
TO: MPO Technical Committee
FROM: David Pesnichak, Transportation Planner
SUBJECT: Bicycle and Pedestrian Counting
DATE: August 15, 2013

Purpose

At the May 16, 2013 MPO Technical Committee meeting, a request was made to Staff to review and present options and feasibility for a City-wide bicycle and pedestrian counting program.

This memo outlines the current status of bicycle and pedestrian counting in Lincoln and proposes an institutionalized program which is intended to be as comprehensive as possible. The program is intended to collect the following data.

- Count of On-street and Off-street users (trails and streets)
- Purpose for trip (recreation, commuter, transportation, etc.)
- Mode of travel (walking or biking)

Background / Current Status

Bicycle and pedestrian counts have been occurring on Lincoln trails by local non-profits since 1991. These counts were all conducted manually by volunteers and have occurred one time per year from 1991 until 2010 when the counts became biannual.

In addition, through the assistance of the Nebraska Department of Roads (NDOR), over the years several experimental automatic counters have been placed at the Helen Boosalis Trail / Rock Island Trail / 27th Street intersection. Currently, NDOR has a TrafX Passive Infrared counter at this location. The data is collected by NDOR and passed on to the City of Lincoln Parks and Recreation Department every month. David Schoenmaker of NDOR will be providing an overview of the technologies used at this location. (See Appendix 1)

The City Public Works and Utilities Department also conducts periodic counts at locations for the needs of specific projects. Since this data is project driven, it may not fit into a comprehensive counting program.

Need

Recent Transportation Demand Management (TDM) surveys have found that about 7% of commuters in Lincoln use a bicycle as their primary commute mode while 50% use a bicycle at some point throughout the year for commuting purposes. In addition, 6% of commuters primarily walk to school or work while 47% walk to school or work at some point throughout the year. Further, University of Nebraska student bicycle counts for 2012 show roughly a threefold increase on the East Campus and twofold increase on the City Campus since 2010.

Despite these numbers, current bicycle and pedestrian counting activities are not comprehensive, tend to be focused on trails and are dependent on volunteers. In addition, the City currently does not have accurate year-round user data for non-auto users or differentiate between user types (commuter, transportation, recreation, etc.). A more comprehensive program which tracks both on-street and off-street users over time is important for transportation planning and would be valuable in tracking commuter traffic.

The benefits of a consistent and more comprehensive program include:

- Support for funding requests from public and private sources
- Inform bicycle and pedestrian systems planning
- Capacity to gauge the impact of bicycle and pedestrian related infrastructure investments
- Ability to track bicyclist and pedestrian demands over time
- Assessment of traffic safety and management interventions
- Assist the City, County and MPO in safety, public health and sustainability analysis

Proposed Program

In order to gain the best and most complete data possible, a program which involves several data collection methods is recommended as outlined and then further detailed below. The full institutionalization of such a program will likely need to happen in phases.

- Manual counts (maintain counts conducted biannually by GPTN)
- Automated counts (deploy automatic counters, primarily on trails to monitor usage year round)
- Voluntary user data gathering (smart phone application)
- User surveys and rack occupancy counts (periodic on-line surveys and manual rack occupancy counts)

Manual Counting

The current counting program, although very valuable, relies primarily on manual volunteer labor over the course of two to three days every other year. The periodic nature of this counting method and high labor demand reduces the ability to gain more nuanced usage trends. However, there are benefits to maintaining this biannual counting because it does provide valuable data which an automatic counter cannot detect such as helmet usage, runners vs. walkers, presence of pets, trailer usage and, depending on the technology, direction. Further, when combined with automatic counters, manual counting can work as data verification. This said, maintaining manual counting on a biannual basis is recommended into the future in order to verify information received from automatic counters as well as obtain more detailed user characteristics.

Automatic Counters

Approximately six automatic data collectors are recommended on the shared-use-path system. The initial recommended locations (subject to change) for these six counters are: MOPAC bridge over 27th St, MOPAC bridge over O St., Billy Wolff trail between N St and J St., Billy Wolf trail east of Holmes Lake, John Dietrich trail near Fleming Fields and the intersection of the Rock Island and Helen Boosalis trails at 27th St where NDOR operates a counter today. See Appendix 5 for cost breakdown for different options and Appendix 7 for a Technology Overview.

