Minuteman Commuter Bikeway[1]

Know Your Path:

COLLECTING LONG-TERM BICYCLE AND PEDESTRIAN COUNTS ON SHARED USE PATHS

In June 2019, the Massachusetts Department of Transportation (MassDOT), acting on behalf of the Massachusetts Trails Team (MassTrails), installed automatic permanent bicycle and pedestrian counters on four shared use paths. This was part of a pilot program to adopt permanent count stations throughout the state. The four locations were specifically chosen to provide data to support an ongoing study of the impacts and benefits of shared use paths in Massachusetts.

MassDOT collects continuous, long-term motor vehicle traffic counts on their roadways, but until now, bicycle and pedestrian counts have only been collected on a short-term basis through manual or temporary automatic counters.

This guide details MassDOT's experience with the MassTrails pilot program counters, outlines best practices learned from peer agencies around the country, and serves as a primer for those who wish to install their own bicycle and pedestrian counters on shared use paths.

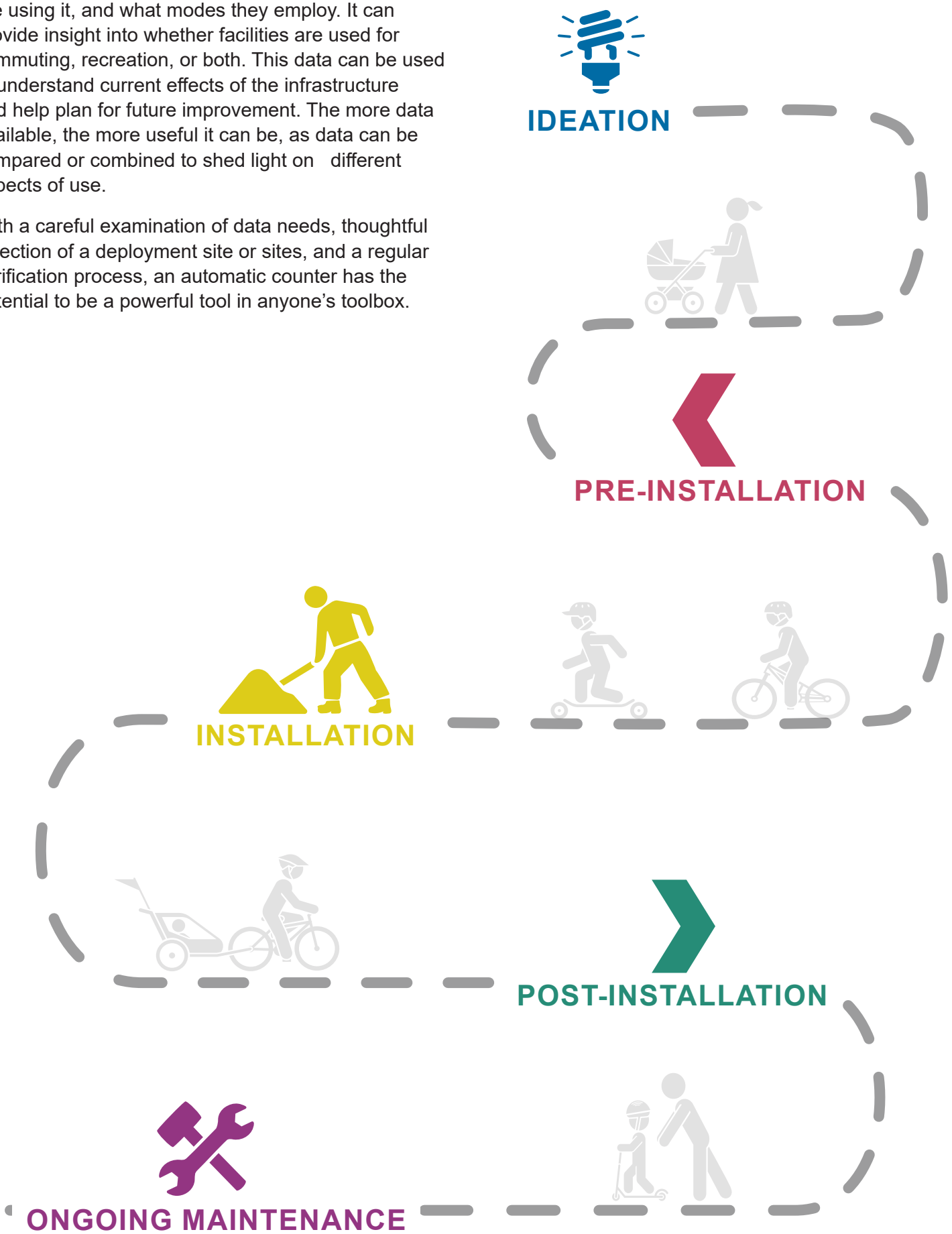
This primer focuses on performing bicycle and pedestrian counts on shared-use paths, and the processes outlined here may not capture all needs for implementing pedestrian and bicycle counts on other types of facilities.

