Analysis of 2016 Trail Usage Patterns along the Great Allegheny Passage

Final Report
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By Dr. Andrew R. Herr
Associate Professor of Economics
Saint Vincent College

Executive Summary

- The Great Allegheny Passage trail system is well-used. I estimate the total number of trail users to be in the range of 1,027,488 to 1,164,487 in 2016, with a mid-range estimate of 1,091,706. I estimate that overall trail use increased by 9% between 2015 and 2016.

- Data collection in 2016 was substantially more comprehensive than in 2015. The 2016 TrafX data include a total of 3,126 usable count days compared to 2,307 in 2015, a 36% increase. In addition, volunteers conducted a full set of synchronized counts, with a total of 72 observations (6 at each of the 12 counter locations). This is a vast improvement over 2015, when only 47 of 72 observations were completed.

- The improved quality and quantity of data collection in 2016 increases the reliability of the trail use estimate.

- In 2015, two important changes were made in data collection. First, the number of TrafX counter locations increased from 9 to 12. Second, the synchronized counts were moved from trailhead locations to the TrafX locations. These changes were continued in 2016.

- I recommend making every reasonable effort to gather the data in a consistent manner from year to year. Specifically, this would mean keeping the TrafX locations the same from year to year and continuing to conduct the synchronized counts at the TrafX locations.

- I also recommend collecting as much data as possible. With regard to the TrafX counters, this would mean setting up each counter in early March in order to provide a more complete set of TrafX data. With regard to the synchronized counts, this would mean making every effort to conduct counts at every location on each count date. These recommendations were followed in 2016, as. This recommendation was followed in 2016. All 12 TrafX counters began operating in March. Also, the synchronized count data set was nearly 100% complete.

- Finally, I recommend that at least two of the synchronized counts be conducted on a weekend day (Saturday and/or Sunday). This recommendation was followed in 2016, as 3 of the 6 synchronized count days were on weekends.

Summary of Methodology

This report estimates trail use patterns along the Great Allegheny Passage (GAP), from Cumberland to Pittsburgh. These estimates are based on two primary data sources. The first is information gathered from TrafX counters, infrared counters that track trail use at fixed locations along the trail. The second is information gathered from synchronized manual counts conducted at TrafX counter locations. These synchronized counts occurred on six dates in 2016: Friday, May 27, Saturday, June 18, Thursday, July 14, Sunday, August 7, Tuesday, September 13, and Saturday, October 15. In each case, these counts were conducted over a two-hour period (10-noon, 11-1, or noon-2).

I have conducted similar GAP trail use reports in previous years (2010, 2011, 2012, 2013, and 2015). The 2010-13 reports also relied heavily on information gathered from TrafX counters and synchronized manual counts, but significant changes in data collection occurred in 2015. To start, three TrafX counters were added, and several existing counters were relocated. In addition, the method for conducting synchronized counts changed substantially in 2015. Previously, synchronized counts were conducted close to trailhead locations, but in 2015 the synchronized counts were moved to the TrafX counter locations. Starting in 2015, the synchronized counts were conducted at fewer locations (12 locations versus 18 in 2013). Data collection in 2016 followed the 2015 model. **As a result of the differences in data collection, the trail count numbers reported in 2015 and 2016 are not directly comparable to those of previous years.**

I use the following methodology to estimate trail use along the GAP. First, I report the TrafX counts by location and month for April through November (Table 2). These numbers are based on direct TrafX counts, but I also fill in data for days in which no counts are reported or in which the counts do not seem to be reasonable. Next, I adjust the initial counts to account for the fact that the TrafX counters typically under-count the actual number of trail users. I use the 2016 synchronized counts to derive a Count-to-Pass Factor (CP Factor) for each location (Tables 3 and 5). I then apply these CP Factors to derive adjusted TrafX counts (Table 6), and I use these adjusted TrafX counts to derive high-, middle-, and low-range estimates of total trail use along the GAP.

