



THE UNIVERSITY OF NORTH CAROLINA
**HIGHWAY SAFETY
RESEARCH CENTER**

National Capital Region (NCR) Trail Monitoring and Analysis Program Annual Report

Report No. 2

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In response to:

National Capital Region National Park Service

Introduction

The National Park Service (NPS) needs to understand trail travel patterns and usage to better serve visitors. This includes those visiting on foot and by bicycle. Other local agencies around the Capital Region seek to quantify pedestrian and bicyclist travel in the region too. This project addresses these needs by providing a centralized database and dashboard to house and manage existing and future trail count data from various jurisdictions, where all can access it in a standard format. The project not only manages and maintains the data, but also encourages collaboration between agencies through quarterly meetings between NPS and local and regional agencies. In addition, the project produces quarterly and annual reports on travel patterns and monitoring system expansion, validation and maintenance and engages university partners in research activities including network volume estimation using emerging datasets.

This report is the second of our annual reports. It follows the template developed last year, and we continue to seek input from NPS and project partners on the type of summaries provided and the way the information is presented, to guide our future reports and efforts to automate reporting.

The report contains three sections a summary of work done during the past year by task, and an appendix with a

- financial summary
- data summary
- inventory of counters

The data summary lists counters and their volumes for 2018-2022 for four main trail corridors. Summary tables include an inventory of all counters in the region including name and status of whether they have been uploaded to BikePed Portal yet. Summary graphs of volume per month by trail corridor are provided for 2022. Maps of count sites by mode show 2022 traffic volumes relative to other sites on the trail corridors.

Work Done in Year 2 (Aug. 2022 to Aug. 2023)

Below is a summary of work done by the five Task Areas.

1. Jurisdiction Coordination
2. Maintenance of Automated Counters and Siting New Counters
3. Enhancements to Shared Regional Database and Public Dashboard and Data Monitoring
4. Analysis and Reporting
5. Explore Big Data Procurement and Analysis

Task Area 1. Jurisdiction Coordination

Quarterly Meetings. The team hosted four quarterly meetings (October 2022, January 2023, April 2023, July 2023). Notes and presentations from the meetings are posted in the “Quarterly Meetings” folder on the “NCA Trail Count Program” Teams account.

Monthly Meetings. The team held monthly meetings with the National Park Service and other special meetings as necessary. Notes from these meetings are now posted in the “Monthly Progress Meetings” folder on the “NCA Trail Count Program” Teams account.

In addition, HSRC staff responded to emails from NPS staff throughout the year and met with potential partners, including DDOT.

Task Area 2. Maintenance of Automated Counters and Siting New Counters

The Virginia Tech (VT) Team hired a Master’s student who joined in Fall 2022 and a Ph.D. student who joined in Spring 2023. From August 2022 – December 2022, the VT team used its trail camera to collect recordings of trail traffic at counter locations on the Rock Creek Trail, Mount Vernon Trail, C&O Trail, and Piney Branch Trail. Before pausing video recording due to cold weather, the VT team collected video recordings for 8 counter sites ranging from 30 to 40 hours per site.

During the winter, the VT team purchased a second camera to speed up the process of video recording. The VT team resumed video recording during March 2023 (when the weather was again warm) and collected video recordings at 27 counter sites through August 2023. The VT team also validated 14 sites from August 2022 – August 2023 (three sites had video recording from the studio class from fall 2021) by having undergraduate students manually count traffic using the recordings.

The criteria for validation were that a counter site must have an R2 value of at least 0.975 (manual vs. automated count) and the automated to manual count ratio was 0.70 to 1.30 for Eco-counters and 0.50 to 1.50 for TRAFx counters after censoring the bypass and unusual events. Furthermore, there must be at least 20 hours of data after eliminating the unusual and bypass events. Otherwise, the counter must have an automated to manual count ratio between 0.85 to 1.15. Five out of the 14 sites fully passed the validation (Table 2). For five sites, there were issues with pedestrian sensors, but the bicycle counter passed the validation. Four sites failed the validation for both the bicycle and pedestrian sensor. Reasons for a counter to fail were placement of the pedestrian sensor towards traffic (P-street), overcounting pedestrians (Lock 5), double counting bicyclists as both a bicyclist and pedestrian (Kenilworth, Deane Avenue), incorrect installation of bicycle loops (Waynewood Blvd), high bypass/unusual events (Shoreham Drive), and low bicyclist volume (Piney Branch).

Based on these findings, the VT team added a pre-validation procedure to identify counters with significant problems before attempting a full validation. Pre-validation includes counting at least 10 pedestrians and 10 bicyclists going in each direction across each detection zone. The counter is approved for full validation if it passes the pre-validation or sent for full diagnostics if it fails the pre-validation.

The VT team pre-validated 16 sites of which 10 passed and 6 failed. The reasons for counters failing pre-validation were: double counting pedestrians, bicyclists counted as both a bicyclist and pedestrian, missed counts of pedestrians on the far side of the trail, and the bicycle loop not detecting bicyclists. The failed sites were then diagnosed with the UNC team and the jurisdiction that manages the counter to try to resolve the issues.

The VT team hired and trained two new undergraduate students to replace students who graduated and left the project. The VT team also tested the interference on trail pavement for two proposed new counter sites during the winter and developed a summary document of the validation procedure for future reference.

[Ongoing Maintenance and Validation](#)

During this year, the team worked with Arlington, DDOT, and NPS staff to access, identify maintenance issues, and validate counters.

After the studio class, the VT team created a thorough validation procedure, similar to that used by NCHRP 797 and NCDOT, which involves collecting roughly 30 hours of video of the count site and counting it manually in the office. Data was collected using video cameras specific for this type of multi-day outdoor video traffic data collection. The VT team began collecting this video for the ART count sites and hired students to watch and code the video for validation. This process includes identification of trail user types to help pinpoint potential reasons for over or undercounts: trail users in groups or side by side, those who walk or ride outside of the counted area (bypass riders/walkers), non-typical trail users (scooters, skateboarders, inline skaters, etc.), and other characteristics or behaviors which may be associated with under or overcounts. This data can help with both creating bias adjustment factors or functions, and troubleshooting potential problems that could be corrected by changes to the counter location, physical setup, or software settings. Results of these validations will be summarized in future reports. See Table 2 for Validation details.

[Site Selection](#)

In January 2023, the university team and NPS staff visited several potential sites along the Rock Creek Trail under and south of the Roosevelt Bridge. In February, we measured the electrical interference at 5 potential installation sites near Roosevelt Bridge and at 3 more potential sites near the Roosevelt Bridge and the Lincoln Memorial Beach Volleyball Courts. We evaluated the potential for reflections off the Potomac River to interfere with the functioning of a Pyro infrared detector and found no evidence of interference. In discussion with NPS and in consultation with the equipment vendor, Eco-Counter, we recommended the site just north of the tunnel for the installation of a counter near the Roosevelt Bridge. In the spring, we provided measurements, specifications, and augmented photographs to support the proper installation of counters at the Roosevelt Bridge and Lincoln Memorial Beach Volleyball courts.

As a field trip before the April quarterly meeting, we toured the closed portions of Beach Drive with NPS on April 18 and identified four general locations for future counter installations along Beach Drive: north of Broad Branch Road, south of the Park Police Station, north of Picnic Grove 10, and south of the Maryland Line.

Table 1 Summary of Validation Results

| Counter Name | Total Hours Validated | Mode | Average Hourly Count | MAPE (error) ^a | Adjustment Factor | Passed/ Failed ^b | Reason if validation failed | Status for resolving issue |
|----------------------------------|-----------------------|------------|----------------------|---------------------------|-------------------|-----------------------------|------------------------------|---|
| River Terrace | 35 | Bicycle | 12 | 13.9% | 0.93 | Passed | - | - |
| | | Pedestrian | 12 | 20.9% | 0.97 | Failed | Low R ² | The UNC team is troubleshooting |
| Kenilworth | 43 | Bicycle | 23 | 21.9% | 0.96 | Passed | - | - |
| | | Pedestrian | 7 | 61.6% | 0.47 | Failed | High error | The UNC team is troubleshooting |
| Deane Avenue | 35 | Bicycle | 25 | 11.1% | 1.03 | Passed | - | - |
| | | Pedestrian | 6 | 58% | 0.62 | Failed | High error | Ready to validate again |
| Theodore Roosevelt Island Bridge | 37 | Bicycle | 6 | 15% | 0.97 | Passed | - | - |
| | | Pedestrian | 10 | 22.5% | 1.21 | Passed | - | - |
| Waynewood Blvd | 30 | Bicycle | 6 | 44.5% | 0.82 | Failed | Installation of bicycle loop | The UNC team fixed the counter. Currently, it is sent back to the manufacturer. |
| | | Pedestrian | 17 | 38.7% | 0.78 | Failed | | |
| P- Street | 33 | Bicycle | 17 | 23% | 0.82 | Failed | Counter facing traffic | The pedestrian post was knocked down. The UNC team conducted diagnostics. |
| | | Pedestrian | 118 | 62% | 0.51 | Failed | | |
| Pierce Mill | 30 | Bicycle | 21 | 21.9% | 0.90 | Passed | - | - |
| | | Pedestrian | 51 | 10.7% | 0.97 | Passed | - | - |
| Shoreham Drive | 30 | Bicycle | 65 | 16.5% | 0.93 | Failed | High number of bypass events | |
| | | Pedestrian | 101 | 11.2% | 1.18 | Failed | | |
| Piney Branch | 36 | Bicycle | 2 | 35.5% | 0.78 | Failed | Low bicycle volume | Need to validate again |
| | | Pedestrian | 11 | 6.4% | 1.01 | Passed | - | - |
| Lock 5 | 27 | Both | 18 | 38.4% | 0.63 | Failed | High error | |
| Lock 8 | 40 | Both | 30 | 22.5% | 1.32 | Passed | - | - |
| Mulebridge Counter | 30 | Both | 95 | 11.6% | 0.98 | Passed | - | - |
| Key Bridge East | 39 | Bicycle | 26 | 32.5% | 0.80 | Failed | High error | |
| | | Pedestrian | 123 | 12.5% | 1.14 | Passed | - | - |
| Key Bridge West | 38 | Bicycle | 18 | 40.8% | 0.70 | Failed | High error | |

^aMAPE: Mean Average Percent Error.