In addition, Staff has been working with the N Street Cycle Track consulting team (Alta) to get at least one permanent counter installed in the cycle track corridor. Although the consulting team has recommended that three counters be installed, the exact location and number of counters depend on funding availability. The initial cost of these counters has not been included in this report as it is anticipated that any counters would be a part of the project infrastructure cost. The physical and data maintenance of these counters is anticipated to be managed along with this City-wide effort.

Voluntary User Data Gathering

Using smart phones, the software interface and data access for voluntary user data gathering can be conducted relatively inexpensively. The annual cost for such a program through the San Francisco County Transportation Authority (SFCTA) is approximately \$200/year for a government agency. The application can be downloaded for free on any iPhone or Android device and is activated by the user. The advantage to this program is it allows some insight into how users interface between the shared-use-path and road system. In addition, it is possible to learn why the trips are made, the exact route as well as the overall distance. The downside is that because it is voluntary, a concerted effort through advertising and working with community groups will be needed to get the word out to residents walking or biking around Lincoln. However, even on a small sample, the information collected can be very valuable in system planning. (See Appendix 6)

User surveys and rack occupancy counts

In order to gain the most comprehensive picture possible, employing periodic online surveys or rack occupancy counts will likely be necessary. The purpose of the on-line surveys will be to get a more in depth view of where and why people are walking or bicycling. It is anticipated that such surveys will be distributed in conjunction with the Bike Lincoln website following its launch. Rack occupancy counts, meanwhile, is a method consistent with those utilized by the University of Nebraska to determine a snapshot of user demand.

Data Collection and Compilation

The data collection for the manual counts is anticipated to continue as it has historically using volunteers organized by GPTN. The data is then made available to the City Parks Department.

The Planning Department, with the assistance of other City departments, is creating a Bike Lincoln website. Pages such as this have been very successful in other communities. Such a webpage will be very valuable to get the word out about a smart phone application for voluntary user data gathering, on-line surveys and to display bicycle and pedestrian count data.

For the automatic counters, the technology provided by Eco-Counter, using the GSM daily data download to either their servers in Montreal or to our local system using a Shared Data Environment (SDE), can be accessed using web-based software by any City department. In addition, it is possible to set up the system to update user counts and information regularly to the public website. This information can further be georeferenced and displayed using GIS.

Rack inventories are anticipated to be staffed by the Planning Department, potentially utilizing future intern time.

Cost, Maintenance and Management

The overall data maintenance is anticipated to be handled by the Planning Department in cooperation with the Public Works and Utilities Department and Parks and Recreation Department.

On-line surveys, rack occupancy counts and any voluntary user data collection will be developed and maintained by the Planning Department.

Automatic Counters

- Cost

The physical cost of the automatic counters depends on the options incorporated in the equipment (See Appendix 3 and Appendix 5). Such options include the ability to differentiate between a bicyclist and pedestrian, the ability to differentiate the direction of travel and whether the information is sent via GSM. The equipment costs for six counters from Eco-Counter ranges from \$16,050 to \$32,400, depending on the options chosen. The annual maintenance cost for GSM transmittal is \$420 per unit per year (\$2,940 per year for seven counters) while the battery replacement is about \$120 per unit every two years (\$840 for seven counters every two years).

- Physical Maintenance and Installation

Following conversations with Public Works as well as Eco-Counter, it appears that installation and routine physical maintenance of the automatic counters (including biannual battery replacement) can be conducted by Public Works. Since most of the counters would be located on shared-use-paths, it is anticipated that the Parks Department would manage vegetation around the counters to prevent interference.

- Data Management

Since the data can be automatically downloaded to either local or remote locations, there is no need for a regular presence at any of the counters. Using the automatic download, it is possible and probably preferable to have the information downloaded wirelessly (GSM) nightly to the Eco-Counter servers in Montreal. The information is still the property of the City of Lincoln but can be accessed by any department who has appropriate login information. In addition, this data can then be displayed directly to a City website and/or City data storage for further local access, manipulation and as an additional backup. It is anticipated that the data would be managed by the Planning Department in conjunction with the Bike Lincoln website.

