

Appendix PHL – Philadelphia, Pennsylvania 2003 Annual Report on Freeway Mobility and Reliability

This report is a supplement to: *Monitoring Urban Freeways in 2003: Current Conditions and Trends from Archived Operations Data*. Texas Transportation Institute and Cambridge Systematics, Inc., Report No. FHWA-HOP-05-018, December 2004, available at <http://mobility.tamu.edu/mmp>.

Exhibit PHL-1: Current Measures and Trends

Measures	Current Year	Last Year		Two Years Ago	
	2003	2002	Change	2001	Change
Performance Measures					
Travel Time Index	1.21	1.22	-1% ↓	1.22	0% —
Planning Time Index	1.49	1.48	0% —	1.50	-1% ↓
Buffer Index	19%	18%	+1% ↑	20%	-1% ↓
% Congested Travel	52%	50%	+2% ↑	52%	0% —
Total Delay (veh-hours) per 1000 VMT	3.92	4.01	-2% ↓	3.78	+4% ↑
Explanatory Measures					
Peak Period VMT (000)	3,250	3,270	-1% ↓	2,000	+63% ↑
Avg. Annual DVMT (000)	11,440	11,410	0% —	7,080	+62% ↑
Data Quality Measures					
% complete	91%	93%	-2% ↓	91%	0% —
% valid	99%	99%	0% —	96%	+3% ↑
% of VMT covered	36%	37%	-1% ↓	24%	+12% ↑
% of freeway miles	36%	37%	-1% ↓	37%	-1% ↓

* See pages 7 and 8 for maps of freeway coverage, measure definitions, and further documentation.

Exhibit PHL-2: 2000 to 2003 Annual Trends

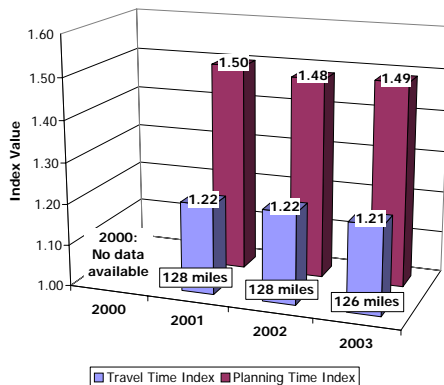
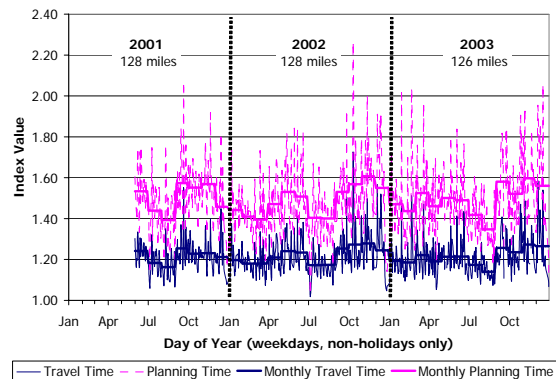


Exhibit PHL-3: Daily and Monthly Trends



Comments

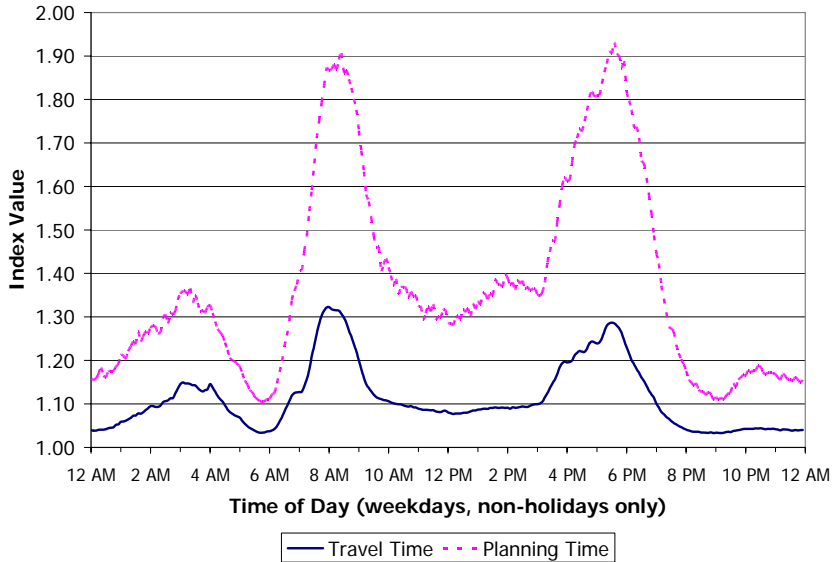
- Traffic congestion in Philadelphia has remained relatively stable since 2001, with a slight decrease in the travel time index and total delay, and slight increase in the buffer index and percent congested travel.
- Vehicle travel (DVMT) has remained stable since 2002. The 62-63% increase in VMT from 2001 is most likely a result of less than a full year of data in 2001.

