Up on The 606

Understanding the Use of a New Elevated Pedestrian and Bicycle Trail in Chicago, Illinois

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The 606 is the world's first multiuse elevated trail, extending for 2.7 mi (4.35 km) through diverse neighborhoods whose per capita of open space is one of the lowest in Chicago. The trail connects six ground-level parks and is managed for recreation, but it also serves as a cross-town transportation connector and was funded partially with transportation dollars. Managers sought information about trail use to maintain a safe and harmonious experience for users, to plan operations and maintenance, and to document the benefits of trail development. The use of The 606 was examined during the first 6 months of 2016, and on the basis of those results, its use for the entire year was projected. Automated traffic monitoring with active infrared counters followed procedures in the FHWA *Traffic Monitoring Guide.* Screenline calibration tests revealed relatively high rates of occlusion owing to user type and traffic volume, yielding an adjustment factor of 1.239. Most users were pedestrians, but proportions varied by day of the week and time of day. Average daily traffic volumes between January 1 and June 30 at counters near the east and west ends of the trail were 3,500 and 3,000, respectively, with peak daily traffic exceeding 10,000. A regression model using weekdays and weekends, location on the trail, and temperature variables explained 80% of the daily use variation. Model extrapolation with historical weather averages estimated annual traffic volumes at 1.46 million and 1.3 million for the two sites, and a combined total annual miles traveled of 3.7 million (5.95 million km). Management implications and future research directions are highlighted.

Although the rails-to-trails movement that popularized recreational reuse of abandoned rail corridors is now more than 50 years old, the conversion of elevated rail corridors is relatively new and poses novel challenges to trail providers. Two such corridors, the High Line in New York City and the Promenade Plantée in Paris, are noteworthy as the first elevated rail conversions. But while both feature continuous paths, they were conceived mainly as linear parks, with use restricted to pedestrians and access gated with fixed hours of operation (*1, 2*).

As the third known elevated trail, Chicago's 606 trail contrasts with each of those as the world's first to be truly multiple use. It connects six ground-level parks with a 2.7-mi (4.35-km) elevated trail, providing needed recreational opportunities to diverse neighborhoods historically underserved by open space. The trail is also intended to serve as a cross-town transportation connection. About half of the $95 million project funding came through federal Congestion Mitigation and Air Quality program dollars, requiring that it be open to bicyclists as well as pedestrians. Other types of nonmotorized wheeled vehicles are also allowed on the trail as are dogs, making for a diverse mix of user types, social groups, ages, and experience levels.

Given the trail's popularity, maintaining a safe and harmonious experience for everyone is a major challenge, and use data are critical to those who oversee its operation. For the Chicago Park District, which manages the trail, use data can provide feedback for maintenance and staffing requirements. For the lead partner for planning, development, and community engagement, the Trust for Public Land, short- and long-term use monitoring can help communicate the benefits of development to funders and other groups (*3*). To address those and other needs, the authors began a use monitoring pilot study in late 2015 following procedures outlined in the FHWA *Traffic Monitoring Guide* and other recent guidance (*4, 5*). The objectives were to

1. Establish procedures for systematic, accurate collection of trail traffic data on The 606, quantifying the error in traffic counts caused by occlusion and comparing results with previously reported values;
2. Identify variation in trail traffic as a function of location on the trail and in relation to the sociodemographic characteristics of surrounding neighborhoods;
3. Develop a model for estimating daily traffic flows based on weather, weekdays and weekends, and trail location variables, and illustrate how the model can be used to estimate daily use when counts are not available as well as total annual traffic flows and total annual miles traveled; and
4. Assess hourly use variation by weekend versus weekday and month of year to help understand recreational and utilitarian components of use.

BACKGROUND

Urban Trails

Reinvestment in cities and renewed interest in urban living have spurred development of trail corridors as public open spaces, particularly in densely populated neighborhoods where traditional open spaces are lacking. Urban trail infrastructure is also becoming an

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important component of promoting nonmotorized transportation and commuting by local residents (*6*). Cities' investments in trails and dedicated bike lanes are yielding significant benefits across the country by increasing rates of bike commuting and reducing cyclist fatalities (*7*). While bike commuters are fairly time sensitive when selecting travel routes, they are often willing to travel a longer distance for the safety, convenience, and aesthetic benefits of a trail (*8, 9*). Elevated corridors can offer additional benefits in cities that street-level trails and recreational spaces cannot. For example, recent research on the High Line suggests that pedestrians face less exposure to noise and air pollutants on elevated walkways than on roadside sidewalks (*10*).

