

# Tempe Bike Count Report

## 2016

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Tempe Bicycle Action Group  
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### 1. Abstract

In April, the sixth annual city-wide bike count in Tempe was conducted as a way of understanding cycling habits and to identify routes and intersections that are problematic or dangerous. In total, 11,944 bicyclists were counted by 67 volunteers from a total of 59 different locations, with 14 locations counted for all 6 years from 2011 to 2016. Overall helmet use was 19%, wrong way riding was 20% and sidewalk riding was 41%. Helmet use was fairly consistent over the six years of bike count data (range of 17 to 21%) while sidewalk riding percentage had more variability over the six year period (range of 32 to 46%), but stabilizing in the most recent four years. Wrong way riding appears to be steady (17 to 20% range over six years). Helmet use was lower while wrong way and sidewalk riding were much higher than values obtained in Pima County, AZ (Tucson area).

## 2. Introduction

In 1974, the Planning Department of the City of Tempe released the comprehensive Tempe Bikeway Plan, the first plan of its kind in Arizona. The Bikeway Plan aimed to “encourage use of the bicycle for everyday transportation,” among other goals, as a way to decrease automobile traffic, reduce the environmental impacts of transportation, and raise the quality of living in Tempe. Now, over forty years later, Tempe has more than 175 miles of bikeways [1], was recently promoted to the gold-level League of American Bicyclists ‘Bicycle Friendly Community’ [2] (first inducted 1997), and has the highest percentage of residents who bike to work, at 4.2%, in the county [1]. The City of Tempe has a long-standing commitment to encouraging bicycle and pedestrian travel [1], a goal shared by Tempe Bicycle Action Group (TBAG). TBAG is a non-profit 501(c)(3) organization dedicated to advancing the bicycle as a safe, efficient, and sustainable form of transportation [3]. Despite bicycling infrastructure progress, collision data is still high, at 1107 pedalcyclist collisions over the 5-year period from 2010 to 2014 [4], [5].

This is the 6<sup>th</sup> annual Tempe Bike Count Report [6]-[10]. On March 29-31, 2016, 67 volunteers observed a total of 11,944 cyclists at 59 intersections during morning (7-9 am) and evening (4-6 pm) rush hours. The count of cyclists traveling through an imaginary cordon around the ASU-Tempe campus was 489 per hour in-bound in the morning and 638 per hour out-bound in the afternoon. Besides a count, additional data was collected covering rider gender, helmet use, riding on the sidewalk, and riding on the wrong side of the street (against traffic). In addition to these data, our analysis considers vehicular traffic volume data by intersection made available by the City of Tempe [11]. The Tempe bike count method was modeled in part after a similar program by the Pima Association of Governments (PAG) [12]-[16]. Other recent reports on bicycle transportation include those from Maricopa Association of Governments [17] and a Bike Network Connectivity Study for SRP [18].

## 3. Results

A summary of count data and attribute data is shown in Table 1. Count and attribute data are depicted geographically in Appendix A. Historical bike count data by location is tabulated in Appendix F. A detailed tabulation of results for 2016 is given in Appendix G. Raw data is available in reference [19].

Report	Total Count	# locations	Recorders	Wrong way%	Sidewalk%	Helmet%	Female%
Tempe 2016	11,944	59	67	19.6%	41.0%	19.2%	23.2%
Tempe 2015	15,429	53	81	16.6%	37.7%	21.0%	24.2%
Tempe 2014	12,577	48	78	19.2%	41.8%	20.6%	24.7%
Tempe 2013	14,750	54	91	17.2%	40.6%	19.0%	26.1%
Tempe 2012	6,563	28	20	18.7%	45.8%	17.6%	29.8%
Tempe 2011	9,407	45	58	17.5%	31.8%	17.2%	24.8%
PAG 2015	12,778	101		3.0%	6.0%	55.0%	27.0%
PAG 2014	18,426	107		2.9%	4.7%	47.2%	28.9%
PAG 2013	13,265	82		2.9%	6.0%	50.9%	28.0%
PAG 2012	12,211	86		3.2%	7.0%	54.6%	24.5%
PAG 2011	15,898	117		2.5%	5.9%	50.3%	26.8%

Table 1 Summary of count data and attribute data [6]-[10], [12]-[16].

### a. Attribute Analysis

Attributes collected were wrong-way riding, riding on the sidewalk, wearing a helmet, and gender. The calculation of overall attribute percentages was weighted according to the total count for each intersection/direction. The high incidences of cyclists riding against traffic, riding on the sidewalk and riding without a helmet are all matters of significant concern.

Overall wrong way riding was 20% which was counted for both on-street and on-sidewalk riding. This is substantially higher than that observed in the count by PAG of 3% [16]. The 20 intersections with the highest fraction of wrong-way riding are shown in Figure 1. In all, there were 24 intersections at which 25% or more of the cyclists observed were riding the wrong direction. ARS §28-812 concerns applicability of traffic laws to bicycle riders. Riding on the wrong side is dangerous, as motorists often do not anticipate or look for wrong-way traffic. While some of the intersections with high wrong-way riding lack a dedicated bike lane in the problem direction, many, such as several along University Drive in the ASU area, do have bike lanes.

Overall sidewalk riding was 41%. This is substantially higher than that observed in the count by PAG of 6%. Four intersections had greater than 90% sidewalk riding. The 20 intersections with the highest fraction of sidewalk riding are shown in Figure 2. In all, 27 intersections out of 59 had 50% or more of the cyclists riding on the sidewalk. Tempe City Code sec. 7-52 concerns riding on sidewalks or bicycle lanes. Sidewalk riding can create a hazard for pedestrians and it can create conflicts between motorists and cyclists, as motorists often do not anticipate relatively fast-moving traffic on sidewalks. This is especially true when the sidewalk traffic is moving opposite of street traffic.

Overall helmet use was 19% across the 59 intersections observed in 2016. This statistic is notably lower in the Tempe count as compared with the PAG count from 2015 (55% of riders wearing helmets). The city of Tempe does not require helmets for adults in the city, although bicycle safety groups including TBAG, Arizona State University Health & Wellness, Bike Saviours and other groups encourage usage and will assist riders in acquiring helmets.

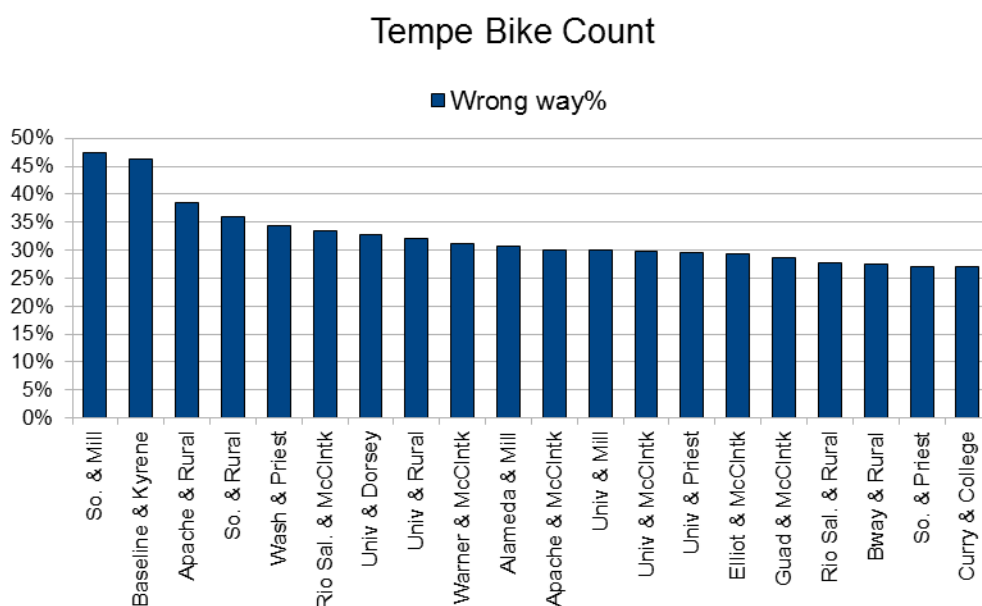


Figure 1 Top 20 locations by percentage of wrong-way riders, by intersection (directions combined)

## Tempe Bike Count

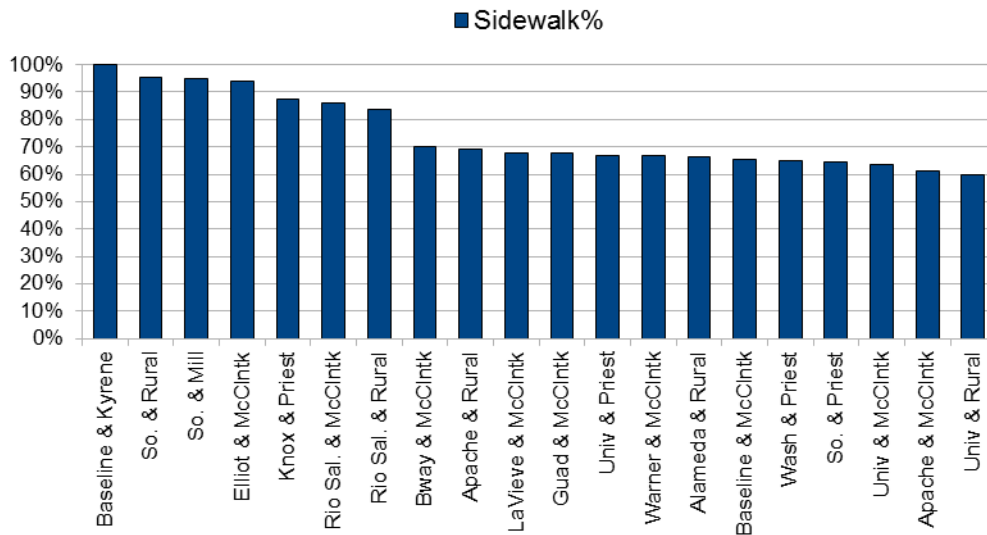


Figure 2 Top 20 locations by percentage of cyclists on sidewalk, by intersection (directions combined).