^bCurrent criteria for validation are: (1) an R² of greater than 0.975 and (i) an R² value is also greater than 0.975 after censoring unusual events (at least 20 data points), (ii) an automated to manual count ratio between 0.7 to 1.3 for Eco-counters and .5 to 1.5 for TRAFx counters or, (2) The error based on automated to manual count ratio should be between 0.85 to 1.15.

Task Area 3. Creation of Shared Regional Database and Public Dashboard and Data Monitoring

Portland State University's Transportation Research and Education Center (PSU TREC) now has 90 count sites and their associated data in the BikePed Portal (<https://bikeped.trec.pdx.edu/>) database:

- 29 TRAFx counters on C&O and Capital Crescent Trails managed by NPS
- 20 DDOT Eco-Counters
- 2 Alexandria MVT Eco-Counters
- 39 Arlington County Eco-Counters

Of these sites, 16 have been retired, but are still kept in BikePed Portal as important historic records of past bicycle and pedestrian volumes.

While the BikePed Portal publicly provides basic online data (counter location, summary graphs and statistics), additional information and features are available to those with accounts. Such accounts were provided to partner agencies. There are four levels of authorization for partner accounts: organization owner, organization user, research, and public. The features available to partners in the BikePed Portal accounts include review and editing quality checks and improved data download functionality.

The TREC team also investigated what announcement categories should be added to the BikePed Portal database to flag data for known events or issues such as construction on the trail, extreme weather events, races, or other organized events, or known maintenance issues, such as battery failure or insect infestation. The team hosted meetings with data users from DDOT and Arlington to identify the categories. This feature has been deployed and is available to data owners and partners who have been given permission to use this feature.

BikePed Portal also includes automated checks for over 48 hours of zero volumes and for over a given number of same value non-zero volumes in a row. Data were also checked manually by HSRC staff. Comparing volumes shows similar AADT values from BikePed Portal and manual calculations. Data owners can accept or reject the automated checks in the BikePed Portal User Interface.

BikePed Portal provides basic information about the count sites including AADT values, graphs of average and AADT volumes over all years for which data are available, over any given year, over any given month, and over any given day of the year by mode and direction of travel.

This year BikePed Portal implemented a regional view to explore data. Previously, locations were selected based on the state. Now, the user can select locations based on either a predetermined geographical location (e.g., National Capital Region and partner organizations), or by state.

Current updates to the regional dashboard are available through the user login site where users can select data based on either the organizations or regions. Additional functionalities to the dashboard are under development, including a user interface to make it easier to add and edit metadata. This feature was originally developed by a capstone computer science class at Portland State University and is being improved and de-bugged by the project team.

Another tool under development will allow data owners to add a correction factor to the raw data based on work done to validate count data. The corrected data will be displayed on the user interface and the downloaded data will include both the corrected and raw data.

Task Area 4. Analysis and Reporting

Annually and quarterly reports were provided.

The HSRC team has explored different ways of presenting the count data by count site, trail, and travel type (walk, bike, or both). The results of these analyses were shared informally in presentations to NPS and the larger group of partners. Annualized volume data for 2018-2022 are summarized in this document (see Table 4 and graphs and maps herein).

Note that as stated above, BikePed Portal can plot data on volumes and AADT for a given site using the “Explore” feature across years, by month for any given year, by day for any given month, and by hour for any given day of the year. Such graphs can supplement the summary graphs provided in this report if detailed information on the counter is desired. For those with BikePed Portal accounts, detailed data can also be readily downloaded for further analysis. For those without accounts, graphs and summary data are available.

Task Area 5. Explore Big Data Procurement and Analysis

This year, the Virginia Tech PhD student explored emerging big data sources in a technical memo format, assessing their compatibility with NPS project needs and detailing their strengths and weaknesses. An extensive literature review was then conducted, focusing on the utilization of crowd-sourced data for estimating trail traffic volume. The review examined data sources, such as Strava, StreetLight, imagery data, bikeshare data, and local fitness tracking apps. These sources were evaluated based on the experiences reported in prior studies to explore their potential for enhancing pedestrian and bicyclist volume estimation.

The review found that while these data sources offer valuable insights into active transportation patterns, they must be used with caution due to potential biases and limitations inherent to each. Furthermore, the review underscored the importance of integrating counter data with crowd-sourced data to ensure maximum reliability and accuracy in traffic volume estimation. See Table 3 for Data Source details.

Table 2 Overview of Data Sources

| Data Source | Strengths | Weaknesses | Potential integration with count data |
|--------------------------------------|--|---|--|
| Fitness-Tracking Apps (e.g., Strava) | <ul style="list-style-type: none"> - Enriched spatial and temporal attributes - Abundance of GPS traces and data | <ul style="list-style-type: none"> - Biased towards certain demographics - Limited demographic info | Highly beneficial in enhancing volume estimation models when fused with count data; significant potential to reduce errors and improve precision. |
| Regional Apps (e.g., CycleTrack) | <ul style="list-style-type: none"> - Attributes about Individual trips -GPS traces and data | <ul style="list-style-type: none"> -Small sample size - Biased towards certain demographics | Could bring rich potentials to fill out the gap of detailed trip attributes by fusing with other sources like Strava |
| Imagery Data (e.g., GSV, POI) | <ul style="list-style-type: none"> - Captures street-level activity - Vast collection of panoramic images | <ul style="list-style-type: none"> - Requires manual annotation - Limited coverage in rural or not paved trails | Advanced algorithms can automate annotation and improve fusion with count data; promising for detailed route and facility-level estimations. |
| Multi-app LBS (e.g., StreetLight) | <ul style="list-style-type: none"> - Large-scale data collection - High locational precision | <ul style="list-style-type: none"> - Inaccuracies during dynamic activities - Limited detailed individual information | Integration with count and Strava data improves accuracy, estimation did not perform well without integration. |
| Bike Share Systems (BSSs) | <ul style="list-style-type: none"> - Origin-Destination data - Trip data with detailed patterns | <ul style="list-style-type: none"> - Lack of detailed route trajectories - Limited data availability in some systems | Enhances station-specific volume estimations; effective when fused with count data to validate trends; potential to improve route-level estimation models. |

APPENDIX

Data Summary

Summary Metrics

Several Summary metrics are used: MADT, AADT, and WWI as defined below.

Monthly Average Daily Traffic (MADT): For each day of the week for each month in each year for each segment area for each mode, compute MADT (from FHWA-PL-015-008, 201)

$$MADT_{m,y} = \frac{1}{7} \sum_{j=1}^7 \left[\frac{1}{n} \sum_{i=1}^n V_{ijmy} \right]$$

where V = total traffic volume for i^{th} occurrence of the j^{th} day of the week within the m^{th} month, for year y .

n = the count of the j^{th} day of the week during the m^{th} month for which traffic volume is available (a number between 1 and 5)

Annual Average Daily Traffic (AADT):

$$AADT_y = \frac{1}{12} \sum_{m=1}^{12} MADT_{m,y}$$

Where m is the month of the year, y

Finally, the Weekend/Weekday Index was calculated by average the total Weekend volume and the total Weekday volume and dividing the Weekend average by the Weekday average.

Weekend-Weekday Index (WWI) (*Miranda-Moreno et al. 2013*)

$$WWI = V_{we}/V_{wd}$$

where:

WWI = Weekend/Weekday Index

V_{we} = average weekend daily traffic

V_{wd} = average weekday daily traffic

Trail Volumes

Table 4 summarizes pedestrian and bicycle volumes by trail. This is followed by three maps showing the trail volumes for 2022 by mode: pedestrian-only, bicycle-only, and combined pedestrian-bicycle traffic, which includes sites where pedestrians are not distinguished from bicyclists and those where pedestrians and bicyclists are counted separately but are added together for inclusion in the map.

The blanks in the AADT columns demonstrate the need for more consistent data collection in order to track change over time. It also shows that all trail sites have higher weekend traffic than weekday traffic ($WWI > 1$) which is associated with recreational travel as expected on these trails. *WWI is calculated for 2021 but can be updated for 2022 soon.*

The trail with the highest volume (bike and pedestrians combined) is the Georgetown Mule Bridge, which has been validated and adjusted although not all sites have been.

This table includes a column for 2022 adjusted volume. This value is the value in the AADT 2022 column multiplied by the adjustment factor listed in Table 2, as computed from the validation conducted by Virginia Tech. Not all counters have been validated yet, so not all counters show the adjusted values. We aim to eventually only use adjusted values in order to account for known bias of particular counters.

Table 3 Summary of Traffic Volume for Trails

| Trail | Count Site | Mode | 2018 AADT | 2019 AADT | 2020 AADT | 2021 AADT | 2022 AADT | 2022 Adjusted AADT | WWI 2021 |
|-------------------------------|--------------------------------|------|-----------|-----------|-----------|-----------|-----------|--------------------|----------|
| C&O Canal Trail | Dickerson Conservation Park | Both | | | 128 | 76 | 34 | | |
| | Marsden Tract Foot Bridge | Both | | | 290 | 213 | | | 3.1 |
| | Lock 10 | Both | | | | 215 | | | 2.2 |
| | Lock 8 | Both | | | | 259 | 208 | 275 | 1.6 |
| | Glen Echo | Both | | | 297 | 202 | | | 1.8 |
| | Lock 7 | Both | | | | 123 | | | 2.1 |
| | Lock 6 | Both | 151 | 150 | 289 | | | | |
| | Lock 5 | Both | | | 298 | | 242 | 152 | |
| | Chain Bridge Access | Both | | | 786 | 297 | | | 2.0 |
| Capital Crescent Trail | Capital Crescent | Both | 432 | 320 | | 729 | 569 | | 2.1 |
| | Georgetown Mule Bridge | Both | | | 1,794 | 1,645 | 1,423 | 1,395 | 2.1 |
| | Georgetown Level 3 Access (VC) | Both | | | | 343 | 482 | | 1.8 |
| Anacostia River Trail | Benning | Bike | | 255 | | | | | 2.6 |
| | Benning | Ped | | 87 | | | | | 1.8 |
| | Benning | Both | | 342 | | | | | 2.3 |
| | Deane Ave | Bike | | 188 | | 336 | 242 | 249 | 2.4 |
| | Deane Ave | Ped | | 73 | | 99 | 88 | 55 | 1.6 |
| | Deane Ave | Both | | 261 | | 435 | 330 | 304 | 2.2 |
| | Kenilworth Park | Bike | | 232 | | 398 | | | 2.4 |
| | River Terrace | Bike | | 180 | | 329 | 252 | 234 | 2.2 |
| | River Terrace | Ped | | 85 | | 177 | | | 1.6 |
| | River Terrace | Both | | 265 | | 506 | | | 1.6 |
| Mount Vernon Trail | MVT Airport | Bike | 1,459 | 1,872 | 1,737 | 1,238 | | | 1.6 |
| | MVT Airport | Ped | | 332 | 508 | 387 | | | 1.8 |
| | MVT Airport | Both | | 2,204 | 2,245 | 1,625 | | | 1.7 |
| | CC Connector | Ped | 493 | 576 | 526 | 425 | | | 1.3 |
| | CC Connector | Both | 1,003 | 1,088 | 973 | 809 | | | 1.3 |
| | 14th Street Bridge | Bike | | 1,487 | 1,133 | 956 | 1,042 | | 1.4 |
| | 14th Street Bridge | Ped | | 339 | 249 | 245 | 213 | | 2.0 |
| | 14th Street Bridge | Both | | 1,826 | 1,382 | 1,201 | 1,255 | | 1.5 |
| Rock Creek Trail and Vicinity | Peirce Mill | Bike | | | | | 363 | 327 | |
| | Peirce Mill | Ped | | | | | 842 | 817 | |
| | Peirce Mill | Both | | | | | 1,205 | 1,144 | |
| | Piney Branch Trail | Bike | | | | | | | |
| | Piney Branch Trail | Ped | | | | | | | |
| | Piney Branch Trail | Both | | | | | | | |