Monitoring Urban Trail Traffic

Trail managers have been documenting use for more than 20 years, mainly through manual field counts but increasingly with automated monitors. While proficiency in monitoring has increased, monitoring is not yet routine and refinements are needed to address unique circumstances on new facilities. New facilities also provide opportunities to validate patterns observed elsewhere, including daily variation resulting from weather and other factors. Two challenges in monitoring—adjusting automated counts for occlusion and analyzing how weather affects use—have been important in monitoring The 606.

Adjusting for Occlusion

Systematic undercounting is a common problem in using automated counters to collect trail use data (*11, 12*). Occlusion is a chief source of counting error and occurs when multiple people simultaneously pass a sensor or break the infrared beam, as is the case with the active infrared counters used in this study. High-volume trails like The 606 more often experience systematic undercounting because of occlusion (*13*). Manual counts via screenline observation tests are necessary to calibrate automated counters as counts vary depending on the type of counter as well as the unique characteristics of trail users and locations on a trail (*14, 15*). Correction factors reported for active infrared counters typically fall in the 12% to 18% range (*16*).

Understanding Weather Effects

Weather is another important consideration in monitoring and predicting trail use. Certain trends, such as increased use of outdoor trails in the summer months or on weekends, are to be expected. But outdoor physical activity can also be affected by factors such as temperature and precipitation. Generally, warmer temperatures increase and precipitation decreases trail use (*17*). However, the relationship between trail use and weather conditions can also vary by purpose of use (*18*). For example, joggers may be less affected by conditions such as relative humidity and temperature than are walkers on a trail. Weekend versus weekday use can also differ—people appear to be more sensitive to fluctuations in temperature or precipitation on weekdays than on weekends. Cycling patterns are similarly subject to weather conditions; warmer temperatures and lower rainfall generally mean more cyclists. However, the purpose of the activity once again moderates that relationship. Commuting cyclists are less sensitive to precipitation than are recreational cyclists.

STUDY AREA AND METHODS

The 606

The 606 (http://www.the606.org) grew out of a late 1990s park inventory identifying the Logan Square neighborhood near the abandoned Bloomingdale Line as having the least amount of open space per resident in the city. Planners concluded that a trail along the corridor would provide park space for much of the neighborhood lying within its 0.5-mi (0.8-km) catchment area (10-min walk), consistent with recommended open space standards (*19*). It would also connect other neighborhoods along it, from strongly Hispanic Humboldt Park on the west end to trendy and gentrifying Bucktown on the east. Efforts during the next decade from neighborhood groups, planners, and nonprofit organizations culminated in the 2012 *Bloomingdale Trail and Park Framework Plan* (*20*). Construction began in 2013 with funds contributed by the city, raised by the Trust for Public Land as project manager, and obtained through the federal Congestion Mitigation and Air Quality program. The project was renamed The 606 in reference to the city's zip code prefix, denoting its broader purpose as a trail corridor and system of six ground-level parks and signifying it as a resource for all Chicagoans. Ownership was transferred to the Chicago Park District, and The 606 opened to use in June 2015.

The trail runs uninterrupted for 2.7 mi nearly 20 ft (6.1 m) above the surface streets. Sixteen ramped entrances provide easy access to neighborhoods along the way and connections to street bikeway, bus, and rail transit systems (Figure 1). Its right-of-way width averages 30 ft (9.1 m) and consists of a 10-ft (3-m) concrete trail bed with yellow dividing line flanked by two 2-ft (.61-m) wide rubberized running treads. Much of the remaining space is intensively planted with more than 200 species and varieties of trees, shrubs, and ground layer plants. Several street overpasses include trailside seating and activity spaces with attractive views to the neighborhoods below.

Data and Analytic Methods

Trail reconnaissance and consultation with project partners identified bridge crossings at Honore Street (east) and Spaulding Avenue (west) as optimal locations for counting users and detecting use variations (Figure 1). TrailMaster TM1550 16,000-count capacity active infrared counters were mounted at a 32-in. (81-cm) height above the trail surface on bridge end posts over each street, with transmitter and receiver units directly across from each other. Data collection (i.e., daily to weekly manual downloads, depending on volumes) commenced in late December 2015, 6 months after the trail opening, to minimize nonrepresentative use levels associated with the newness of the facility and to establish a more accurate baseline for long-term monitoring.

To correct for undercounting resulting from occlusions, fifty 15-min interval screenline tests were conducted with accepted procedures (*5*). Tests were conducted at Honore ($n = 43$) and Spaulding ($n = 7$) from March 6 through May 8 during peak and off-peak periods on weekdays and weekends to provide a range of different traffic volumes in which occlusions might be experienced. Counts were tallied separately for walkers, runners, bicyclists, and other wheeled users; bike trailers and child strollers were classified the same as those pushing or pulling them. Regression estimates for use calibrations were done with IBM SPSS Version 22.