[1] *Arlington, Massachusetts near Arlington Center*

Collecting data is imperative to understanding when infrastructure is being used, how many people are using it, and what modes they employ. It can provide insight into whether facilities are used for commuting, recreation, or both. This data can be used to understand current effects of the infrastructure and help plan for future improvement. The more data available, the more useful it can be, as data can be compared or combined to shed light on different aspects of use.

With a careful examination of data needs, thoughtful selection of a deployment site or sites, and a regular verification process, an automatic counter has the potential to be a powerful tool in anyone's toolbox.

COUNTER INSTALLATION PROCESS



Ideation

To get the most out of your counter installation...

1. **Identify Data Needs:** Define the need or purpose for data collection
2. **Select the Facility:** Establish desired facility characteristics and select one or more sites
3. **Select a Counter Type:** Determine necessary counter characteristics
4. **Coordinate with Stakeholders and Partners**

The following sections provide more detail about what should be considered for each of these steps.

1. Identify Data Needs

Understanding the data needs of the interested party will inform future decision-making, such as whether an automatic permanent counter is the right solution, how many counters should be installed, where each counter should be installed, and what types of permanent counters will yield the most benefit.

Common Data Needs

- Track changes in pedestrian and bicycle activity over time
- Model transportation networks and estimate annual volumes
- Evaluate the effects of new infrastructure on pedestrian and bicycle activity
- Conduct risk or exposure analyses
- Inform the prioritization of pedestrian and bicycle projects

[1] Source: NCHRP 797, *Guidebook on Pedestrian and Bicycle Volume Data Collection*.

Data Needs Example: MassTrails Pilot Program

The purpose of the MassDOT shared use path benefits study is to identify the social, environmental, transportation, accessibility, economic, and health impacts of shared use paths across the state. To understand benefits broadly, it's important to know how many people are affected by a path. Bicycle and pedestrian volume data help extrapolate a per person impact and quantify the full impact on everyone who uses a trail. Data was collected at a range of sites to capture different trail characteristics across the state. Since it was not feasible to collect counts on every trail across the state, it was important to determine defining characteristics of the different types of trails. This allowed a representative cross-section of Massachusetts' trail types to be captured.

The primary use of the counters is capturing trail counts on each trail at least during the peak use season (approximately June to October). Other desires for the trail counters included the ability to use long-term data to track changes in trail impacts over time and to support the MassDOT bicycle and pedestrian permanent count initiative which will ultimately collect and report bicycle and pedestrian counts across the state. A cost analysis showed that renting and deploying short-term counters for the peak season would cost at least as much as purchasing permanent counters. Because of the cost analysis and because the permanent counters would help fulfill the additional desires, the team decided to purchase and deploy permanent counters.

Before determining how many counters are necessary and where the counters need to go, it's important to consider the goals for data collection.

2. Select the Facility

Facility selection is the process of identifying the corridor(s) or shared use path(s) upon which you would like to deploy an automatic counter. Facility selection should happen in parallel with data needs identification so both processes can feed into each other. Data needs will vary based on the facilities, and the facilities will vary based on the data needs.

The purpose for your data collection may easily determine where you choose to install the counter. For example, if you are a *Friends of the Trail* group, you are likely interested only in collecting data on your trail or the facilities leading to it. If this is not the case, you may want to define the characteristics of the facilities that will best support your data needs. Below are common characteristics you may want to consider.