Appendix 1

Below is an outline of some of the technologies used by NDOR at the Helen Boosalis / Rock Island Trail intersection.

Technology	Notes
Passive Infrared	Captures about 75% of traffic. Cannot differentiate between bicycles and pedestrians.
Piezo-Electric Sensor	Captures only bicycles and about 10% of peds Signal dies below 20 degrees
Hose Based Sensor (Traditional Highway)	Only counts bicycles Hoses taken out by snow plows Reasonable option for counting bicycles for short periods of time
Radar	Higher error rate with windblown objects
Video	Very accurate Prohibitively expensive due to labor costs Cannot handle darkness well

Appendix 2

Below is a summary table of available technologies which was compiled by the Active Living Research (February 2013).

TABLE 1: Considerations for Counting Bicyclists and Pedestrians⁶⁻¹⁰

This table summarizes the level of accuracy and the costs associated with several methods of counting bicycle and pedestrian activity.

Count Methodology	Accuracy	Cost	Other Considerations
COUNTING BICYCLISTS OR PEDESTRIANS			
Manual Counts	Depends on training and experience (1%–25% subject to human error)	High (depending on duration of counts)	Few equipment costs; Labor intensive, requires trained observers; Impractical for long-term, comprehensive applications; Directional counts possible
Video (manual analysis)	High (subject to human error)	High (depending on duration of counts)	Costs of video camera installation and operation; Labor intensive; Can capture some user characteristics; Directional counts possible
Active Infrared (count is recorded when user breaks infrared beam)	Systematic undercounting (5%–15% due to clusters of people)	Low	Portable; Visual obstructions may affect counts; Can provide long-term, 24-hour counts
Passive Infrared (count is recorded when monitor senses temperature differential)	Systematic undercounting (5%–50% due to clusters of people)	Low	Widely tested and available; Directional counts possible
Computer Visioning	Depends on computer algorithms	Medium	Well-suited for crowded environments; Costs of video camera installation; Requires greater sophistication for analysis
COUNTING BICYCLISTS ONLY			
Inductive Loops	Varies depending on installation and maintenance of system	Depends on location of installation	Directional counts possible if maintained; Can provide long-term, 24-hour counts; Difficult to use in shared lanes
Pneumatic Tubes (commonly used to count cars)	High	Depends on location of installation	Requires trained personnel; Can provide long-term, 24-hour counts; Can provide estimates of speed; Poses problems for skaters on paths
COUNTING PEDESTRIANS ONLY			
Piezometric Pads	May not count groups accurately	High for installation, low for maintenance	Senses pressure when pedestrians step on sensor; Appear to be less widely deployed than infrared sensors

Appendix 3

The following automatic counting technology is available from Eco-Counter:

Technology	Application	Portable	Direction Detection	Range	Unit Cost	GSM Maint. Cost	Battery Maint. Cost
Eco-Multi w/ passive infrared and loops (Pedestrians and Bicycles)	Shared-Use-Path	No	Yes	15	\$5,400	\$420/yr	\$120 / 2 yrs
Eco-Multi w/ passive infrared and loops (Pedestrians and Bicycles)	Shared-Use-Path	No	No	15	\$4,800	\$420/yr	\$120 / 2 yrs
Zelt Loop (Bicycles Only)	Cycle Track	No	Yes	15	\$3,500	\$420/yr	\$120 / 2 yrs
Zelt Loop (Bicycles Only)	Cycle Track	No	No	15	\$2,700	\$420/yr	\$120 / 2 yrs
Pyro Sensor w/ passive infrared (Peds and Bicycles – no differentiation)	Shared-Use-Path	Yes	Yes	15	\$3,275	\$420/yr	\$120 / 2 yrs
Pyro Sensor w/ passive infrared (Peds and Bicycles – no differentiation)	Shared-Use-Path	Yes	No	15	\$2,675	\$420/yr	\$120 / 2 yrs

Appendix 4

Diagram of Operation for Recommended Eco-Multi with Zelt Loops and Passive Infrared



Appendix 5

Possible options for 6 shared-use-path counter locations and 1 on cycle track:

Preferred

Option 1 (Can differentiate between bicycles and pedestrians and can determine direction)