U.S. census data from the 2010-to-2014 five-year American Community Survey were used to contextualize observed use patterns

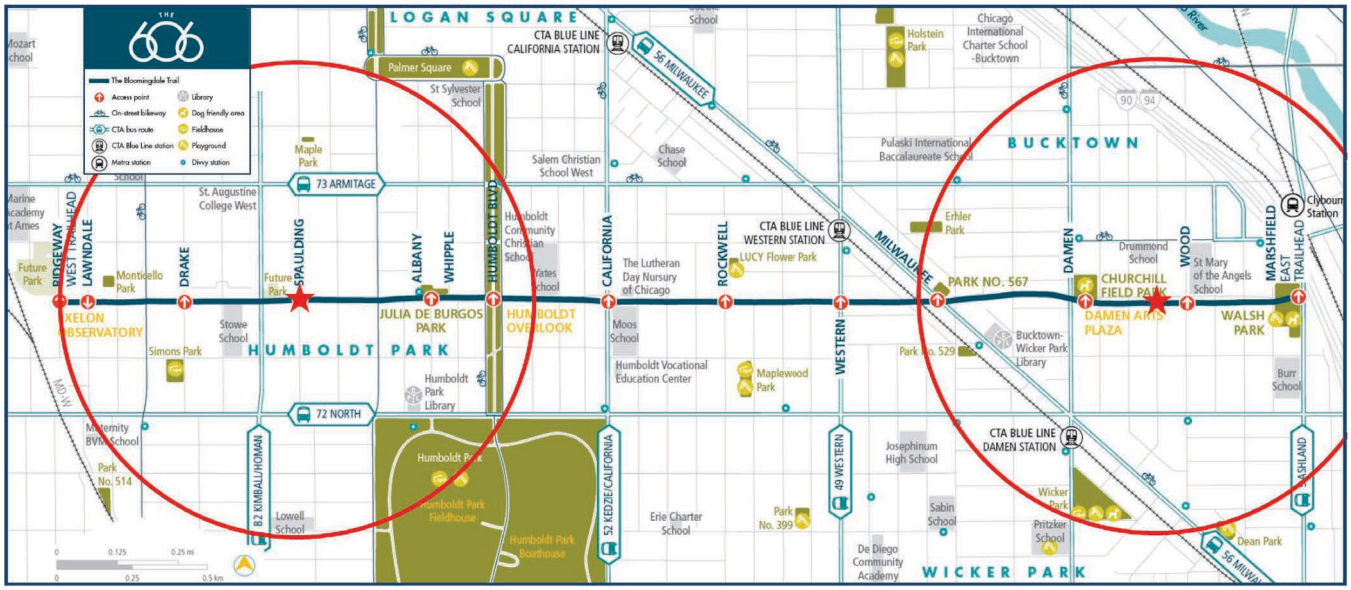

FIGURE 1 Visitor map of 606 trail (red stars = location of counters at Honore Street (east, right) and Spaulding Avenue (west, left) and circles = 0.5-mi (0.8-km) neighborhood service radius). (Source: The Trust for Public Land.)

in the trail's 0.5-mi service distance (*19*). Following procedures to minimize scale-related attribution errors resulting from the modifiable area unit problem, population, race and ethnicity, and income data from block groups that had their centers within a 0.5-mi radius of the trail measured from Honore and Spaulding (Figure 1) were aggregated (*21, 22*). Employment activity in these areas was also examined with the use of the place-of-work variable from the American Community Survey; as these data are reported only at the census tract level, a straight proportion of employment was assumed for the area of each block group in the chosen radii divided by the total area of its associated census tract (*22*). National Weather Service and Weather Underground data were used to develop predictive models of daily use. Data included high, low, and average temperature (°F); precipitation and snowfall (in.); average wind speed (mph); sky cover (0.1 increments from 0 = completely sunny to 1 = completely overcast); and visibility (0 to 10 mi). Multiple regression analyses were done with the IBM SPSS Version 22.

RESULTS

Screenline Observations and Calibration of Automated Count Data

Field counts from the fifty 15-min observations ranged from 41 [Friday, March 11, 7:30 a.m., 40°F (4.4°C)] to 265 [Sunday, April 24, 11:45 a.m. 70°F (21.1°C)]. Values of counter-measured versus field-observed counts were used to estimate a validation equation (Figure 2) (*15*). A simple linear regression without intercept (scaling factor), $y = 1.239x$, provided the best goodness of fit, with $R^2_{adj} = .994$. This factor was applied to raw count data for both sites, and the adjusted values served as estimates of actual use (volume) in all results reported below.

The screenline observations provided insight into the different types of users on the trail and how their use was associated with rates of occlusion. Walkers tended to dominate weekend use, while use was fairly evenly distributed among walkers, runners, and bikers on weekdays (Table 1). Other users accounted for less than 5% of group type.