Data Source(s): Mobility Technologies, Inc. (<http://www.mobilitytechnologies.com/> and <http://traffic.com>)
Includes 126 of 352 (26%) total freeway miles in Philadelphia; collected using microwave and acoustic sensors; see page 7 for additional information on the data source

Data Analysis: Texas Transportation Institute, analysis completed September 2004

Time of Day Patterns and Trends

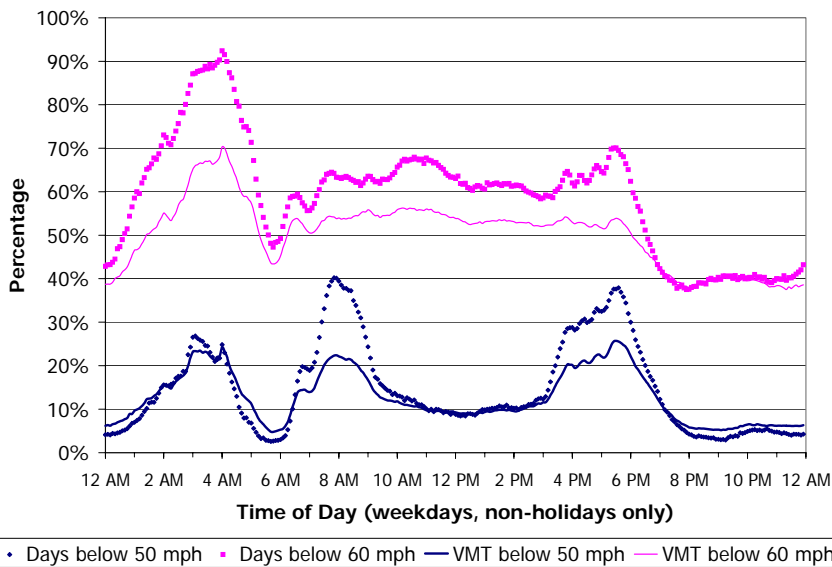
The charts on this page illustrate average weekday (no holidays included) traffic patterns and trends that were measured on the freeway sections instrumented with operations-based traffic sensors.



Comments

- This chart shows areawide congestion and reliability patterns. The difference between the solid line (travel time index) and the dashed line (planning time index) is the additional “buffer” or “time cushion” that travelers must add to average trip times to ensure 95% on-time arrival.
- The evening congestion level is comparable to the morning congestion level.
- Travelers must add 30-45% additional buffer time during peak times to account for traffic unreliability.

Exhibit PHL-4: Mobility and Reliability by Time of Average Weekday



Comments

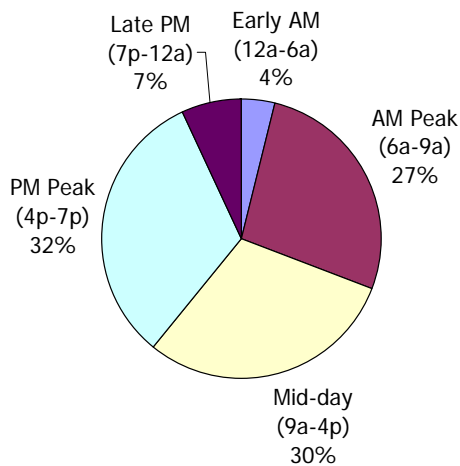
- This chart illustrates the difference in using two different speed thresholds (50 and 60 mph) to compute the percent of congested days as well as the percent of congested travel.
- This chart indicates slow speeds (even less than 50 mph) in the early morning hours. The cause of these slow speeds is unknown, but traffic volumes during this time indicate that slow speeds are not being caused by heavy traffic.