| Trail | Count Site | Mode | 2018 AADT | 2019 AADT | 2020 AADT | 2021 AADT | 2022 AADT | 2022 Adjusted AADT | WWI 2021 |
|---------------------------------|----------------------|--|-----------|-----------|-----------|-----------|-----------|--------------------|----------|
| | Rose Park @ P Street | Bike | | | | | 262 | 246* | |
| | Shoreham Drive | Bike | | | | | | | |
| | Shoreham Drive | Ped | | | | | | | |
| | Shoreham Drive | Both | | | | | | | |
| Washington & Old Dominion Trail | Bon Air Park | Bike | 693 | 689 | 717 | 620 | 575 | | |
| | Bon Air Park | Ped | | | | | 504 | | |
| | Bon Air Park | Both | | | | | 1,079 | | |
| | Columbia Pike | Bike | | | | | 706 | | |
| | Columbia Pike | Ped | | | | | 646 | | |
| | Columbia Pike | Both | | | | | 1,352 | | |
| | <200 AADT | *P Street bike counter was re-validated with an adjustment factor of 0.94. | | | | | | | |
| | 200-600 AADT | | | | | | | | |
| | >600 AADT | | | | | | | | |

Figure 1 Pedestrian 2022 Trail Counter Volumes

Pedestrian Counter Map