As a function of time of day, the proportion of walkers was highest from midmorning through afternoon, while runners tended to dominate the early morning hours. Consistent with typical commuting patterns, bicyclists were prevalent in early morning and late afternoon on weekdays.

To better understand how counts were influenced by occlusion, during 10 of the 50 observation periods, observers were stationed in front of the open box housing the counter so that they could record how the counters performed when different user groups crossed the screenline. Occlusions from users approaching from opposite directions were random with respect to group type, but those occurring from a pair or multiple number of users moving down the trail together side by side were much more likely to be walkers (Figure 3). Seventy-three percent of walkers crossed the screenline in groups of two or more versus 25% for runners and 21% for bikers. In other words, walkers as a group were greater than three times more likely to be undercounted because they tended to use the trail with companions walking by their side. Because pedestrians dominate use on weekends when traffic is higher, rates of occlusion and undercounting are higher.

Daily Use and Variations by Location

Daily use volumes for the first 6 months of 2016 at Honore ranged from a low of 277 on January 12 to 10,365 on April 24, with a daily average of 3,531. Use volumes at Spaulding ranged from 259 to 8,709 on these same dates, with a daily average of 3,087. Cumulative daily use counts during the study period totaled 642,705 at Honore and 561,822 at Spaulding, with the volume at Spaulding averaging 87% of that at Honore.

The 2010 population residing in block groups intersecting a 0.5-mi radius of the trail at Honore was 17,503, compared with

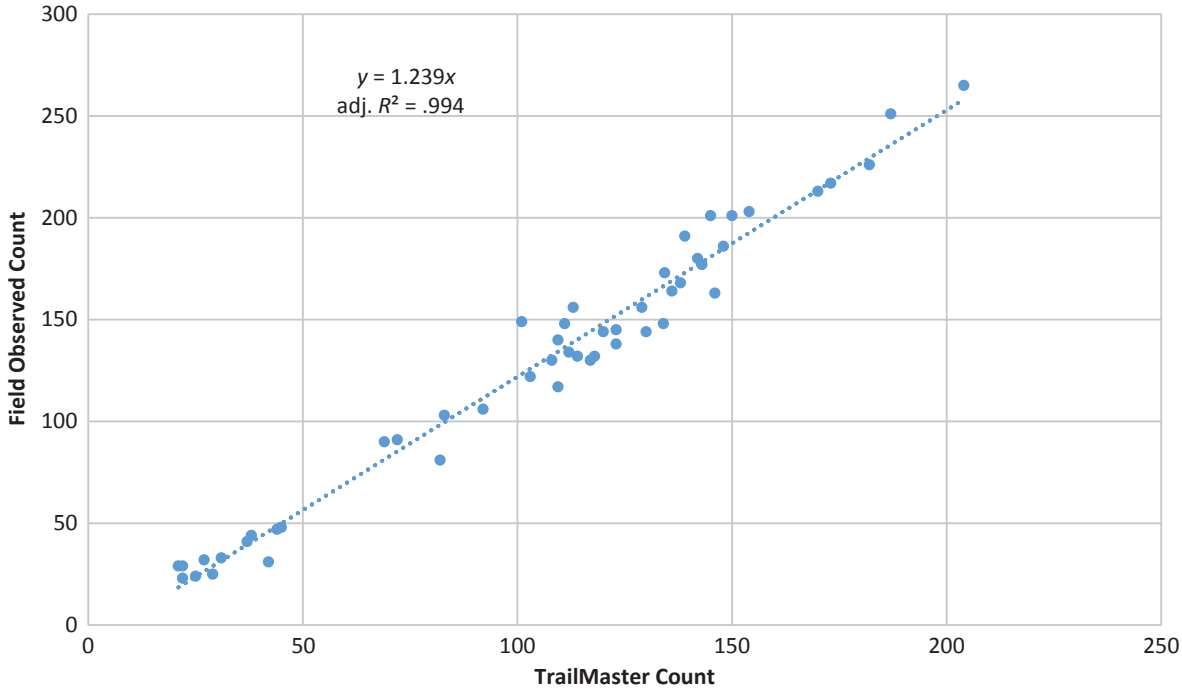

FIGURE 2 Results of screenline field calibration tests for 606 trail data ($N = 50$).

TABLE 1 Observed Distribution of Trail Users

	Weekday ($N = 30$)		Weekend ($N = 20$)	
Mode	Mean %	SD	Mean %	SD
Walk	28.1	0.080	50.9	0.057
Run	35.8	0.099	27.5	0.072
Bike	33.9	0.089	17.1	0.062
Other	2.3	0.027	4.5	0.029

22,350 at Spaulding, with corresponding densities of 19,373 and 25,168 persons per mi^2, respectively (50,176 and 65,184 persons per km^2) (Table 2). If local population was the sole driver of trail use, one would expect a substantially higher volume at Spaulding than at Honore. Significant differences in median income and race and ethnicity are potential explanatory factors for this disparity in use (*23*). The mix of commercial uses near the trail could also affect volumes, and the 11% higher employment density in the Honore service radius partially supports that hypothesis. Transit connections may also play a role; Honore is closer to Chicago's central

(a) (b)

FIGURE 3 Examples of occlusions from (*a*) opposing and (*b*) the same directions. Automated counts were compared with actual counts by, as shown in (*a*), stationing observers at screenline in front of automated counter with cover removed.