Land Use

When selecting a facility to install your counter, consider adjacent land uses. These land uses determine a facility's purpose in the surrounding community, influencing what the community uses the path for. For example, an urban or suburban facility that connects residential areas to commercial areas and a transit hub is likely to be used by commuters and people running errands. These users will likely be traveling at typical commute times, in the morning and late afternoon on weekdays, and use a broader variety of modes, from bicycles and scooters to mobility devices and skateboards. A facility that passes through rural or more sparsely populated suburban areas and nature reservations may draw different types of path users. These areas may have heavier use in early afternoon and weekends. Although the user types are not likely to vary much from people walking and biking, some users may be unique to this setting. Equestrians, snowmobilers, and cross-country skiers are possible user types that would be unique to a more rural or suburban setting. Many shared use paths have a wide variety of adjacent land uses, especially paths built on former railroad right of way. The goals and data needs will dictate what land uses, and thus what path usage patterns, should abut the target facility.

Connectivity

When thinking about counter location, it is also important to consider connectivity to other bicycle and pedestrian facilities and destinations. Is this on a marked bicycle or pedestrian route? Are there many destinations like schools, grocery stores, or transit stops nearby? Or is this a section of trail that does not provide access to destinations and is more likely to be used for recreational use?

Parallel Networks

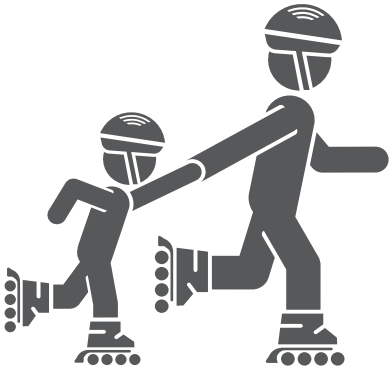
If there are parallel high-comfort bicycle and pedestrian facilities that provide the same or better levels of connectivity to destinations or other locations where people walking and biking may choose an alternate path, there will likely be fewer users on the shared use path. Choosing a location where the adjacent facilities end and users are likely connecting to the shared use path can provide a snapshot of the importance of the shared use path in providing full network connectivity.

Other Facility Types

The list below categorizes some of the other facility types where one can install counters. MassDOT has recommendations for counter vendors that work best with your chosen facility type. You can reference the appendix to learn more about these vendors.

- Pedestrian crosswalk
- Pedestrian sidewalk
- Striped bicycle lane
- Separated bike lane
- Side path adjacent to a roadway

3. Select a Counter Type



What do you need to capture to answer your question or what type of data would you like to capture to better understand those volumes?

What modes do you need to capture? Do you need to capture only pedestrians, only bicyclists, or both? If you're capturing both bicyclists and pedestrians, would it be useful to understand how many of each there are? Some counters (infrared only, etc.) do not differentiate between the types of trail users but can be collected at low cost. Often, though, the split between cyclists and pedestrians is important to capture so that you can more accurately infer other types of information, such as the reason for the trip, the distance of the trip, and the benefits of the trip. We do not recommend relying upon counters that do not differentiate between people walking and biking because they are not comprehensive enough in answering common data needs.

- **How many locations** should you capture?
- Do you need to capture **direction of travel**?
- How do you need the results to be shared so the public can **easily understand**?
- **Who** needs to be able to access this data?
- **How long** do you need to collect data?

4. Coordinate with Stakeholders and Partners

Interested parties, or stakeholders, range from state and federal agencies, metropolitan planning organizations, and municipalities to local businesses, advocacy groups, and residents. Stakeholders can help inform what types of counters and locations are appropriate or infeasible. Local stakeholders can share information about conflicting underground utilities and expected land use changes so they can be avoided when identifying potential installation sites. It's also necessary to gain permission from and coordinate with the facility owners. For the MassTrails pilot's permanent counter installation, the team worked with the Department of Conservation and Recreation (DCR) to obtain the needed permits.