Volunteer observers recorded 23% female ridership. Ma & Dill [20] show that inexperienced riders as well as female riders regardless of experience are more likely to use infrastructure that “gives the appearance of safety.” This allows the ratio of female riders to be used as a proxy for perceived safety of infrastructure.

### b. Correlation Analysis

Both sidewalk riding and wrong way riding are plotted vs. vehicular traffic volume, with each point representing a unique location and direction (N/S or E/W), in Figure 3 and Figure 4. Similarly to previous years, both sidewalk riding and wrong way riding are positively correlated with vehicular traffic volume. That is, the higher the volume of vehicular traffic in a particular direction, the higher the incidence of both riding on the sidewalk and riding against traffic. These correlations indicate the need to recognize the effect of traffic volume on cyclist riding behavior.

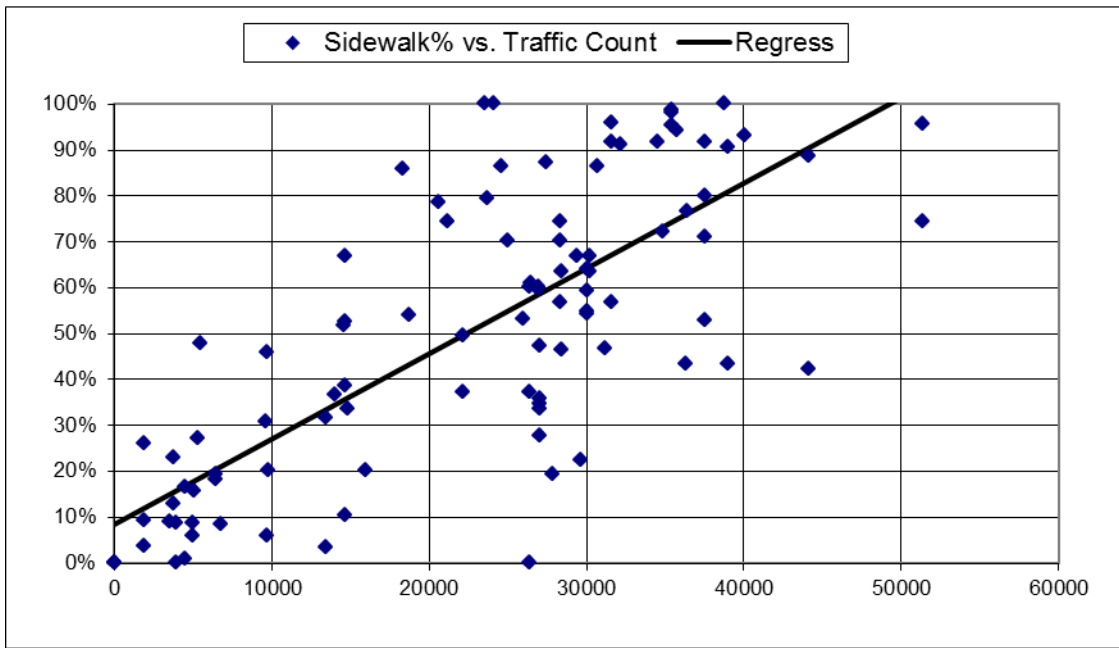


Figure 3 Scatterplot of sidewalk riding % vs. vehicular traffic count (24 hour period, aggregated through 2015 and interpolated to intersections), E/W and N/S directions separated.  $R^2 = 0.57$ .

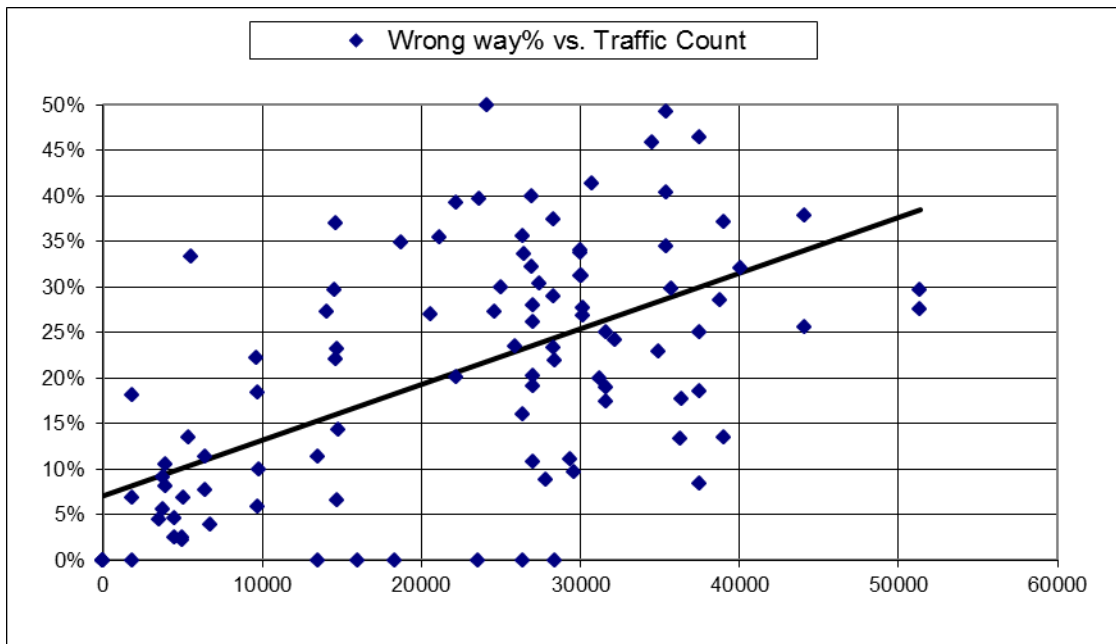


Figure 4 Scatterplot of wrong way riding % vs. vehicular traffic count (24 hour period, aggregated through 2015 and interpolated to intersections), E/W and N/S directions separated.  $R^2 = 0.32$ .

With regard to collision data analysis, the reader is referred to Tempe Bike Count Report 2014 [9], section 3b, Figure 5 and Appendix B of that report.

The plot in Figure 5 shows that the highest bicycle usage areas are adjacent to the ASU campus.

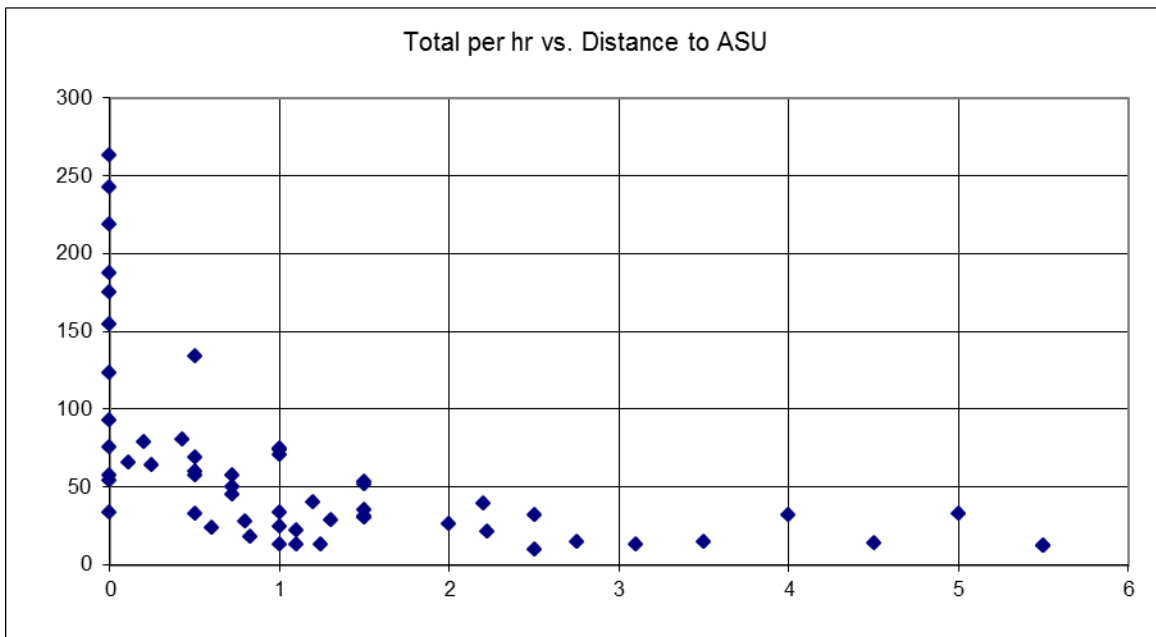


Figure 5 Relationship between cyclist count per hour and distance to ASU (miles).