TABLE 2 Sociodemographic Data for Trail Locations

	Honore	Spaulding
Population	17,503	22,350
Population density (no./mi^2)	19,373	25,168
Median annual household income	$101,082	$39,891
Race–ethnicity		
Hispanic (%)	13.80	64.10
White non-Hispanic (%)	73.80	19.20
Black non-Hispanic (%)	3.00	13.10
Employment density (no./mi^2)	12,954	11,619

NOTE: 1 mi^2 = 2.59 km^2.

business district, and its service radius encompasses Milwaukee Avenue, which along with a major bus line and rail transit station, has a dedicated bicycle lane that is a major bicycling route to downtown.

Trends in Use

Monthly use volume steadily increased across the study period (Figure 4). Counts for January through June ranged from 35,961 to 189,111 at Honore, with average daily volume per month ranging from 1,160 to 6,304. Volume at Spaulding ranged from 29,969 in January to 177,979 in June, with average daily volume ranging from 967 to 5,933. The previously reported gap in volume between Spaulding and Honore narrowed with the warmer months. For January through June, volumes at Spaulding were consistently about 83% of Honore, but subsequently there was a steady upturn, with 87% in May, 94% in June, and (data otherwise not reported here) 97% for the first 10 days in July.

Hourly Use Patterns

Hourly count data revealed distinct use signatures for weekday versus weekend use, with additional variation by month (Figure 5). Weekend volumes follow a bell-shaped curve that begins to rise at about 7 a.m. and then peaks in the early afternoon before dropping after 5 p.m. The exception is for June, in which the peak comes a few hours earlier and drops sharply into the early afternoon before leveling off and then dropping toward evening. By contrast, weekday volumes rise quickly from 5 to 8 a.m. before leveling off at about 3 p.m., at which time they rise to a sharp peak at about 6 p.m. and then fall off quickly during the next 2 to 3 h. The weekend and weekday signatures reflect a "mixed recreational" profile although informal observation shows that a significant proportion of use in the early morning and evening commuting time is by recreational and fitness runners and walkers (*24*).

April 24 was mentioned earlier as the peak day so far in daily use, and it also had the highest counts for hourly (1,265 at 1 to 2 p.m.) use. This finding translates to one person crossing the screenline every 3 s, and while counts this high were rare, the trail experienced increasingly longer periods of sustained high use toward the latter part of the sampling period. By June, hourly counts above 360 (1 person every 10 s) occurred across more than one-third of the day at Honore and more than one-fourth of the day at Spaulding. The warm weather of June also brought significant numbers of users to the trail outside the official open hours of 6 a.m. to 11 p.m., with counts averaging 79 at Honore and 64 at Spaulding between 11 p.m. and 12 a.m., and 70 at Honore and 57 at Spaulding between 5 and 6 a.m.

Predicting Daily Use

Daily use volumes are highly influenced by the weather and day of the week. For the lowest and highest volume days mentioned above, January 12 was a Tuesday just after a 3-in. (7.6-cm) overnight snowfall, and high winds kept the wind chill index below zero (–17°C) most of the day. By contrast, April 24 was a Sunday that brought near-perfect conditions for outdoor recreation in Chicago—sunny skies, a moderate breeze, and temperatures near 80°F (27°C).

Bivariate correlations between daily use and weather variables showed that temperature was by far the best predictor of daily use, with daily high temperature a better predictor than daily low or daily average. Visibility and the inverse of sky cover as indicators

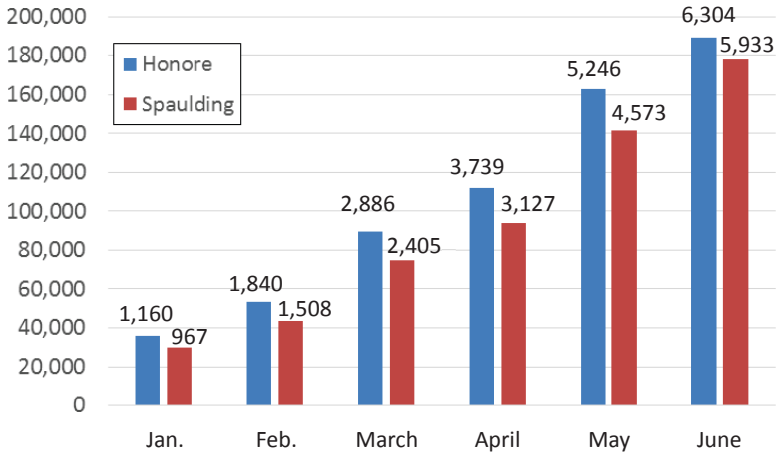

FIGURE 4 Monthly use volumes (average daily volumes for each month shown above bars).