Exhibit PHL-5: Frequency and Percentage of Congested Travel by Time of Average Weekday

Time Period of the Day Patterns and Trends

The charts on this page illustrate average weekday (no holidays included) traffic patterns and trends that were measured on the freeway sections instrumented with operations-based traffic sensors. The time periods are defined uniformly for all cities to facilitate trend analysis over time and between cities. The time periods are defined as follows:

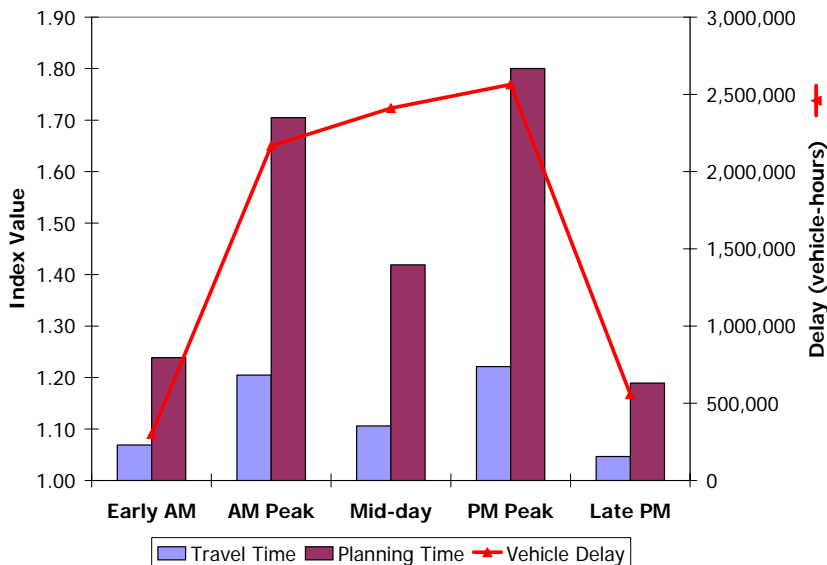
- Early AM: 12 to 6 am
- AM Peak: 6 to 9 am
- Mid-day: 9 am to 4 pm
- PM Peak: 4 to 7 pm
- Late PM: 7 pm to 12 am



Comments

- This chart shows the percent of delay that occurred during different time periods of an average weekday. Note that the AM and PM peak periods are the same duration, but that the other time periods have different lengths.
- The delay in the afternoon peak period is slightly greater than during the morning peak period.
- Delay during the mid-day period is slightly greater than during the morning peak period.

Exhibit PHL-6: Percent of Delay by Time Period



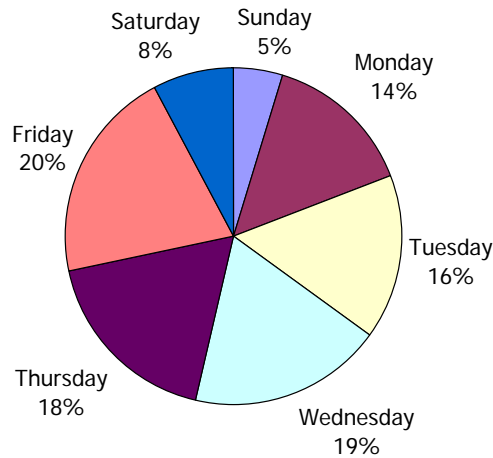
Comments

- This chart shows congestion and reliability (shown as bars) as well as delay (shown as a line) during different time periods of an average weekday.
- The trends in this chart follow closely those shown in Exhibit 6.
- The travel time index for the mid-day period is low, but the delay is relatively high because of the length of this time period (7 hours).