TrafX Data

In 2016, TrafX counters collected data at 12 locations along the Great Allegheny Passage. Table 1 provides information on these counters and the data that they gathered.[1]

It is worth noting that the quantity and quality of count data improved dramatically between 2015 and 2016. The 2016 data include a total of 3,126 usable count days compared to 2,307 in 2015, a 36% increase. This increase is due to two factors. First, the TrafX counts started earlier in the year in 2016, with all TrafX counters operating in March. In 2015, most counters were not operating until the end of April or beginning of May. Second, the counters were considerably more reliable in 2016, when there were only 38 missing or "bad" days of TrafX counts for all 12 counters combined. In 2015, there were 224 such days. The improved data directly improves the estimate of overall trail use, and David Cotton deserves much credit for his work in coordinating volunteers overseeing the operation of the TrafX counters.

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[1] The milepost locations of the TrafX counters were provided by David Cotton in an email dated June 2, 2016.

Table 1: Summary of TrafX Count Data (2016)

Location	Counter milepost	# Usable Count Days	First Date	Last Date
Cumberland	1.5	256	26-Mar	6-Dec
Frostburg	16.5	268	14-Mar	6-Dec
Deal	22.5	266	15-Mar	5-Dec
Garrett	34.5	266	14-Mar	6-Dec
Rockwood	45.5	265	14-Mar	5-Dec
Ohiopyle	69.0	252	17-Mar	7-Dec
Connellsville	85.0	261	22-Mar	7-Dec
Perryopolis	102.0	248	22-Mar	8-Dec
West Newton	111.5	262	22-Mar	8-Dec
Boston	122.0	262	22-Mar	8-Dec
Rankin Bridge	138.0	263	22-Mar	9-Dec
Hot Metal Bridge	146.0	257	22-Mar	9-Dec

Table 2 displays counts by month (March-December) at the 12 TrafX counter locations, with slight modifications for days in which a counter registers no data or registers a count that is unreasonably high or low. For each counter, I calculate an average weekday and weekend count for each month.[2] On days in which a counter has missing or "bad" data, I insert the average count for that location and month.[3] The March-December range of data represents an expansion from 2015, when I reported counts for April-November. This is a direct result of the fact that the TrafX counters were operational for a longer period of time in 2016. The increased range of data improves the quality of my trail use estimate.

Finally, it should be noted that the counters are intentionally located away from the trailheads, sometimes as much as 2 miles away. Because of this, many walkers are not included in the count. With these caveats in mind, Table 2 summarizes the raw TrafX counts for each location by month.

Synchronized Counts

Synchronized counts were conducted on Friday, May 27, Saturday, June 18, Thursday, July 14, Sunday, August 7, Tuesday, September 13, and Saturday, October 15. In each case, these counts were conducted over a two-hour period (10-noon, 11-1, or noon-2).

The synchronized count data was considerably more complete in 2016 compared to 2015. With six count dates scheduled for each of the 12 locations, a full set of synchronized count data includes 72 observations. In 2016, all 72 observations were completed (the only exception is that the volunteer at Rockwood on July 14 gathered only one hour of data rather than two). In 2015, only 47 of the 72 observations occurred. Because synchronized counts provide information that is critical to developing a reliable estimate of trail use, the completeness of this year's synchronized counts tremendously improve the quality of the 2016 trail use estimate. Every effort should be made to continue providing a complete set of synchronized counts in future years.

Table 3 summarizes the Synchronized Count and TrafX count at each counter for each count day. The last column calculates the overall Count-to-Pass Factor (CP Factor) for each location. The CP Factor equals the manual count divided by the TrafX count.

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[2] I define "weekday" as Monday through Friday and "weekend" as Saturday and Sunday. I also count holidays as "weekend" days, even if they occur during the week. In 2015, I counted the following holidays as weekend days: Memorial Day, July 4th, Labor Day, Thanksgiving day, and the day after Thanksgiving.

[3] Specifically, I interpolated counts in this manner for 2 days at the Garrett counter, 2 days at Rockwood, 14 days at Ohiopyle, 14 days at Perryopolis, and 6 days at the Hot Metal Bridge.