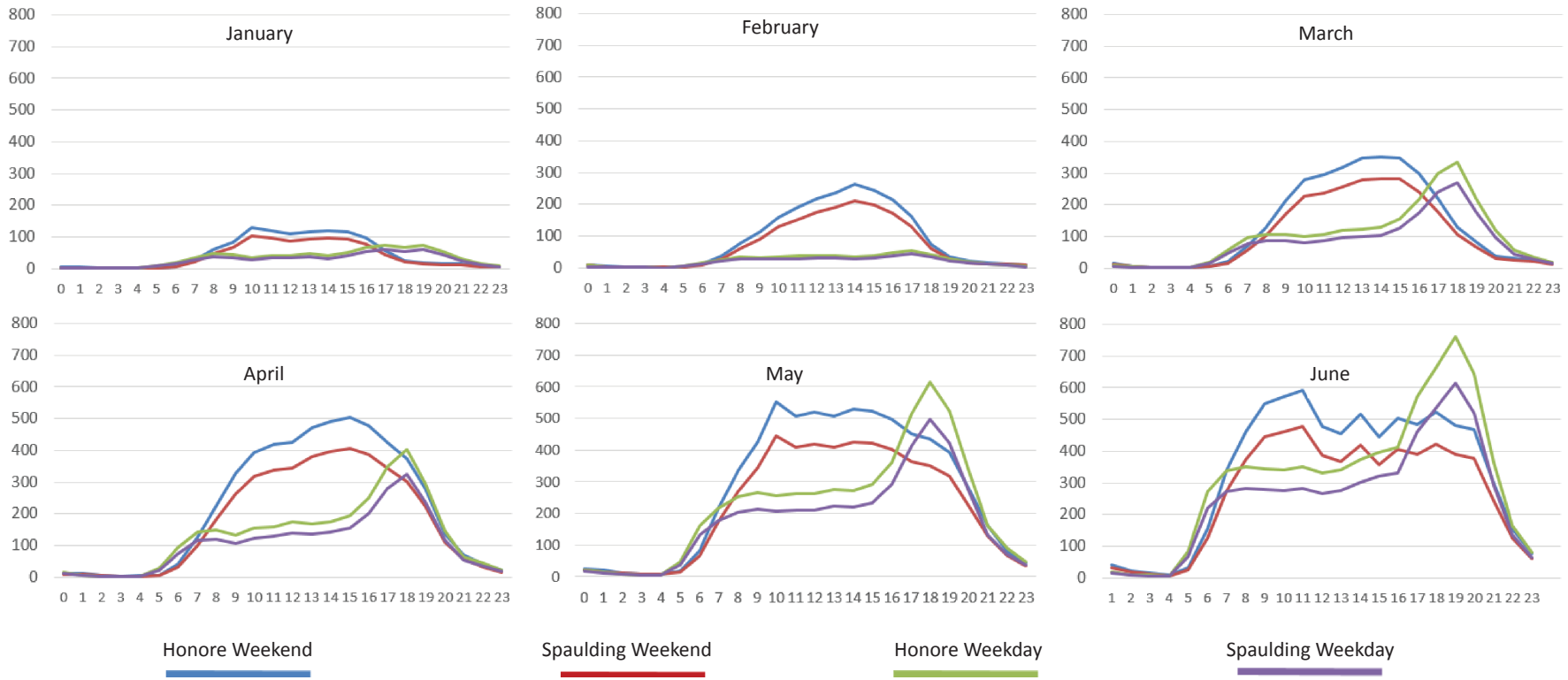

FIGURE 5 Average hourly volumes at Honore Street and Spaulding Avenue, by weekend versus weekday.

TABLE 3 Models of Daily Use

	Full Descriptive Model		Predictive Model	
Term	*B*	*t*	*B*	*t*
(Constant)	−2,882.515	−7.767**	−2,618.645	−14.687**
Site (Spaulding = reference)	444.429	3.991**	444.429	3.864**
Weekend	1,133.409	9.240**	1,118.336	8.852**
High temperature	95.428	32.548**	100.81	35.971**
Precipitation	−1,294.508	−4.360**	−1,879.847	−7.141**
Wind	−57.359	−3.945**	na	na
Visibility	123.823	3.385*	na	na

NOTE: B = regression coefficient; t = two-tailed t-test; na = not applicable.
*p = .001; **p < .001.

of clear and sunny conditions correlated positively with daily use, and precipitation, snow, and wind correlated negatively.