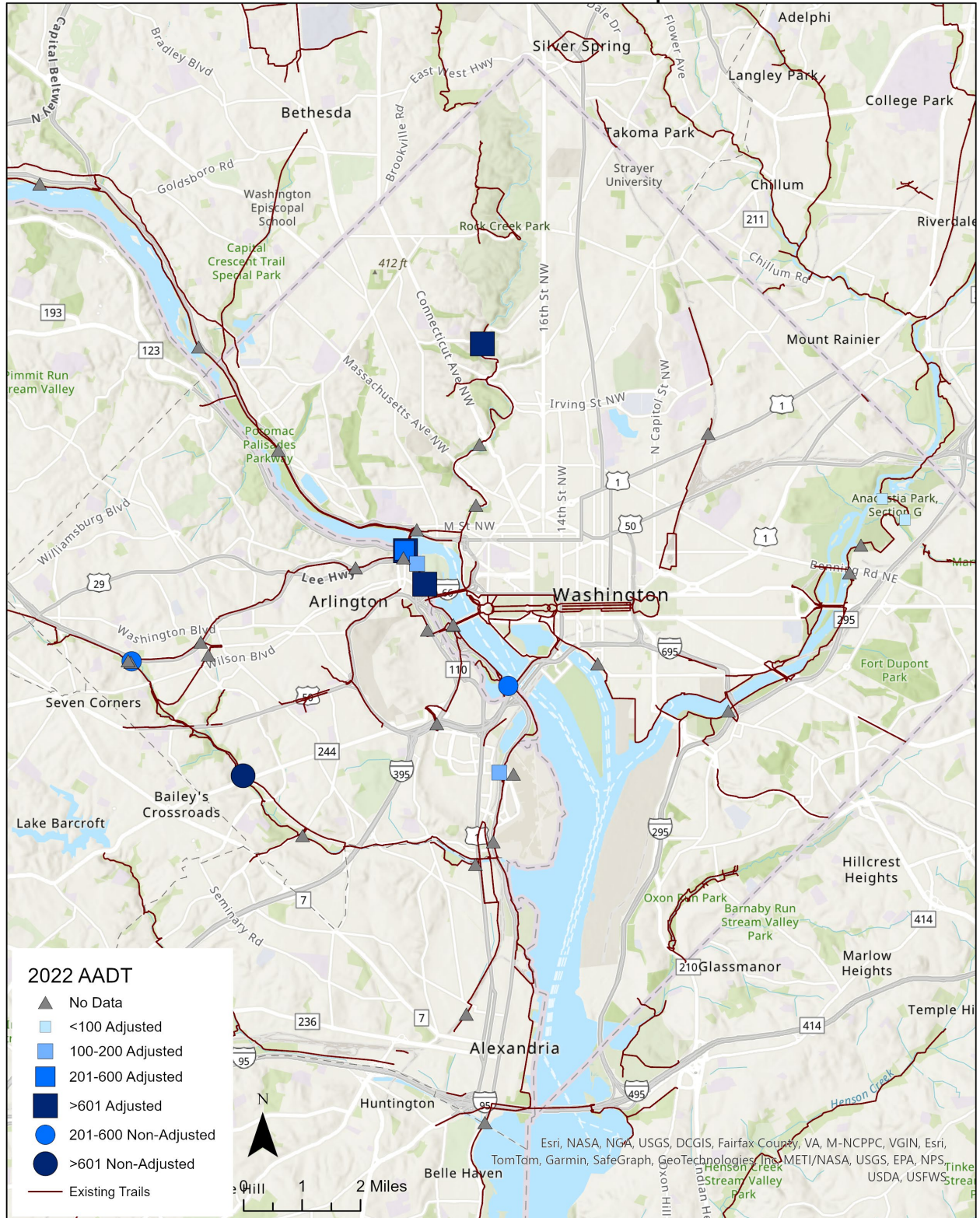


Figure 2 Bicycle 2022 Trail Counter Volumes

Bike Counter Map

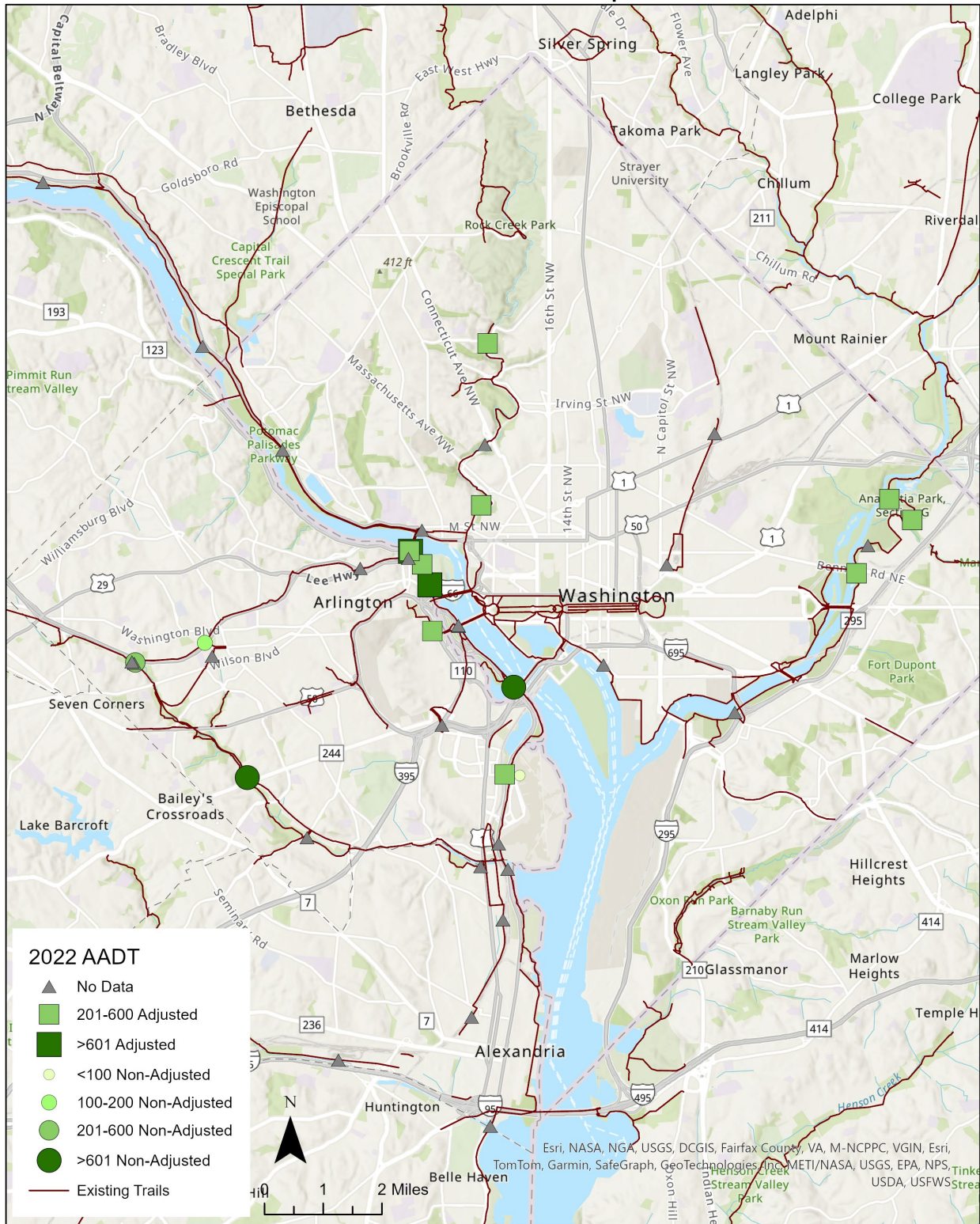
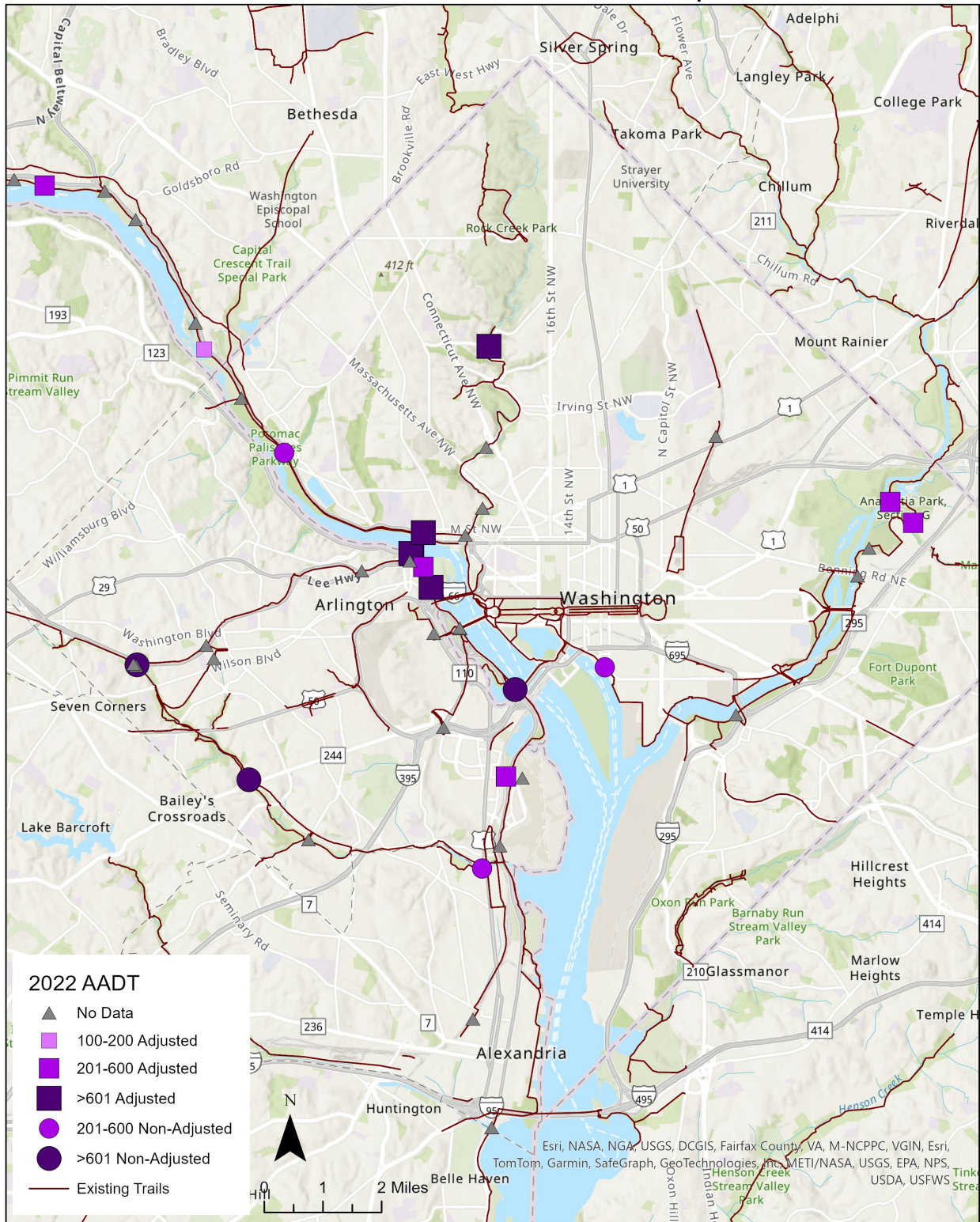


Figure 3 Combined Pedestrian and Bicycle 2022 Trail Counter Volumes

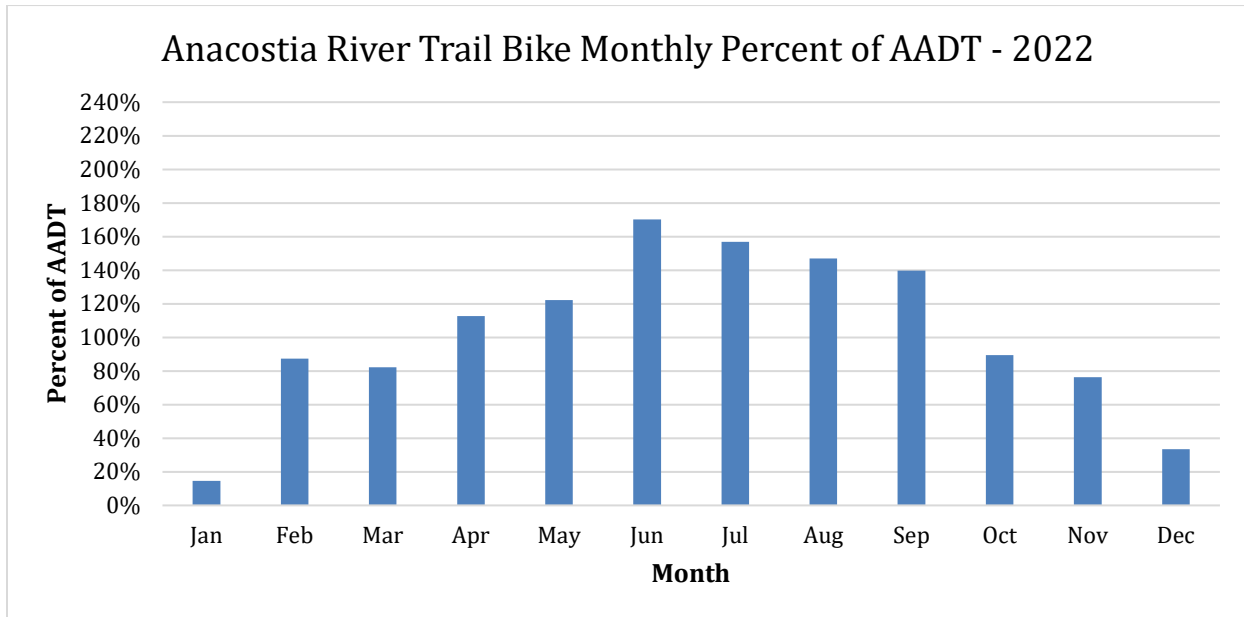
Bike/Pedestrian Counter Map



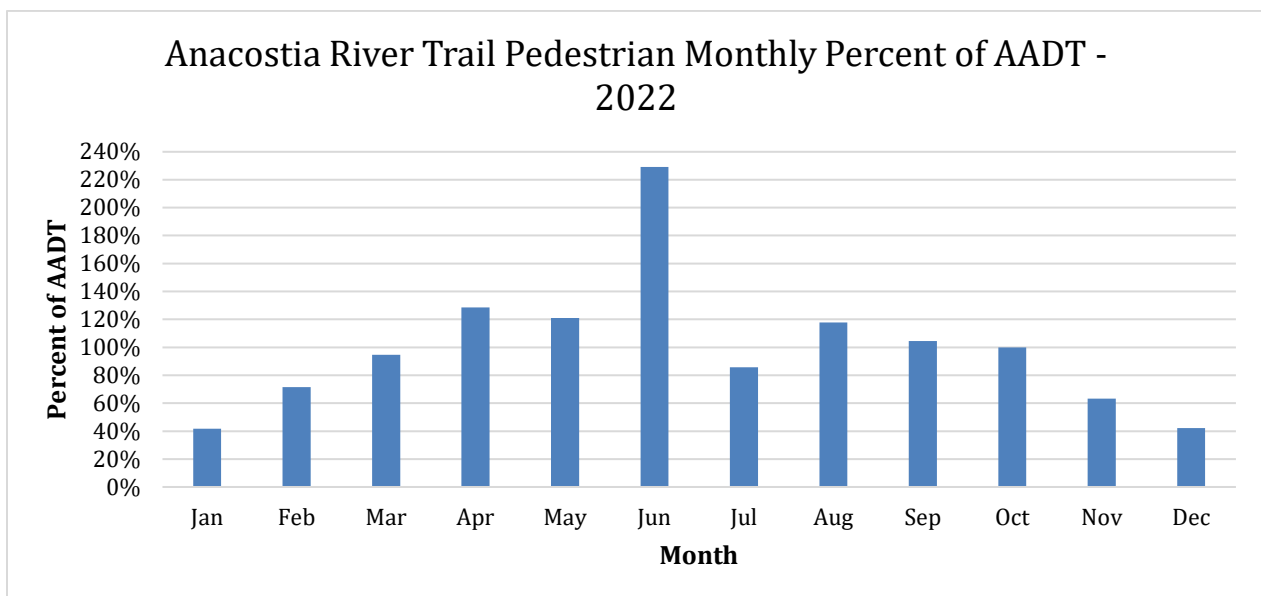
Volume Graphs by Month by Trail by Travel Mode

In this section we provide graphs of average trail traffic for 2022 by trail and mode by month as a percent of AADT. The purpose of these graphs was to determine the seasonality of the travel. They show that traffic is highest in summer, but relatively high throughout the non-winter months (March through October). Plots for other years were also created but are not shown because they were not substantially different from those shown below. Generally pedestrian travel tends to be less seasonal (more equal throughout the year) than bicycle travel as can be seen in the ART, Rock Creek Trail, Washington & Old Dominion Trail, and MVT.