Table 2: Raw TrafX Counts by Location and Month (2016)

Location (distance to next counter)	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Cumberland (15 miles)	3,164	3,682	4,103	4,696	4,342	3,249	3,837	4,840	2,747	1,802	**36,462**
Frostburg (6 miles)	1,232	1,658	2,188	3,449	3,505	2,738	3,027	2,827	1,336	877	**22,837**
Deal (12 miles)	359	527	1,455	2,128	2,094	1,187	1,423	1,606	374	38	**11,192**
Garrett (11 miles)	513	879	1,511	2,347	2,327	1,766	2,052	1,412	343	76	**13,225**
Rockwood (23.5 miles)	252	815	1,622	2,500	2,090	1,429	1,698	1,260	368	96	**12,131**
Ohiopyle (16 miles)	756	1,403	2,661	3,774	3,596	2,225	3,140	2,435	505	85	**20,581**
Connellsville (17 miles)	1,677	1,874	2,294	2,829	2,894	2,449	3,424	2,736	771	142	**21,090**
Perryopolis (9.5 miles)	692	1,106	1,899	2,478	2,302	1,610	2,305	1,698	442	188	**14,719**
West Newton (10.5 miles)	4,551	5,249	6,940	9,065	10,181	7,380	7,529	5,214	2,211	642	**58,962**
Boston (16 miles)	2,620	3,206	4,302	5,883	5,855	4,918	6,593	4,051	1,677	352	**39,457**
Rankin Bridge (8 miles)	7,864	8,080	6,518	6,334	5,847	3,805	6,687	5,463	3,556	1,257	**55,410**
Hot Metal Bridge (NA)	13,369	13,618	12,143	13,231	9,007	7,374	12,513	12,929	8,578	5,443	**108,204**
Total	37,049	42,097	47,636	58,715	54,040	40,130	54,228	46,471	22,908	10,997	**414,271**

Table 3: Synchronized Trail Counts (2016)

Location	27-May-16 Manual	27-May-16 TrafX	18-Jun-16 Manual	18-Jun-16 TrafX	14-Jul-16 Manual	14-Jul-16 TrafX	7-Aug-16 Manual	7-Aug-16 TrafX	13-Sep-16 Manual	13-Sep-16 TrafX	15-Oct-16 Manual	15-Oct-16 TrafX	Total Manual	Total TrafX	CP
Cumberland	46	43	90	74	15	16	130	55	40	15	107	106	428	309	1.385
Frostburg	24	10	82	63	29	20	48	40	30	20	92	57	305	210	1.452
Deal	25	12	54	16	31	11	67	19	10	11	95	35	282	104	2.712
Garrett	19	14	96	72	18	27	58	23	11	7	28	28	230	171	1.345
Rockwood	24	26	38	26	3	3	42	26	39	16	35	18	181	115	1.574
Ohiopyle	81	21	213	106	78	16	184	78	40	10	196	104	792	335	2.364
Connellsville	22	16	109	52	14	21	89	34	32	24	39	39	305	186	1.640
Perryopolis	21	13	46	43	23	23	47	37	10	0	23	23	170	139	1.223
West Newton	39	82	135	120	25	37	245	159	60	31	95	54	599	483	1.240
Boston	54	17	144	48	51	10	184	63	59	37	100	64	592	239	2.477
Rankin Bridge	111	63	212	127	54	25	286	144	62	40	91	58	816	457	1.786
Hot Metal Bridge	149	32	308	71	58	21	313	59	102	48	228	128	1,158	359	3.226
Total	615	349	1,527	818	399	230	1,693	737	495	259	1,129	714	5,858	3,107	1.885

CP Factors

By their nature, the TrafX do not count trail users perfectly. Specifically, when riders are traveling side-by-side or following close behind one another or traveling in a group, TrafX counters tend to undercount the number of riders. Thus, the accuracy of a TrafX counter declines when trail use is heavy.

In order to gauge the accuracy of each TrafX counter, volunteers conduct manual counts at the TrafX counters. These manual counts are then compared to the counts registered by the TrafX counters during the same time period. I use this data to calculate a CP Factor by dividing the manual count by the TrafX count. I then use the CP Factors to derive adjusted TrafX counts at each location.

