FALLS CHURCH URBAN DEVELOPMENT AREA PEDESTRIAN CONNECTION ALTERNATIVES REPORT

Prepared for the City of Falls Church

AUGUST 2022

FALLS CHURCH URBAN DEVELOPMENT AREA PEDESTRIAN CONNECTION

Alternatives Report

ACKNOWLEDGMENTS

Paul Stoddard, Director of Planning, Department of Community Planning and Economic Development Services, City of Falls Church
Kerri Oddenino, AICP, Senior Planner, Department of Community Planning and Economic Development Services, City of Falls Church
Jitender Ramchandani, AICP, PMP, OIPI Statewide Transportation Planning (STP) Manager, Virginia Office of Intermodal Planning and Investment, Office of the Secretary of Transportation
Consultant services provided by a team from Toole Design Group, LLC, led by Alia Anderson, AICP, Barbara Mosier, PE, Leon Yacoubian, PE, Katie Heuser, and Kate Maker, PE

ABOUT GAP-TA

The Growth and Accessibility Planning Technical Assistance Program (GAP-TA) is run by the Virginia Office of Intermodal Planning and Investment (OIPI). The program seeks to align infrastructure development with designated Urban Development Areas (UDAs) or growth areas to improve efficiency and effectiveness. Visit vtrans.org/about/GAP-TA for information about the Growth and Accessibility Planning Technical Assistance program.

CONTACT INFORMATION

Kerri Oddenino, AICP
Senior Planner
Department of Community Planning and Economic Development Services
300 Park Avenue, Suite 105E
City of Falls Church, Virginia
Office: 703-248-5477 (TTY 711)
Cell: 571-419-7317 (TTY 711)
koddenino@fallschurchva.gov

The opinions and conclusions expressed or implied in this report are those of the authors and are not necessarily those of the Office of Intermodal Planning and Investment (OIPI).

OIPI does not endorse products or manufacturers. Any trade or manufacturers' names that appear herein are solely because they are considered essential to the object of the report.

CONTENTS

INTRODUCTION

The Falls Church "Parks for People: Parks, Open Space, and Recreation" chapter of the City's Comprehensive Plan identifies pathways, the general design of those pathways, and other recommended improvements. While there is an existing vision to provide better connections between these regional transportation facilities, the method of providing these connections and their exact location is yet to be determined. Toole Design has prepared this report evaluating the alignment and connection alternatives within the study area and making recommendations for a preferred alignment, as well as connection design considerations.
This report includes key findings from the existing conditions analysis as previously presented in a technical memo as well as recommended alignments, cross sections, crossing locations, and lane markings.

The report presents:

- A description of the study area
- An overview of state and national design guidance relevant to this project
- A summary of relevant findings from past plans and studies
- Existing facilities and conditions for biking and walking
- Recommended trail alignments and roadway connection alternatives
- Recommendations for trail crossings
- Planning level cost estimates

Study Area

The purpose of this study is to develop a more detailed plan with alignment, typical cross-sections of on- and off-street segments, right-of-way constraints, planning-level cost estimates, location of sidewalks, crosswalks, and ramps, and phasing of an approximately 4.25-mile-long pedestrian pathway between S Washington St and the Washington and Old Dominion (W&OD) Trail shown in red in **Figure 1**, including along Tripps Run.

The study area runs through areas that are zoned[1] as:

- Low Density Residential
- Medium Density Residential
- Multi-Family Residential
- General Business

Figure 1. Falls Church and Study Area (Highlighted in Red)
Source: Adapted from "Parks for People: Parks, Open Space, and Recreation Chapter of the City's Comprehensive Plan"

As shown in **Figure 1**, the future pedestrian pathway will connect the following parks:

- Cavalier Trail Park
- Howard E. Herman Stream Valley Park
- Berman Park
- West End Park

The Aurora House and Oak Street Elementary School (previously Thomas Jefferson Elementary School) are points of interest that fall along the general range of the proposed pedestrian pathway.[2] The Aurora House is a residential counseling center for girls between the ages of 13 and 20.

DESIGN GUIDANCE

This section summarizes the leading state and national design guidance for three facility types that are applicable to this study:

- Shared use paths
- On-road bicycle facilities
- Sidewalks

Shared Use Paths

Figure 2 depicts the national design guidance for a typical cross section of a shared use path.[3] The minimum paved width for a two-directional shared use path is 10 feet. Typically, widths range from 10 to 14 feet, with the wider values applicable to areas with high use and/or a wider variety of user groups. The Virginia Department of Transportation requires a minimum paved width of 10 feet with a level buffer of at least 2 feet wide. This width allows for users to pass each other in each direction. A width of 8 feet is allowed for short distances if needed due to a physical constraint such as an environmental feature, bridge abutment, utility structure, etc.[4] Signs, trees, poles, walls, or other obstructions must have a minimum of a 3 foot clearance from the edge of the path.

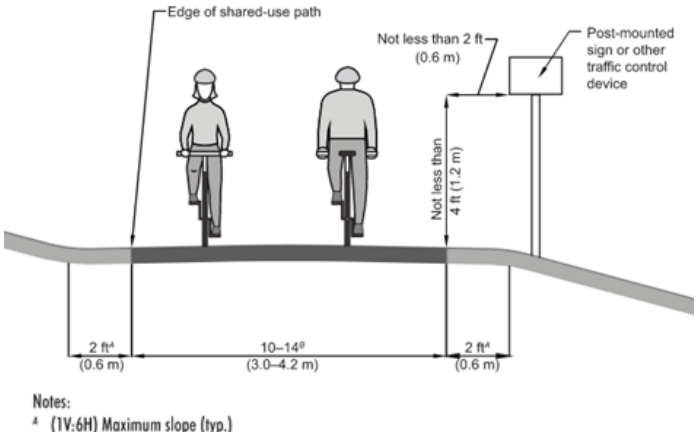


Figure 2. Typical Cross Section of Two-Way, Shared Use Path on Independent Right-of-Way Source: 2012 AASHTO Bike Guide

Wider shared use paths are able to accommodate more trail users. They create more comfortable conditions for people to travel side-by-side or to pass each other. A single person passing two people side-by-side is feasible at 10 feet and comfortable at 11 feet. In general, a trail wider than 10 feet should be considered:

- Where a substantial amount of bicyclists, skaters, and pedestrians are expected,
- Near popular trailheads and major access points, and/or
- In situations where widening the trail can be done without incurring costs in excess of the budget.

Other state design guidance, such as the Ohio Department of Transportation Multimodal Design Guide, which was adopted in April 2022, distinguishes between shared use path level of service (SUPLOS) and operating conditions. This is shown in **Table 1**.

Table 2 shows preferable shared use path widths to achieve a SUPLOS of "C" for typical mode split conditions.

Table 1: Shared Use Path Operating Conditions Based on Level of Service Criteria

SUPLOS	Description	Peak Operating Conditions
A	Excellent	A significant ability to absorb more users across all modes is available
B	Good	A moderate ability to absorb more users across all modes is available
C	Fair	Path is close to functional capacity with minimal ability to absorb more users
D	Poor	Path is at its functional capacity. Additional users will create operational and safety problems
E	Very Poor	Path operation beyond its functional capacity resulting in conflicts and people avoiding path
F	Failing	Path operating beyond functional capacity resulting in significant conflicts and people avoiding the path

Table 2: Shared Use Path Width and Operational Lanes

Operational Lanes	Preferable Width (ft)	SUPLOS "C" Peak Hour Volumes at Preferable Width	Minimum Width (ft)	SUPLOS "D" Peak Hour Volumes at Minimum Width
2	10-12	150-300	8	50
3	12-15	300-500	11	400
4	16->20	500->600	15	600

FHWA SUPLOS Methodology

The US Federal Highway Administration (FHWA) found in their Shared Use Path Level of Service Calculator User's Guide that widths of 11 - 15 feet provide improved levels of service (LOS) for higher volumes and more balanced user mixes than narrower widths. This is consistent with AASHTO recommendations that under certain conditions it may be necessary or desirable to increase the width of a shared-use path to 12 feet or even to 14 feet, due to substantial use by people walking, biking, and those using wheelchairs, scooters, skateboards, and other modes. Trails of 11 – 15 feet are wide enough to operate as three-lane paths. The increased passing capacity provided by a trail that operates as three lanes improves LOS and increases the trail's ability to absorb higher volumes and a wider variety of use-types without degrading service.

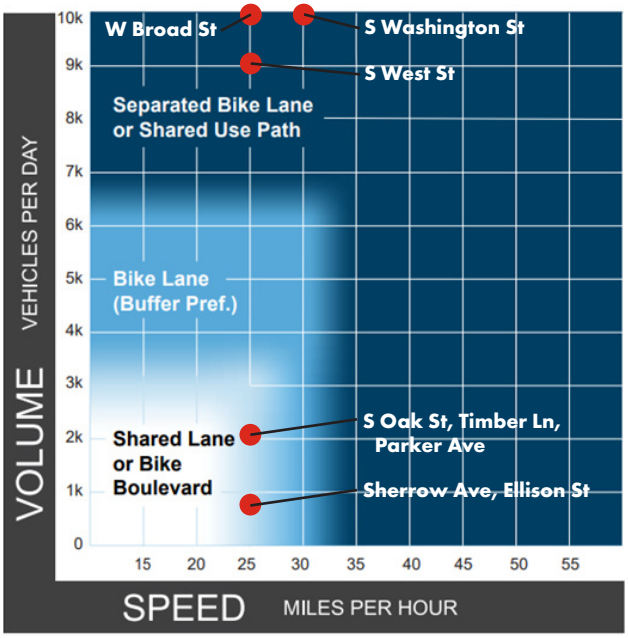


Figure 3. Preferred Bikeway Type for Urban, Urban Core, Suburban and Rural Town Contexts. Source: FHWA Bikeway Selection Guide, 2019.

Notes: 1. Chart assumes operating speeds are similar to posted speed. 2. Advisory bike lanes may be an option where traffic volume is <3K ADT.

On-Road Bicycle Facilities

For on-road facilities, the FHWA published the Bikeway Selection Guide in February 2019 which highlights the preferred bikeway type for based on volume and speed. This is depicted in **Figure 3.**

Daily volumes and speeds for the roadways within this study area are shown in **Figure 3**. The recommendations for on-road connections later in this document are based on this guidance.

Shared Lane Design

Since bicycles may be operated on all roadways except where prohibited by statute or regulations, shared lanes already exist without markings in many different contexts. Marked shared lanes are often provided as an interim strategy where physical separation is not feasible, but otherwise desirable. Shared lane markings, or "sharrows," are roadway pavement markings used to indicate a shared lane environment for bicycles and vehicles. They reinforce bicyclists' legal right to the roadway. Shared lane markings are relatively inexpensive, can be implemented quickly, and require no additional street space. They can be used in conjunction with wayfinding signs to provide supplemental information to guide bicyclists along a network of routes.

Figure 4. Shared lane in Alexandria, Virginia.

For the majority of the population, a shared lane will only be comfortable in low-speed and low-volume environments. The recommendation for shared lanes is below 3,000 vehicles/day and operating speeds are at or below 25 mph. Note that shared lanes are not a substitute for bike lanes or other dedicated bikeways, as research indicates they do not increase user safety or comfort.

Sidewalks

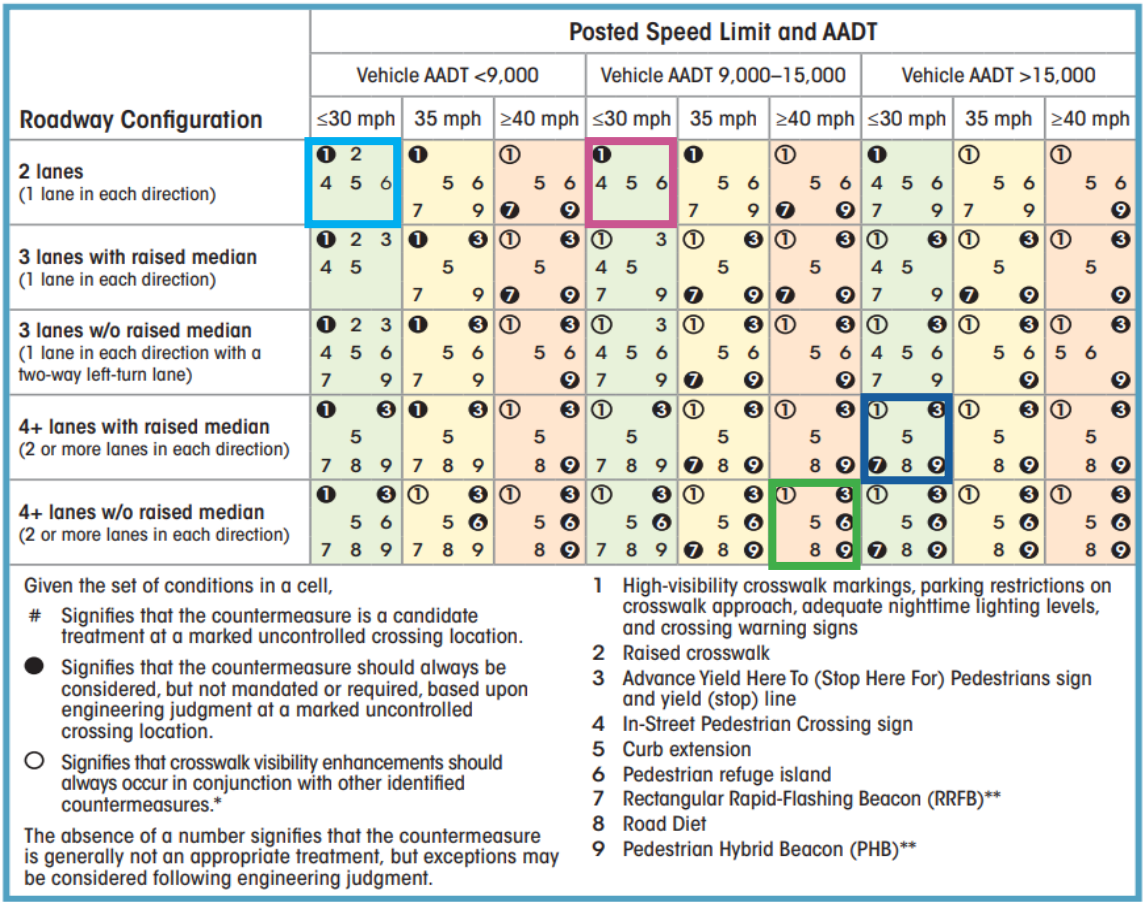
Virginia Department of Transportation (VDOT) Road Design Manual[4] includes Appendix A which outlines geometric design standards. The Manual notes that a sidewalk must be a minimum of 5 feet wide, though, if possible, it is recommended to widen it further to allow users side-by-side passing. As per both the roadway design guidelines, and the pedestrian guidelines in Appendix A(1) referenced previously, a 5 foot sidewalk, excluding the width of the curb, with a minimum buffer of 4 feet for roadways posted at greater than 25 mph and 3 feet for the roadways posted at 25 mph and less is required. Narrower widths are allowable for unique situations and short sections.