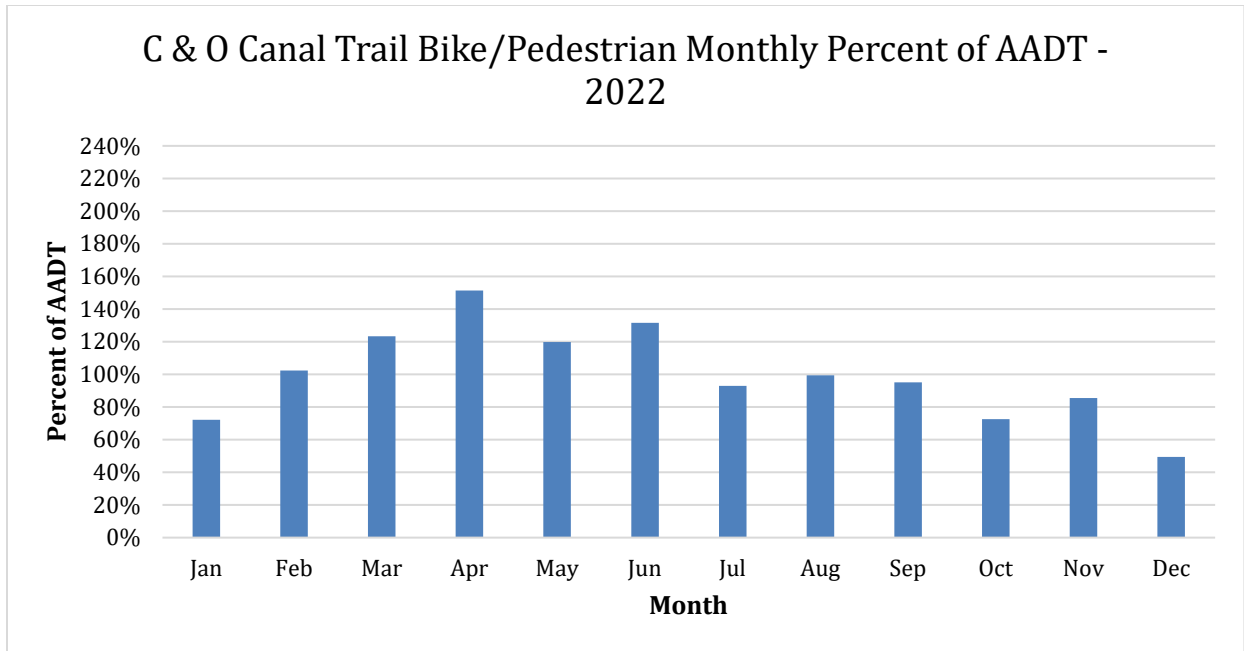
Anacostia River Trail – Bike



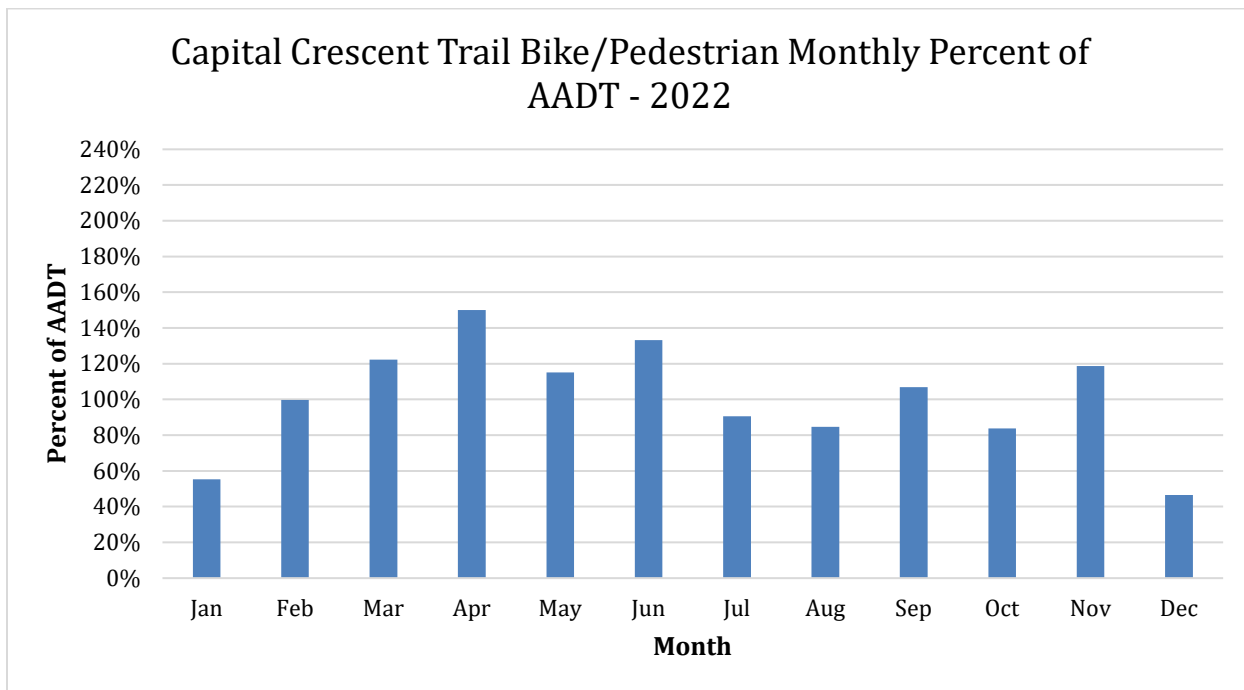
Anacostia River Trail – Pedestrian



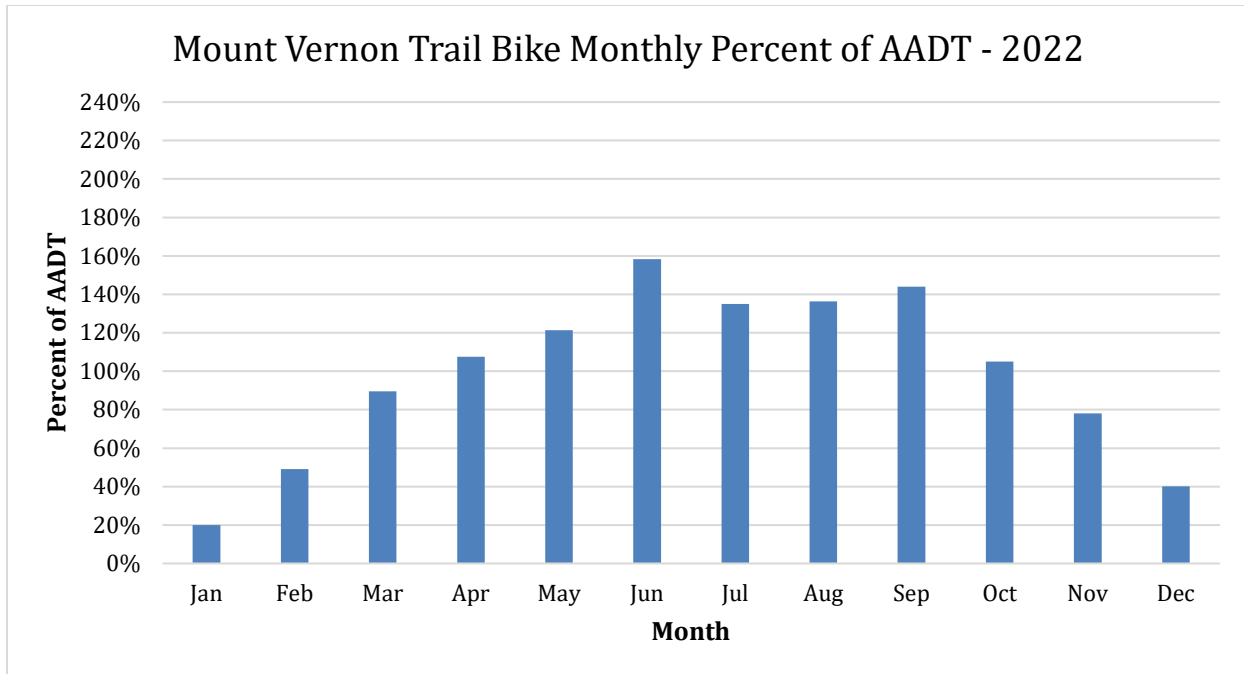
C & O Canal Trail – Bike/Pedestrian



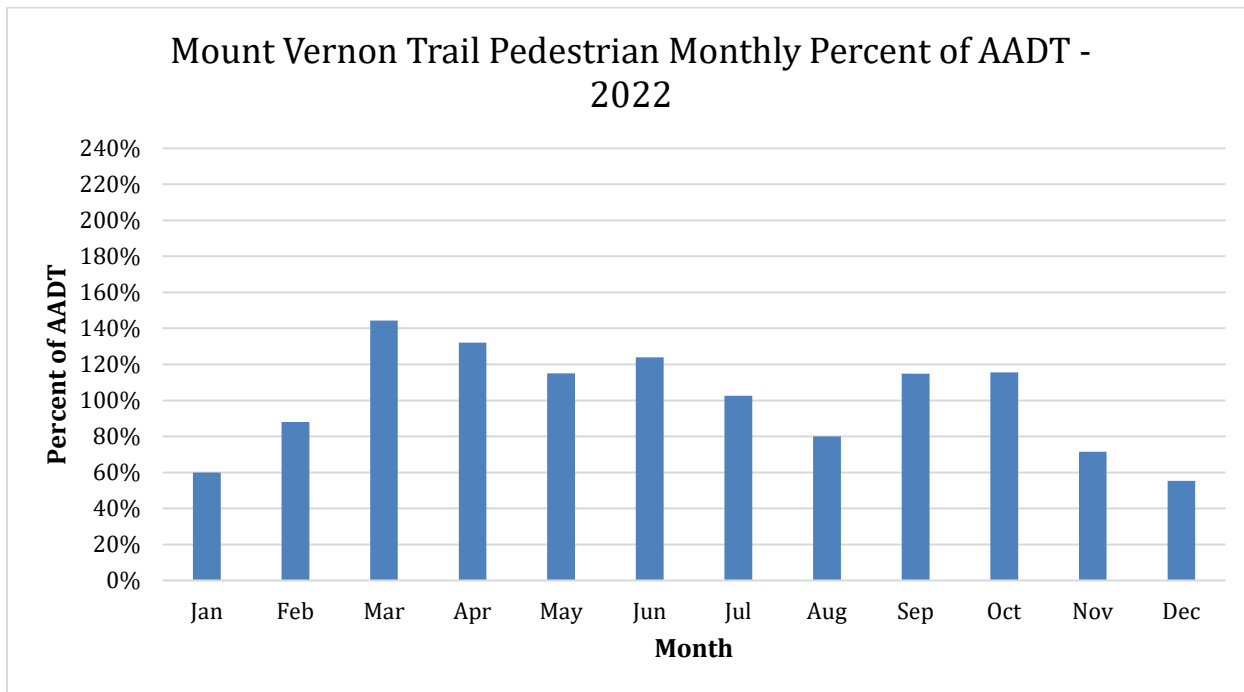
Capital Crescent Trail – Bike/Pedestrian