### c. Error Detection

Error detection methods were applied to the collected data. The detailed procedure is provided in Appendix A. Errors were detected by visual inspection and numerically as attribute count exceeding the bike count for a specific time and direction. Three recording sessions (pairs of count sheets) were thrown out due to anomalies such as substantial missing data, inconsistencies or wrong time counted. Of the remaining data, there were 25 detected errors out of 2336 data rows (where “row” is a 15-minute time block containing count and attribute data). Of these, 8 were recording errors and 17 were transcription errors. A recording error occurs at the time of the count; a transcription error occurs when converting handwritten marks to numbers in a database. Corrections to transcriptions are straight forward and simply involves checking the count sheets. Corrections to recording data errors can be sometimes be inferred as either a bike count mark missed or a false mark applied to the attribute column. Most of the recording corrections applied here resulted in an increase of 1 count for the given time segment. As a result of these estimated corrections, the total bicycle count increased by 6. Based on the low percentage of errors for included sessions, the counting procedure appears to be sound. With error rate on the order of 1%, there does not appear to be a serious problem in the data collection methodology, at least as far as the error detection method used reveals. That error detection methods were applied to detect questionable data improves confidence in the data analysis.

## 4. Recommendations

The City of Tempe has made great strides in developing the city as a bicycle-friendly community. This bike count indicates that there is still work to do to improve bicycle safety both in terms of infrastructure improvement (bicycle lanes and paths) and education. In particular, we recommend that the city look at bike lanes on routes that are popular with cyclists. Sidewalk riding is a concern relating to car-bike collisions, especially when the bike is going the wrong way on the sidewalk. TBAG continues to work with the city on plans to improve roads, to add bike lanes, and to work on educational and enforcement campaigns.

## 5. References

- [1] Tempe Transportation Master Plan (Jan 2015), <http://www.tempe.gov/home/showdocument?id=30317>.

- [2] Tempe, AZ Bicycle Friendly Community. The League of American Bicyclists, Fall, 2015. [http://www.bikeleague.org/sites/default/files/bfareportcards/BFC\\_Fall\\_2015\\_ReportCard\\_Tempe\\_AZ.pdf](http://www.bikeleague.org/sites/default/files/bfareportcards/BFC_Fall_2015_ReportCard_Tempe_AZ.pdf)
- [3] Tempe Bicycle Action Group (TBAG), [www.biketempe.org](http://www.biketempe.org).
- [4] Tempe Traffic Collisions. Arizona Bike Law, Dec 11, 2015. <http://azbikelaw.org/tempe-traffic-collisions/>.
- [5] ADOT traffic collision database, <http://azbikelaw.org/blog/adot-traffic-collision-database/>  
<http://azbikelaw.org/blog/arizona-crash-facts-2013/>
- [6] 2011 Tempe Bike Count Report, <http://www.biketempe.org/wp-content/uploads/2011/12/Tempe-Bike-Count-2011-Final-Report1.pdf>.
- [7] Tempe Bike Count Report 2012, [http://www.biketempe.org/wp-content/uploads/2013/01/Tempe\\_Bike\\_Count\\_Report\\_2012.pdf](http://www.biketempe.org/wp-content/uploads/2013/01/Tempe_Bike_Count_Report_2012.pdf).
- [8] Tempe Bike Count Report 2013, [http://www.biketempe.org/wp-content/uploads/2014/04/Tempe\\_Bike\\_Count\\_Report\\_2013.pdf](http://www.biketempe.org/wp-content/uploads/2014/04/Tempe_Bike_Count_Report_2013.pdf).
- [9] Tempe Bike Count Report 2014, [http://www.biketempe.org/dls/Tempe\\_Bike\\_Count\\_Report\\_2014.pdf](http://www.biketempe.org/dls/Tempe_Bike_Count_Report_2014.pdf)
- [10] Tempe Bike Count Report 2015
- [11] Traffic count data from the City of Tempe. <http://www.tempe.gov/city-hall/public-works/transportation/traffic-counts>.
- [12] 2011 Regional Bicycle/Pedestrian Count Summary, <http://www.pagnet.org/documents/bicycle/2011RegionalBicycleCountReport.pdf>.
- [13] 2012 Regional Bicycle and Pedestrian Count Summary Report, <http://www.pagnet.org/documents/bicycle/2012RegionalBicycleCountReport.pdf>.
- [14] 2013 Regional Bicycle and Pedestrian Count Summary Report, <http://www.pagnet.org/documents/bicycle/2013RegionalBicycleCountReport.pdf>.
- [15] 2014 Regional Bicycle and Pedestrian Count Summary Report, <http://www.pagnet.org/documents/bicycle/2014RegionalBicyclePedestrianCountReport.pdf>.
- [16] 2015 Regional Bicycle and Pedestrian Count Summary Report, <http://www.pagnet.org/documents/bicycle/2015RegionalBicyclePedestrianCountReport.pdf>.
- [17] MAG Bicycles Count: Final Report and Implementation Plan, [https://www.azmag.gov/Documents/BaP\\_2014-08-21\\_FINAL-MAG-Bicycle-Count-Data-Summary-Report.pdf](https://www.azmag.gov/Documents/BaP_2014-08-21_FINAL-MAG-Bicycle-Count-Data-Summary-Report.pdf)
- [18] Bike Network Connectivity Study for SRP Service Area, <http://www.public.asu.edu/~mikekuby/BikeNetworkConnectivity/>.
- [19] Raw data for Tempe Bike Count: <https://github.com/biketempe/DataAnalysis>.
- [20] Ma, L. & Dill, J. (2017). Do people’s perceptions of neighborhood bikeability match “reality?”. The Journal of Transport and Land Use. (10)1, 1-18. DOI: <http://dx.doi.org/10.5198/jtlu.2015.796>.
- [21] National Centers for Environmental Information, Climate Data Online <https://www.ncdc.noaa.gov/cdo-web/>

## Acknowledgements

Tempe Bike Count 2016 was a concerted effort by a diverse team representing a wide cross-section of the bicycle-interest community. Many thanks go out to the volunteers who contributed their time to recording data and other areas of this effort.

Bike count coordinator:

- William Terrance

Bike count principal investigator:

- Clifford Anderson

Other bike count contributors:

- Jenn Guzy

Count recorders:

- 67 count volunteers



## Appendix A Geographical Presentation of Statistics

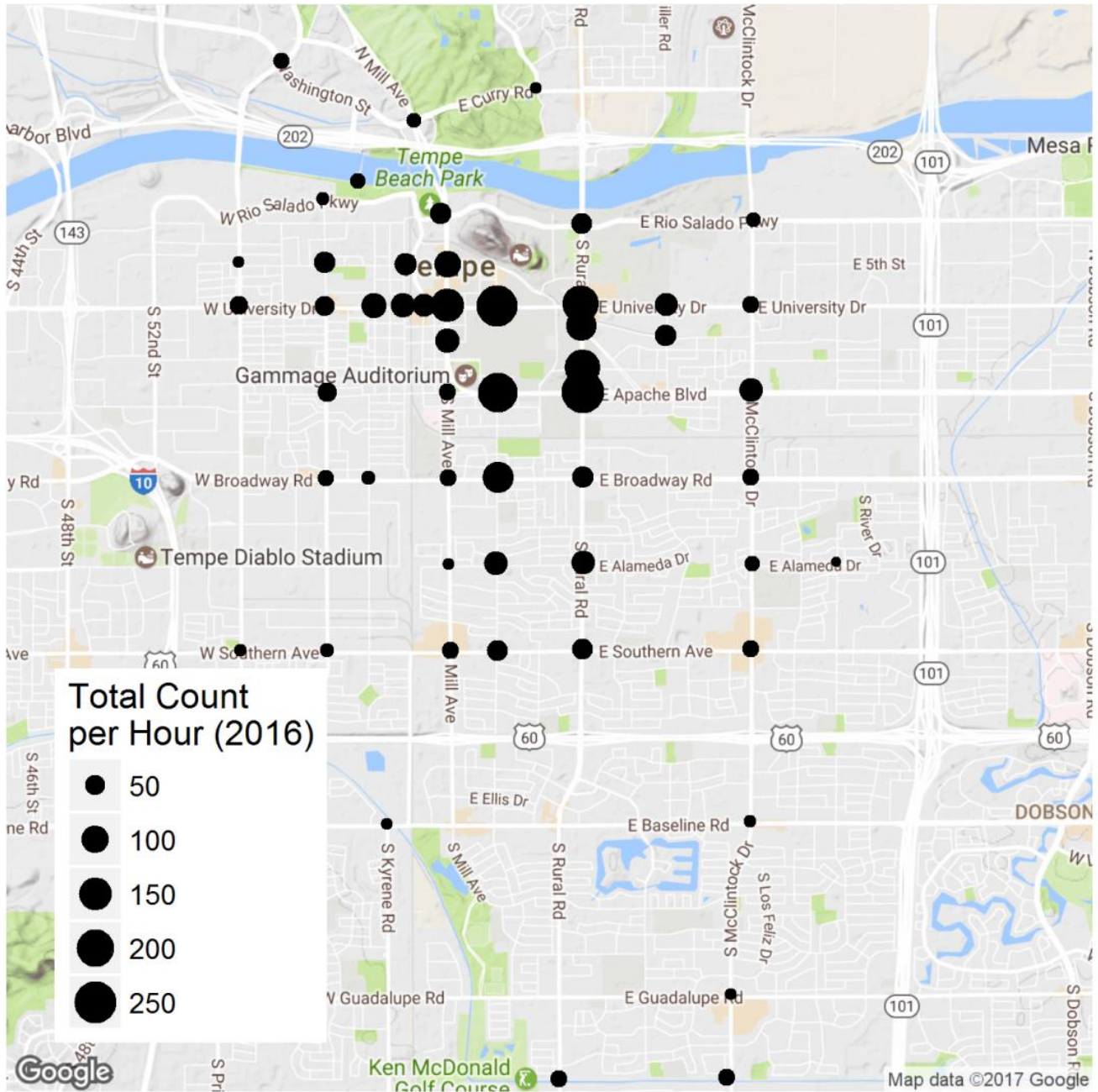


Figure A1. Total Bicycle Count per Hour

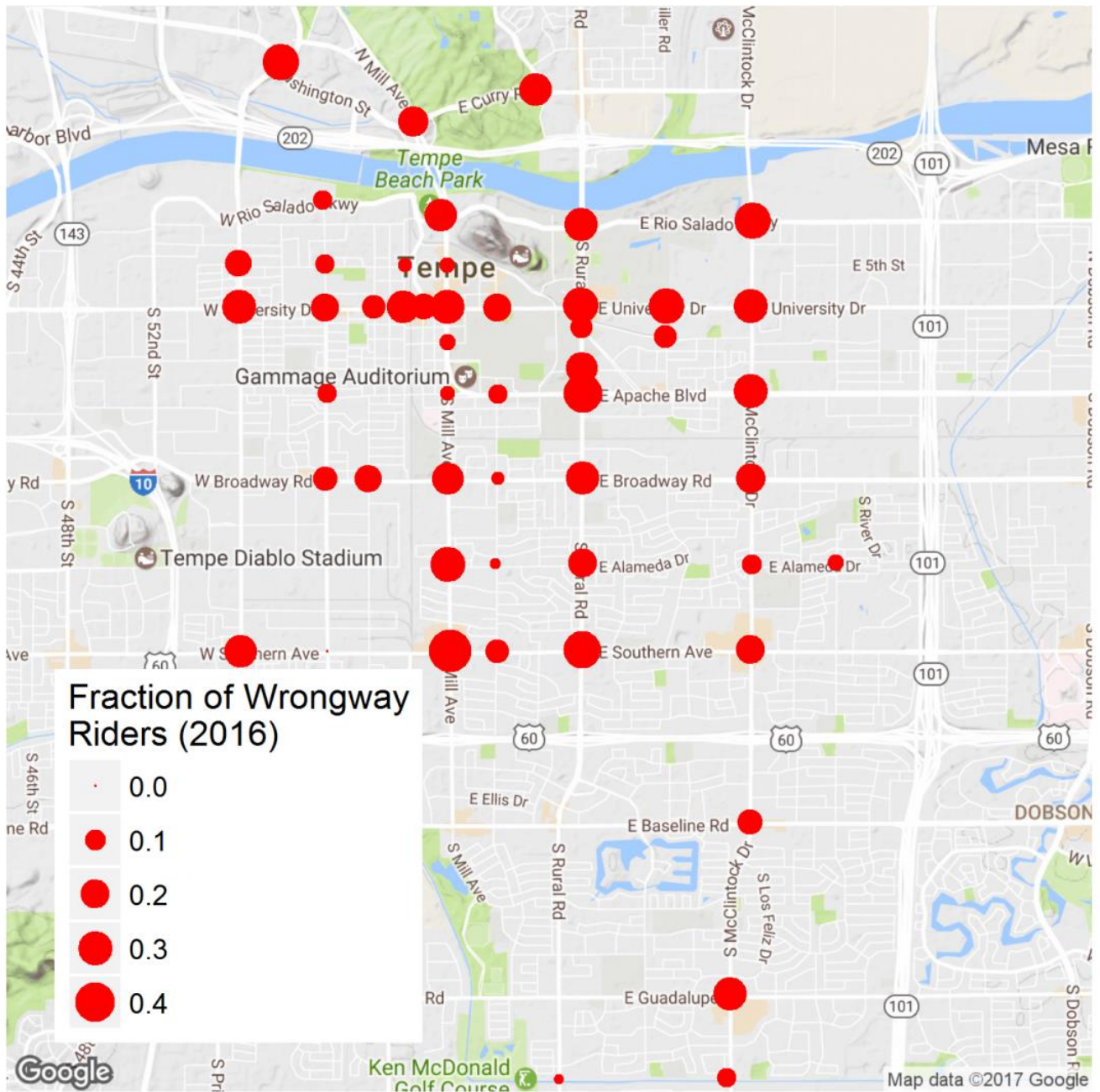


Figure A2. Fraction of Wrong Way Riders

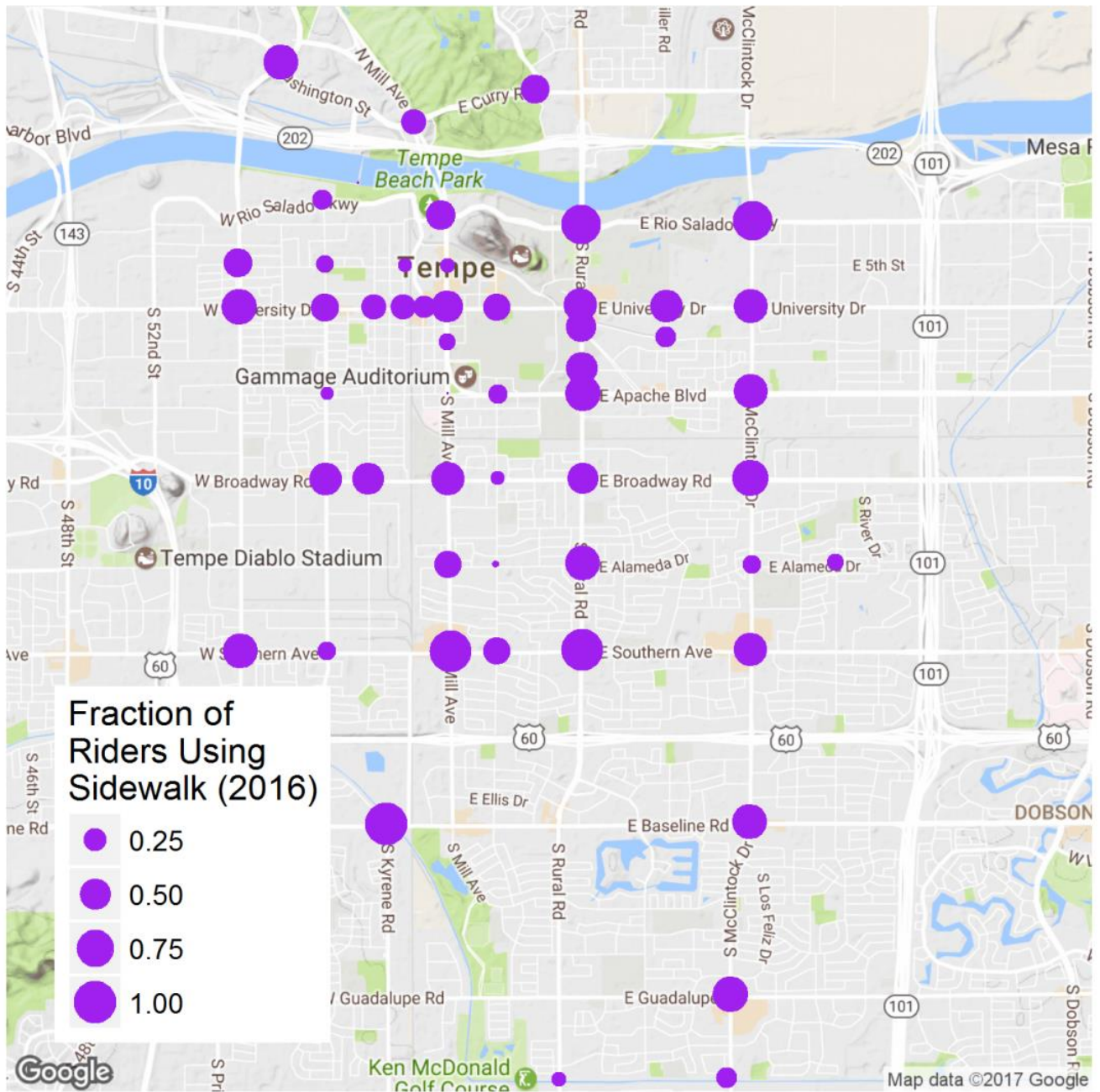


Figure A3. Fraction of Riders Using Sidewalk

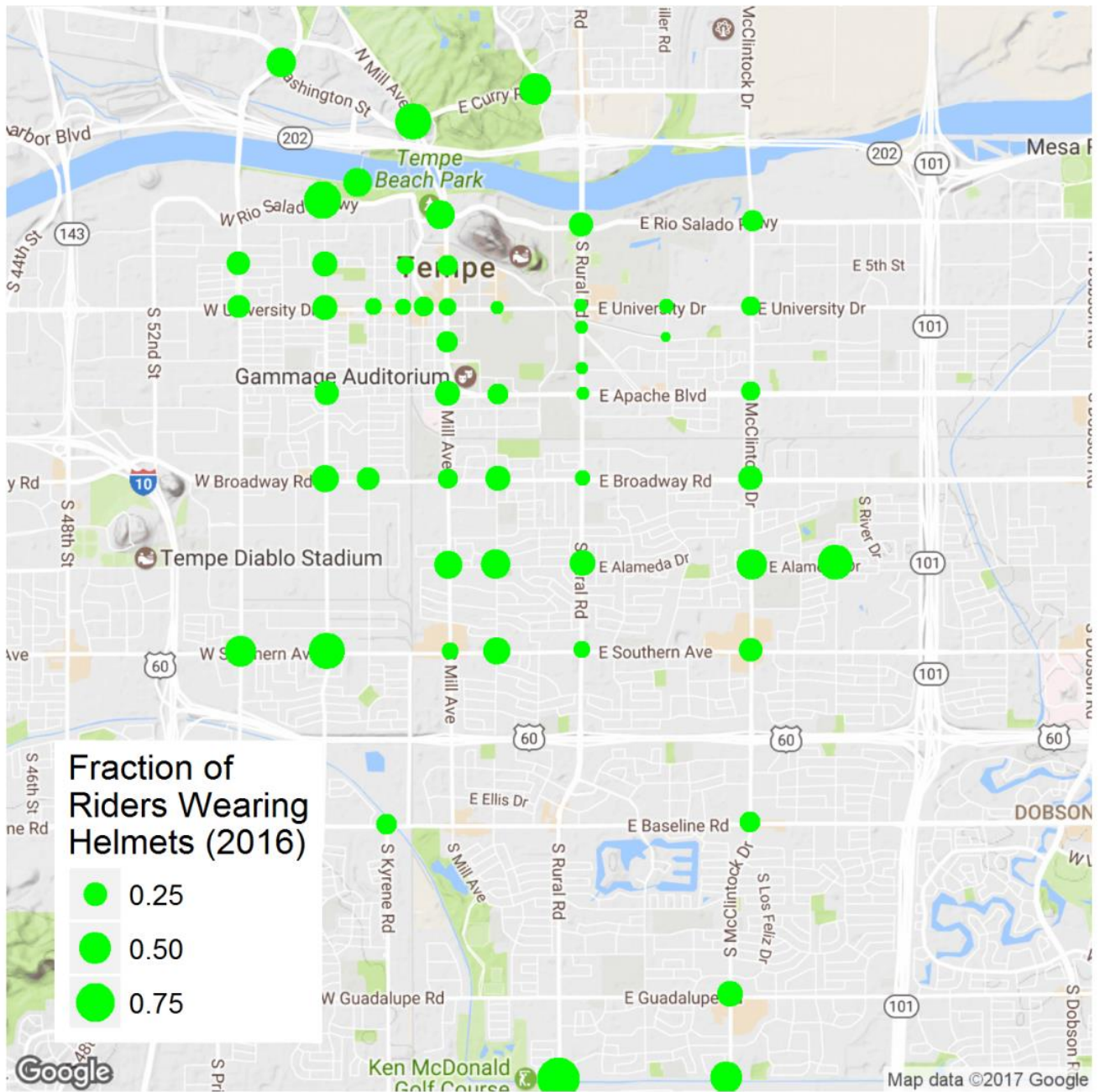


Figure A4. Fraction of Riders Wearing Helmets

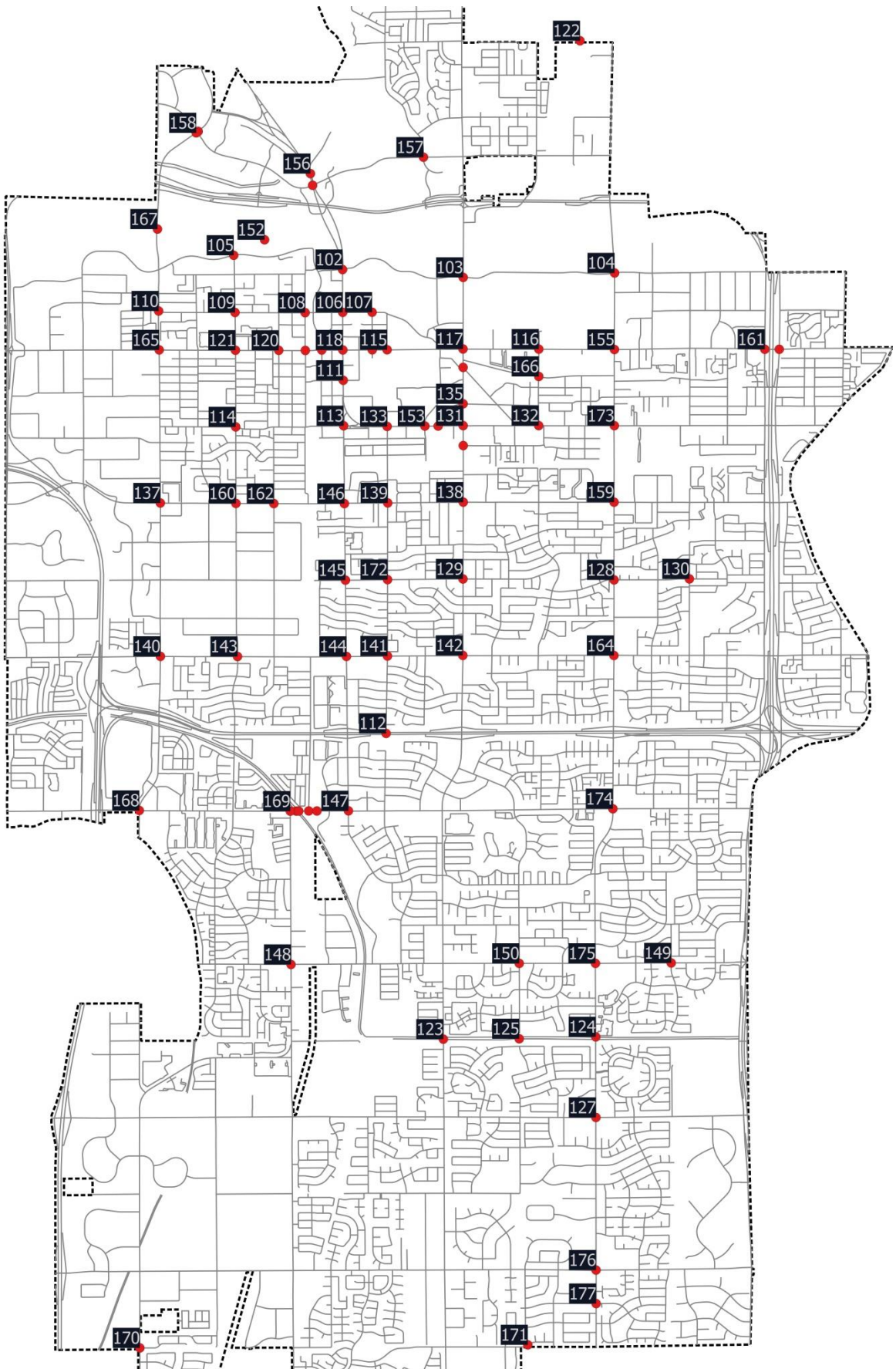


Figure A5. Location IDs (some omitted for clarity)

## Appendix B Methodology

Locations and times for collecting data were selected based on the following characteristics (not in order of priority):

- a. High anticipated bicycle count
- b. Intersections
- c. Recent or planned infrastructure improvements
- d. High incidence of bicycle collisions
- e. Establishment of cordon around (traffic in and out of) ASU
- f. Coverage of a representative sample of the City of Tempe
- g. Practicality of volunteer participation
- h. Historical count location
- i. Stakeholder recommendations (e.g., City of Tempe)

The total number of intersections in the initial plan was capped at about 50, but was limited practically by volunteer participation.

The cordon for ASU was defined as follows:

- West border: Mill Ave
- South border: Apache Blvd
- East border: Rural Rd
- North border: Rio Salado Pkwy

The time periods 7-9am and 4-6pm were chosen to be consistent with prior years and to include the morning and afternoon peak time periods while also allowing volunteers to participate with minimal interference with their normal work schedules. Tuesday, Wednesday and Thursday were selected to be consistent with prior years' counts, and are anticipated to be the highest volume days of the week and roughly equivalent to each other. Volunteers were allowed to select, at will, any one of the three days for data collection. The data collection worksheet consisted of 15 minute bins.

The set of instructions conveyed to recorders is shown in Appendix D. Training sessions were held and made available to all recorders.