Exhibit PHL-7: Mobility, Reliability, and Delay by Time Period

Day of Week Patterns and Trends

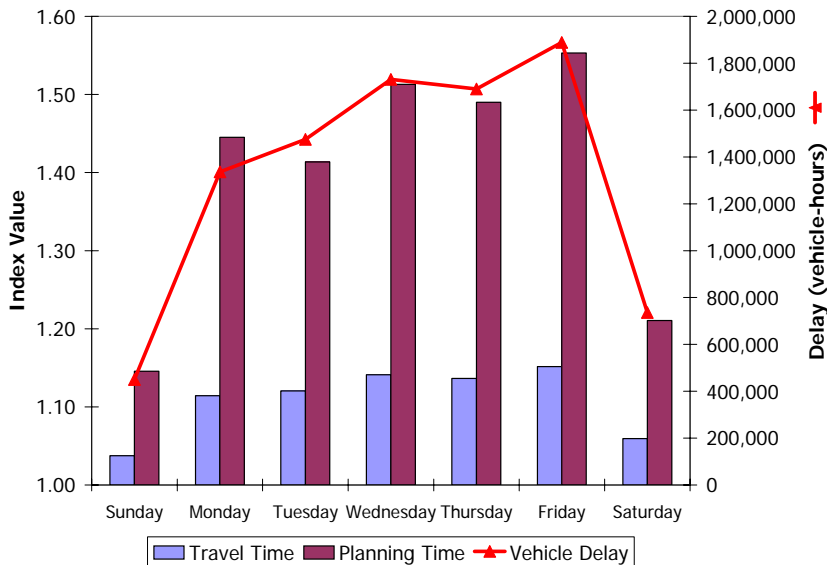
The charts on this page illustrate average traffic patterns and trends that were measured on the freeway sections instrumented with operations-based traffic sensors. Because of different peak period times and lengths on weekdays and weekends, the statistics presented on this page are 24-hour daily totals or averages.



Comments

- This chart shows the percent of total daily delay that occurred during each day of the week.
- Friday has the most delay, and Monday has the least delay of all weekdays.
- Each weekend day has about 30-50% of the delay of a typical weekday.

Exhibit PHL-8: Percent of Daily Vehicle Delay by Day of Week



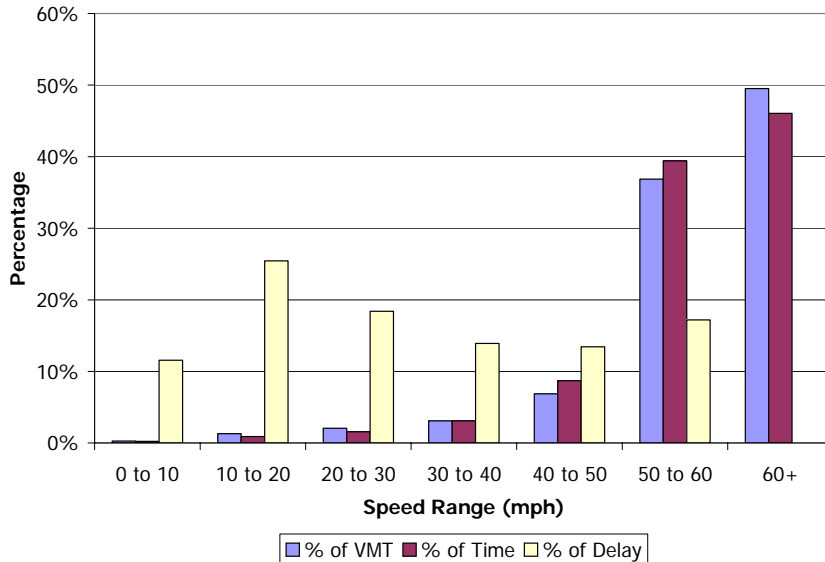
Comments

- This chart shows average daily congestion and reliability (shown as bars) as well as total daily delay (shown as a line) during each day of the week.
- The trends in this chart follow closely those shown in Exhibit 8.
- Friday has the most delay and also is the least reliable day (highest planning time index).