According to VDOT, bicycles may be ridden on sidewalks unless prohibited by local ordinance or traffic control devices. While on sidewalks and shared use paths, bicyclists must always yield the right of way to pedestrians and give an audible signal before passing a pedestrian.

ADA Compliant curb ramps should also be provided at all corners where pedestrian access is provided and at all pedestrian pathway crossings.

These minimums provide a basic pedestrian access route for users of all types, and while a 5-foot minimum width provides adequate access for people walking alone, in areas of heavy use, wider sidewalks should be considered. The *NACTO Urban Street Design Guide* suggests a width of 5-7 feet for residential areas.[5]

Trail and pedestrian path crossings at uncontrolled locations may need additional design features to provide for a safe and comfortable crossing experience. The FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations, often referred to as the STEPS Guide,[6] provides guidance on appropriate crossing treatments based on vehicular speed and volume and will be referenced when reviewing potential treatments recommended for this project. The countermeasure summary chart from the STEPS guide is shown in **Figure 5**, where the sections relevant to the roadways in this study area are highlighted.



Roadway Configuration	Posted Speed Limit and AADT								
	Vehicle AADT <9,000			Vehicle AADT 9,000–15,000			Vehicle AADT >15,000		
	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph
2 lanes (1 lane in each direction)	❶ 2 4 5 6	❶ 5 6 7 9	① 5 6 ❼ ❾	❶ 4 5 6	❶ 5 6 7 9	① 5 6 ❼ ❾	❶ 4 5 6 7 9	① 5 6 7 9	① 5 6 ❾
3 lanes with raised median (1 lane in each direction)	❶ 2 3 4 5	❶ ❸ 5 7 9	① ❸ 5 ❼ ❾	① 3 4 5 7 9	① ❸ 5 ❼ ❾	① ❸ 5 ❼ ❾	① ❸ 4 5 7 9	① ❸ 5 ❼ ❾	① ❸ 5 ❾
3 lanes w/o raised median (1 lane in each direction with a two-way left-turn lane)	❶ 2 3 4 5 6 7 9	❶ ❸ 5 6 7 9	① ❸ 5 6 ❾	① 3 4 5 6 7 9	① ❸ 5 6 ❼ ❾	① ❸ 5 6 ❾	① ❸ 4 5 6 7 9	① ❸ 5 6 ❾	① ❸ 5 6 ❾
4+ lanes with raised median (2 or more lanes in each direction)	❶ ❸ 5 7 8 9	❶ ❸ 5 7 8 9	① ❸ 5 8 ❾	① ❸ 5 7 8 9	① ❸ 5 ❼ 8 ❾	① ❸ 5 8 ❾	① ❸ 5 ❼ 8 ❾	① ❸ 5 8 ❾	① ❸ 5 8 ❾
4+ lanes w/o raised median (2 or more lanes in each direction)	❶ ❸ 5 6 7 8 9	① ❸ 5 ❻ 7 8 9	① ❸ 5 ❻ 8 ❾	① ❸ 5 ❻ 7 8 9	① ❸ 5 ❻ ❼ 8 ❾	① ❸ 5 ❻ 8 ❾	① ❸ 5 ❻ ❼ 8 ❾	① ❸ 5 ❻ 8 ❾	① ❸ 5 ❻ 8 ❾

Given the set of conditions in a cell,

- # Signifies that the countermeasure is a candidate treatment at a marked uncontrolled crossing location.
- ● Signifies that the countermeasure should always be considered, but not mandated or required, based upon engineering judgment at a marked uncontrolled crossing location.
- ○ Signifies that crosswalk visibility enhancements should always occur in conjunction with other identified countermeasures.*

The absence of a number signifies that the countermeasure is generally not an appropriate treatment, but exceptions may be considered following engineering judgment.

1 High-visibility crosswalk markings, parking restrictions on crosswalk approach, adequate nighttime lighting levels, and crossing warning signs
2 Raised crosswalk
3 Advance Yield Here To (Stop Here For) Pedestrians sign and yield (stop) line
4 In-Street Pedestrian Crossing sign
5 Curb extension
6 Pedestrian refuge island
7 Rectangular Rapid-Flashing Beacon (RRFB)**
8 Road Diet
9 Pedestrian Hybrid Beacon (PHB)**

Figure 5. STEPS Guide Pedestrian Crossing Countermeasures. Source: FHWA "Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations"[9]

Parks Department Master Plans

The City of Falls Church Recreation and Parks Department has developed Master Plans for the parks noted above. The plans highlight each park's purpose as well as the desired future visitor experience. The following points are relevant to the future alignment that would connect the parks.

Cavalier Trail Park

The purpose of the park is to preserve and protect natural resources as well as provide a variety of passive and active recreational activities for all age groups. The aim for future visitors is to participate in recreational activities as well as be able to learn more about environmental issues such as backyard composting, reforestation, and improving water quality. Cavalier Trail Park has been designated in the City's Comprehensive Plan as a Community Park. Community Parks in the City serve the entire community and for many residents are "drive to" parks. The lighted basketball court, lighted tennis courts, the City's Bike Trail, and the wooded areas all serve to attract residents from the entire City. It also functions as a neighborhood "walk to" park for many residents living adjacent to the park. In addition to the amenities mentioned above, the playground equipment, picnic tables, and park benches make the park an attractive destination for neighbors of the park.

Howard E. Herman Stream Valley Park

The purpose of the park is to preserve and protect natural resources, provide environmental education, provide a variety of passive recreational activities, and provide a trail as part of the City's greenway system to establish a connecting corridor between Oak Street Elementary School and West Broad Street. The master plan highlights that the desired future visitor experience is for visitors to participate in recreational activities, enjoy the natural trail and related activities such as bird watching, and learn more about environmental issues.

Berman Park

Berman Park is a linear park located between Parker Street and Ellison Street, running from the west side of Kent Street to the east side of Irving Street. The Park is 2.3 acres in size and is adjacent to the Boy Scout Property on South Spring Street. The purpose of the park is to preserve and protect natural resources, provide a variety of passive and active recreational activities for all age groups, and provide a trail as part of the City's greenway system with the goal of providing effective non-vehicular transportation corridors. The desired future visitor experience includes participating in recreational activities as well as walking, running, or biking through the park on the trail.

West End Park

West End Park can be found just northwest of the future alignment. It is located adjacent to the W&OD Bike Trail near the Route 7 bike bridge, northwest of the trail's intersection with Grove Avenue, and is approximately two acres in size. The purpose of the park is to preserve and protect natural resources, and to provide a variety of passive and active recreational activities for all age groups.

Ongoing Projects

Fellows Park

In 2019, the City of Falls Church purchased the property located at 604 South Oak Street shown in **Figure 6**. Commonly known as the Fellows Property, the property is approximately 1.9 acres nestled between Parker Avenue and Fellows Court and is across the street from Oak Street Elementary. The property previously featured the home of City resident Lydia "Betty" Fellows. The City plans to convert the property into a park and conducted a survey for nearby residents to determine their preferences regarding the future use. A majority of survey respondents preferred to access the park from S Oak Street; however, the City noted that access should

Figure 6. Fellows Park Location

still be included from Fellows Court and Parker Avenue. The desired future visitor experience is to enjoy the park through walking, biking, and creative play.

Mixed-Use Development Projects – Founders 1&2

A mixed-use development project is planned near the Northern terminus of the project, at the intersection of S West Street and W Broad Street shown in **Figure 7**. The project is expected to create a new destination for local residents as well provide additional pedestrian infrastructure. There is a proposal to install a pedestrian flashing beacon at the intersection of Ellison Street and S West Street.

Figure 7. Mixed-Use Development Project Location

Ellison Street Sidewalk

The City is planning to install a sidewalk on the west side of Ellison Street between S West Street and Kent Street. This sidewalk would connect to the picnic area, as well as a new school bus stop on Kent Street. A small segment of the sidewalk has been funded, while the remainder is in planning stages.

Bridge Projects and Reports

Oak Street Bridge Reconstruction

There currently exists a small bridge north of Oak Street Elementary School on S Oak Street between Timber Lane and S Lee Street, shown in **Figure 8**. A routine bridge safety inspection was conducted in early 2021. It was determined that structure of bridge No. 8000 (S Oak Street over Tripps Run) is generally in poor condition.[7]

Bridge replacement plans have been prepared and anticipated construction to occur in the near term. The bridge replacement will widen the sidewalks as well as add a crosswalk to cross S Oak Street and connect to the existing trail, Tripps Run, shown as a dashed line in **Figure 8**. The City has secured the easements for the project. Currently there is no wayfinding or other signage for this section of trail.

Figure 8. Oak Street Bridge Replacement Location

Bridge Inspection Reports

Bridge inspection reports for several structures along the potential future alignment were provided by the City of Falls Church and are discussed below.

Bridge No. 9007 – Cavalier Trail Park Pedestrian Footbridge over Tripps Run

It was deemed that the structure is in overall fair condition. It was advised to continue to monitor differential sag and the timber decay on the beam end. The sag is shown in the photograph shown as **Figure 9** which was taken on April 11, 2022. The deterioration rate of timber varies and depends on moisture and air content; therefore, it will be difficult to determine remaining service life.

Bridge No. 9019 – Cavalier Trail Park Pedestrian Footbridge over Tripps Run

The structure is in overall fair condition, except for several truss diagonal connections which are in serious condition. Cracked/ failed welded connections between truss diagonals and bottom chord are present and need to be repaired.

Bridge No. 9008 – Howard E. Herman Stream Valley Park Pedestrian Footbridge over Tripps Run

The structure is in overall fair condition, except for 2 truss diagonals and 1 vertical member which are in poor condition. Advanced corrosion, section loss and bulging of steel members were identified during the inspection.

Bridge numbers 9007, 9008, and 9019 noted above are nearing the end of their viable service lives and have been recommended to be replaced before they become a critical need.

Figure 9. Sag on Bridge No. 9007

EXISTING TRANSPORTATION/ TRAIL FEATURES AND DATA

Vehicular Characteristics

The existing trails and future alignment are adjacent to, intersecting, and affected by the street network. Roads that are relevant to this project include:

- S Washington Street
- S Maple Avenue
- Sherrow Avenue
- S Oak Street
- Timber Lane
- Parker Avenue
- S Spring Street
- Irving Street
- Ellison Street
- S West Street
- W Broad Street

W Broad Street runs roughly parallel to the proposed future alignment and is a major arterial in the City of Falls Church. The other roadways included are roadways which the trail may cross or may include on-road sections of trail in some areas. **Table 3** below classifies and identifies the speed limit, as posted by the City of Falls Church, of roads relevant to this effort. Turning movement counts at relevant intersection locations within the study area can be found in the appendix.

Pedestrian Facilities

W&OD Trail

The W&OD trail is a 45-mile route that connects Shirlington, East of this project location, to Purcellville, West of this project location. Access to the trail can be found near the intersection of W Broad Street and Falls Avenue, near the Northern terminus point of the study area. Access to the this trail is vital as it provides connections for multimodal users in Falls Church to a major east-west multimodal commuter and recreational route. The W&OD trail provides a direct connection to multiple neighboring towns, cities and transit facilities including the East Falls Church Metro station and other regional trails.

Sidewalks

Based on a field visit conducted on April 11, 2022, the following roads have sidewalk on only one side:

- S Spring St
- Ellison St
- Timber Ln
- Parker Ave

Table 3: Roadway Types and Speed Limits

	Classification	Posted Speed	Daily Vehicular Volume[1]
S Washington Street	Major Arterial	30	14,000[2]
S Maple Ave	Collector	25	-
Sherrow Avenue	Residential	25	1,000
S Oak Street	Collector	25	2,000
Timber Lane	Residential	25	1,500
Parker Avenue	Residential	25	1,600
S Spring Street	Residential	25	-
Irving Street	Residential	25	-
Ellison Street	Residential	25	400
S West Street	Minor Arterial	25	9000
W Broad Street	Major Arterial	25	18,000

1. Except where noted, daily vehicular traffic estimated based on adjacent peak hour turning movement counts and an assumed k value of 0.1.
2. 2020, VDOT Average Daily Traffic Volumes with Vehicle Classification Data on Interstate, Arterial, and Primary Routes, https://www.virginiadot.org/info/ct-TrafficCounts.asp

Irving St has no sidewalk. All other roadways of interest in this study area have sidewalk on both sides. Specific dimensions are discussed below in the Study Area Segments section.