Bicycle count data was collected for each of the directions (typically 4) of each intersection. For analysis, two statistics reported are a) the sum of all directions; and b) the sum of the two opposite direction counts, e.g., E/W = sum of east, west.

Total count per hour is calculated as the sum of the A.M. and P.M. sessions (4 hours total) divided 4, or if data is available only for A.M. or P.M., then the total for 2 hours is divided by 2. In the unusual event of duplicate valid counts, the counts are averaged so that total count per hour is consistent. Note that because of the difference between AM and PM count averages as shown in Figure B1, averages reported that consist of only AM or only PM are potentially skewed. This should be taken into account when comparing data between years.

Error detection methods were applied to the collected data. For each cyclist observed, instructions required that one notation be recorded in the count column, with attribute data recorded in addition in each respective column as applicable. Therefore, for a given 15 minute bin, if the sum of notations for any one attribute exceeds the count column total, an error has occurred. Possible causes for errors include:

- a. accidental double-counting in the attribute column
- b. accidental uncounted data in the count column
- c. improper procedure followed
- d. data translation error from hand-written sheets to database

Time of day for the manual count was consistent with prior Tempe counts. It is intended to capture the peak morning and afternoon “rush hour” bicycle traffic, while accommodating work schedules of prospective volunteers. Average bike count per hour vs. time of day, as shown in Figure B1, peaked for the AM counts at the end of the morning shift (8:45 to 9:00 am). For the PM counts, relative peaks occurred for the 4:15-4:30 and 5:45-6:00PM segments. PM counts were higher than AM, on average. Since these are averages over all locations, it is possible that some areas exhibited peak ridership at other times. The data was likely influenced by class schedule at ASU.