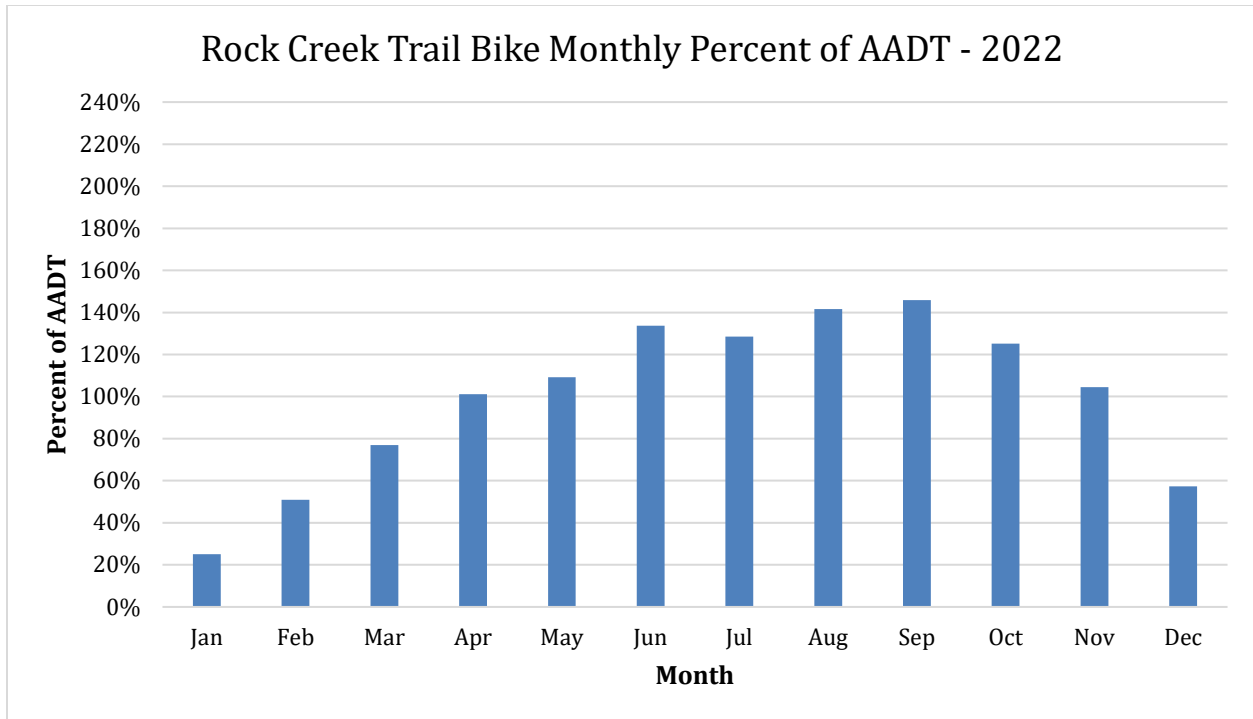
Mount Vernon Trail – Bike



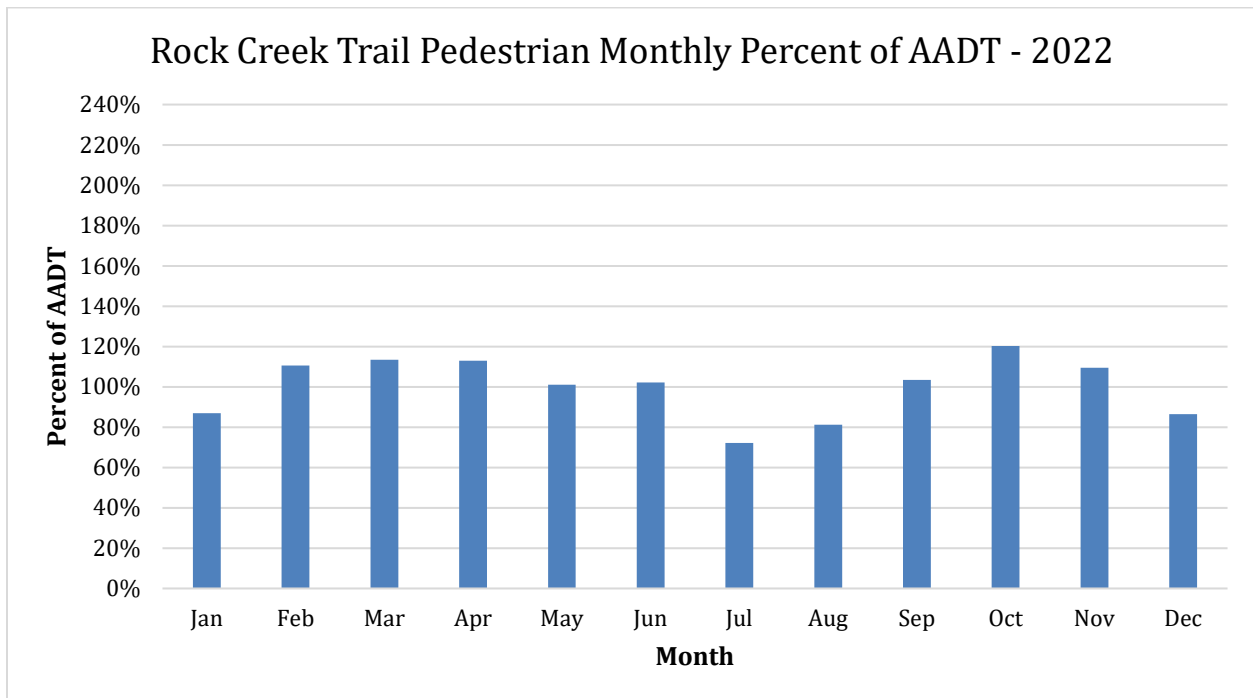
Mount Vernon Trail – Pedestrian



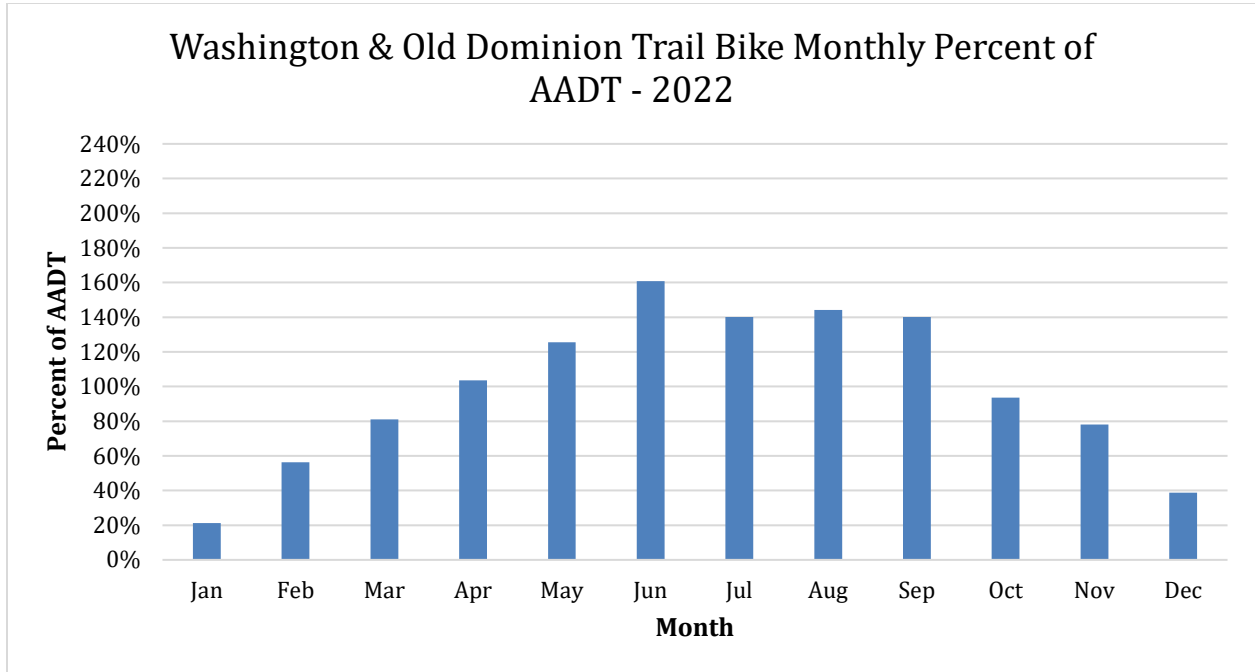
Rock Creek Trail – Bike



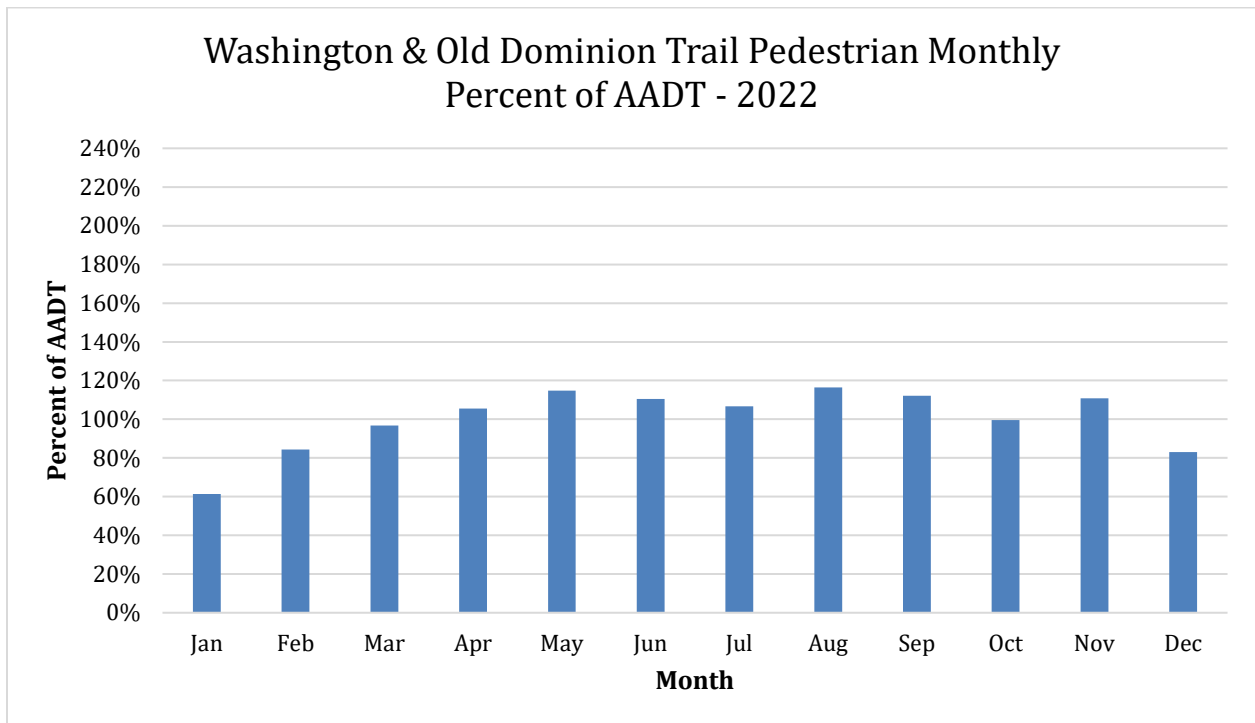
Rock Creek Trail – Pedestrian



Washington & Old Dominion Trail – Bike



Washington & Old Dominion Trail – Pedestrian



Inventory

Table 5 summarizes 153 counters in the National Capital Region, most of which are permanently installed. This is based on the inventory provided by Volpe, and updated with newly installed counters and a column to indicate if the counter has been loaded into BikePed Portal. It includes 13 retired counters indicated with an asterisk next to the counter name.

Table 4 Inventory of Pedestrian and Bicycle Counters in the National Capital Region

| Owner Agency | Model Company | Facility Name | Counter Name | Direction Capable | Separate Bike and Ped Detection | Loaded into BikePed Portal? |
|--------------|---------------|---------------------------|---|-------------------|---------------------------------|-----------------------------|
| Alexandria | Eco-Counter | Beauregard Trail | Beauregard Trail | Yes | Yes | |
| Alexandria | Eco-Counter | Eisenhower Trail | Eisenhower Trail | Yes | Yes | |
| Alexandria | Eco-Counter | Four Mile Trail | Four Mile Trail | Yes | Yes | |
| Alexandria | Eco-Counter | Holmes Run Trail | Holmes Run Trail | Yes | Yes | |
| Alexandria | Eco-Counter | Metro Linear Trail | Metro Linear Trail | Yes | Yes | |
| Alexandria | Eco-Counter | MVT | Mount Vernon Trail #1 | Yes | Yes | Yes |
| Alexandria | Eco-Counter | MVT | Mount Vernon Trail #2 | Yes | Yes | |
| Alexandria | Eco-Counter | MVT | Mount Vernon Trail #3 | Yes | Yes | Yes |
| Alexandria | Eco-Counter | Old Cameron Run Trail | Old Cameron Run Trail | Yes | Yes | |
| Alexandria | Eco-Counter | Onroad | Commonwealth at Mount Vernon | Yes | No - bikes only | |
| Alexandria | Eco-Counter | Potomac Yard Trail | Potomac Yard Trail #1 | Yes | Yes | |
| Arlington | Eco-Counter | Arlington Memorial Bridge | Pyro 11 (Memorial Circle/Arlington Memorial Bridge Sidewalk Ped in Bike Ped Portal) * | Yes | No | Yes |
| Arlington | Eco-Counter | Arlington Memorial Bridge | Memorial Bridge South | Yes | Yes | |
| Arlington | Eco-Counter | Arlington Memorial Bridge | Memorial Bridge North | Yes | Yes | |
| Arlington | Eco-Counter | Four Mile Run Trail | Four Mile Run Trail | Yes | Yes | Yes |

| Owner Agency | Model Company | Facility Name | Counter Name | Direction Capable | Separate Bike and Ped Detection | Loaded into BikePed Portal? |
|--------------|---------------|-------------------------|---|-------------------|---------------------------------|-----------------------------|
| Arlington | Eco-Counter | Bluemont Junction Trail | Bluemont Connector | Yes | Yes | Yes |
| Arlington | Eco-Counter | Custis Trail | Custis Bon Air | Yes | Yes | Yes |
| Arlington | Eco-Counter | Custis Trail | Ballston Connector | Yes | Yes | Yes |
| Arlington | Eco-Counter | Custis Trail | Custis Rosslyn | Yes | Yes | Yes |
| Arlington | Eco-Counter | Custis Trail | Custis Trail (Ballston Beaver Pond) * | Yes | Yes | Yes |
| Arlington | Eco-Counter | Four Mile run | Four Mile Run - piezo* | Yes | No - bikes only | Yes |
| Arlington | Eco-Counter | Four Mile run | Pyro 04 - Four Mile Run* | Yes | No | Yes |
| Arlington | Eco-Counter | Joyce Street | Joyce SB | Yes | Yes | Yes |
| Arlington | Eco-Counter | Joyce Street | Joyce NB | Yes | Yes | Yes |
| Arlington | Eco-Counter | MVT | MVT Airport | Yes | Yes | Yes |
| Arlington | Eco-Counter | MVT | CC Connector | Yes | Yes | Yes |
| Arlington | Eco-Counter | MVT | 14th Street Bridge | Yes | Yes | Yes |
| Arlington | Eco-Counter | MVT | Roosevelt Bridge | Yes | Yes | Yes |
| Arlington | Eco-Counter | MVT | TR Island | Yes | Yes | Yes |
| Arlington | Eco-Counter | MVT | Bikeometer | Yes | No - bikes only | Yes |
| Arlington | Eco-Counter | MVT | Key Bridge East | Yes | Yes | Yes |