Walk Score

VTrans is Virginia's statewide transportation plan. A component of VTrans is an online, interactive data portal with dozens of data sets relevant to transportation in Virginia (InteractVTrans, https://vtrans.org/interactvtrans/map-explorer). One of the data sources available through InteractVTrans is Walk Score, which the website describes as:

> "Walk Score measures the walkability of any address using a patented system. For each address, it analyzes hundreds of walking routes to nearby amenities. Points are awarded based on the distance to amenities in each category. Amenities within a 5-minute walk (.25 miles) are given maximum points. A decay function is used to give points to more distant amenities, with no points given after a 30-minute walk. Walk Score also measures pedestrian friendliness by analyzing population density and road metrics such as block length and intersection density. Data sources include Google, Factual, Great Schools, Open Street Map, the U.S. Census, Localeze, and places added by the Walk Score user community."[8]

Definitions for various Walk Score results are shown in **Table 4**. The VTrans website provides a map explorer that allows users to quickly identify the Walk Score of specific addresses (see example in **Figure 10**). Addresses adjacent to the study area for this project were collected and averaged. The study area was found to have an average Walk Score of 78 (Very Walkable).

Table 4: Walk Score Definitions

Walk Score	Category	Description
90-100	Walker's Paradise	Daily errands do not require a car
70-89	Very Walkable	Most errands can be accomplished on foot
50-69	Somewhat Walkable	Some errands can be accomplished on foot
25-49	Car-Dependent	Most errands require a car
0-24	Car-Dependent	Almost all errands require a car

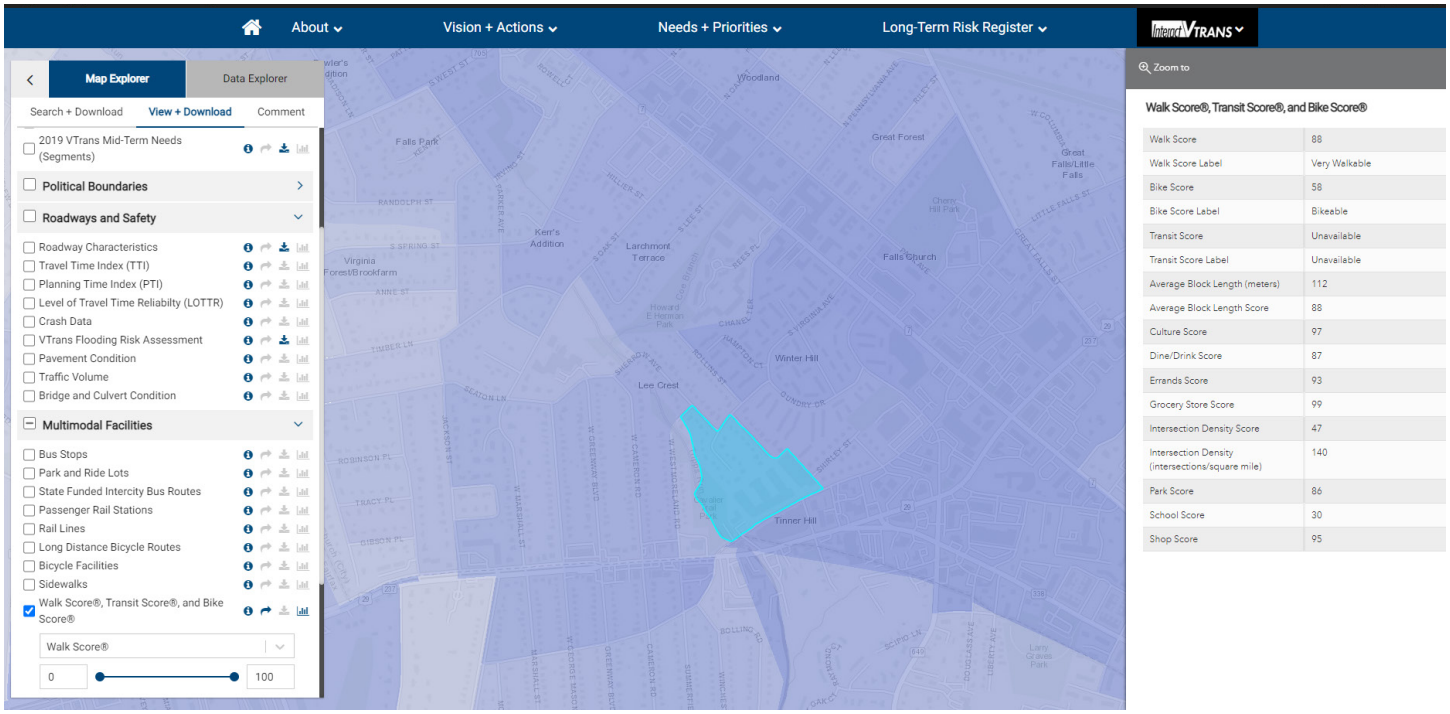


Figure 10. VTrans Website – Walk Score Retrieval

Bicycle Facilities

Bike Routes and Bikeshare

Within the study area, there is currently one Capital Bikeshare station near the entrance to Cavalier Trail Park. Designated bicycle routes by the City of Falls Church are shown in **Figure 11.**

Bike Score

In addition to a Walk Score, InteractVTrans provides Bike Score data, which estimates the relative comfort of an area for biking. For a given location, a Bike Score is calculated by measuring bike infrastructure (lanes, trails, etc.), hills, destinations and road connectivity, and the number of bike commuters. These component scores are based on data from the USGS, Open Street Map, and the U.S. Census. Definitions for various Bike Scores are shown in Table 5. Similar to the Walk Score assessment, the study team gathered Bike Score data for addresses adjacent to the proposed alignment. The average Bike Score was 68 (Bikeable), indicating there is more room for improvement for bikeability in the study area.

Table 5: Bike Score Breakdown

Bike Score	Category	Description
90-100	Biker's Paradise	Daily errands can be accomplished on a bike
70-89	Very Bikeable	Biking is convenient for most trips
50-69	Bikeable	Some bike infrastructure
0-49	Somewhat Bikeable	Minimal bike infrastructure

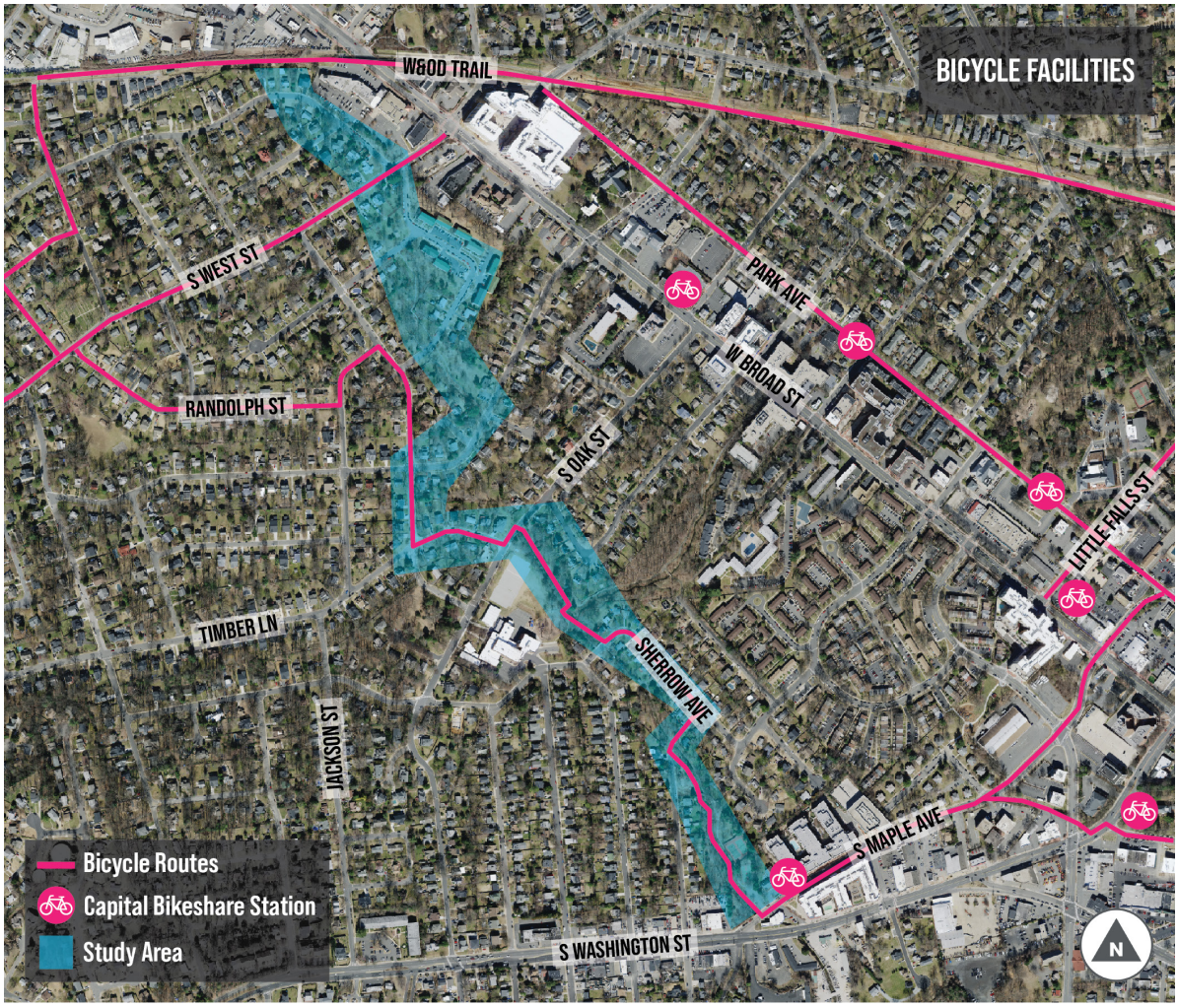


Figure 11. Bike Routes Relative to the Study Area

STUDY AREA SEGMENTS

The study area is broken into five segments as shown in **Figure 12**. Segments are based on existing conditions, feasibility as determined by the analysis of existing conditions such as right-of-way, input from the field visit conducted on April 11, 2022, and concurrence from the City. (Survey was not conducted as part of this project, so estimates of feasibility are based on engineering judgement from visual inspection in the field). ***Table 7*** summarizes the benefits and challenges for each of the preferred alignment alternatives in each segment.

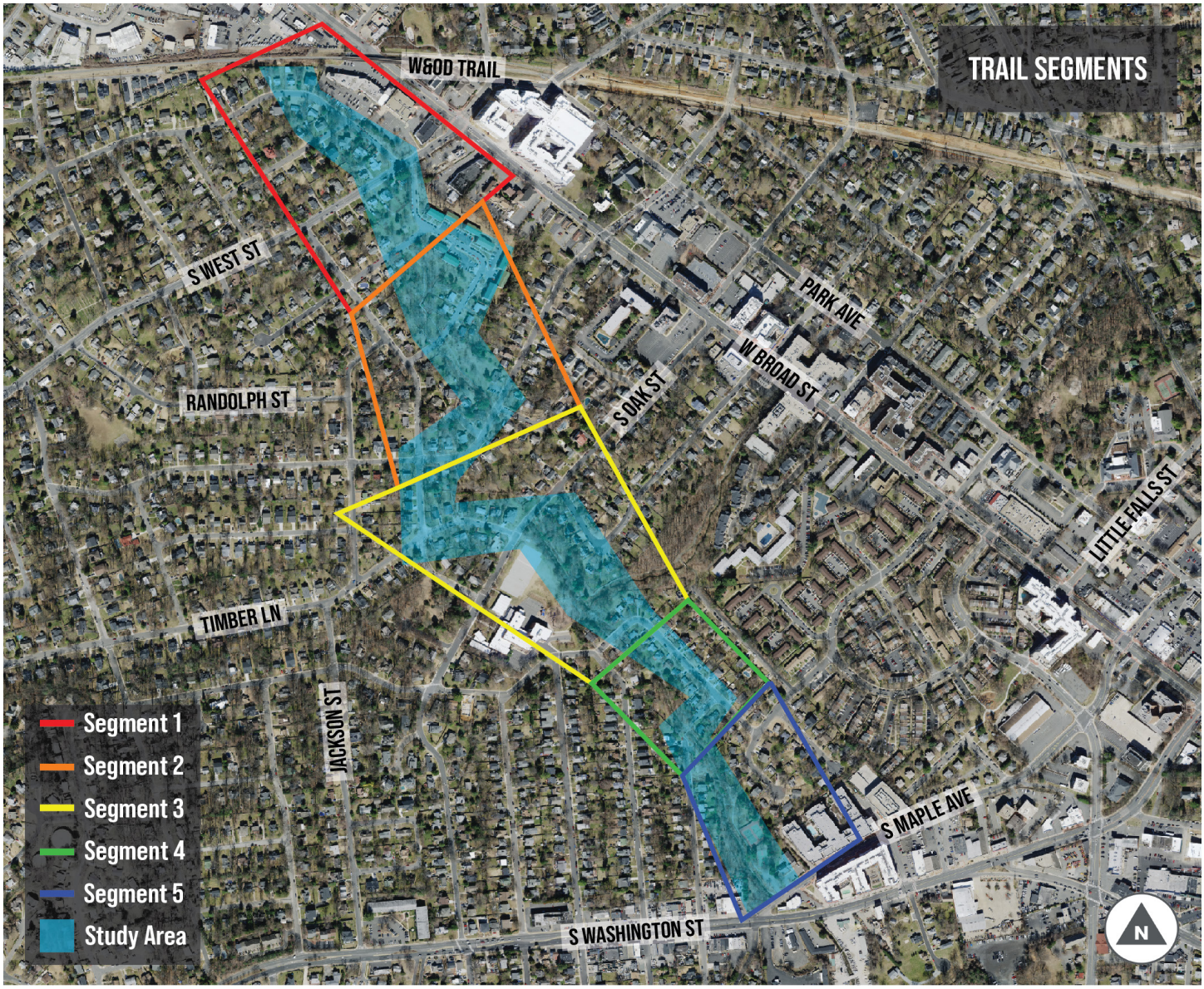


Figure 12. Study area segments

Segment 1 – W&OD to Kent Street

There currently is no trail facility connecting the W&OD trail to Kent Street. The connecting roadways include W Broad Street, S West Street, and Ellison Street. As shown in **Figure 13**, Ellison Street has a 3.5-foot sidewalk on the North side of the street, with a 30-foot curb to curb width. The roadway is two-way, with no marked centerline, and parking permitted on both sides. The existing sidewalk is not compliant with ADA and does not meet VDOT guidelines for sidewalk widths.