Technology	Number of Units	Application	Total Cost	Total Annual Maint. w/GSM
Eco-Multi w/direction	6	Shared-Use-Path	\$32,400	\$2,520
Zelt Loop w/direction	1	Cycle Track	Installed with Project	\$420
TOTAL	7		\$32,400	\$2,940

Option 2 (Can differentiate between bicycles and pedestrians but cannot determine direction)

Technology	Number of Units	Application	Total Cost	Total Annual Maint. w/GSM
Eco-Multi w/o direction	6	Shared-Use-Path	\$28,800	\$2,520
Zelt Loop w/o direction	1	Cycle Track	Installed with Project	\$420
TOTAL	7		\$28,800	\$2,940

Option 3 (Cannot differentiate between bicycles and pedestrians and cannot determine direction)

Technology	Number of Units	Application	Total Cost	Total Annual Maint. w/GSM
PYRO Sensor w/o direction	6	Shared-Use-Path	\$16,050	\$2,520
Zelt Loop w/o direction	1	Cycle Track	Installed with Project	\$420
TOTAL	7		\$16,050	\$2,940

Appendix 6

Cycle Tracks Application for Smart Phones – Example Displays



Appendix 7

Technology Overview

Although bicycle and pedestrian counting technology has become much more sophisticated and accurate in recent years, it generally lags behind that of vehicular counting technology. (See Appendix 2)

Based on several recommendations and wide use, the technology provided by Eco-Counter was examined for this analysis. Based out of Montreal, Eco-Counter is among the largest bicycle and pedestrian counter providers in the world, including installations in 38 US states. See Appendix 3 for a breakdown of the different automatic technologies and Appendix 4 for an operational diagram of the pedestrian and bicycle counter offered by Eco-Counter.

There are also options using smart phones which can provide interactive and voluntary user centered data gathering at a low cost. Such applications are offered using either an Android or iPhone and are available from such organizations as the San Francisco County Transportation Authority (SFCTA), but can provide information for Lincoln by Lincoln system users. (For more information, visit <http://www.sfcta.org/modeling-and-travel-forecasting/cycletracks-iphone-and-android>). Such data collection techniques require substantive advertizing to get the word out to users, but the data is be tabulated in real-time to describe the nature of the trip, distance and exact route. More low-tech versions of this technique can be used as well, including periodic user interviews and paper feedback (such as door hangers on parked bicycles requesting information).

**OPTION COMPARISON FOR
LANCASTER COUNTY**



Since 1998, the dedicated Eco-Counter team has had the privilege of providing solutions for monitoring pedestrians and cyclists for organizations around the world, making us leaders in our field.

Our Approach

Eco-Counter is a world leader in providing solutions for counting pedestrians and cyclists in both urban and rural environments.

- 15 years of expertise, globally recognized reference in the market
- Exclusively patented, high-quality products made to last
 - Waterproof (IP 68)
 - Ability to count in severe weather conditions (-40° F - 140° F)
- Strong culture of continuous innovation and development
- Dedicated team from inquiry through data analysis and diffusion
- Intuitive software development and technical support
- Systems capable of detecting the direction of passage (A or B)



PYRO Sensor



PYRO Sensor with Direction Detection

Eco-Counter North American References



Installations in 38 U.S. states and 6 Canadian provinces

PYRO Sensor



A lens sensitive to the infrared radiation emitted by the human body detects each time a person passes. The narrowness of the area means that two people following each other closely can be counted. This sensor will count pedestrians and cyclists without distinction. It is possible to determine the direction of the hiker or cyclist. The battery will last for 10 years without being charged or plugged in.



PYRO Sensor in a PYRO-Box

With this system, the PYRO sensor and all of its components are housed in a vandal-proof box. This box is sturdy enough to be installed permanently but easy enough to install and take down that it can be installed temporarily as well. The advantage of this is that the PYRO-Box can be moved from location to location depending on your needs, all you need is a post or tree.



Pricing

Range	No direction detection	With direction detection
4 feet	\$2,125	-
15 feet	\$2,675	\$3,275
50 feet	\$3,625	\$4,225

ZELT Loops



Our ZELT inductive loop technology makes it possible to analyze the electromagnetic signature of each wheel. The inductive loops can be installed on any surface including asphalt, concrete and soil.

