this general approximation of pedestrian and bicycle activity. One key difference in the point system between pedestrian and bicycle projects is that bicycle projects are also given a higher number of points for being on or near a signed bicycle route.

[26] Portland Pedestrian Master Plan. City of Portland, OR, 1998. Online: http://www.portlandonline.com/transportation/index.cfm?c=dhage

[27] District of Columbia Pedestrian Master Plan project website, 2007. Online: http://www.tooledesign.com/projects/dc/reports.html.

[28] Other projects did not have scores within a "no buffer" area because their locations were marked as points.

The actual number of pedestrians and bicyclists near an attractor may vary significantly by time of day, day of week, or season. However, the points are assigned based on an approximation of average pedestrian and bicycle activity throughout the year.

The points are a relative measure that has not been calibrated to actual pedestrian and bicycle counts. Typical planning assumptions have been made. For example, it was assumed that more pedestrians and bicyclists will access rail stations than bus stops. It was also assumed that people will walk and bicycle longer distances to transit stations than to other attractors (studies have shown that a typical walk to transit is one-quarter to one-half mile, and many people walk even further[29]).

Population and Employment Density and Automobile Ownership
This category incorporates population and employment forecasts for 2025 from the Metropolitan Washington Council of Governments (MWCOG) and household automobile ownership from the 2000 US Census. Recommended project locations in MWCOG Traffic Analysis Zones (TAZs) with greater future population and employment density were assigned more points. Because more pedestrian trips per person are typically generated from a residential location than an employment location, population density forecasts were assigned greater values than employment density forecasts. Locations were also assigned points based on surrounding household vehicle ownership rates. US Census block groups with lower automobile ownership were given more points. Population, employment, and automobile ownership data were divided into five categories, and points assigned for each category as follows:

2025 Population Forecast (per sq. mile)	**Points**	**2025 Employment Forecast** (per sq. mile)	**Points**	**2000 Household Automobile Ownership** (percent of households with no vehicles)	**Points**
0 – 5,285	0	0 – 3,823	0	0-9	0
5,286 – 8,751	5	3,824 – 10,567	3	10-19	3
8,752 – 10,538	10	10,568 – 22,285	6	20-29	6
10,539 – 15,674	15	22,286 – 34,897	9	30-39	9
15,675 – 38,735	20	34,898 – 75,478	12	40-100	12

The points were summed to generate an overall rating for existing and future pedestrian and bicycle activity near each recommended project. These ratings are shown on two separate maps (see Figure P6: Potential Pedestrian Activity and Figure P7: Potential Bicycle Activity).

Public Input
Residents who walk and bicycle in Alexandria are familiar with many of the locations that should be improved for pedestrian and bicycle travel. Therefore, locations that were mentioned frequently by citizens were an important part of the prioritization process. Below are locations that were mentioned at least two times through public input opportunities at the first public meeting, e-mail comments submitted to the City, or responses to the DASH or online questionnaires.

<u>Locations for Pedestrian Facility Improvements</u>

[29] Weinstein, A., V. Bekkouche, K. Irvin, and M. Schlossberg. "How Far, by Which Route, and Why? A Spatial Analysis of Pedestrian Preference," Presented at 2007 Transportation Research Board Annual Meeting.

- King Street
- Washington Street in Old Town
- Eisenhower Avenue Trail crossing of Eisenhower Avenue
- Eisenhower Avenue Trail
- Pegram Street
- Pickett Street
- Holmes Run Trail
- Connection between Lake Barcroft Trail (in Fairfax County) and the Holmes Run Trail
- Union Street (Mount Vernon Trail)
- Connections between existing trails and roads in the Taylor Run area
- Eisenhower Avenue Metro area (1/4-mile radius)
- King Street Metro area (1/4-mile radius)
- Van Dorn Street Metro area (1/4-mile radius)
- Braddock Road Metro area (1/4-mile radius)
- Duke Street
- Landmark Mall (intersection of Duke Street & Van Dorn Street (1/4-mile radius)
- Van Dorn Street
- Connections between Cameron Station and the Van Dorn Street Metro area
- Connections between the Duke Street Corridor and Eisenhower Avenue
- Bus stops in west Alexandria
- Mount Vernon Trail connection into Old Town from the south
- Connections across the railroad tracks north of the Braddock Road metro station near the Monroe Street Bridge and the Potomac Yards area
- Intersection of King Street & Braddock Road & Quaker Lane (and 1/8 mile radius)
- Interchange of Duke Street & Telegraph Road
- New multi-use trail in Fort Ward Park
- Commonwealth Avenue
- Mount Jefferson Park Greenway Trail
- Intersection of Edsall Road & Whiting Street
- US 1 (including Patrick Street and Henry Street)
- George Washington Middle School (intersection of Mount Vernon Avenue & Braddock Road) (1/8-mile radius)
- Interchange of Duke Street & I-395
- Potomac Yard area
- George Mason Elementary School (intersection of Cameron Mills Road & Virginia Avenue) (1/8-mile radius)
- West Street between Roundhouse Lane and Wilkes Street
- Gunston Road*
- Mount Vernon Avenue
- Mount Vernon Recreation Center (1/8-mile radius)
- TC Williams High School (intersection of King Street & Kenwood Avenue) (1/8-mile radius)
- Intersection of Braddock Road & Scroggins Road*
- Monroe Avenue Bridge
- Slaters Lane
- Mount Vernon Trail
- Powhattan Street
- 1st Street (between Patrick Street & Powhattan Street)