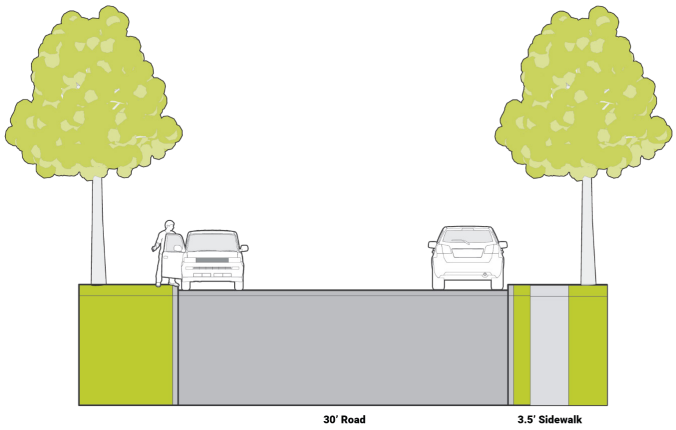


Figure 13. Ellison Street Existing Cross Section

There is not a simple, comfortable transition from the W&OD trail to Kent Street. The current most obvious route is as follows:

- Use ramp off the W&OD trail onto W Broad Street
- Walk southeast on the sidewalk
- Turn onto S West Street and proceed west
- Make a left turn onto Ellison Street which has only one sidewalk on the East side of the road, and
- Turn onto Kent Street which has access to Berman Park.

This route is shown in **Figure 14**. The sidewalk on Ellison Street ends at the intersection with Kent Street and there currently is no marked crossing across Ellison Street. As is shown in **Figure 15**, users typically walk along the grass on the side of the road. The study team observed during the April 11, 2022 field visit that the intersection at Ellison Street and S West Street had a noticeable number of turning vehicalswith drivers not yielding to pedestrians.

Figure 14. Existing route from W&OD Trail to Berman Park

A multimodal facility in the Segment One area would connect Berman Park to the W&OD trail as well as to West End Park. As noted, before, one of the Berman Park purposes was to "provide a trail as part of the City's greenway system in an effort to provide effective non-vehicular transportation corridors". This segment would facilitate that purpose by not only providing an efficient and safe multimodal route, but by also connecting to the W&OD trail.

Figure 15. Berman Park Entrance on Kent Street

Alignment Discussion

Recommended Trail Alignment

Toole Design recommends a 10-wide shared use path or expanded sidewalk on the south side of W Broad Street between the W&OD trail and the proposed mix-use development at Founders II Row. The proposed trail would then continue through the Founders II development using the pedestrian access included in that development plan and across S West Street to the east side of Ellison Street using the sidewalk access currently in design.The trail would enter Parcel 2932 to the east of the picnic shelter and continue across Kent Street. The trail alignment should be designed to provide access to the picnic shelter, either directly or with a small offshoot path as necessary based on final engineering, ading and alignment design. Based on initial field assessment direct connection is feasible.

A planning level cost estimate created using a VDOT Cost Estimating Tool for the recommended alignment for this segment ranges from $399,000 to $722,000, for more details see the Cost Estimate section of the appendix."

Benefits

- Provides access to the picnic structure and school bus stop at the corner of Ellison Street & Kent Street
- Provides multi-modal connectivity to the businesses at West End Plaza

Challenges

- Grading differences near the West End Plaza parking lot
- Visibility of trail users at West End Plaza driveways
- Grading differences and minor flooding on Parcel 2932
- Available width on Broad Street.

Alternative Trail Alignment

Toole Design also considered an alternative route through the West End Plaza parking lot. Trail users would travel along the northern edge of the parking lot to Ellison Street. The alternative alignment then continues on the off-road path on the east side of Ellison Street and through Parcel 2978. This alternative is not recommended due to the limited space, need to remove parking, and potential conflict points with cars in the parking lot. However, based on field observations, the route through the parking lot is currently in use, and is likely to remain a preferred route for some cyclists since it avoids the heavier traffic on Broad Street. Wayfinding and/or shared use markings through the parking lot to the W&OD trail connection would facilitate this use and could be implemented in addition to the recommended alignment on Broad Street for minimal cost.

Roadway Crossings

The crossing at S. West Street, as noted in the existing conditions section, has a higher number of turning vehicles than elsewhere in the study area, and it was observed that drivers have poor pedestrian yielding behavior. Based on an estimated average daily traffic (ADT) volumes of 9,000 vehicle per day (vpd), and a speed limit of 25, a Rectangular Rapid Flashing Beacon (RRFB) or, if warranted, a Pedestrian Hybrid Beacon (PHB) is a recommended addition to marking the crosswalk area recommended here. Examples of these crossing treatments are shown in **Figure 18 and 19**. The Founders Row II development may be required to provide a crossing treatment at this location that would meet this need, and the design should be coordinated to accommodate this alignment.

Figure 16. Segment 1 Recommended and Alternative Alignments

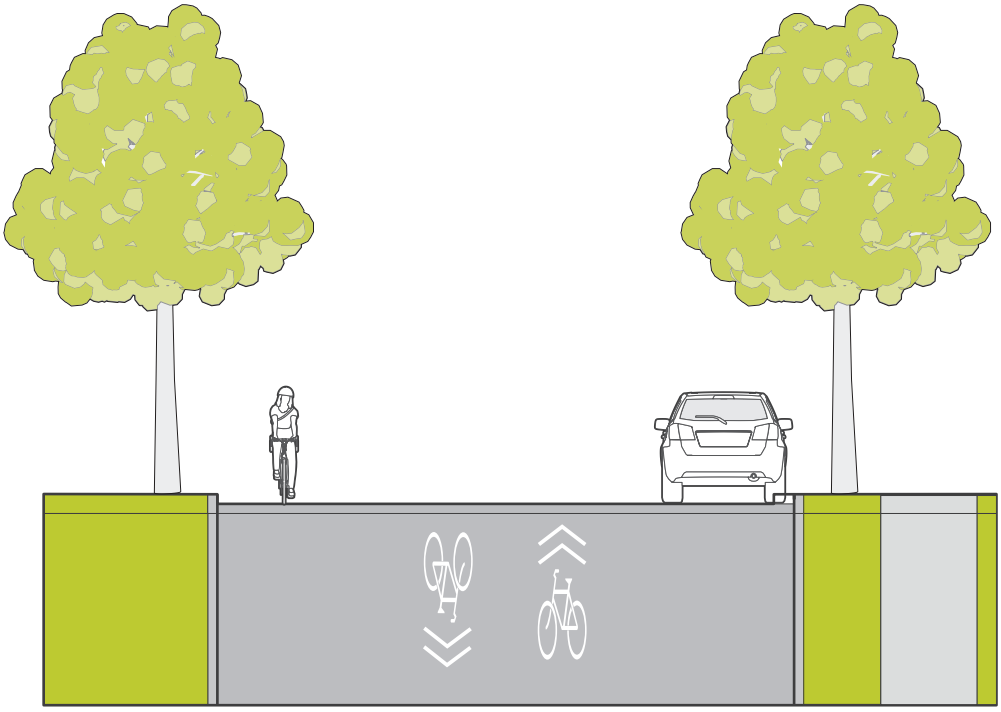


Figure 17. Ellison Street Proposed Cross Section

Figure 18. Example of a Rectangular Rapid Flashing Beacon (RRFB) on the W&OD trail in Ashburn, VA

Figure 19. Example of a Pedestrian Hybrid Beacon (PHB), which indicates to drivers when a pedestrian wants to cross (Tuscon, Arizona)

Segment 2 – Berman Park Area

Segment Two connects S Spring Street to Kent Street via Berman Park and the Falls Church Scout Building Association path. It is important to note that this is a gravel path (**Figure 22**) that transitions into an asphalt path (**Figure 23**) leading directly to the entrance of Berman Park, and as noted by Falls Church staff during a field review, the use agreement for this parcel requires that it remain a natural surface trail. This trail does not appear on mobile map applications (Google Maps and Apple Maps) though is listed as a trail through the City of Falls Church Open GIS Data. Segment Two currently has a full network of paths that provide recreational access; however, the widths are narrower than VDOT or AASHTO standards for shared use paths.

Irving Street, Ellison Street, and Parker Avenue can be found within this segment. It was noted earlier that these streets have a sidewalk on only one side of the road, making multimodal connections, especially pedestrian connections, more difficult, requiring additional crossings and reducing pedestrian capacity.

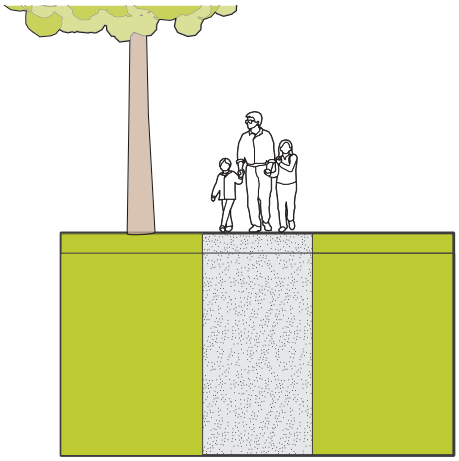


Figure 20. Falls Church Scout Building Association Trail Existing Cross Section

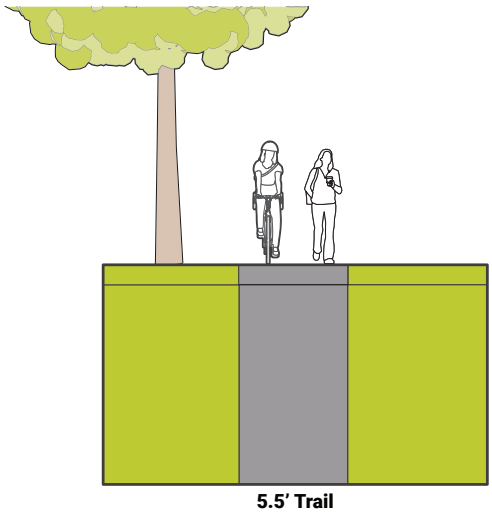


Figure 21. Berman Park Trail Existing Cross Section

Figure 22. The Falls Church Scout Building Association Gravel Path

Figure 23. Transition from the Gravel Path to the Asphalt Path on City property

Alignment Discussion

Recommended Trail Alignment

In Segment 2, Toole Design recommends a paved 10-foot trail in Berman Park and city-owned property. In Berman Park, the recommended trail is routed slightly west to avoid the rain garden and boardwalk path. The City anticipates widening the boardwalk path from 3.5 feet to 7 feet sometime within the next 5-7 years, however a parallel full 10-foot asphalt path is recommended to serve more users. The trail alignment planning should proceed concurrently with ongoing planning for replacement/expansion of play equipment on this parcel. The play area layout should be designed to allow space for the trail, and the trail alignment should be designed to provide access to without inpinging on the play area.

On the Scout Building Association property, Toole Design recommends working with the Boy Scouts of America to widen the existing gravel path. Though a natural surface trail will not provide full accessibility for all users, particularly those with small wheel scooters or walkers, the trail surface could also be upgraded

when widened to a more stabilized surface that will maximize accessibility and minimize maintenance as much as possible. Surface materials such as crushed rock or packed dirt should be considered. Additional information on natural surface options is provided in the appendix. Mid-block crossings on Irving Street and Kent Street, which will be implemented as part of the City's Berman Park project, will connect the trail.

The planning level cost estimate for the recommended alignment for this segment ranges from $550,000 to $1,021,000, for more details see the Cost Estimate section of the appendix.

Benefits

- Consistent path that is comfortable for trail users of all ages and abilities
- Improves safety of existing pathways
- Allows bicycle access through Berman Park

Challenges

- Separating trail from play structures in Berman Park. Play structure may be rotated to position the slide away from the proposed path
- Potential tree impacts – 3 mature trees identified, additional younger trees
- Increased runoff due to additional impervious surfaces

Roadway Crossings

The alignment as shown here will cross Kent Street, Irving Street and Spring Street. There is currently a marked crosswalk on Spring Street at Lea Court which is to be widened to 10 feet, but is otherwise adequate. Based on an estimated daily volume of 1,500 vpd and a speed limit of 25 mph, a high visibility crosswalk treatment with an in-street pedestrian crossing sign is recommended for the Kent Street and Irving Street mid-block crossing locations. Curb extensions should also be considered at these locations to maximize crossing visibility between parked cars.

Figure 24. Segment 2 Recommended and Alternative Alignments

Segment 3 – Oak Street Area

This segment connects Oak Street Elementary School and Howard E Herman Park to the City of Falls Church Scout Building Association Trail (near the intersection of Lea Court and S Spring Street). This segment features a paved 6.75-foot shared use path (**Figure 25**). The Howard E Herman trailhead is on Sherrow Avenue though it does not have any signage/wayfinding other than a bike route sign (**Figure 27**). The trail leads to S Oak Street where the Bridge Reconstruction project will occur as noted in an earlier section.