| Arlington | Eco-Counter | MVT | Key Bridge West | Yes | Yes | Yes |
| Arlington | Eco-Counter | MVT | Mt. Vernon Trail (Lee Hwy & N Lynn St.) * | Yes | Yes | Yes |
| Arlington | Eco-Counter | Onroad | Crystal NB | No | No - bikes only | Yes |
| Arlington | Eco-Counter | Onroad | Eads NB | No | No - bikes only | |
| Arlington | Eco-Counter | Onroad | Eads SB | No | No - bikes only | |

| Owner Agency | Model Company | Facility Name | Counter Name | Direction Capable | Separate Bike and Ped Detection | Loaded into BikePed Portal? |
|--------------|---------------|---------------------------------------|--|-------------------|---------------------------------|-----------------------------|
| Arlington | Eco-Counter | Onroad | Fairfax EB | No | No - bikes only | Yes |
| Arlington | Eco-Counter | Onroad | Fairfax WB | No | No - bikes only | Yes |
| Arlington | Eco-Counter | Onroad | Quincy SB | No | No - bikes only | Yes |
| Arlington | Eco-Counter | Onroad | Quincy NB | No | No - bikes only | Yes |
| Arlington | Eco-Counter | Onroad | Clarendon EB | No | No - bikes only | Yes |
| Arlington | Eco-Counter | Onroad | Wilson WB | No | No - bikes only | Yes |
| Arlington | Eco-Counter | Onroad | Military NB | No | No - bikes only | Yes |
| Arlington | Eco-Counter | Onroad | Military SB | No | No - bikes only | Yes |
| Arlington | Eco-Counter | Arlington National Cemetery by Rt 110 | 110 Trail (Medgar Evers Bike Trail) | Yes | Yes | Yes |
| Arlington | Eco-Counter | W&OD | W&OD Bon Air East | Yes | Yes | Yes |
| Arlington | Eco-Counter | W&OD | W&OD Bon Air West | Yes | Yes | Yes |
| Arlington | Eco-Counter | W&OD | W&OD Columbia Pike | Yes | Yes | Yes |
| Arlington | Eco-Counter | W&OD | W&OD East Falls Church | Yes | Yes | Yes |
| Arlington | Eco-Counter | Washington Boulevard Trail | Washington Boulevard Trail | Yes | Yes | |
| Arlington | Eco-Counter | Arlington Boulevard Trail | Arlington Boulevard Trail* | | | Yes |
| Arlington | Eco-Counter | | Sidewalk on Campbell Avenue (outside Robeks) * | | | Yes |
| Arlington | Eco-Counter | | Sidewalk on N Nash Street (Arlington Temple) * | | | Yes |
| Arlington | Eco-Counter | | Trail along N Rhodes Street* | | | Yes |
| Arlington | Eco-Counter | | W&OD (near Fire Station 6) * | Yes | Yes | Yes |

| Owner Agency | Model Company | Facility Name | Counter Name | Direction Capable | Separate Bike and Ped Detection | Loaded into BikePed Portal? |
|--------------|---------------|---------------|--|-------------------|---------------------------------|-----------------------------|
| DDOT | Eco-Counter | ART | Anacostia River Walk Trail 11th Street | Yes | Yes | Yes |
| DDOT | Eco-Counter | ART | Anacostia River Walk Trail River Terrace | Yes | Yes | Yes |
| DDOT | Eco-Counter | ART | Anacostia River Walk Trail Benning | Yes | Yes | Yes |
| DDOT | Eco-Counter | ART | Anacostia River Walk Trail Deane Ave | Yes | Yes | Yes |
| DDOT | Eco-Counter | ART | Anacostia River Walk Trail Kenilworth Park | Yes | Yes | Yes |
| DDOT | Eco-Counter | MBT | Met Branch Trail | Yes | Yes | Yes |
| DDOT | Eco-Counter | Onroad | Wharf Classic - Maine Ave Cycle Track | | | Yes |
| DDOT | Eco-Counter | Onroad | Eye St SW bikelane* | | | Yes |
| DDOT | Eco-Counter | Onroad | East Capitol Street | | | Yes |
| DDOT | Eco-Counter | Onroad | 1st St NE | | | Yes |
| DDOT | Eco-Counter | Onroad | Kaiser Permanente Center for Total Health* | | | Yes |
| DDOT | Eco-Counter | Onroad | 11th St NW | | | Yes |
| DDOT | Eco-Counter | Onroad | 15th St NW Cycletrack* | | | Yes |
| DDOT | Eco-Counter | Onroad | R Street NW | | | Yes |
| DDOT | Eco-Counter | Onroad | Columbia Rd NW | | | Yes |
| DDOT | Eco-Counter | Onroad | 14th St NW | | | Yes |
| DDOT | Eco-Counter | ROCR | Rose Park Trail @ P Street NW | Yes | Yes | Yes |
| DDOT | Eco-Counter | ROCR | Rock Creek Trail @ Shoreham Drive | Yes | Yes | Yes |
| DDOT | Eco-Counter | ROCR | Zoo Loop Trail | Yes | Yes | Yes |
| DDOT | Eco-Counter | ROCR | Piney Branch Trail | Yes | Yes | Yes |