MassDOT's Bicycle and Pedestrian Plans call for the agency to invest in various forms of data collection and evaluation to inform the plans' initiatives and measure performance. To that end, MassDOT is investing in its own fleet of permanent counters and coordinating with our external partners to share collected data. This will assist MassDOT in identifying long-term trends in bicycling and walking, overall traffic volumes, and other important data needs. Moreover, other groups such as municipalities, regional and metropolitan planning organizations, community and advocacy groups, and non-profits will be able to leverage this data to inform their own bicycle and pedestrian initiatives.

Coordinate with stakeholders and partners through the entire lifecycle of the counter.

Pre-installation

Once you have identified your data needs and necessary facility and counter characteristics, and coordinated with stakeholders, you can begin the pre-installation activities of choosing the specific site(s) for installation and specific type of counter that will serve your needs. Like the ideation phase, all activities in the pre-installation phase feed into each other and should be executed in parallel.

Site selection

Technical limitations of the counter's sensors, installation requirements, and site context are major factors in selecting a site for the counter. Consult the vendor's installation manual for specific information. To capture the highest number of users, choose a natural narrow point on the path where all users will be detected by the counter's sensors. Consider the presence of nearby access points and path user behavior. Balance site context with technical limitations and installation requirements, as these factors will likely compete with each other. For example, a pinch point may be helpful in guiding all path users to where they will be detected, but the users may bunch up and travel slowly at the pinch point, which could cause incorrect counts.

When selecting a site, it is also important to understand whether there are detour options, like sidewalks and other safe paths for pedestrians and young or inexperienced cyclists uncomfortable riding with vehicle traffic. The pilot study's counters involve loop detectors and so required a brief detour during installation. One of the sites was moved to better accommodate the detour. We'd like to note that not all counters require significant detours for installation, but it is always important to plan for one. Other site considerations based on counter requirements include space for a post, hand hole or other equipment, and power source availability if your selected counter does not use batteries. Many pedestrian counters use infrared sensors, so it's important to choose a site without nearby heat sources or other human activity (cars, playgrounds, etc.) in front of the expected counter location.

Some counters can't differentiate between modes, or differentiate only between bicyclists and pedestrians.*

*Non-pedestrians and bicyclists will often be considered a bicyclist or pedestrian, depending on their characteristics.

Counter selection

Data needs and site context are the two major factors in selecting a counter. User type and travel direction are the key data points that differentiate counters. The site context also determines whether a counter is right for the application. For example, a counter that needs to be installed on a bridge deck will likely be unable to make use of inductive loops because the loops will need to be embedded in pavement, which may be more complicated on a bridge than other facilities.

After having selected a facility and counter type, you can reference MassDOT's pre-qualified vendors and move forward with the procurement process. MassDOT assessed permanent and portable counter technologies from a variety of vendors based on overall cost, installation time, power source, data storage, data interface & format, ability to differentiate between users, and overall count accuracy.

As a result, we have preapproved vendors that meet minimum performance specifications listed on Commbuys, the official procurement record system for the Commonwealth of Massachusetts' Executive Departments. MassDOT has also invested in the MS2 Non-Motorized Database System (NMDS) as the data warehouse for all bicycle and pedestrian counts taking place throughout the state,including those collected by municipalities, regional planning associations, or others. You can find out more about accessing the list of pre-qualified vendors and the MS2 NMDS in the appendix.

Installation

Challenges that arise in the installation phase will vary depending on the chosen site and counter. The counters selected for this pilot include induction loops embedded in the pavement to detect bicyclists, but not all counters use this type of detection technology. Embedding induction loops requires heavy machinery and chemicals that release toxic fumes. The install team and MassDOT needed to take care to avoid placing path users in harm's way during installation.

Be prepared to close the path during installation. Set a detour route, notify the public, and clearly mark the detour.

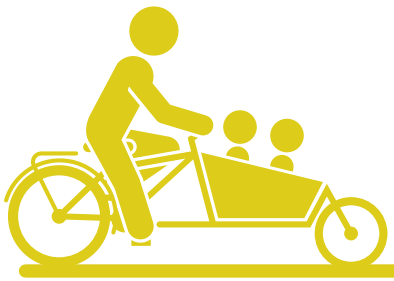
Staging area

A staging area is a place where installation teams can store trucks, tools, machines, and other equipment when not in use. Ideally, the staging area is entirely in the shared use path's right of way. Otherwise, restrict the staging area to other public rights of way, such as that of the local municipality or the state, and coordinate with the appropriate agencies. If the site is constrained in a way that makes keeping the staging area in a public right of way impossible, consider path-abutting private property such as open areas, parking lots, plazas, and driveways, and coordinate with the property owners.