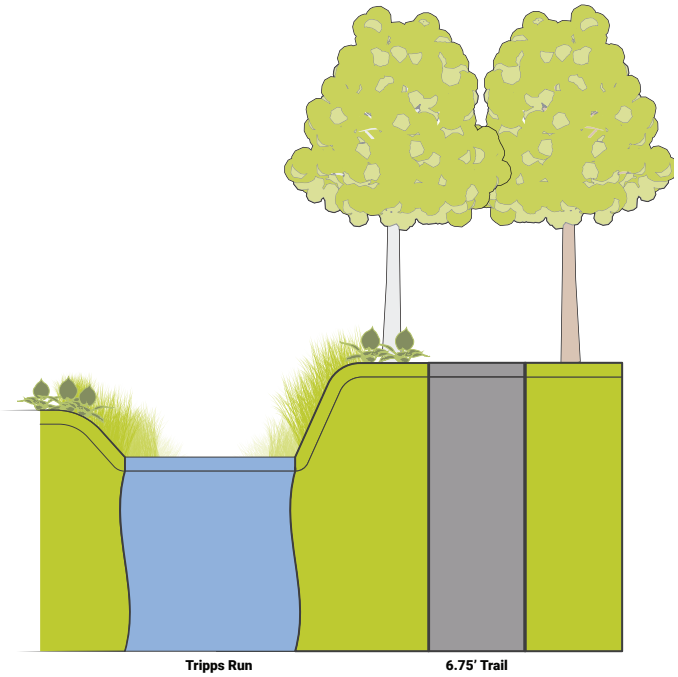


Figure 25. Howard E Herman Park Trail Existing Cross Section

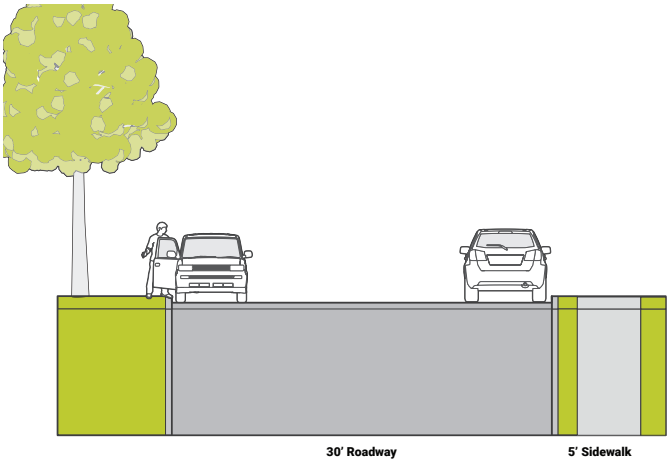


Figure 26. Timber Lane Existing Cross Section

Figure 27. Howard E Herman Trailhead on Sherrow Avenue

Alignment Discussion

Recommended Trail Alignment

Toole Design recommends installing a bike boulevard from the intersection of S Spring Street and Lea Court to the proposed 10 foot off-road path, which would begin between S 147 and 159 Spring Street and run along the two properties. The path would continue along City-owned property between 302 S Oak Street and 300 Timber Lane. A crossing is recommended at this location on S Oak Street to connect to the trail north of Oak Street Elementary. Toole Design proposes expanding this trail to 10 feet wide.

The planning level cost estimate for the recommended alignment for this segment ranges from $592,000,000 to $1,079,000, for more details see the Cost Estimate section of the appendix.

Benefits

- Consistent path that is comfortable for trail users of all ages and abilities
- Improves comfort and safety of existing trail
- Connection to Howard E Herman Park trail

Challenges

- Affects two private properties
- Potential tree impacts – 3 mature trees identified
- Potential grading differences to address
- Increased runoff due to additional impervious surfaces

Alternative Trail Alignment

An on-street facility has been identified as an alternative for the trail section between Oak and Spring Street. A bike boulevard may be installed on the following street segments:

- Spring Street between Lea Court and Parker Avenue
- Parker Avenue between Spring Street and Timber Lane

Figure 28. Segment 3 Recommended and Alternative Alignments

- Timber Lane between Parker Avenue and Oak Street
- Oak Street between Timber Lane and the entrance to the trail at Oak Street Elementary

South of Oak Street, no alternative alignment is identified as the recommended alignment follows the existing trail.

The minimum for the recommended bike boulevard treatment consists of shared lane markings and wayfinding for cyclists, as well as a widening sidewalks through these sections to meet the VDOT minimum of a five foot wide sidewalk with a three foot foot buffer. Based on an estimated ADT of 1,500 vpd and a posted speed limit of 25 mph, a shared lane treatment is appropriate for these roadways as shown in **Figure 30**. A bike lane, preferably with a buffer would be more comfortable for all users, but would require parking removal.

Benefits

- Shared lane markings are relatively inexpensive

Challenges

- Shared lanes are not comfortable for all trail users
- Additional wayfinding required to make path intuitive
- Sidewalk widening likely to affect abutting private properties

Roadway Crossings

The alignment as shown here will cross Oak Street. The ongoing bridge replacement project at Oak Street as previously discussed includes a pedestrian crossing. This crossing should be designed to accommodate the alignment as discussed in this report. Based on the 25 mph speed limit and the estimated ADT of 2,000 vpd, a high visibility crosswalk with an in-street pedestrian crossing sign is recommended. If feasible with the bridge replacement project, consider pedestrian curb extensions to increase the visibility of the crossing.

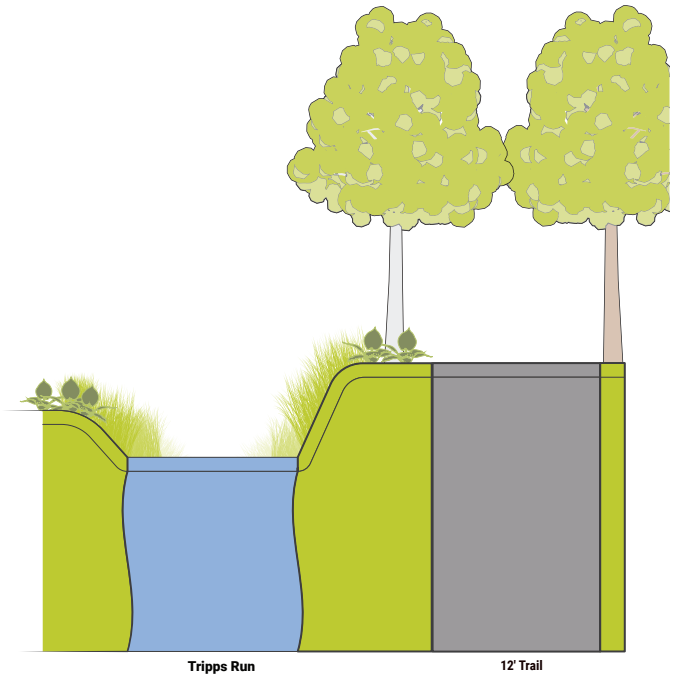


Figure 29. Howard E Herman Park Trail Proposed Cross Section

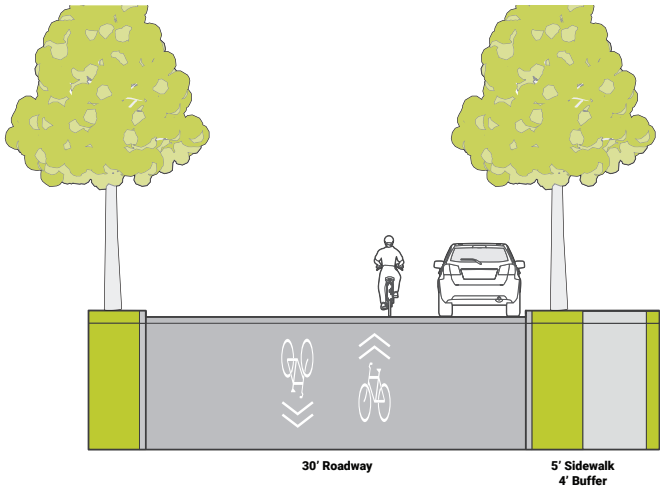


Figure 30. Timber Lane Proposed Cross Section

Segment 4 – Cameron/Sherrow Area

This segment connects Cavalier Trail Park to Oak Street Elementary School as well as Howard E Herman Park. This segment is particularly difficult to traverse as a pedestrian due to a lack of multimodal infrastructure. After exiting Cavalier Trail Park, one may walk on Sherrow Avenue which has a sidewalk with a measured width of 3.5 feet, which is not compliant with ADA or VDOT standards, as shown in **Figure 31**.

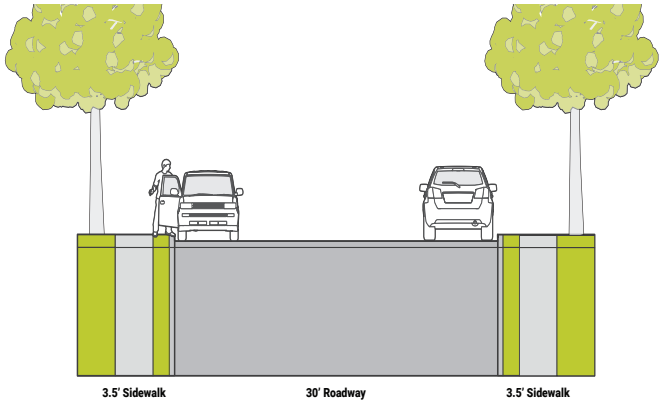


Figure 31. Sherrow Lane Existing Cross Section

Alignment Discussion

Recommended Trail Alignment

Toole Design recommends that the alignment continues off-street by extending the trail from Cavalier Trail Park along the eastern side of Tripps Run. This segment would begin between 421 and 423 Sherrow Road and run along the back property lines of 8 properties through the section adjacent to or above the underground stream/culvert. These private properties are within a floodway, and the City has begun discussions with property owners on acquiring an easement through the back of the parcels. A crossing is recommended on Sherrow Avenue at the Howard E Herman Trailhead.

The planning level cost estimate for the recommended alignment for this segment ranges from $259,000 to $457,000, for more details see the Cost Estimate section of the appendix.

Benefits

- Comfortable path that is a natural continuation of the Cavalier Trail Park path

Challenges

- 8 private properties are affected
- Potential tree impacts
- Potential need to address grading differences
- Increased runoff due to additional impervious surfaces, as private properties are within the floodway

Alternative Trail Alignment

The trail may continue through shared lane markings on Sherrow Ave and on W Westmoreland Road to the Cavalier Trail Park pedestrian footbridge over Tripps Run. Wider sidewalks (5 feet) are also recommended on this segment to accommodate higher pedestrian volumes. On the west side of Sherrow Road, the existing sidewalk can be widened on the private property side so the curb is not impacted. A crossing is recommended on Sherrow Avenue at the Howard E Herman Trailhead.

Benefits

- Maintain on-street parking

Challenges

- Traffic volumes are high during arrival and dismissal for Oak Street Elementary
- Less cohesive and intuitive. Additional wayfinding is needed to create a trail-like feel
- Less comfortable for bicyclists of all ages and abilities, especially during Oak Street Elementary School's arrival and dismissal

Alternative Trail Alignment

An additional alternative is a shared lane on W Cameron Road to the utility easement between 200 and 124 W Cameron Road properties. The easement currently has a mulch path that connects W Cameron Road to W Westmoreland Road. Based on feedback received during the field meeting with Falls Church staff, this alternative alignment is preferred over Sherrow Avenue to avoid the majority of the pick-up/drop-off activity on Sherrow Avenue.

Benefits

- Maintain on-street parking
- Existing motor vehicle volumes are appropriate for a bicycle boulevard

Challenges

- Less cohesive and intuitive. Additional wayfinding is needed to create a trail-like feel
- Less comfortable for bicyclists of all ages and abilities, especially during Oak Street Elementary School's arrival and dismissal
- Utility easement has limited width for a shared use path

Roadway Crossings

All alignments as discussed here will cross Sherrow Avenue. Based on the 25 mph speed limit and the estimated ADT of 1,000, a high visibility crosswalk with an in-street pedestrian crossing sign is recommended. Based on collected volumes and feedback from staff during our field review, Sherrow Avenue is often used for parent pick-up/drop-off at the adjacent elementary school. The design of the pedestrian crossing at this location may require modification to avoid impacts to the existing bridge/culvert structure, but if feasible pedestrian curb extensions would be strongly recommended here to increase the visibility of the crossing due to heavy parent pick-up and drop-off activity.

Figure 32. Segment 4 Recommended and Alternative Alignments

Segment 5 – Cavalier Trail Park

This segment encompasses the entirety of Cavalier Trail Park. The Park itself can be considered a destination due to the variety of facilities available, including basketball and tennis courts. The segment connects US 29 and S Maple Avenue to Sherrow Avenue. The path width within Cavalier Trail Park is narrower than VDOT and national guidance recommendations.

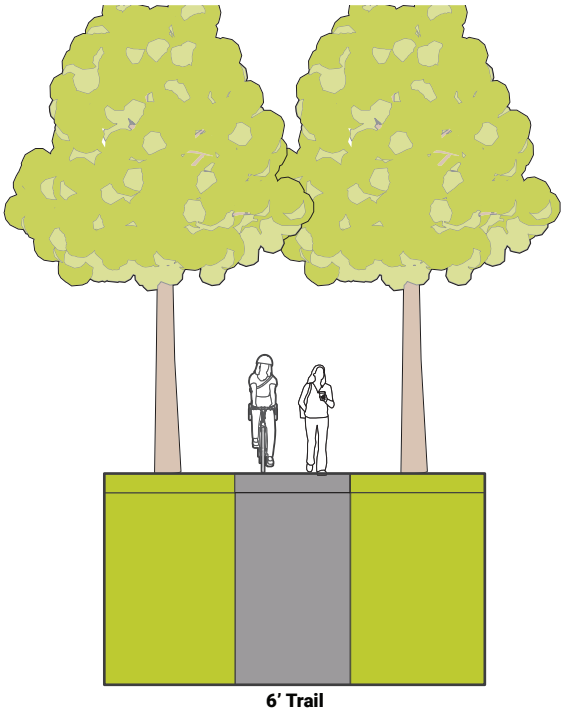


Figure 33. Cavalier Trail Park Existing Cross Section

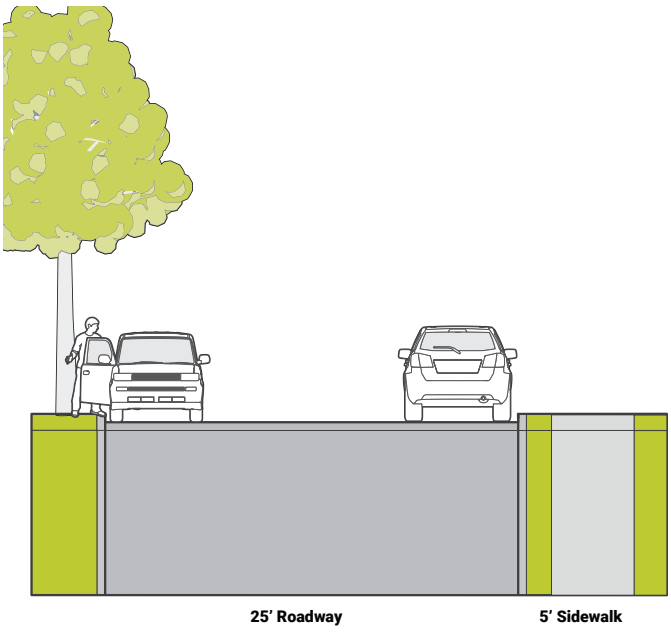


Figure 34. W Westmoreland Rd Existing Cross Section

Alignment Discussion

Recommended Trail Alignment

Toole Design recommends maintaining the alignment of the existing trail and widening it to 10 feet.