- 2nd Street (between Patrick Street & Powhattan Street)
- Cameron Station Boulevard
- Somerville Street*
- Washington Street
- Intersection of Edsall Road and Pickett Street
- Russell Road between Windsor and Woodland*
- Four Mile Run Trail
- Hammond Middle School (intersection of Seminary Road & Library Lane) (1/8-mile radius)
- Patrick Henry Elementary School (intersection of Taney Avenue & Latham Street) (1/8-mile radius)
- Seminary Road
- Intersection of Cameron Mills Road & Virginia Avenue
- Jordan Street between Duke Street & Seminary Road*
- Northern Virginia Community College (Campus Avenue and Campus Drive)
- North Old Town Housing Project areas
- James Polk Elementary School (intersection of Pegram Street & Richenbacher Avenue) (1/8-mile radius)
- Polk Avenue
- Interchange of Seminary Road & I-395
- Connection between Del Ray neighborhood and Mount Vernon Trail
- Interchange of US 1 & I-495
- Interchange of Telegraph Road & I-495*
- Intersection of Prince Street & Dangerfield Road
- Intersection of Telegraph Road & Mill Road
- Linden Street
- Intersection of GW Parkway & Slaters Lane
- Intersection of US 1 & Slaters Lane
- Interchange of Washington Street & I-495
- Wythe Street
- Stevenson Avenue between Van Dorn Street & Yoakum Parkway

Locations for Bicycle Facility Improvements

- Eisenhower Avenue Trail crossing of Eisenhower Avenue
- Holmes Run Trail
- Connection between Lake Barcroft Trail (in Fairfax County) and the Holmes Run Trail
- New bicycle lanes in Old Town
- Eisenhower Avenue/Eisenhower Avenue Trail
- King Street
- Seminary Road
- Janney's Lane
- Van Dorn Street
- Duke Street
- Connect Cameron Station to the Van Dorn Street Metro area
- Connect the Duke Street Corridor to Eisenhower Avenue
- Union Street (Mount Vernon Trail)
- Connections across the railroad tracks north of the Braddock Road metro station near the Monroe Street Bridge and the Potomac Yards area

- King Street & Braddock Road & Quaker Lane
- Interchange of Duke Street & Telegraph Road
- Mount Vernon Trail connection into Old Town from the south
- New multi-use trail in Fort Ward Park
- Mount Jefferson Park Greenway Trail
- Abingdon Drive

Development of Priority Categories

Reported crashes, existing conditions, and existing and future demand were combined to classify all of the recommended facilities into groups of short-term, medium-term, and long-term projects for each program. The values for each of these factors were converted to a 0 to 100 scale. For example, a project in a location with the highest density of reported pedestrian crashes in the City would receive a score of 100 for the reported crashes category. A project in a location with the lowest potential existing and future demand would receive a score of 0 for the existing and future demand category. Then the scaled scores for the three categories were summed. Projects with the highest combined scores (in a range of 0 to 300) were placed in the short-term category, and projects with the lowest combined scores were placed in the long-term category.

The final factor, public input, was used to adjust the phasing category of a project. If a specific recommendation received two or more public comments during the planning process, it was moved to the next-highest phasing category. For example, a project may have been placed in the medium-term category based on the first three factors, but significant public input would make it a short-term priority. Short-term projects receiving significant public input were classified as “early-action” projects.