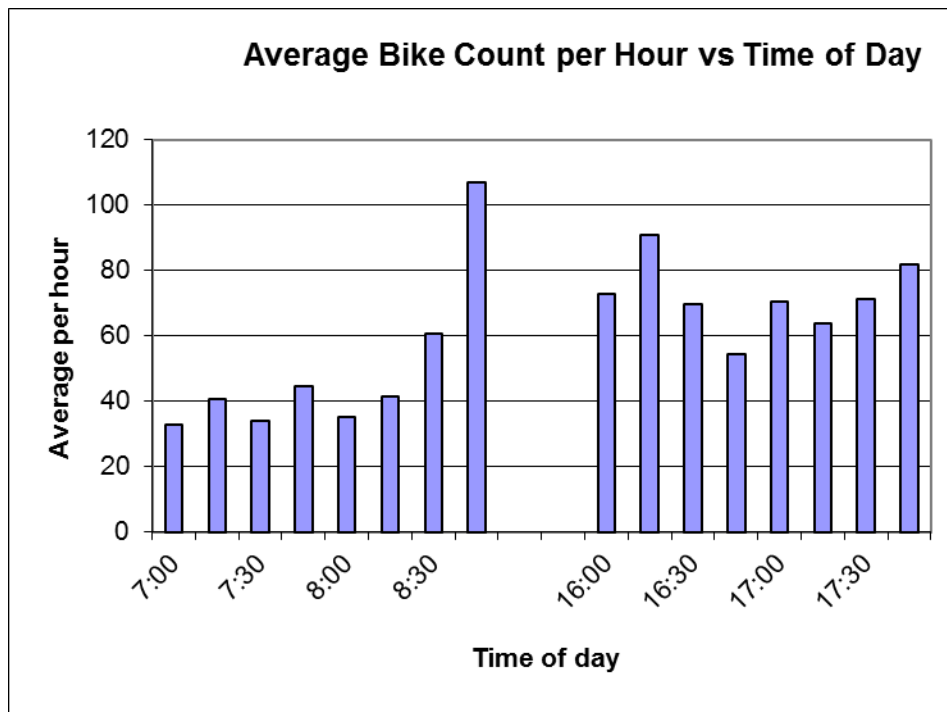


Figure B1. Average bike count per hour vs. time of day

Traffic count was obtained from City of Tempe data [11]. This data represents vehicular traffic flow over a 24-hour period in the two opposite directions (e.g., east and west, or north and south). The locations are generally not at intersections. Vehicular data has been collected over a number of years, but the locations change somewhat from year to year. The following method was used to interpret vehicular traffic data for the purpose of this study:

- The most recent data for each sampling location was used.
- For the two sides of a given intersection/direction (east/west or north/south), the larger of the two values was used. If data was available for only one side, that value was used.

## Appendix C - Bike Count Form

Name: _____		Count Sheet		page #:		
Date:		Location ID#:		Intersection of streets:		
Check for every cyclist:		Also check all that apply:				
Hour	Approach Direction	COUNT	FEMALE	Wearing HELMET	Wrong Way Riding	Riding on Sidewalk
_AM _PM	NB SB EB WB					
:00						
:15						
:30						
:45						
Observations/ Notes: Construction etc.						

Return all completed sheets to the Spinelli's Volunteer Appreciation Party, Bicycle Cellar (200 E 5th St #105, Tempe), Boulders on Broadway's hostess desk or mail to Tempe Bicycle Action Group, PO Box 1884, Tempe, AZ 85280. Thank you for your participation! 2015 versions 1.



## Appendix D - Bike Count Instructions

### 1. Count Form Structure.

- a. 1 hr: each form tracks 1 full hr of activity, broken into 15 minute increments.
- b. Total # of Cyclists recorded in "Count" Column. Attributes broken out in following columns.

### 2. Fill In: - Important please include the following info on each tracking sheet.

- a. Your Name (cell#)
- b. Location ID# & Location (Intersection) – this info was sent to you in your volunteer confirmation email.
- c. Hour (i.e. 4-5pm) – please record hr in far left column
- d. Total Hrs (bottom left) = total amount of time you were able to stay & count that location (i.e. 1.5 hrs or 2hrs)
- e. Page # (example: 1 of 2 – etc.)

### 3. Count Shifts (2 hr) – you will need at least 2 count sheets per shift. Busier locations may require more sheets. Extra count sheets will be available.

- AM Rush hour: 7-9am
- PM Rush hour: 4-6pm

### 4. Priority 1: Count (Bikes)

### 5. Columns "Count" = Total # Cyclists

- a. Approach Direction (NB, SB, EB, WB): Record the approach direction (northbound, southbound –etc.)
- b. note: turn direction is not recorded
- c. Intervals – the data is recorded in 15 minute intervals.

### 6. Priority 2: Record Attributes

once you've marked the cyclists (or pedestrian) then break out the attributes as well as you can.

### 7. Cyclist Attributes: **\*\* Default = Male without Helmet \*\***

- a. **Approach Direction** (NB, EB, WB, SB)
- b. **Gender:** Male is assumed \* Mark if cyclist Female
- c. **Helmet** (No Helmet is assumed) - Mark if the cyclist is wearing a Helmet
- d. **Wrong-Way Riding** - cycling against traffic
- e. **Sidewalk Riding** – does not include quick transitions at intersections or parking lots etc.

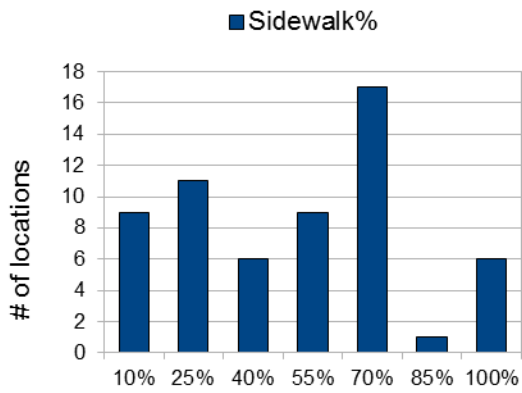
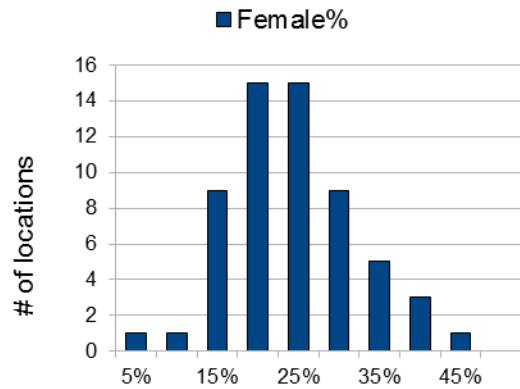
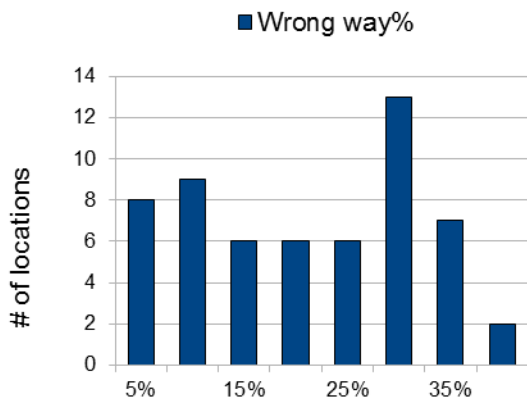
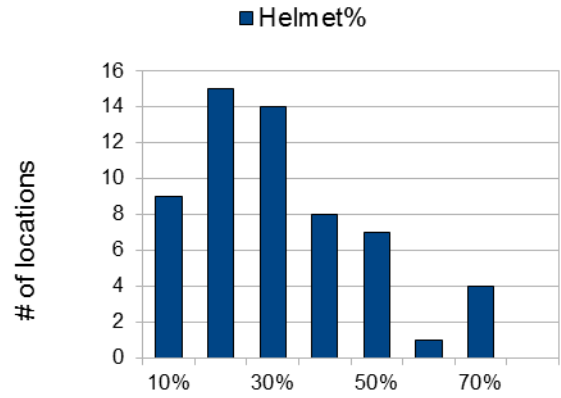
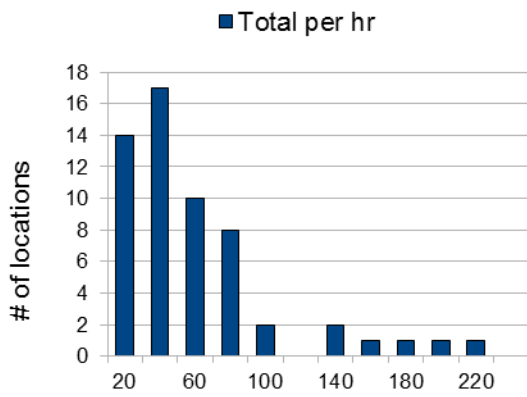
### 8. Special cases

- a. if there are multiple riders on a bike (tandem, child carrier or trailer, riding on BMX pegs, etc), each person gets counted
- b. Mopeds and e-bikes operating under peddle power are included in the count

### Notes:

- Count sheets with pre-filled shift (location, hour, am/pm, intersection, location id) and counter's name were given to most new counters (those attending a training session), starting 2015.