Using 13 differentiation criteria, the technology is able to properly detect the passage of a cyclist. This technology has been uniquely patented by Eco-Counter and uses various algorithms to ensure unparalleled accuracy in any environment (share lanes, bike paths, greenways, etc.) Please tell us as much as possible about your counting site so we can be sure to provide you with the appropriately calibrated loops for your counting needs (ignoring cars, counting large groups, etc.)



The table below represents testing results in the Friesland Province of the Netherlands during the morning with clusters of bicycles going to school (groups of 20 children bicycling).

Bicycle Groups	Manual Counting	Eco-Counter	Accuracy
1	157	158	100,6%
2	60	55	91,7%
3	30	28	93,3%
>3	156	152	97,4%
Total	403	393	97,5%

ZELT Inductive Loops

This system uses our inductive ZELT loops to detect the magnetic signature of passing bicycles, therefore detecting cyclists. The ZELT loops will distinguish between cyclists and cars. This is a **permanent** solution for counting the number of cyclists using a path with the possibility of knowing in which direction they are riding.

Installations on pavement involve cutting into the path to lay the loops and burying a provided manhole containing the counter's data logging components and battery.



Installations in natural soil involve digging a shallow trench into the path in order to lay the ZELT loops for bicycle counting and burying the manhole to the side



Pricing

Range	No direction detection	With direction detection
5 feet	\$2,450	\$3,000
10 feet	\$2,750	\$3,600
15 feet	\$3,050	\$4,275

Easy-ZELT Inductive Loops

This system uses our inductive ZELT loops to detect the magnetic signature of passing bicycles, therefore detecting cyclists. This **semi-permanent** solution for counting the number of cyclists using an area while ignoring cars is great for a period of 1 month to a year.

The advantage of this system is that installation is less intrusive than with the permanent loops. The installation involves adhering the highly resistant ZELT loops for bicycle counting to the surface and burying a provided manhole containing the counter's data logging components and battery. On the flip side, the loops will need to be replaced periodically (about once a year, \$150 per 5-foot wide loop) and should not be put in the path of snow plows.



Pricing

Range	No direction detection	With direction detection
5 feet	\$2,600	\$3,300
10 feet	\$3,050	\$4,200
15 feet	\$3,500	\$5,100

TUBES



This system uses our pneumatic TUBES to detect pressure changes when cyclists ride over them. This easy-to-move temporary solution for counting the number of cyclists while ignoring cars is best for a period of 1 month but is possible for longer periods by replacing the TUBES themselves. The counting system will include one set of TUBES.

The installation involves laying the TUBES across the road and chaining the counter’s data logging components in a provided metal box to a post or tree.

When choosing a counting site, be careful to choose a site where two cars will not drive over the TUBES at the same time in opposite directions. This will not damage the counter but could produce a false count. Also keep in mind that vandalism (cutting of the TUBES in particular) is a possibility, so it’s a good idea to check on the TUBES regularly. It is also wise to tighten the TUBES about once a week.