In addition, volunteers have been conducting manual counts for many years. Table 4 exhibits this data for 2010-2016.[4] It is worth noting that the manual and TrafX counts in 2016 were substantially higher than in any previous year and that the overall CP Factor in 2016 was slightly higher relative to previous years.

Table 4: Historic CP Factors (2010-2016)

Year	Manual	TrafX	CP Factor
2010	2,564	1,524	1.682
2011	1,821	1,000	1.821
2012	882	468	1.885
2013	1,123	633	1.774
2014	NA	NA	NA
2015	2,345	1,324	1.771
2016	5,858	3,107	1.885
Total	14,593	8,056	1.811

Table 5 lists the CP Factors by locations for 2016 and, for comparison, for 2015. This data highlights the fact that these factors varied considerably from location to location in 2016 (from 1.223 in Perryopolis to 3.226 at the Hot Metal Bridge).

Table 5: CP Factors by Location (2016)

Location	Manual	TrafX	CP Factor	2015 CP Factor
Cumberland	428	309	1.385	1.559
Frostburg	305	210	1.452	1.544
Deal	282	104	2.712	1.304
Garrett	230	171	1.345	3.324
Rockwood	181	115	1.574	1.350
Ohiopyle	792	335	2.364	1.611
Connellsville	305	186	1.640	NA
Perryopolis	170	139	1.223	1.538
West Newton	599	483	1.240	0.932
Boston	592	239	2.477	1.921
Rankin Bridge	816	457	1.786	1.873
Hot Metal Bridge	1,158	359	3.226	2.793
Total	5,858	3,107	1.885	1.771

A linear regression of CP Factor as a function of manual count shows that the CP Factor is positively related to the manual count. Specifically, for every additional 100 trail users counted, the CP Factor tends

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[4] No manual counts were conducted in 2014.

to rise by 0.581. This effect is statistically significant at a confidence level of 99% and is consistent with the notion that TrafX counters will tend to undercount trail users more severely when trail use is heavy.

Adusted TrafX Counts

As mentioned previously, the TrafX counters tend to undercount trail users, particularly when users ride side-by-side or in groups. For this reason, it is appropriate to apply CP Factors to the raw TrafX counts to obtain a more accurate estimate of actual trail use.

Table 6 lists the adjusted TrafX counts by location and month after applying the CP Factors. For the months of March through December, each count listed in Table 6 equals the corresponding count in Table 2 multiplied by the CP Factor for each location. For example, Cumberland's CP Factor is 1.385, and its raw count for March (listed in Table 2) is 3,164. Thus, the adjusted count for Cumberland in March in Table 6 is 4,383 = (1.385) x (3,164). All other counts listed for March through December in Table 6 are calculated in a similar manner. The TrafX did not operate during January and February, so I estimate trail use at 100 for each location during these months. This is consistent with what I have done for "off" months in the past.

The adjusted trail use in 2016 is substantially higher than that of 2015. In 2015, I had solid TrafX for the months of May through November only.[5] Comparing the months of May through November, the overall adjusted TrafX count for 2016 (669,843) is 9% larger than the comparable count for 2015 (613,477). ***Thus, my analysis indicates that trail use along the Great Allegheny Passage (GAP) increased by 9% between 2015 and 2016.***

Interpreting the Adjusted TrafX Counts

The adjusted TrafX counts in Table 6 are derived by multiplying the raw Trafx counts by the CP Factor for each location. As such, the adjusted TrafX counts are a best estimate of the times a trail user passes a TrafX counter. Moreover, the adjusted TrafX counts at any location also represent a reasonable estimate of the number of trail users who enter at the trailhead closest to that counter.