The planning level cost estimate for the recommended alignment for this segment ranges from $346,000 to $612,000, for more details see the Cost Estimate section of the appendix.

Benefits

- Improving the comfort and safety of existing trail
- Comfortable path for pedestrians and bicyclists, with space for trail users to pass each other
- No impacts to private property
- Limited changes to Cavalier Trail Park

Challenges

- Potential tree impacts – 2 mature trees identified
- Potential impacts to lighting and fencing along the western edge of the tennis courts
- Potential need to address grading differences
- Increased runoff due to additional impervious surfaces

Alternative Trail Alignment

A bike boulevard may be installed on W Westmoreland Road from the northern entrance of Cavalier Trail Park to Route 29. Sharrows and bicycle wayfinding help people in cars and people on bikes share the road. There is an existing 5 foot sidewalk on the east side of W Westmoreland Road that is in fair condition.

Benefits

- Maintain on-street parking
- Limited impact to right-of-way

Challenges

- Shared lanes are not comfortable for all trail users
- Additional wayfinding required to make path intuitive

Figure 35. Segment 5 Recommended and Alternative Alignments

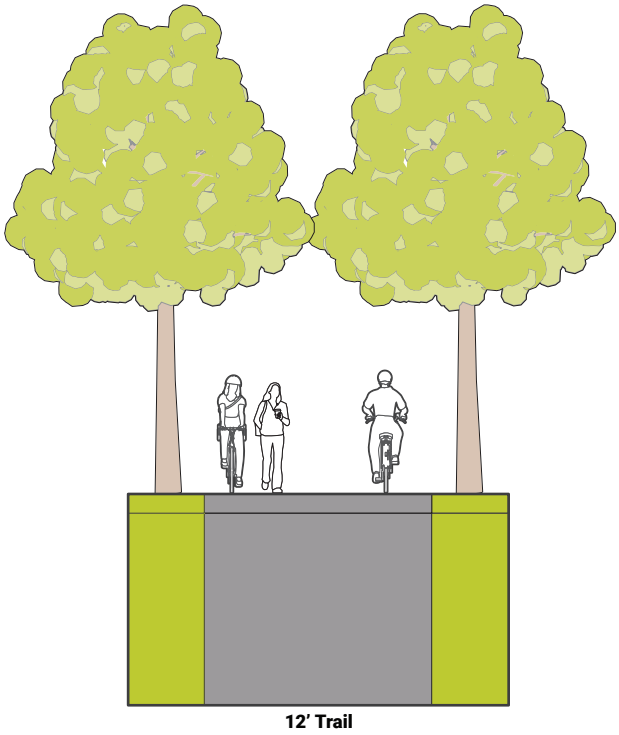


Figure 36. Cavalier Trail Park Proposed Cross Section

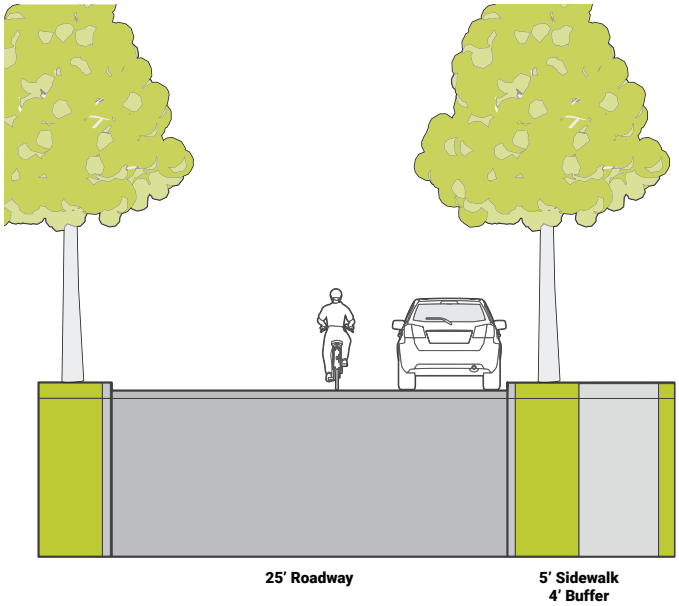


Figure 37. W Westmoreland Rd Proposed Cross Section

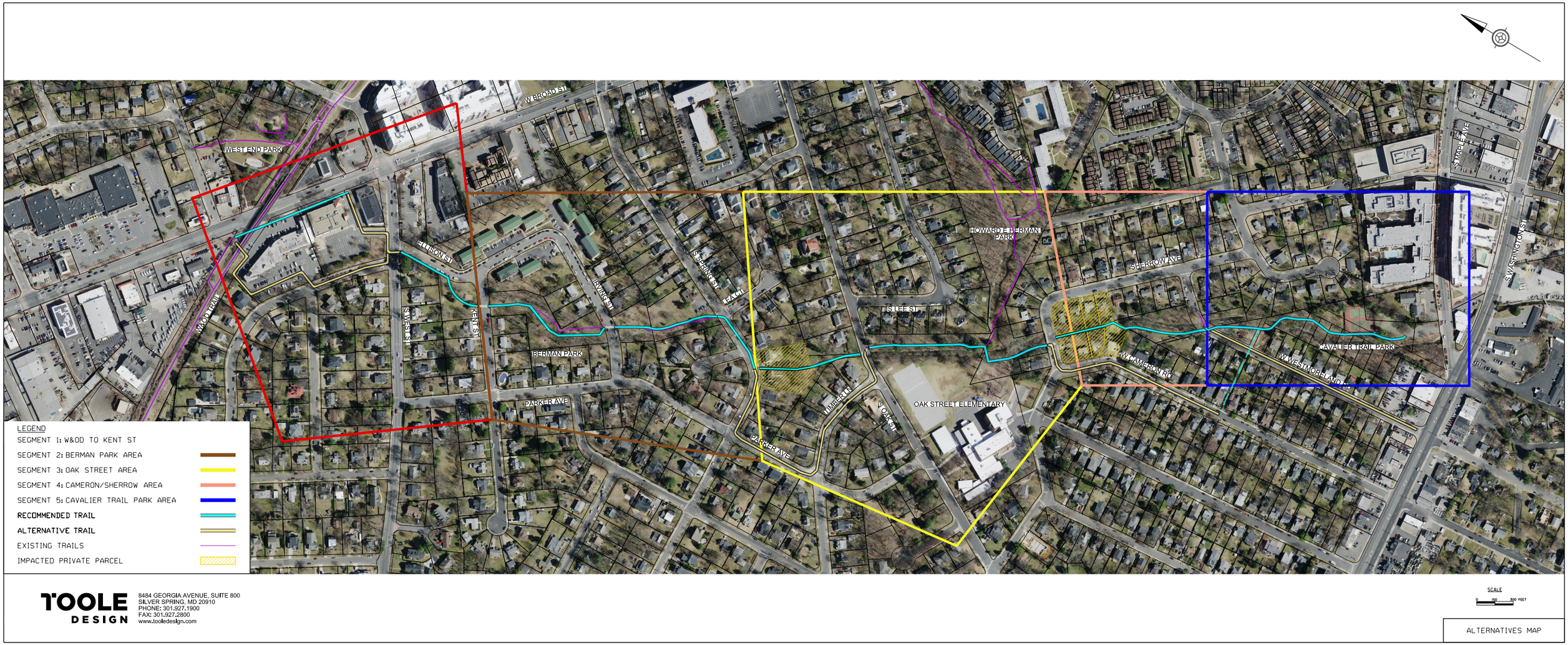
Table 7: Recommended Alignment Benefits and Challenges Summary

Segment	Benefits	Challenges
1 - W&OD to Kent Street	▪ Provides access to the picnic structure and school bus stop at the corner of Ellison Street & Kent Street ▪ Provides multi-modal connectivity to the businesses at West End Plaza	▪ Grading differences near the West End Plaza parking lot ▪ Visibility of trail users at West End Plaza driveways ▪ Grading differences and minor flooding on Parcel 2932
2 - Berman Park Area	▪ Consistent path that is comfortable for trail users of all ages and abilities ▪ Improves safety of existing pathways ▪ Allows bicycle access through Berman Park	▪ Separating trail from play structures in Berman Park. Play structure may be rotated to position the slide away from the proposed path ▪ Potential tree impacts – 3 mature trees identified, additional younger trees ▪ Increased runoff due to additional impervious surfaces
3 - Oak Street Area	▪ Consistent path that is comfortable for trail users of all ages and abilities ▪ Improves comfort and safety of existing trail ▪ Connection to Howard E Herman Park trail	▪ Affects two private properties ▪ Potential tree impacts – 3 mature trees identified ▪ Potential grading differences to address ▪ Increased runoff due to additional impervious surfaces
4 - Cameron/ Sherrow Area	▪ Comfortable path that is a natural continuation of the Cavalier Trail Park path	▪ 8 private properties are affected ▪ Potential tree impacts ▪ Potential need to address grading differences ▪ Increased runoff due to additional impervious surfaces, as private properties are within the floodway
5 - Cavalier Trail Park	▪ Improving comfort and safety of existing trail ▪ Comfortable path for pedestrians and bicyclists, with space for trail users to pass each other ▪ No impacts to private property ▪ Limited changes to Cavalier Trail Park	▪ Potential tree impacts – 2 mature trees identified ▪ Potential need to address grading differences ▪ Increased runoff due to additional impervious surfaces

ENDNOTES

1. City of Falls Church Geospatial Services Open Data, https://opendata-fallschurch.opendata.arcgis.com/
2. City of Falls Church Geospatial Services Open Data, https://opendata-fallschurch.opendata.arcgis.com/
3. American Association of State Highway and Transportation Officials (AASHTO) *Guide for the Development of Bicycle Facilities*, 2012.
4. Virginia Department of Transportation, *Roadway Standards Appendix A(1): Bicycle and Pedestrian Facility Guidelines, Bus Stop Design, and Parking Guidelines*, https://www.virginiadot.org/business/resources/locdes/rdm/Appenda1.pdf
5. https://nacto.org/publication/urban-street-design-guide/street-design-elements/sidewalks/
6. Federal Highway Administration, Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations, https://safety.fhwa.dot.gov/ped_bike/step/docs/STEP_Guide_for_Improving_Ped_Safety_at_Unsig_Loc_3-2018_07_17-508compliant.pdf
7. 2021, VDOT, Routine Bridge Safety Inspection Report
8. Interact VTrans, https://vtrans.org/interactvtrans/map-explorer
9. Federal Highway Administration, *Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations*, https://safety.fhwa.dot.gov/ped_bike/step/docs/STEP_Guide_for_Improving_Ped_Safety_at_Unsig_Loc_3-2018_07_17-508compliant.pdf

APPENDIX A - ALIGNMENT MAP



TOOLE DESIGN
8484 GEORGIA AVENUE, SUITE 800
SILVER SPRING, MD 20910
PHONE: 301.927.1900
FAX: 301.927.2800
www.tooledesign.com

SCALE
0 150 300 FEET

ALTERNATIVES MAP

Figure A1. Alignment Map

APPENDIX B - COST ESTIMATE

Cost Estimate

The following is a planning level cost estimate for the construction of the proposed sidewalk sections, and trail sections. During the Engineering Design process, these values will likely change as the design is finalized. The estimated values are based on VDOT prices for residential/suburban settings, adjusted for inflation. Using the VDOT Cost Estimating Tool, the estimates are presented below as ranges, with a low-end and high-end estimate for each project. Estimated costs for crossing treatments, a 10' paved shared-use off-road path, downtown signage, right-of-way/utility allowances, and contingencies are included in the overall sidewalk and trail cost estimates. The range in estimates accounts for additional expenses that may be needed for some projects, such as retaining walls or other features. Additional details about the cost estimate assumptions and unit costs applied are available in the submitted Planning Level Cost Opinion excel workbook. These cost estimates were prepared in July 2022 and should be considered valid for no more than 6 months.