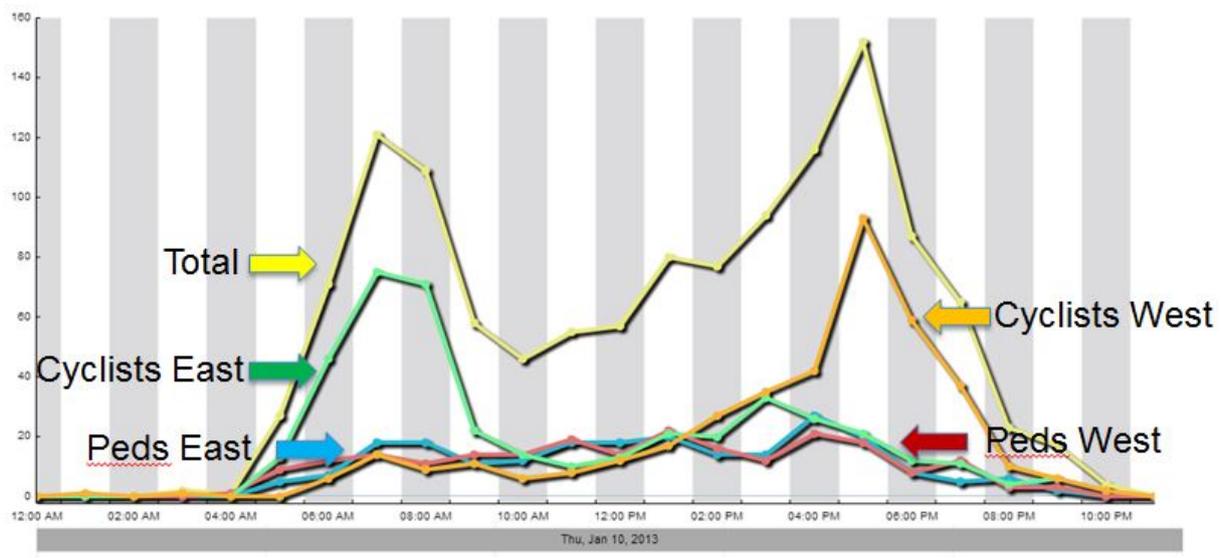
Pricing

Range	No direction detection	With direction detection
As needed	\$2,125	\$2,650
Addtl. Selective TUBES	\$15 per yard/meter	\$15 per yard/meter
Addtl. Greenways TUBES	\$10 per yard/meter	\$10 per yard/meter

Eco-MULTI: Counting and Identifying User Types

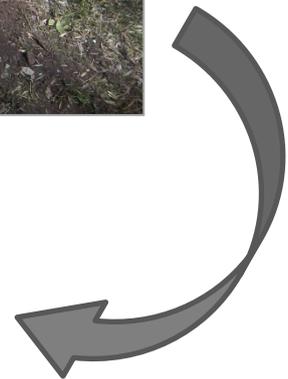
Our Eco-MULTI Systems are capable of detecting different user types and distinguishing between them.

This system combines the PYRO and ZELT technologies to count users while identifying their mode. This is an ideal way of knowing not only how many people are on your paths but also what users are present. The installation can be done on paved surfaces or natural soil.



Eco-MULTI on paved surfaces

This system will differentiate between pedestrians and cyclists. The installation involves cutting into the path in order to lay the ZELT loops for bicycle counting. A provided wooden post houses the PYRO sensor for counting pedestrians and optional direction detection. An included manhole houses the data logging components and battery.

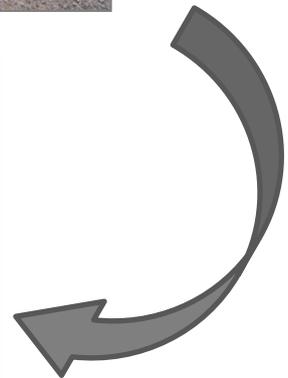


Pricing

Range	No direction detection	With direction detection
10 feet	\$3,950	\$4,550
15 feet	\$4,800	\$5,400
20 feet	\$5,350	\$5,950

Urban Eco-MULTI

This system will differentiate between pedestrians and cyclists. The installation involves cutting into the path in order to lay the ZELT loops for bicycle counting. A provided metal post houses the PYRO sensor for counting pedestrians and optional direction detection. All of the counting components as well as the battery are housed in the metal post specifically designed to blend into urban environments and resist possible vandalism.

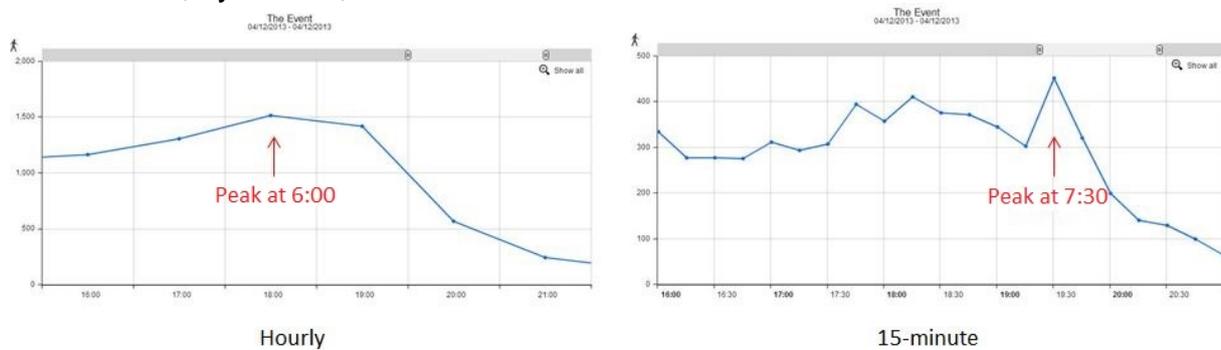


Pricing

Range	No direction detection	With direction detection
10 feet	\$4,600	\$5,200
15 feet	\$5,450	\$6,050
20 feet	\$6,000	\$6,600