| Owner Agency | Model Company | Facility Name | Counter Name | Direction Capable | Separate Bike and Ped Detection | Loaded into BikePed Portal? |
|--------------|---------------|----------------------|---|-------------------|---------------------------------|-----------------------------|
| DDOT | Eco-Counter | ROCR | Rock Creek Trail @ Peirce Mill | Yes | Yes | Yes |
| DDOT | Eco-Counter | MGT | Marvin Gaye Trail - 48th Pl (also called MG at 44th St) | Yes | Yes | |
| DDOT | Eco-Counter | MGT | Marvin Gaye Trail - 60th St | Yes | Yes | |
| DDOT | Eco-Counter | ORP | Oxon Run Park East Bank | Yes | Yes | |
| DDOT | Eco-Counter | ORP | Oxon Run Park West Bank | Yes | Yes | |
| GBID | Eco-Counter | Onroad | 1325 Wisconsin | | | |
| GBID | Eco-Counter | Onroad | 1629 Wisc (Book Hill) | | | |
| GBID | Eco-Counter | Onroad | 2929 M St | | | |
| Montgomery | Eco-Counter | CCT | CCT #1 @ Bethesda | Yes | Yes | |
| Montgomery | Eco-Counter | CCT | CCT #1 @ Bethesda | Yes | Yes | |
| Montgomery | Eco-Counter | CCT | CCT #2 @ Dalecarlia | Yes | Yes | |
| Montgomery | TRAFx | CCT | CCT & Little Falls N | No | No | |
| Montgomery | TRAFx | CCT | CCT & Little Falls S | No | No | |
| Montgomery | TRAFx | CCT | CCT @ Loughboro Mill | No | No | |
| Montgomery | TRAFx | Little Falls Parkway | LFPkwy NB Mass Av | | | |
| Montgomery | TRAFx | Little Falls Parkway | LFPkwy SB Mass Av | | | |
| Montgomery | TRAFx | Little Falls Parkway | Little Falls Pkwy N | No | No | |
| Montgomery | TRAFx | Little Falls Parkway | Little Falls Pkwy S | No | No | |
| Montgomery | Eco-Counter | Matthew Henson Trail | Matthew Henson Trail 1@ Layhill | Yes | Yes | |
| Montgomery | Eco-Counter | Matthew Henson Trail | Matthew Henson Trail 2 @ Winding Creek | Yes | Yes | |

| Owner Agency | Model Company | Facility Name | Counter Name | Direction Capable | Separate Bike and Ped Detection | Loaded into BikePed Portal? |
|--------------|---------------|----------------------|---|-------------------|---------------------------------|-----------------------------|
| Montgomery | TRAFx | Onroad | BH RP Contact Station | No | No | |
| Montgomery | TRAFx | Powerline Trail | Powerline @ Colton | No | No | |
| Montgomery | TRAFx | Powerline Trail | Powerline @ 118 | No | No | |
| Montgomery | TRAFx | ROCR | Beach Dr @ Knowles | No | No | |
| Montgomery | TRAFx | ROCR | Beach Dr @ Wildwood | No | No | |
| Montgomery | Eco-Counter | ROCR | Rock Creek Trail @ Baltimore | Yes | Yes | |
| Montgomery | Eco-Counter | ROCR | Rock Creek Trail @ Wildwood | Yes | Yes | |
| Montgomery | TRAFx | ROCR | Rock Creek Trail @ Wildwood | No | No | |
| Montgomery | TRAFx | Sligo Creek Parkway | Sligo Creek Pkwy @ Dennis | No | No | |
| Montgomery | TRAFx | Sligo Creek Parkway | Sligo Creek Pkwy @ Kennebec | No | No | |
| Montgomery | TRAFx | Sligo Creek Parkway | Sligo Creek Pkwy @ Piney Branch S | No | No | |
| Montgomery | TRAFx | Sligo Creek Trail | Sligo Creek Trail @ Dennis | No | No | |
| Montgomery | TRAFx | Sligo Creek Trail | Sligo Creek Trail @ Kennebec | No | No | |
| Montgomery | TRAFx | Sligo Creek Trail | Sligo Creek Trail @ Piney Branch S | No | No | |
| Montgomery | TRAFx | Ten Mile Creek Trail | Ten Mile Creek Trail @ 121 | No | No | |
| Montgomery | TRAFx | Ten Mile Creek Trail | Ten Mile Creek Trail @ Old West Baltimore | No | No | |
| Montgomery | TRAFx | | NW Branch South of Lamberton | No | No | |
| Montgomery | TRAFx | | RC Greenway South of Springbrook | No | No | |
| NPS | Eco-Counter | MVT | MVT at Waynewood Blvd. (Bridge 12) | Yes | Yes | Yes |
| NPS CHOH | TRAFx | C&O Canal Trail | Falls Road Spur | No | No | Yes |

| Owner Agency | Model Company | Facility Name | Counter Name | Direction Capable | Separate Bike and Ped Detection | Loaded into BikePed Portal? |
|--------------|---------------|-----------------|--|-------------------|---------------------------------|-----------------------------|
| NPS CHOH | TRAFx | C&O Canal Trail | Chain Bridge Access | No | No | Yes |
| NPS CHOH | TRAFx | C&O Canal Trail | Lock 5 | No | No | Yes |
| NPS CHOH | TRAFx | C&O Canal Trail | Lock 6 | No | No | Yes |
| NPS CHOH | TRAFx | C&O Canal Trail | Lock 7 | No | No | Yes |
| NPS CHOH | TRAFx | C&O Canal Trail | Glen Echo | No | No | Yes |
| NPS CHOH | TRAFx | C&O Canal Trail | Lock 8 | No | No | Yes |
| NPS CHOH | TRAFx | C&O Canal Trail | Lock 10 | No | No | Yes |
| NPS CHOH | TRAFx | C&O Canal Trail | Marsden Tract Foot Bridge | No | No | Yes |
| NPS CHOH | TRAFx | C&O Canal Trail | Anglers Inn | No | No | Yes |
| NPS CHOH | TRAFx | C&O Canal Trail | Berma Road | No | No | Yes |
| NPS CHOH | TRAFx | C&O Canal Trail | Swains Lock | No | No | Yes |
| NPS CHOH | TRAFx | C&O Canal Trail | Pennyfield | No | No | Yes |
| NPS CHOH | TRAFx | C&O Canal Trail | Violettes Lock | No | No | Yes |
| NPS CHOH | TRAFx | C&O Canal Trail | Sycamore Landing access | No | No | Yes |
| NPS CHOH | TRAFx | C&O Canal Trail | Whites Ferry | No | No | Yes |
| NPS CHOH | TRAFx | C&O Canal Trail | Dickerson / Warm Water access | No | No | Yes |
| NPS CHOH | TRAFx | C&O Canal Trail | Lock 31 access | No | No | |
| NPS CHOH | TRAFx | C&O Canal Trail | Lock 33 | No | No | |
| NPS CHOH | TRAFx | C&O Canal Trail | Lock 38 Lower | No | No | Yes |
| NPS CHOH | TRAFx | C&O Canal Trail | Lock 38 Upper | No | No | Yes |
| NPS CHOH | TRAFx | C&O Canal Trail | McMahon's Mill access | No | No | Yes |
| NPS CHOH | TRAFx | C&O Canal Trail | Fort Frederick access | No | No | |
| NPS CHOH | TRAFx | C&O Canal Trail | Cumberland Terminal | No | No | Yes |
| NPS CHOH | TRAFx | C&O Canal Trail | Cohill Station | No | No | |
| NPS CHOH | TRAFx | C&O Canal Trail | Little Pool access | No | No | |
| NPS CHOH | TRAFx | C&O Canal Trail | Billy Goat Trail A - Upstream Entrance | No | No | Yes |
| NPS CHOH | TRAFx | C&O Canal Trail | Billy Goat Trail C | No | No | Yes |
| NPS CHOH | TRAFx | C&O Canal Trail | Weaverton | No | No | Yes |

| Owner Agency | Model Company | Facility Name | Counter Name | Direction Capable | Separate Bike and Ped Detection | Loaded into BikePed Portal? |
|-----------------|---------------|-----------------|------------------------------------|-------------------|---------------------------------|-----------------------------|
| NPS CHOH | TRAFx | CCT | Georgetown VC (Level 3 access) | No | No | Yes |
| NPS CHOH | TRAFx | CCT | Georgetown Mule Bridge (MM-1) | No | No | Yes |
| NPS CHOH | TRAFx | CCT | 31st St Georgetown at C&O Trail | No | No | |
| NPS CHOH | TRAFx | CCT | Potomac St Georgetown at C&O Trail | No | No | |
| NPS CHOH | TRAFx | CCT | Capital Crescent | No | No | Yes |
| NPS CHOH | TRAFx | CCT | Whites Ferry Towpath | No | No | |
| Prince George's | Eco-Counter | ART | ART, Bladensburg Waterfront Park | Yes | | |
| Prince George's | Eco-Counter | ART | ART, Route 1 | Yes | | |
| Prince George's | Eco-Counter | ART | ART, Cottage City | Yes | | |
| Prince George's | Eco-Counter | NW Branch Trail | Riverfront West Hyattsville | Yes | | |

* indicates counter has been retired.

References

Miranda-Moreno, L., Nosal, T., Schneider, R., & Proulx, F. (2013). Classification of Bicycle Traffic Patterns in Five North American Cities. *Transportation Research Record: Journal of the Transportation Research Board*, 2339, 68-79. <https://doi.org/doi:10.3141/2339-08>