Daily high temperature and the rest of the non-temperature weather variables were used in an ordinary least squares multiple regression analysis along with dummy variables for weekday and weekend and for location. All variables except for sky cover were significant ($p < .05$), with $R^2_{adj} = .812$, although besides high temperature and precipitation, the other weather variables each added less than 1% improvement in R^2 (Table 3).

National Weather Service daily averages (1981 to 2010) for high temperature and precipitation were used along with weekend and location dummy variables to extrapolate daily use for the rest of the year (July 1 to December 31). Without the other weather variables, this simplified model had an $R^2_{adj} = .798$. From this model, the current total annual use was estimated to be 1.46 million at Honore and 1.30 million at Spaulding, with annual average daily traffic at 4,000 and 3,550, respectively. With the conservative assumption that users at Honore and Spaulding each traverse half of the trail [1.35 mi. (2.2 km)] per trip, this estimation of annual use translates to 3.7 million mi (5.95 million km) of trail travel in 2016.

While the linear regression formula above provides a straightforward means for 606 trail managers to predict daily use, scatterplots of daily use by temperature show that the relationship is more complex (Figure 6). Use remains relatively flat at daily high

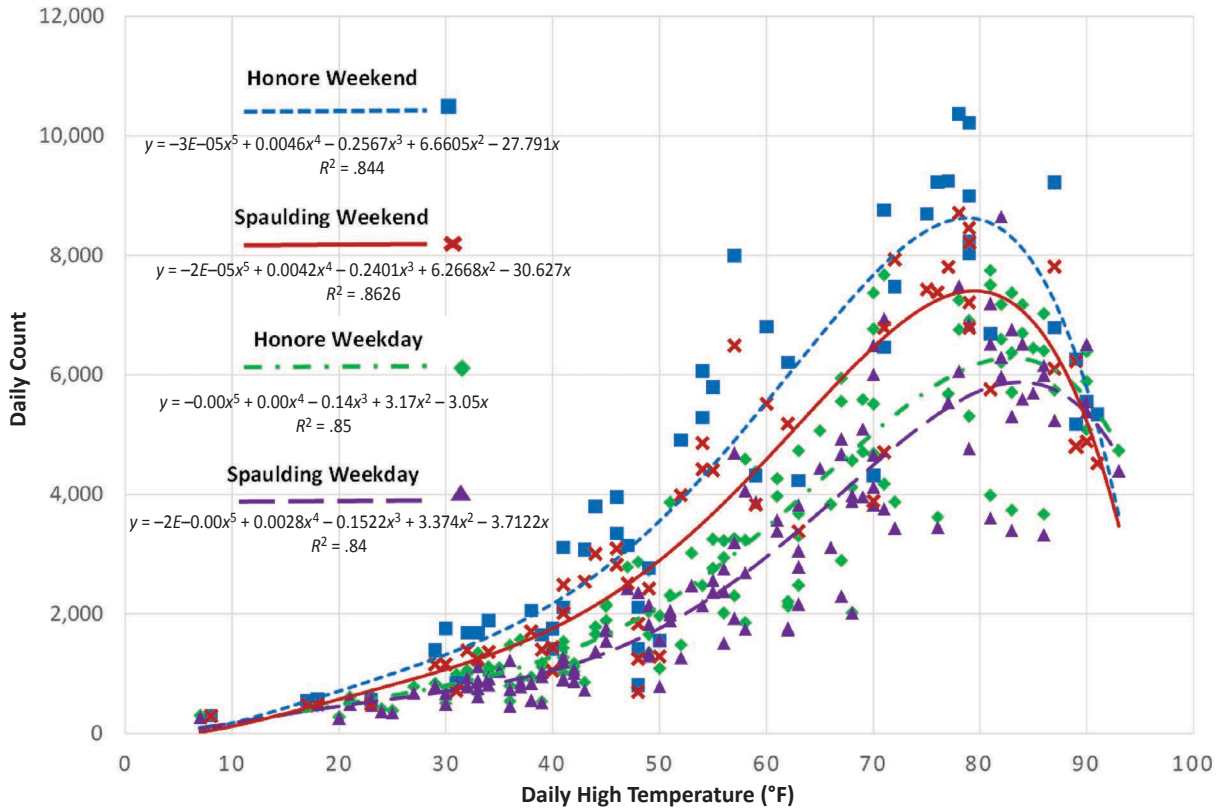

FIGURE 6 Daily use–temperature relationships.

temperatures below 20°F (−7°C), with a sharp rise between 40°F and 75°F (4°C to 24°C) to a plateau at about 80°F (27°C), followed by a rather sharp drop when daily highs reach into the 90s (>32°C). A range of different transformations fit the data well with R^2 values > .80 although the 5th order polynomial curves shown in the figure seem to best describe the relationship with the data collected so far.