Options for all Counters: Time Segments

Your data is, by default, recorded in 1-hour intervals.



Your project may benefit from more detailed time information. If so, 15-minute intervals are available for \$200 per counter.

Options for all Counters: Data Transmission

Your data is stored on a secure and centralized server. This means no accidentally deleted or lost data. You have two options for how you would like the data to be sent: **Bluetooth** and **Automatic**.

The **Bluetooth** transmission is done by manually accessing the counter and retrieving the data with a Bluetooth enabled Laptop or Netbook. This option is free of charge.



With **Automatic** transmission, data is sent automatically once a day. There is no need to physically access the counter which can cut down on operational costs significantly as leaving the office is not necessary. Along with automatic data retrieval you will also be notified if there are no counts, low counts or high counts with our Eco-Alert system.

- Modem transmission: \$420 per counter, per year
- Modem battery to be replaced every 2 years: \$75

Eco-Visio is always included

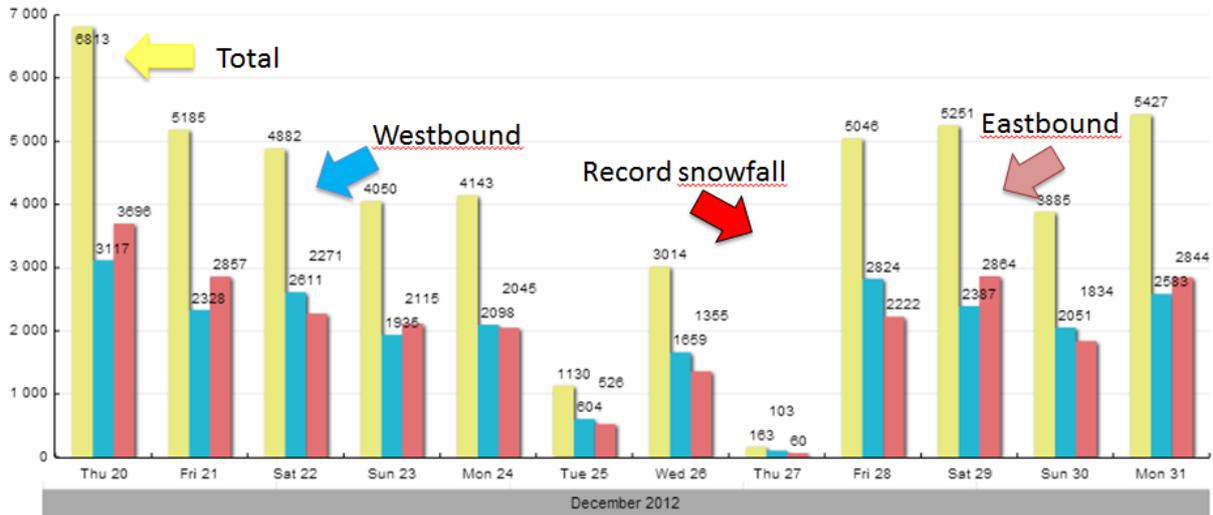


Our web-based software, Eco-Visio, gives you the tools you need to manage your data. You can access Eco-Visio via web browser so there's nothing to download or install, and your data is safely secured and centralized on our servers.



Managing counters is easy with battery level indications, the possibility to upload a photo of the site and the ability to pinpoint their location on a map. You can create user profiles to share and exchange counting data with relevant organizations.