Table A1. Recommended Alternative Cost Estimate Summary – Segment 1

	Trail Segment 1	
	Low	**High**
Project Length (Miles)	.17	
Subtotal Roadway Cost	$213,030	$350,227
Right-of-way and Utilities Cost[1]	$106,515	$227,48
Total Roadway Cost[2]	$319,545	$577,875
TOTAL SEGMENT COST[3]	**$399,432**	**$722,344**

[1] Low end estimate assumes 50% and high end assumes 65% [2] Includes crossings [3]Includes contingency

Table A2. Recommended Alternative Cost Estimate Summary – Segment 2

	Trail Segment 2	
	Low	**High**
Project Length (Miles)	0.21	
Subtotal Roadway Cost	$293,333	$495,000
Right-of-way and Utilities Cost[1]	$146,667	$321,750
Total Roadway Cost[2]	$440,000	$816,750
TOTAL SEGMENT COST[3]	**$550,000**	**$1,020,938**

[1] Low end estimate assumes 50% and high end assumes 65% [2] Includes crossings [3]Includes contingency

Table A3. Recommended Alternative Cost Estimate Summary – Segment 3

	Trail Segment 3	
	Low	**High**
Project Length (Miles)	0.25	
Subtotal Roadway Cost	$315,758	$523,182
Right-of-way and Utilities Cost[1]	$157,879	$340,068
Total Roadway Cost[2]	$473,636	$863,250
TOTAL SEGMENT COST[3]	**$592,045**	**$1,079,063**

[1] Low end estimate assumes 50% and high end assumes 65% [2] Includes crossings [3]Includes contingency

Table A4. Recommended Alternative Cost Estimate Summary – Segment 4

	Trail Segment 4	
	Low	**High**
Project Length (Miles)	0.12	
Subtotal Roadway Cost	$137,879	$221,591
Right-of-way and Utilities Cost[1]	$68,939	$144,034
Total Roadway Cost[2]	$206,818	$365,625
TOTAL SEGMENT COST[3]	**$258,523**	**$457,031**

[1] Low end estimate assumes 50% and high end assumes 65% [2] Includes crossings [3]Includes contingency

Table A5. Recommended Alternative Cost Estimate Summary – Segment 5

	Trail Segment 5	
	Low	**High**
Project Length (Miles)	0.16	
Subtotal Roadway Cost	$184,545	$296,591
Right-of-way and Utilities Cost[1]	$92,273	$192,784
Total Roadway Cost[2]	$276,818	$489,375
TOTAL SEGMENT COST[3]	**$346,023**	**$611,719**

[1] Low end estimate assumes 50% and high end assumes 65% [2] Includes crossings [3]Includes contingency

Table A6. Alternative Cost Estimate Summary – Segment 1

	Road Segment 1	
	Low	**High**
Project Length (Miles)	.0.08	
Subtotal Roadway Cost	$52,159	$134,451
Right-of-way and Utilities Cost[1]	$26,080	$87,393
Total Roadway Cost[2]	$78,239	$221,844
TOTAL SEGMENT COST[3]	**$97,798**	**$277,305**

[1] Low end estimate assumes 50% and high end assumes 65% [2] Includes crossings [3]Includes contingency

Table A7. Alternative Cost Estimate Summary – Segment 2

	Road Segment 2	
	Low	**High**
Project Length (Miles)	0.21	
Subtotal Roadway Cost	$119,938	$288,134
Right-of-way and Utilities Cost[1]	$59,969	$187,287
Total Roadway Cost[2]	$179,906	$475,422
TOTAL SEGMENT COST[3]	**$224,883**	**$594,277**

[1] Low end estimate assumes 50% and high end assumes 65% [2] Includes crossings [3]Includes contingency

Table A8. Alternative Cost Estimate Summary – Segment 3

	Road Segment 3	
	Low	**High**
Project Length (Miles)	0.25*	
Subtotal Roadway Cost	$896,116,648	$1,440,297,519
Right-of-way and Utilities Cost[1]	$448,058,324	$936,193,387
Total Roadway Cost[2]	$1,344,174,972	$2,376,490,906
TOTAL SEGMENT COST[3]	**$1,680,218,714**	**$2,970,613,633**

*[1] Low end estimate assumes 50% and high end assumes 65% [2] Includes crossings [3]Includes contingency *includes 10' trail in Howard E Herman Park*

Table A9. Alternative Cost Estimate Summary – Segment 4

	Road Segment 4	
	Low	**High**
Project Length (Miles)	0.12	
Subtotal Roadway Cost	$64,449	$193,324
Right-of-way and Utilities Cost[1]	$32,224	$125,661
Total Roadway Cost[2]	$96,673	$318,984
TOTAL SEGMENT COST[3]	**$120,842**	**$398,730**

[1] Low end estimate assumes 50% and high end assumes 65% [2] Includes crossings [3]Includes contingency

Table A10. Alternative Cost Estimate Summary – Segment 5

	Road Segment 5	
	Low	**High**
Project Length (Miles)	0.16	
Subtotal Roadway Cost	$74,511	$220,720
Right-of-way and Utilities Cost[1]	$37,256	$143,468
Total Roadway Cost[2]	$111,767	$364,188
TOTAL SEGMENT COST[3]	**$139,709**	**$455,234**

[1] Low end estimate assumes 50% and high end assumes 65% [2] Includes crossings [3]Includes contingency

APPENDIX C - TRAIL SURFACE REFERENCE MATERIAL (2)

TOOLE DESIGN

10055 106 STREET NW
UNIT 1270
EDMONTON, AB T5J 2Y2

780.655.2259
TOOLEDESIGN.COM

Toole Design has provided a comparison between various surface materials appropriate for shared use paths where natural surface may be desired. Details on five surface materials are provided and a comparison between each is shown. This information is general in nature and is provided for general reference.

The material of a shared pathway has significant bearing on the user experience. For many trails universal accessibility a priority, however a familiar granular aesthetic is preferred by some. This comparison chart includes two granular products that may be able to meet these needs, Organic-Lock™ and CORE™ Gravel Foundation Systems. (See below for brief product descriptions or use the hyperlinks to access product websites). Finally, the comparison includes concrete surfacing as there are locations along roadways that may be reconstructed as concrete pathway by widening the existing sidewalk.

"Organic-Lock™ is the strongest organic binder on the market today. Designed for stabilizing aggregate surfaces, its functionality allows you to create natural, aesthetically pleasing, permeable surfaces that hold up to extreme conditions". (https://www.organic-lock.com/)

"CORE Gravel™ is a gravel stabilizing system that consists of a foundation of connected honeycomb-celled panels with a geotextile backing. Once filled with gravel, this system is ideal for vehicle or pedestrian traffic with no compromise in strength and durability". (https://www.coregravel.ca/core-foundations/core-gravel/products/)

Considerations

Based on our experience in trail, active transportation corridor, and accessibility projects across North America, the following considerations were noted as having an impact on the final choice of surface material:

Aesthetics
What is the visual appearance of the surface?

Accessibility
How well does the surface accommodate users with mobility impairments?

User Accommodation and Impact
What types of users does the trail accommodate and what type of physical impact does the surface have on users?

Environmental Sustainability
Does the surface use environmentally sustainable materials or can it be constructed in a way that is more environmentally sustainable?

Construction Impact
What is the scale of the construction impact based on the total structure depth and construction methods?

Surface Erosion
Is the material susceptible to surface erosion and undermining?

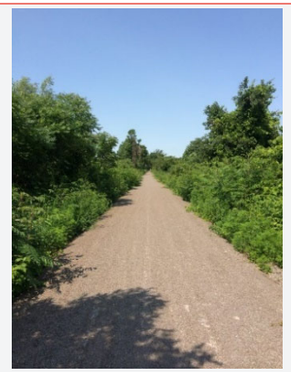
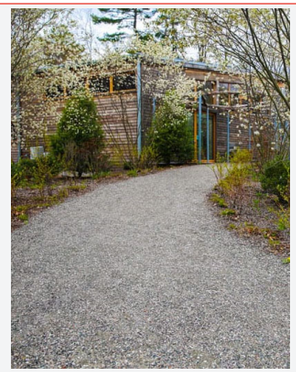
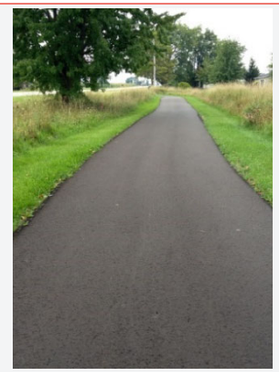
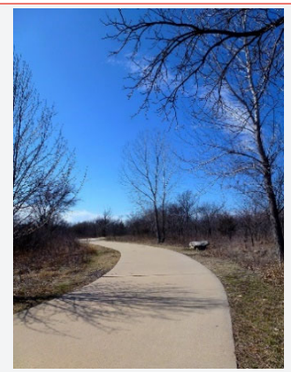
Maintenance
What type of routine maintenance is required? What type of winter maintenance activities or considerations are required?

Durability and Repairs
How durable is the surface to regular wear? What types of repairs are needed and how costly are they?

Lifespan
How long does the surface last?

Construction and Lifecycle Cost
How much does the surface cost to install and maintain?

Trail Materials Comparison Chart

	Non-Stabilized Granular (Traditional Granular Trail)	Stabilized Granular (Organic-Lock™)	CORE™ Gravel Foundation System	Asphalt	Concrete
Aesthetics					
Accessibility	Not Accessible Not accessible for wheelchair users or people who use walkers. Due to surface inconsistencies, people with vision impairments who use a cane may find the rough surface uncomfortable to navigate depending on the type of cane tip and their caning technique. Steep grades can pose accessibility issues due to loose gravel.	Limited Accessibility Not accessible for all wheelchair users or people who use walkers. People who use walkers and people who have wheelchairs with small, hard front casters may find the surface difficult to use as the loose stone can hinder the wheels from rolling smoothly. People with vision impairments who use a cane may find the surface uncomfortable to navigate depending on the type of cane tip and their caning technique.	Limited Accessibility Not accessible for all wheelchair users or people who use walkers. People who use walkers and people who have wheelchairs with small, hard front casters may find the surface difficult to use as the loose stone can hinder the wheels from rolling smoothly. People with vision impairments may find the surface uncomfortable to navigate depending on the type of cane tip and their caning technique.	Accessible A universally smooth surface that provides a comfortable path for users with mobility aids.	Accessible Provides a smooth surface; however, construction joints can impact the comfort of users if they are too frequent or pronounced. This can be mitigated by saw-cutting the joints or spacing joints out as far as possible and by smoothing the troweled edges.
User Accommodation and Impact	Some Users Non-stabilized granular is not suitable for people on scooters,	More Users Organic-Lock™ is not suitable for people on scooters, rollerblades or other small, hard-wheeled devices.	More Users CORE™ Gravel System is not suitable for people on scooters,	All Users Asphalt surfacing is adequate for all users.	All Users Concrete surfacing is adequate for all users, however the frequent construction jointing results in a

	rollerblades or other small, hard-wheeled devices. Loose stone, such as pea gravel, is not ideal for running as it shifts underfoot. Crushed stone works better as it “knits” together to create a more stable surface.	Organic-Lock™ is a flexible, shock-absorbing surface without shifting granular material.	rollerblades or other small, hard-wheeled devices. Loose stone, such as pea gravel, is not ideal for running as it shifts underfoot. Crushed stone works better as it “knits” together to create a more stable surface.	There is some research on the difference of the impact on musculoskeletal injuries between asphalt and concrete, much of it identifying that there is little difference, if any, between the two surface materials.[1] However, there is anecdotal information that runners prefer asphalt to concrete.	rougher surface for people on bikes, rollerblades, or scooters. This can be mitigated by saw-cutting the joints and/or by spacing joints out as far as possible and by smoothing the troweled edges. There is some research on the difference of the impact on musculoskeletal injuries between asphalt and concrete, much of it identifying that there is little difference, if any.[1] However, there is anecdotal information that runners prefer asphalt to concrete.
Environmental Sustainability[2,3]	Granular pathways are water permeable (unless highly compacted), contain aggregate that is often recycled content, can typically be sourced locally, and reduce the heat island effect by reflecting solar radiation, rather than retaining heat. Overland water flow can lead to granular wash-out, requiring the material to be replaced.	Organic-Lock™ pathways are water permeable, contain aggregate that is often recycled content, can typically be sourced locally, and reduce the heat island effect by reflecting solar radiation, rather than retaining heat. Additionally, Organic-Lock™ is made primarily from a rapidly renewable plant material and its additional additives are 100% naturally occurring materials.[4]	CORE™ Gravel Foundation pathways are water permeable, contain aggregate that is often recycled content, can typically be sourced locally, and reduce the heat island effect by reflecting solar radiation, rather than retaining heat. The CORE™ Gravel Foundation system is made of recycled plastic materials.	Traditional hot-mix asphalt is not considered an environmentally sustainable material. Asphalt can be made in sustainable ways by using recycled materials, warm & cold mix asphalt, or porous asphalt.[5]	Concrete can be considered moderately environmentally sustainable if the materials can be sourced locally, and by using lighter coloured concrete to reflect solar radiation rather than retaining heat. However, cement used in the creation of concrete is an emissions-intensive substance to produce.