Three of the four pilot counter sites had enough adjacent space in the public right-of-way that staging did not present a challenge, while one site presented constrained conditions and the install team coordinated to use an adjacent business's driveway as the staging area. One site required use of a public street as a staging area. In a scenario like this, take care not to impede public access to the street. If public access cannot be maintained, coordinate with the municipality and local agencies.

Path closure

A path closure can be partial or full, allowing varying degrees of public access during construction. Partial closures affect a portion of the path while work occurs on another, escorting path users through the construction area, or pausing work to allow path users through intermittently. Full closure means all path users must detour to continue their journey. Full closure is not always feasible, especially when a parallel pedestrian and bicycle facility does not exist. Other factors that reduce the feasibility of full closure include a long or inconvenient detour, a detour that places path users on a non-ADA compliant route, or non-compliance of path users to path closure. If full closure must occur and a short, comfortable detour is not feasible, notify the public in advance that the path will be closed and avoid peak commute times.



MassDOT employed a combination of closure methods so the paths were fully closed for a total of about 15 minutes during each install. Sawcutting the pavement and sealing the sawcuts required that the path to be fully closed due to the danger presented to the public by each of those activities. Even though each of the paths was only fully closed for about 15 minutes, a detour was provided for each path. Detour signs were placed to show the detour routes. Some path users preferred to wait nearby until the path reopened instead of using the detour. If your counter installation will require a significant detour (one third of a mile or longer) or is expected to keep the path fully closed for more than 20 minutes, more significant detour tools, like a police detail, may be necessary.

Careful planning of the staging area and path closures will lead to a quick and painless installation with minimal inconvenience to path users. Ensure that a similar level of comfort is provided to all affected users, especially those that require mobility devices, such as wheelchairs. In addition, be mindful of the fact that people on bikes are not always able to dismount, depending on their own age and ability.

Sawcutting grooves into the pavement where the induction loops will go.

Installing the counter

Adherence to the vendor's installation manual is key to protecting the longevity of the counter, ensuring its accuracy, and keeping its warranty in effect, if it has one. Installation requirements conform to the specific vendor or manufacturer requirements, and this guide is not a replacement for an installation manual. Engaging in knowledge sharing with an agency or a firm that has experience with installing counters will reveal the challenges and best practices that are not apparent from simply reviewing the vendor's installation guide.

The counters for this pilot consisted of a wooden post housing an infrared sensor, two induction loops embedded into the pavement, and a handhole containing the battery, communication equipment, and computer. Each installation began with digging two holes near the path edge: one to house the handhole and one to pour the concrete base for the post into. After digging was complete, the concrete base was poured and the wooden post set into it at the appropriate height. Next, the infrared sensor in the wooden post was connected to the main computer and the connections protected in a waterproof casing. The infrared sensor was now hooked up and ready to go. Next came the more challenging of the two sensors: the induction loops. First, chalk outlines of where the loops would be placed were drawn onto the pavement. Then, using a pavement saw, grooves for the loop were carefully cut into the pavement. Wire was looped into the grooves, and then the grooves were sealed. The wires were all connected up and the connections placed in waterproof casings. Finally, the handhole and concrete base of the wooden post were buried and the site cleaned up.

The sites with more constraints and staging areas that were more difficult to access took longer, while sites with large amounts of space to work in had shorter install times.

Post and handhole with trench for wiring.

[2] *Hadley, MA near Cross Path Road*

Post-Installation

Immediately after completing installation, edit the counter's metadata to match the post-build condition. Counter metadata can include GPS coordinates, name, short description, photos of the location, and other details. In addition to editing the metadata, ensure that the counter is working as expected through data verification.

After the installation. Loops (foreground), post (right), and handhole (behind post) are visible.

Data Verification

Once the counter is installed, it's time to verify that the technology is working.