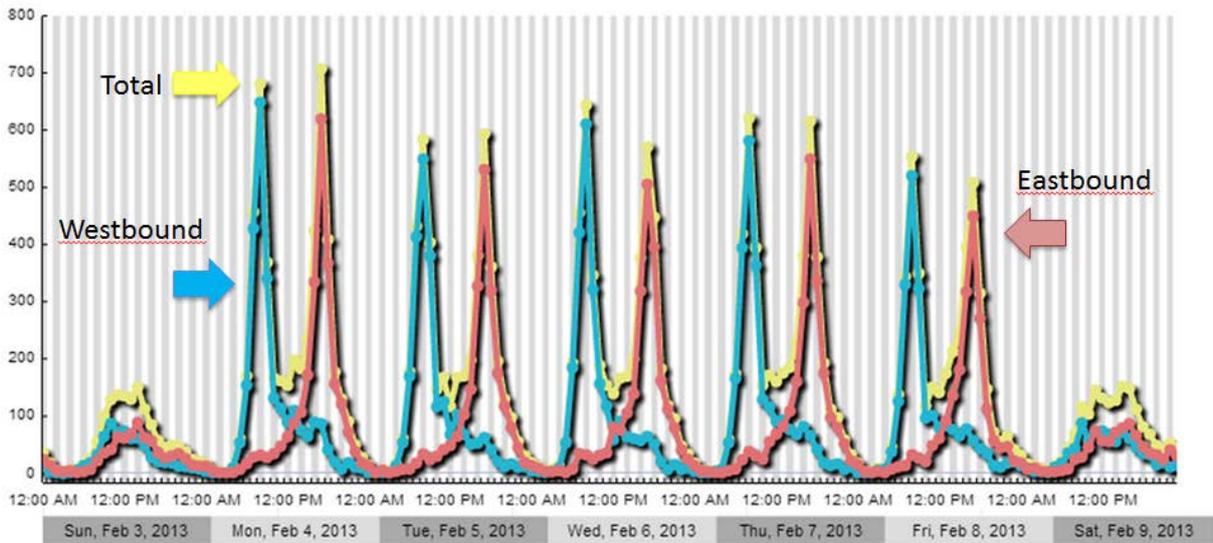




Montreal Pedestrian Counts on a shopping street in May

Around the clock data and analysis will help you gain a better understanding of user trends over time, the success of promotional events and to justify the need for or the completion of changes to infrastructure.

The graph below displays cyclist data with a strong commuter pattern. The yellow line is total counts, the blue line is cyclists going towards downtown while the pink line would represent cyclists riding away from downtown.



Portland Cyclist Counts on a bridge in May

Montréal	Saint Laurent et Bagg Period Analysed: Tuesday 01 May 2012 to Thursday 31 May 2012	
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Key Figures

- Total Traffic for the Period Analysed: 188,341
- Daily Average : 6,076
- Busiest Day of the Week : Saturday
- Busiest Days of the Period Analysed:
 1. Saturday 05 May 2012 (9,251)
 2. Saturday 26 May 2012 (7,765)
 3. Saturday 19 May 2012 (7,758)
- Distribution by Direction:
 - South Direction : 46%
 - North Direction : 54%

Create your own customized work space and edit professional reports in minutes. Reports will include a mapped pinpoint and picture of the site as well as key statistics and you can even put your logo on the report. With Eco-Visio, communicating your data effectively is just a few clicks away.

Montréal	Saint Laurent et Bagg Period Analysed: Tuesday 01 May 2012 to Thursday 31 May 2012																
<h4 style="text-align: center;">Daily Data</h4>	<h4 style="text-align: center;">Weekly Profile</h4> <table border="1"> <thead> <tr> <th>Day</th> <th>Percentage</th> </tr> </thead> <tbody> <tr><td>Mon.</td><td>11.4%</td></tr> <tr><td>Tue.</td><td>12.4%</td></tr> <tr><td>Wed.</td><td>15.5%</td></tr> <tr><td>Thu.</td><td>15.8%</td></tr> <tr><td>Fri.</td><td>15.0%</td></tr> <tr><td>Sat.</td><td>17.1%</td></tr> <tr><td>Sun.</td><td>12.8%</td></tr> </tbody> </table>	Day	Percentage	Mon.	11.4%	Tue.	12.4%	Wed.	15.5%	Thu.	15.8%	Fri.	15.0%	Sat.	17.1%	Sun.	12.8%
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