Consider, for example, trail use at Ohiopyle. The TrafX counter is located a couple miles down the trail toward Confluence. A rider traveling from Ohiopyle to Confluence and back will pass the counter twice, and the adjusted TrafX count would, on average, double-count this trail user. But, other trail users at Ohiopyle will go the other direction, toward Connellsville. These trail users will not pass the TrafX counter at Ohiopyle. Some might be counted by the Connellsville counter, but many will not be counted by any TrafX counter. In addition, most walkers who enter at Ohiopyle will not pass a TrafX counter, even if they walk toward Confluence. So we must balance those trail users who will double-counted with those who are not counted at all. It seems reasonable to assume that these two groups roughly are roughly equal. If this is the case, then the adjusted TrafX count provides a good estimate of the number of trail users at Ohiopyle.

So, given the data available, I view the last column of Table 6 as the best estimate of 2016 trail use at each of the trailheads listed. These estimates will be better for some locations than others depending on how far the TrafX counter is from the trailhead and the proportion of trail users who go in the direction toward the counter. These two factors vary between trailheads, so the estimates in Table 6 likely overestimate trail use at some trailheads and underestimate at others.

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[5] In 2015, I estimated April and March trail use as 50% and 25% of May trail use, respectively. In addition, I estimated December trail use at 100 for each location in 2015, whereas I used actual TrafX counts to estimate December 2016 trail use. Based on the 2016 TrafX counts for March, April, and December, it appears that I substantially underestimated trail use for these of months in 2015.

Table 6: Adjusted Monthly TrafX Counts (2016)

Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
Cumberland	100	100	4,383	5,100	5,683	6,504	6,014	4,500	5,315	6,704	3,805	2,495	50,704
Frostburg	100	100	1,790	2,408	3,178	5,009	5,091	3,977	4,396	4,106	1,940	1,273	33,368
Deal	100	100	975	1,429	3,945	5,770	5,678	3,219	3,859	4,355	1,014	104	30,547
Garrett	100	100	689	1,182	2,032	3,157	3,130	2,375	2,760	1,899	461	102	17,988
Rockwood	100	100	397	1,283	2,553	3,935	3,289	2,249	2,673	1,983	579	152	19,293
Ohiopyle	100	100	1,788	3,317	6,291	8,923	8,503	5,260	7,423	5,757	1,194	200	48,856
Connellsville	100	100	2,750	3,073	3,762	4,639	4,746	4,016	5,615	4,486	1,264	234	34,784
Perryopolis	100	100	846	1,353	2,323	3,031	2,815	1,969	2,819	2,077	541	230	18,202
West Newton	100	100	5,644	6,510	8,607	11,242	12,626	9,152	9,337	6,466	2,742	797	73,323
Boston	100	100	6,490	7,941	10,656	14,572	14,503	12,182	16,331	10,034	4,154	873	97,936
Rankin Bridge	100	100	14,041	14,427	11,638	11,310	10,440	6,794	11,940	9,755	6,349	2,244	99,139
Hot Metal Bridge	100	100	43,122	43,927	39,169	42,678	29,053	23,786	40,362	41,704	27,669	17,556	349,226
Total	1,200	1,200	82,915	91,949	99,837	120,771	105,888	79,479	112,829	99,326	51,713	26,258	**873,365**

Total Trail Use Estimate

The bottom row of Table 6 provides a preliminary estimate of 873,365 total trail users at the 12 TrafX counter locations. As I have argued above, this number is a reasonable estimate of the number of trail users who enter the trail at the trailheads closest to the TrafX counters. But these 12 locations are not the only places where users may enter the trail. As such, this number likely *underestimates* total trail use.

The locations of the TrafX counters were chosen to capture as many as possible while minimizing the occurrence of trail users passing multiple counters on a single trip. I will assume as a midpoint estimate that 80% of the trail users enter at the trail at the trailheads closest to the TrafX counters, with a range of 75% to 85%.[6]

If we assume the midpoint estimate of 80%, then the resulting mid-range estimate of total trail use is 1,091,706 = (873,365 ÷ 0.80). The low-range and high-range estimates are 1,027,488 = (873,365 ÷ 0.85) and 1,164,487 = (873,365 ÷ 0.75), respectively. As mentioned previously, I estimate that trail use along the GAP increased by 9% between 2015 and 2016.

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[6] These estimates are based on input and estimates by ATA.