DISCUSSION OF RESULTS

In this paper, use patterns on a new high-use elevated trail were examined across the first 6 months of 2016 to better understand variations in daily and hourly use by season and as a function of location on the trail. The screenline tests yielded an adjustment factor of 1.239, which is on the high side of reported test results (*5*). According to observations, this finding is likely the result of the high proportion of walkers who tended to use the trail walking side by side. The observational protocol that classified users into walkers, runners, bicyclists, and other wheeled users also helped identify how and when occlusions tended to occur and showed that during periods of high use, the relatively narrow trail width kept larger groups of users from spreading out across the trail, limiting automated counting errors. Further testing by season and trail location could help refine adjustment factors for a more accurate assessment of use volume. User survey and observational data collection on The 606 now under way may provide further insight into the relative proportions of user group types and variations across the day and weekend and weekday (*25*).

Average daily use was found to be 13% lower on the west end of the trail compared with the east. Given the higher population and population densities residing within 0.5 mi (0.8 km) of the west side of the trail, one might expect use there to be significantly higher. While local employment density, public transit nodes, and relative proximity to the central business district may partly explain this difference, observed east–west differences in race and ethnicity and socioeconomic status may also play a role (*25*). These disparities need to be better understood, though monthly data indicate that east–west differences in use were becoming less prominent toward the end of the study period. The causes of these changes in use trends, whether because of warmer temperatures or increasing familiarity with the trail, are unknown at this time. Longer-term monitoring is needed to identify trends, and additional types of data collection would be useful, particularly neighborhood surveys to identify nonusers.

With an estimated annual average daily traffic between 3,550 and 4,000, peak days upward of 10,000, and annual use of 1.30 million to 1.46 million, the 2.7 mi (4.34 km) of The 606 qualifies as a high-use trail. Few urban trails where systematic use data have been collected have recorded volumes that exceed that level of use (*26, 27*). The large volumes may reflect the fact that The 606 is the only place in the neighborhoods it serves where users can travel uninterrupted for nearly 3 mi (5 km) without the need for street crossings.

Higher volumes on urban facilities have been documented, however. As an elevated trail, the 1.45-mi (2.33-km) High Line claims peak days four to five times higher than that of The 606, and current annual visits are estimated at 5 million (*28, 29*). Likewise, the nearby Chicago Lakefront Trail is used by more than 70,000 people on summer weekend days and averages 30,000 users per summer weekday along its busiest trail segments (*30*). The two were designed to serve different purposes. The High Line is located in neighborhoods with a much higher population density and has evolved into a tourist destination, while the 18.5-mi (29.8-km) Lakefront Trail serves the entire city. Neither was designed to meet the open space and transportation needs of underserved neighborhoods. While high use numbers are an important measure of success, trail managers should also be sensitive to overuse that can lead to conflict and accidents. Continued monitoring can help identify what levels of use are problematic, and the approaches described in this paper for understanding daily use and within-day use are an important first step in that direction. Beyond the data, however, managers and stakeholder groups must decide whether, at what point, and how to govern trail use. These are values-based decisions that can be implemented in a variety and combination of ways to help maintain safe and enjoyable experiences for trail users (*31*).

Finally, looking at hourly use variations by weekend and weekday, indications were found that The 606 is used for recreation and transportation purposes. The mix of these two purposes, however, is unclear, and use profiles described in the literature may oversimplify patterns of and reasons for use, particularly utilitarian profiles in the early morning and late afternoon hours (*23*). It was informally observed that much of the use during those hours was from runners and walkers who appeared to be using the trail for recreational, health, and fitness purposes before and after work. While further investigation through observation and survey could help distinguish these components in hourly use profiles, on a different level, a better understanding of the multiple and overlapping reasons for using the trails is also needed.

CONCLUSIONS

Automated counters installed shortly after the opening of The 606 are providing useful data for managing the trail and communicating its benefits to users and those groups involved in its development. For the Park District and the Trust for Public Land, the methods, data, and applications, such as calculation of miles traveled, represent a new, collaborative approach to quantifying bicycle and pedestrian traffic volumes and the importance to local residents. Beyond Chicago, The 606 also serves as an important case study for the further development of elevated rail corridors as trails, as the popularity of the High Line and Promenade Plantée has led city planners across the globe to look up for new open space and pedestrian–bicycle opportunities (*32, 33*). While novelty is certainly part of the attraction, there may also be health benefits through air quality and microclimate advantages, and in the case of The 606, a way to connect diverse communities (*9*). By quantifying use and integrating use data with other information about users and their surrounding communities, planners and managers will be better able to serve the growing interest in bicycle and pedestrian alternatives in cities.

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