## Appendix E – Additional Graphs



## Appendix F – Historical Bike Count Data

Loc ID	Location or Intersection: E/W	Location or Intersection: N/S	2011 Total per hr	2012 Total per hr	2013 Total per hr	2014 Total per hr	2015 Total per hr	2016 Total per hr
101	Washington/Curry	Mill Ave	35		45	29	48	24
102	Rio Salado Pkwy	Mill Ave	47		68	64	60	58
103	Rio Salado Pkwy	Rural Rd	48	44	70	61	57	54
104	Rio Salado Pkwy	McClintock Dr	39	19	21	30	26	25
105	Rio Salado Pkwy	Hardy Dr	8		19			18
106	5th St	Mill Ave	118	91	111	101	112	93
107	5th St	Forest Ave	48		67			
108	5th St	Farmer Ave			79	78	107	64
109	5th St	Hardy Dr		32	59			58
110	5th St	Priest Dr	18		17	20	20	13
111	10th St	Mill Ave		138	136	113	124	76
112	Superstition Fwy	College Ave	33	28	38	28	36	
113	13th St	Mill Ave	49	32	56	53	58	34
114	13th St	Hardy Dr			50	40	43	45
115	University Dr	College Ave	452	174	220	216	310	242
116	University Dr	Dorsey Ln	66		62	73	88	69
117	University Dr	Rural Rd	116	181	143	145	197	187
118	University Dr	Mill Ave	93	117	123	141	154	155
119	University Dr	Ash Ave	88	61	95	96	92	66
120	University Dr	Roosevelt St	46	51	55	53	68	81
121	University Dr	Hardy Dr	62	35	47	57	36	50
122	McKellips Rd	Greenbelt Path	42	41	43	44	47	39
123	Western Canal	Rural Rd		45	62	41	40	33
124	Western Canal	McClintock Dr			38	38	38	33
125	Western Canal	Lakeshore Dr	86	43	55			
126	Baseline Rd	Western Canal	25		38	37	25	
127	Elliot Rd	McClintock Dr	10		13			13
128	Alameda Dr	McClintock Dr	22		24	18	31	27
129	Alameda Dr	Rural Rd			60	64	50	71
130	Alameda Dr	Country Club Wy	12		21			10
131	Apache Blvd	Rural Rd		191	146	180	184	264
132	Apache Blvd	S Dorsey Ln	38		64	66	66	
133	Apache Blvd	College Ave		233	164	243	220	219
134	Apache Blvd	Paseo Del Saber	121	102	182		233	
135	Lemon St	Rural Rd	151		149	168	177	176
136	Spence St	Rural Rd	92	135	170			
137	Broadway Rd	Priest Dr	16		23		17	
138	Broadway Rd	Rural Rd		65	93	72	73	58
139	Broadway Rd	College Ave	105		135	150	152	135
140	Southern Ave	Priest Dr	19		27			15
141	Southern Ave	College Ave		70	62	66	72	54
142	Southern Ave	Rural Rd			33	43	41	52
143	Southern Ave	Hardy Dr	25	23	24	31	22	22
144	Southern Ave	Mill Ave	48	48	41	40	38	35
145	Alameda Dr	Mill Ave	30	24	21	22	20	13
146	Broadway Rd	Mill Ave		37	36	27	34	33

147	Baseline Rd	Mill Ave	17		27	16	21	
148	Guadalupe Rd	Kyrene Rd			27			
149	Guadalupe Rd	Country Club Wy	12		18			
150	Guadalupe Rd	Lakeshore Dr	23		23			
151	University Dr	Forest Ave	130	90	128			
152	Tempe Lake S.	TCA Bridge		36	43	18	47	28
153	Apache Blvd	McAllister Ave						
154	Terrace Rd	Rural Rd			195			124
155	University Dr	McClintock Dr			56	67	68	34
156	Crosscut Canal	Mill Ave				36	18	
157	Curry Rd	College Ave				27	27	13
158	Washington St	Priest Dr					33	31
159	Broadway Rd	McClintock Dr				32	41	32
160	Broadway Rd	Hardy Dr				24	20	29
161	University Dr	Price Rd				25	28	
162	Broadway Rd	Roosevelt St				20	20	22
163	University Dr	Farmer Ave				60	64	79
164	Southern Ave	McClintock Dr				34	29	32
165	University Dr	Priest Dr				26	21	41
166	8th St	Dorsey Ln					56	60
167	Town Lake Path S	Priest Dr					17	
168	Baseline Rd	Priest Dr						
169	Baseline Rd	Kyrene Rd						13
170	Knox Rd	Priest Dr						4
171	Knox Rd	Lakeshore Dr						5
172	Alameda Dr	College Ave						74
173	Apache Blvd	McClintock Dr						75
174	Baseline Rd	McClintock Dr						15
175	Guadalupe Rd	McClintock Dr						14
176	Warner Rd	McClintock Dr						12
177	La Vieve Ln	McClintock Dr						7

## Appendix G Data Summary

### North-South Direction

Loc ID	Location or Intersection: E/W	Location or Intersection: N/S	Total per hr	AM per hr	PM per hr	Helmet%	Wrong way%	Sidewalk%	Female%	Traffic Dir	Loc to ASU	Lane in Dir	Dir
101	Washington/Curry	Mill Ave	18	18		67%	22%	31%	14%	9628	0.6	1	NS
102	Rio Salado Pkwy	Mill Ave	44	29	60	45%	23%	38%	18%	14670	0	1	NS
103	Rio Salado Pkwy	Rural Rd	40	38	42	20%	30%	96%	12%	51380	0	0	NS
105	Rio Salado Pkwy	Hardy Dr	13		13	69%	8%	19%	19%	6409	0.83	1	NS
106	5th St	Mill Ave	42	31	53	29%	7%	10%	21%	14670	0	1	NS
108	5th St	Farmer Ave	8	8		40%	0%	0%	13%		0.25	0	NS
109	5th St	Hardy Dr	22		22	52%	11%	18%	23%	6409	0.72	1	NS
110	5th St	Priest Dr	8	4	12	23%	23%	57%	17%	28310	1.24	1	NS
111	10th St	Mill Ave	20	30	11	27%	16%	37%	25%	26392	0	0	NS
113	13th St	Mill Ave	15		15	20%	0%	0%	37%	26392	0	1	NS
114	13th St	Hardy Dr	21	21	22	38%	6%	6%	28%	9690	0.72	1	NS
115	University Dr	College Ave	124	80	168	6%	7%	16%	27%	5044	0	1	NS
116	University Dr	Dorsey Ln	11	8	14	7%	42%	72%	30%		0.5	1	NS
117	University Dr	Rural Rd	53	37	69	7%	28%	74%	24%	51380	0	0	NS
118	University Dr	Mill Ave	62	34	90	19%	36%	60%	19%	26392	0	1	NS
119	University Dr	Ash Ave	13	13		35%	4%	12%	15%		0.11	1	NS
120	University Dr	Roosevelt St	17		17	12%	21%	27%	33%		0.43	1	NS
121	University Dr	Hardy Dr	23	23	24	39%	18%	46%	20%	9690	0.72	1	NS
122	McKellips Rd	Greenbelt Path	34	19	49	43%	0%	0%	24%	0	2.2	1	NS
123	Western Canal	Rural Rd	5		5	89%	11%	67%	11%	29395	4	0	NS
129	Alameda Dr	Rural Rd	42		42	20%	30%	94%	32%	35740	1	0	NS
130	Alameda Dr	Country Club Wy	5	7	3	53%	5%	21%	37%		2.5	1	NS
131	Apache Blvd	Rural Rd	134		134	6%	38%	88%	16%	44120	0	0	NS
133	Apache Blvd	College Ave	148	134	162	24%	3%	8%	29%	4997	0	1	NS
138	Broadway Rd	Rural Rd	38	33	43	7%	26%	42%	14%	44120	0.5	0	NS
139	Broadway Rd	College Ave	117	97	137	32%	2%	6%	25%	4997	0.5	1	NS
140	Southern Ave	Priest Dr	8	8	8	63%	13%	43%	17%	36313	2.75	1	NS
141	Southern Ave	College Ave	39	32	46	47%	5%	16%	15%	4442	1.5	1	NS
142	Southern Ave	Rural Rd	28	16	40	13%	32%	93%	27%	40059	1.5	0	NS