[1] https://www.researchgate.net/profile/Ana_Ribeiro21/publication/23444709_In-shoe_plantar_pressure_distribution_during_running_on_natural_grass_and_asphalt_in_recreational_runners/links/5b2061770f7e9b0e373ef09e/In-shoe-plantar-pressure-distribution-during-running-on-natural-grass-and-asphalt-in-recreational-runners.pdf

[2] https://www.usgbc.org/credits?Version=%22v4.1%22&Rating+System=%22New+Construction%22

[3] https://www.sustainablesites.org/

[4] https://www.organic-lock.com/resources/product-faq/

[5] https://www.fhwa.dot.gov/pavement/sustainability/hif16012.pdf

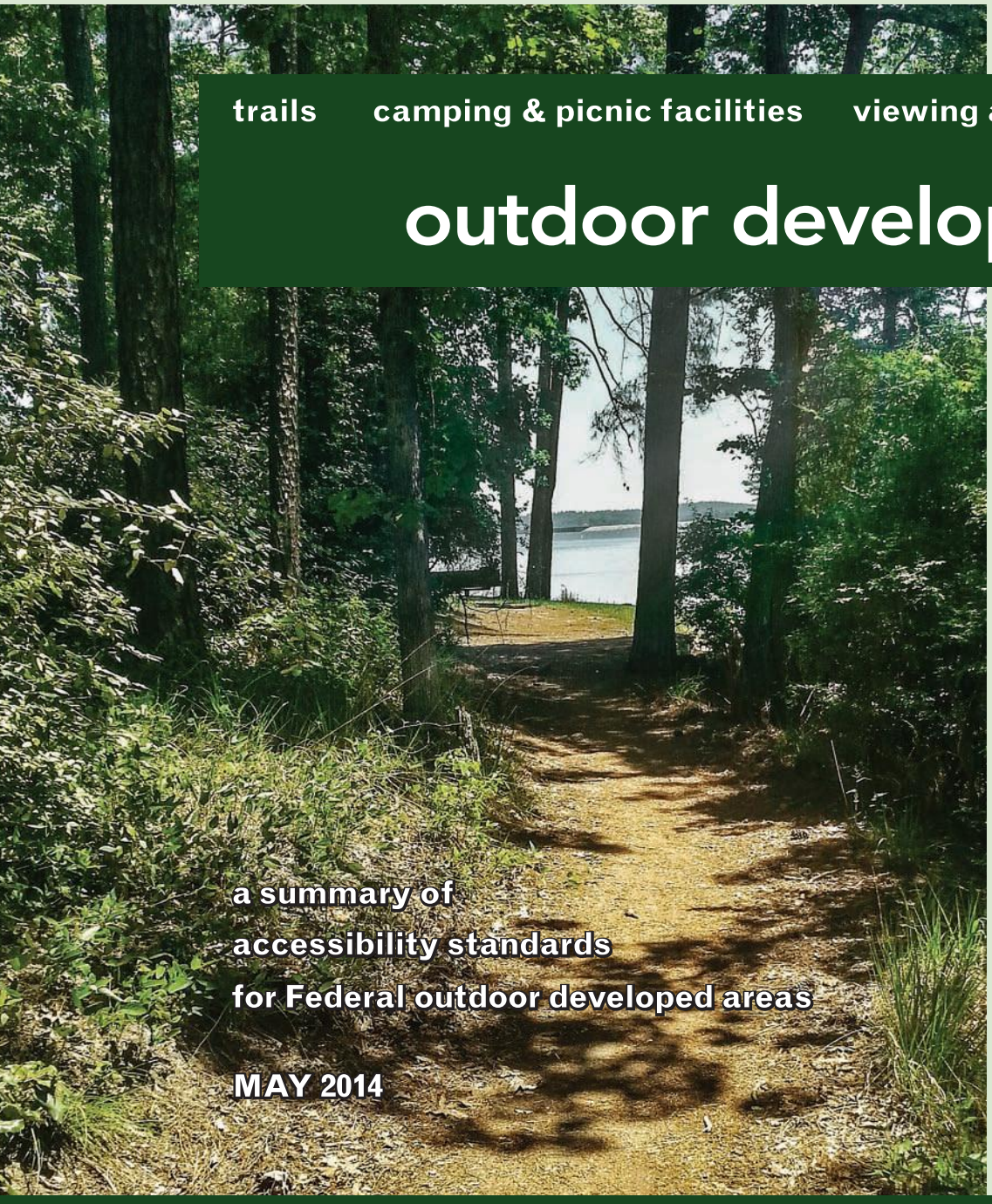
Construction Scale	50mm granular surface 150mm granular base **Total Depth = 200mm** Structure based on City of St. John's Standard Dwg No. 10-530-03	75mm compacted Organic-Lock™ trail aggregate 150mm granular base **Total Depth = 225mm** Structure based on supplier detail	45mm for CORE™ Gravel Foundation System (35mm) and 10mm top-dress layer of granular 150mm granular base **Total Depth = 195mm** Structure based on supplier detail	75mm asphalt surface 150mm granular base **Total Depth = 225mm** Structure based on Toole Design typical detail for an asphalt trail	100mm concrete surface 100mm granular base **Total Depth = 200mm** Structure based on City of St. John's Standard Dwg No. 10-330-03 Required formwork increases the impact area by minimum 500mm on each side of the trail.
Surface Erosion	Significant erosion and undermining can happen in locations where high volumes of water are likely to flow across the trail. Surface erosion along trail segments with steeper grades will occur.	Resistant to surface erosion from water runoff but ponding with standing water will degrade the surface and can lead to undermining of the surface.	Resistant to significant surface erosion. Granular top-dress material may have to be replaced if water flow volumes are high. Standing water on the trail surface can lead to undermining.	Resistant to surface erosion and undermining.	Resistant to surface erosion and undermining.
Maintenance	Requires routine maintenance to repair displacement from water movement and general surface wear, especially along trail segments with steeper grades. Winter maintenance can be completed with a plow blade set 1-2" above the gravel. This leaves a 1-2" layer of snow on the trail surface, which will not be accessible for all users in the winter.	Requires routine maintenance to ensure no standing water. Winter maintenance can be completed with a plow blade set 1-2" above the gravel. This leaves a 1-2" layer of snow on the trail surface, which will not be accessible for all users in the winter.	Requires routine maintenance to redistribute granular after snow melt or heavy rainfall, and to ensure the CORE™ Gravel Foundation System remains covered to reduce UV damage. Wear of the top-dress layer along trail segments with steeper grades will require routine maintenance. Winter maintenance can be completed with a plow blade set 1-2" above the gravel. This leaves a 1-2" layer of snow on the trail surface, which will not be accessible for all users in the winter.	Minimal routine maintenance related to crack sealing. Winter maintenance can be completed with a brush or plow, removing all snow from the trail and creating an accessible surface for all users in the winter.	Minimal routine maintenance related to heaving and cracking. Winter maintenance can be completed with a brush or plow, removing all snow from the trail and creating an accessible surface for all users in the winter.

Durability and Repairs	Highly durable in dry conditions and properly draining conditions. Wet conditions degrade durability more quickly, especially in locations with high user traffic. Takes 2-3 years to settle and compact. If there is high probability of overland water flow, the granular will washout, requiring it to be replaced and the compaction process is slowed.	Highly durable in dry and properly draining conditions, however, standing water can be a major concern and reduce durability. Fixes to surface are relatively easy if damage occurs. Product is flexible and is self-healing if minor cracks occur	Highly durable. Will not shift or crack. Top-dress layer of gravel regrading is required after snow melt or heavy rain to ensure system remains covered.	Highly durable to surface wear. Spot repairs, such as potholes or minor cracks, can be easy to repair. Cracks caused by subbase settlement or slope movement result in major repairs and can be costly.	Highly durable to surface wear. Spot repairs vary in complexity and can be more costly than asphalt, though generally occur less often than asphalt.
Lifespan*	10 Years	20 Years	20 Years	20 Years	20 Years

* Assuming regular maintenance and repairs as needed

The information contained in this document is for planning purposes and should not be relied upon for final design of any project. Readers are cautioned that this is a preliminary report and that all results, recommendations, concept drawings, cost opinions, and commentary contained herein are based on limited data available at the time of preparation. Further engineering analysis and design are necessary prior to implementing any of the recommendations contained herein.

UNITED STATES ACCESS BOARD



trails camping & picnic facilities viewing areas beach access

outdoor developed areas

a summary of
accessibility standards
for Federal outdoor developed areas

MAY 2014

ADVANCING FULL ACCESS AND INCLUSION FOR ALL

Surface [1017.2]

The surfaces of trails, passing spaces, and resting intervals must be firm and stable. A firm trail surface resists deformation by indentations. A stable trail surface is not permanently affected by expected weather conditions and can sustain normal wear and tear from the expected uses between planned maintenances.

Paving with concrete or asphalt may be appropriate for highly developed areas. For less developed areas, crushed stone, fine crusher rejects, packed soil, soil stabilizers, and other natural materials may provide a firm and stable surface. Natural materials also can be combined with synthetic bonding materials to provide greater stability and firmness. These materials may not be suitable for every trail.

DESIGN TIP—Building a firm and stable surface

A firm and stable surface does not always mean concrete and asphalt. Some natural soils can be compacted so that they are firm and stable. Other soils can be treated with stabilizers without drastically changing their appearance. Designers are encouraged to investigate the options and use surfacing materials that are consistent with the site's level of development and that require as little maintenance as possible.

APPENDIX D - TRAFFIC COUNTS

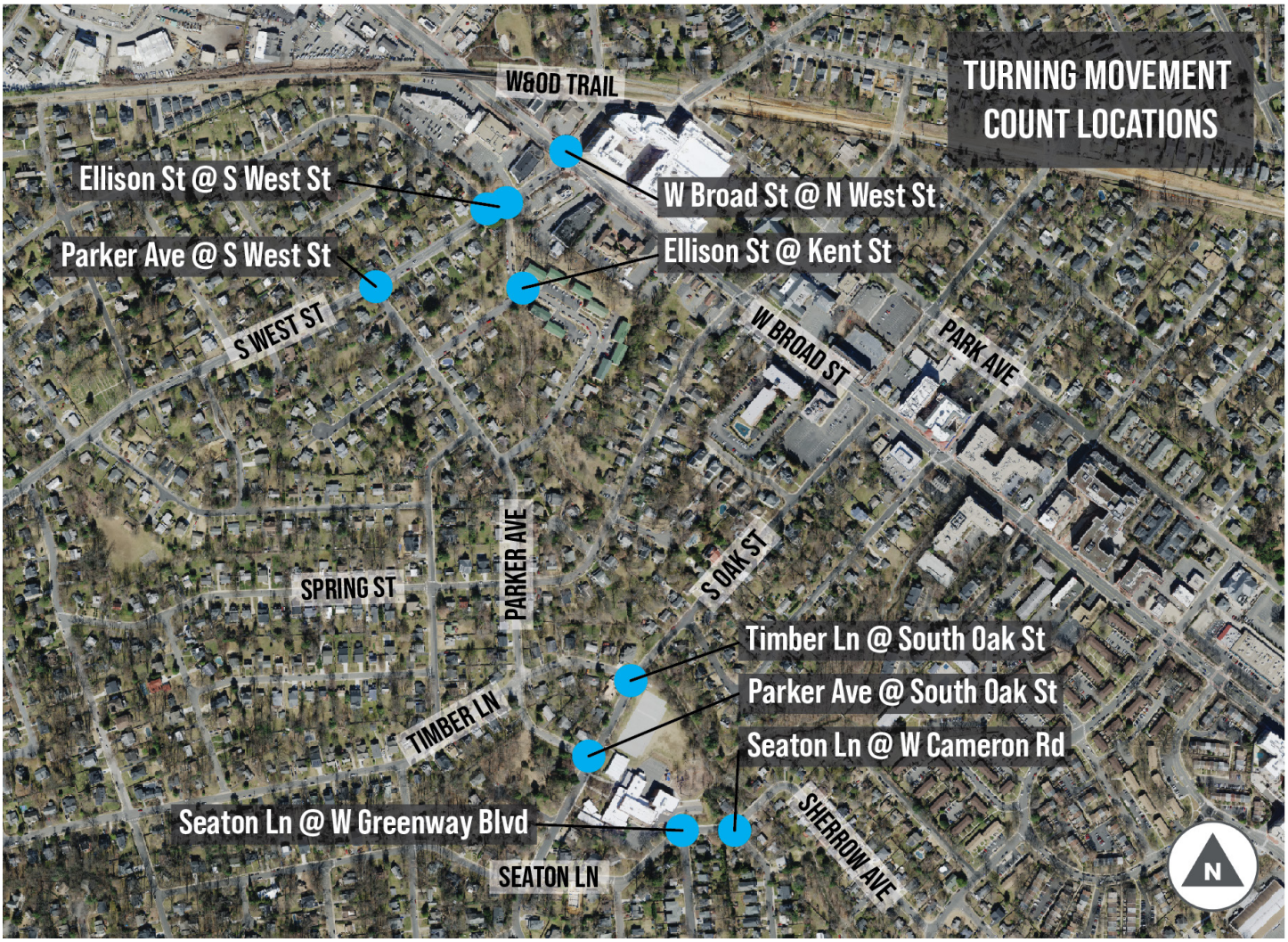


Figure D1. Turning Movement Count Locations

Table D1. Turning Movement Counts

Location	Peak Hour	NBL	NBT	NBR	EBL	EBT	EBR	SBL	SBT	SBR	WBL	WBT	WBR
Timber Ln @ S Oak St	AM	6	86	0	29	0	5	0	55	28	0	0	0
	MID	9	55	0	17	0	1	1	49	28	0	0	0
	PM	6	64	0	20	0	3	1	90	21	0	0	0
Parker Ave @ S Oak St	AM	68	96	0	3	0	36	0	59	1	0	0	0
	MID	19	72	0	3	0	18	0	44	3	0	0	0
	PM	38	63	0	4	0	29	2	93	1	0	0	0
Seaton Ln @ W Greenway Blvd	AM	15	16	5	24	47	7	0	0	1	6	18	24
	MID	11	4	5	2	15	8	1	0	0	4	19	5
	PM	14	3	9	9	35	12	1	3	2	17	30	6
Seaton Ln @ W Cameron Rd	AM	0	0	0	28	10	0	5	0	37	0	12	6
	PM	0	0	0	27	11	0	15	0	34	0	12	9
Ellison St @ Kent St	PM	7	15	0	8	0	1	5	21	3	0	0	0
W Broad St @ N West St	AM	33	906	48	216	260	33	233	906	54	37	94	136
	PM	82	831	15	147	168	56	228	1027	94	48	340	220
Ellison St @ S West St (East)	AM	8	0	23	0	486	3	0	0	0	9	172	0
	PM	12	0	8	0	363	18	0	0	0	13	503	0
Ellison St @ S West St (West)	AM	0	0	0	1	479	0	10	0	4	0	176	4
	PM	0	0	0	8	378	0	3	0	5	0	509	6
Parker Ave @ S West St	AM	10	0	29	0	451	6	0	0	0	18	162	0
	PM	55	0	40	0	346	70	0	0	0	51	463	0