Data verification is checking the data the counter outputs is expected based on the sensor inputs. For example, if someone walks in front of a counter's infrared sensor, the expected count is one pedestrian. If someone rides a bike over the counter's induction loops, the expected count is one bicycle. The vendor will be able to provide more detailed insight into their counter's expected behavior, and several pre-approved vendors send a representtive to the installation to support this process. The pilot's counters counters consisted of two sets of sensors which could also take directionality data, which required extra verification. If the counter is not collecting data within expected limits, refer to the installation manual for insight into what may be going wrong, or call the vendor's customer service line. Several of the directions were flipped for the pilot installations, and the fix was simply to rename the data outputs to the correct direction.

[2] *Hadley, MA near Cross Path Road*

Ongoing Maintenance

Ongoing maintenance of the counters is essential to gathering reliable, accurate data. Maintenance activities include physical maintenance of the counter, verification of the data, and troubleshooting issues that arise.

A maintenance schedule will keep a counter in working order and help catch problems early.

Physical maintenance

Periodically clearing away any sources of interference to a counter's sensors and/or solar cells, if applicable, is advisable. Overgrown leaves, dirt and grime, webs, litter, and snow are examples of sources of interference that can collect over time. Follow the vendor's instructions on how to clean and care for your counter and its sensors.

In addition to sources of interference on, in, and near the counter, ensure that any sources that are detectable to the sensors are cleared away. For example, if an abutting property owner has built a metal fence adjacent to the path, ensure that the metal will not interfere with the counter. Consult the counter's manual for more information on sources of interference.

Verification

Repeat the initial verification process from the post-installation phase at set intervals to make sure the data from the counter is accurate and the counter is still operating as expected. Verifying regularly will allow abnormalities to be identified early.

If the counter has data transmission capabilities, checking those data regularly can also be a tool for verifying that the counter is functioning as expected. When inspecting the data, look for anomalies. Anomalies are unexpected deviations in the data from what would be considered normal, such as zero counts or multiple consecutive identical counts. Identifying anomalies is not an exact science and having a good understanding of the normal characteristics of the data will be helpful. Consider human behavior and other external factors when checking the data.

Data storage services like MS2 can detect a variety of these abnormalities and automatically notify you of any issues. Depending on what platform you use to store your counts, you may or may not need to manually observe your data to ensure that your counter is functioning correctly.

Regular verification will allow data abnormalities to be identified early.

Good data over a long time will establish normal levels of path usage and further aid in identifying anomalies, further highlighting the need to catch and rectify errors quickly.

Troubleshooting

Troubleshooting is the process of identifying how and why something unexpected has occurred. First, identify data that is inconsistent with expectations and consider potential reasons for this data. For example, your data may show that there is a sudden surge of pedestrians that seems abnormal in a short period of time during a cold, rainy day. Consider external factors first. Perhaps a local cross-country team was practicing on the path and their practice route took them past the counter, and the count data is unexpected but true. If inconsistencies continue, consider other potential reasons there may be issues with the counters. There may be insects that are only active during rainfall may be living in the counter's housing and crawling over the sensors. Coordinate with local agencies, the vendor, and peer agencies to aid in identifying possible external factors. If no external factors are identifiable, consider internal factors. Water may be leaching into the internal components during rainfall. Sensor components may have been damaged in some way, such as an infrared sensor's lens being scratched. Coordinate with the vendor for aid in identifying malfunctions and understanding options, which may include a warranty-based replacement.

In late November of 2019 and into December, two of the pilot's counters began registering spikes in pedestrian volumes upwards of 6,000 times the expected volume. After eliminating possible external factors such as electrical or heat interference, investigation of the sensor housing revealed that it had become host to several spider's nests that were disrupting the data.

Troubleshooting can be a time-consuming and frustrating process. Once the cause of an anomaly in the data has been clearly identified, carefully document all findings and assumptions made to reach the conclusion of what the cause was. This documentation will not only aid future efforts but also serve as a knowledge-sharing resource for others.

Cape Cod Rail Trail[3]

If installed and maintained appropriately, automatic pedestrian and bicycle counters can be a valuable part of your data collection toolkit. Counter data provide insight into how our infrastructure is used and can be applied to studies and used for decision making.

[3] *Brewster, MA near Underpass Road*

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