143	Southern Ave	Hardy Dr	15	15		73%	0%	3%	27%	13469	2.22	1	NS
144	Southern Ave	Mill Ave	18	16	21	15%	46%	92%	21%	34482	1.5	1	NS
145	Alameda Dr	Mill Ave	8	8		20%	40%	60%	47%	26912	1	1	NS
146	Broadway Rd	Mill Ave	15	12	18	20%	32%	59%	22%	26912	0.5	1	NS
152	Tempe Lake S.	TCA Bridge	9	8	11	44%	0%	0%	22%	0	0.8	1	NS
154	Terrace Rd	Rural Rd	64	36	92	6%	19%	80%	21%	37510	0	0	NS
157	Curry Rd	College Ave	11	11		48%	33%	48%	5%	5499	1.1	1	NS
158	Washington St	Priest Dr	15	11	18	38%	40%	79%	12%	23678	1.5	1	NS
160	Broadway Rd	Hardy Dr	18		18	49%	11%	31%	14%	13469	1.3	1	NS
162	Broadway Rd	Roosevelt St	13	10	17	25%	13%	27%	23%	5329	1.1	1	NS
163	University Dr	Farmer Ave	18	13	23	14%	20%	21%	32%		0.2	1	NS
165	University Dr	Priest Dr	20		20	18%	38%	70%	8%	28310	1.2	1	NS
166	8th St	Dorsey Ln	25		25	2%	10%	42%	26%		0.5	1	NS
169	Baseline Rd	Kyrene Rd	1	1		0%	0%	100%	0%	23567	3.1	1	NS
170	Knox Rd	Priest Dr	4		4	14%	0%	86%	14%	18344	7.9	0	NS
171	Knox Rd	Lakeshore Dr									6.6	1	NS
172	Alameda Dr	College Ave	60	50	71	43%	2%	1%	22%	4442	1	1	NS
104	Rio Salado Pkwy	McClintock Dr	16	8	23	23%	37%	90%	19%	39025	1	0	NS
124	Western Canal	McClintock Dr	10	7	14	32%	27%	63%	27%	30170	5	1	NS
127	Elliot Rd	McClintock Dr	6	3	9	9%	30%	87%	4%	27418	5.5	1	NS
128	Alameda Dr	McClintock Dr	17	16	18	40%	9%	19%	19%	27807	2	0	NS
155	University Dr	McClintock Dr	9	9	9	12%	18%	76%	29%	36366	1	1	NS
159	Broadway Rd	McClintock Dr	15	15		40%	20%	47%	27%	31175	1.5	0	NS
164	Southern Ave	McClintock Dr	17	16	18	34%	13%	43%	10%	39001	2.5	0	NS
173	Apache Blvd	McClintock Dr	31		31	16%	23%	72%	16%	34880	1	0	NS
174	Baseline Rd	McClintock Dr	9	8	10	22%	8%	53%	0%	37496	3.5	0	NS
175	Guadalupe Rd	McClintock Dr	9	9		28%	28%	67%	22%	30170	4.5	0	NS
176	Warner Rd	McClintock Dr	8	8	8	35%	35%	74%	29%	21129	5.5	0	NS
177	La Vieve Ln	McClintock Dr	6	7	6	29%	25%	71%	38%	37496	6.8	0	NS
135	Lemon St	Rural Rd	60	62	59	5%	46%	92%	21%	37510	0	0	NS

East-West Direction

Loc ID	Location or Intersection: E/W	Location or Intersection: N/S	Total per hr	AM per hr	PM per hr	Helmet%	Wrong way%	Sidewalk%	Female%	Traffic Dir	Loc to ASU	Lane in Dir	Dir
101	Washington/Curry	Mill Ave	6	6		64%	27%	36%	27%	14035	0.6	1	EW
102	Rio Salado Pkwy	Mill Ave	14	6	21	26%	37%	67%	19%	14634	0	1	EW
103	Rio Salado Pkwy	Rural Rd	15	8	22	47%	22%	53%	19%	14634	0	1	EW
105	Rio Salado Pkwy	Hardy Dr	5		5	70%	10%	20%	0%	9784	0.83	1	EW
106	5th St	Mill Ave	51	44	59	10%	4%	8%	23%	6739	0	1	EW
108	5th St	Farmer Ave	57	57		10%	4%	9%	26%	3508	0.25	1	EW
109	5th St	Hardy Dr	36		36	15%	6%	13%	39%	3747	0.72	1	EW
110	5th St	Priest Dr	6	5	7	27%	9%	23%	14%	3747	1.24	1	EW
111	10th St	Mill Ave	55	77	34	19%	1%	5%	36%		0	1	EW
113	13th St	Mill Ave	19		19	35%	8%	0%	38%	3917	0	1	EW
114	13th St	Hardy Dr	24	19	29	19%	11%	8%	31%	3917	0.72	1	EW
115	University Dr	College Ave	118	110	127	6%	34%	61%	27%	26482	0	1	EW
116	University Dr	Dorsey Ln	59	45	73	9%	31%	55%	24%	30015	0.5	1	EW
117	University Dr	Rural Rd	135	97	173	6%	34%	54%	28%	30015	0	1	EW
118	University Dr	Mill Ave	93	72	114	9%	26%	47%	20%	27003	0	1	EW
119	University Dr	Ash Ave	53	53		12%	19%	28%	22%	27003	0.11	1	EW
120	University Dr	Roosevelt St	65		65	12%	11%	33%	20%	27003	0.43	1	EW
121	University Dr	Hardy Dr	27	19	36	22%	20%	36%	17%	27003	0.72	1	EW
122	McKellips Rd	Greenbelt Path	5	6	5	24%	14%	33%	24%	14788	2.2	1	EW
123	Western Canal	Rural Rd	28		28	93%	0%	0%	25%		4	1	EW
129	Alameda Dr	Rural Rd	29		29	48%	7%	26%	34%	1841	1	1	EW
130	Alameda Dr	Country Club Wy	5	4	6	68%	5%	5%	37%		2.5	1	EW
131	Apache Blvd	Rural Rd	130		130	7%	39%	49%	25%	22165	0	1	EW
133	Apache Blvd	College Ave	71	74	68	10%	20%	37%	40%	22165	0	1	EW
138	Broadway Rd	Rural Rd	20	22	18	14%	31%	64%	14%	30063	0.5	0	EW
139	Broadway Rd	College Ave	18	23	13	17%	10%	22%	35%	29614	0.5	0	EW
140	Southern Ave	Priest Dr	7	9	6	31%	41%	86%	14%	30697	2.75	0	EW
141	Southern Ave	College Ave	15	12	19	7%	34%	95%	13%	35372	1.5	0	EW
142	Southern Ave	Rural Rd	24	10	37	10%	40%	98%	18%	35372	1.5	0	EW
143	Southern Ave	Hardy Dr	7	7		46%	0%	46%	8%	28429	2.22	0	EW

144	Southern Ave	Mill Ave	17	14	21	9%	49%	99%	17%	35372	1.5	0	EW
145	Alameda Dr	Mill Ave	6	6		64%	18%	9%	18%	1841	1	1	EW
146	Broadway Rd	Mill Ave	19	15	22	14%	19%	57%	26%	31585	0.5	0	EW
152	Tempe Lake S.	TCA Bridge	19	10	28	36%	0%	0%	27%	0	0.8	1	EW
154	Terrace Rd	Rural Rd	60	61	59	8%	4%	14%	18%		0	1	EW
157	Curry Rd	College Ave	3	3		60%	0%	20%	40%	15990	1.1	1	EW
158	Washington St	Priest Dr	16	14	18	44%	30%	52%	14%	14565	1.5	1	EW
160	Broadway Rd	Hardy Dr	12		12	13%	17%	96%	9%	31585	1.3	0	EW
162	Broadway Rd	Roosevelt St	9	5	14	22%	25%	92%	14%	31585	1.1	0	EW
163	University Dr	Farmer Ave	62	57	67	9%	28%	35%	22%	27003	0.2	1	EW
165	University Dr	Priest Dr	21		21	29%	22%	63%	5%	28413	1.2	1	EW
166	8th St	Dorsey Ln	35		35	4%	14%	6%	17%		0.5	1	EW
169	Baseline Rd	Kyrene Rd	12	12		21%	50%	100%	29%	24094	3.1	0	EW
170	Knox Rd	Priest Dr	1		1	0%	100%	100%	0%		7.9	0	EW
171	Knox Rd	Lakeshore Dr	5		5	22%	22%	11%	44%		6.6	1	EW
172	Alameda Dr	College Ave	14	21	7	34%	0%	4%	23%	1841	1	1	EW
104	Rio Salado Pkwy	McClintock Dr	9	5	14	16%	27%	78%	16%	20597	1	1	EW
124	Western Canal	McClintock Dr	23	18	28	58%	0%	0%	13%		5	1	EW
127	Elliot Rd	McClintock Dr	7	6	8	0%	29%	100%	21%	38743	5.5	0	EW
128	Alameda Dr	McClintock Dr	10	11	9	53%	8%	11%	37%		2	1	EW
155	University Dr	McClintock Dr	25	25	25	18%	34%	59%	16%	30015	1	1	EW
159	Broadway Rd	McClintock Dr	17	17		15%	24%	91%	24%	32138	1.5	0	EW
164	Southern Ave	McClintock Dr	16	15	17	18%	29%	74%	32%	28316	2.5	0	EW
173	Apache Blvd	McClintock Dr	45		45	16%	35%	54%	21%	18699	1	0	EW
174	Baseline Rd	McClintock Dr	6	3	8	14%	27%	86%	5%	24620	3.5	0	EW
175	Guadalupe Rd	McClintock Dr	5	5		40%	30%	70%	10%	25027	4.5	0	EW
176	Warner Rd	McClintock Dr	4	2	7	35%	24%	53%	6%	25930	5.5	0	EW
177	La Vieve Ln	McClintock Dr	1	1	2	50%	25%	50%	25%		6.8	0	EW
135	Lemon St	Rural Rd	115	110	121	6%	14%	33%	20%		0	1	EW



## Appendix H Climate Data, TEMPE ASU AZ US [20]

Date	PRCP	TMAX	TMIN	TOBS_5pm
3/29/2011	0	86	48	81
3/30/2011	0	87	49	82
3/31/2011	0	92	53	91
4/3/2012	0	79	41	76
4/4/2012	0	85	44	80
4/5/2012	0	88	51	85
3/26/2013	0	88	54	85
3/27/2013	0	85	50	82
3/28/2013	0	86	51	84
3/25/2014	0	88	48	76
3/26/2014	0	81	49	72
3/27/2014	0	76	46	68
3/24/2015	0	86	48	86
3/25/2015	0	87	51	86
3/26/2015	0	89	54	87
3/29/2016	0	77	54	65
3/30/2016	0	69	47	67
3/31/2016	0	74	41	71