Exhibit PHL-9: Mobility, Reliability, and Delay by Day of Week

Other Traffic Data Patterns and Trends

The chart on this page illustrates average traffic patterns and trends that were measured on the freeway sections instrumented with operations-based traffic sensors.



Comments

- This chart shows the percent of VMT, time, and delay in different speed ranges. This chart is useful to determine how much VMT and delay occurred at different congestion levels.
- Nearly 20% of the delay is in the 50 to 60 mph range.
- Only 4% of the VMT is below 30 mph, but 55% of the delay occurred below 30 mph.

Exhibit PHL-10: Percent of VMT, Delay and Time Periods in Different Speed Ranges

Mobility and Reliability Statistics for Specific Freeway Sections

The table in this section illustrates average weekday (no holidays included) statistics from the freeway sections instrumented with operations-based traffic sensors. Where possible, the freeway sections have been defined to begin and end at major interchanges, streets, or other locations where traffic conditions are likely to change. The freeway sections are typically between 5 and 10 miles in length.

Exhibit PHL-11. Mobility and Reliability by Section and Time Period

Freeway Section (sorted from most congested to least congested sections)	Length (mi)	Travel Time Index				Buffer Index			
		Morning Peak (6a-9a)	Midday (9a-4p)	Evening Peak (4p-7p)	Average peak period	Morning Peak (6a-9a)	Midday (9a-4p)	Evening Peak (4p-7p)	Average peak period
I-76 EB: I-276 to I-476	5.86								
I-76 WB: I-476 to I-276	6.79								
I-76 EB: I-476 to US 1/City Ave	7.59								
I-76 EB: US 1/City Ave to I-95	9.53								
I-476 SB: PA 3 to I-95	9.38								
US 422 EB: I-76 to PA 29	8.17								
I-76 WB: US 1/City Ave to I-476	7.59								
US 1 SB: SR 611 to I-76	3.83								
I-76 WB: I-95 to US 1/City Ave	9.46								
I-95 SB: PA 63/Woodhaven to I-676	13.20								
US 1 NB: I-76 to SR 611	3.83								
US 202 SB: US 422 to US 30	9.80								
I-95 NB: I-676 to PA 63/Woodhaven	13.45								
I-476 SB: I-276 to I-76	3.99								
I-476 NB: I-95 to PA 3	9.38								
I-476 SB: I-76 to PA 3	6.52								
US 202 NB: US 30 to US 422	9.80								
I-95 NB: Delaware State Line to I-476	7.10								
I-476 NB: I-76 to I-276	3.99								
PA-309 NB: Waverly Rd to Norristown Rd	9.59								
I-95 NB: PA 63/Woodhaven to New Jersey State Line	15.65								
US 422 WB: PA 29 to I-76	8.17								
I-95 SB: I-676 to I-76	3.85								
I-95 SB: I-76 to I-476	11.55								
PA-309 SB: Norristown Rd to Waverly Rd	9.59								
I-95 SB: I-476 to Delaware State Line	7.10								
I-95 NB: I-476 to I-76	11.55								
I-476 NB: PA 3 to I-76	6.52								
I-95 NB: I-76 to I-676	3.60								
I-95 SB: New Jersey State Line to PA 63/Woodhaven	15.65								
Average for all Sections		1.20	1.11	1.22	1.21	37%	27%	44%	41%

Route-specific information is the property of
Mobility Technologies, Inc.
Agencies or companies interested in viewing route-specific
information should direct their request to
Mobility Technologies, Inc. at DataRequests@traffic.com.

Comments

- This table shows average weekday congestion (travel time index) and reliability (buffer index) for specific routes for different time periods of the day.
- All but four of the freeway sections have travel time index values less than 1.50.
- I-76 appears to be the most congested and least reliable freeway corridor.

Source and Coverage of Data

This report was produced using data collected and archived by Mobility Technologies, Inc. (<http://www.mobilitytechnologies.com/>). A map of the freeway routes on which traffic data was collected is shown below.

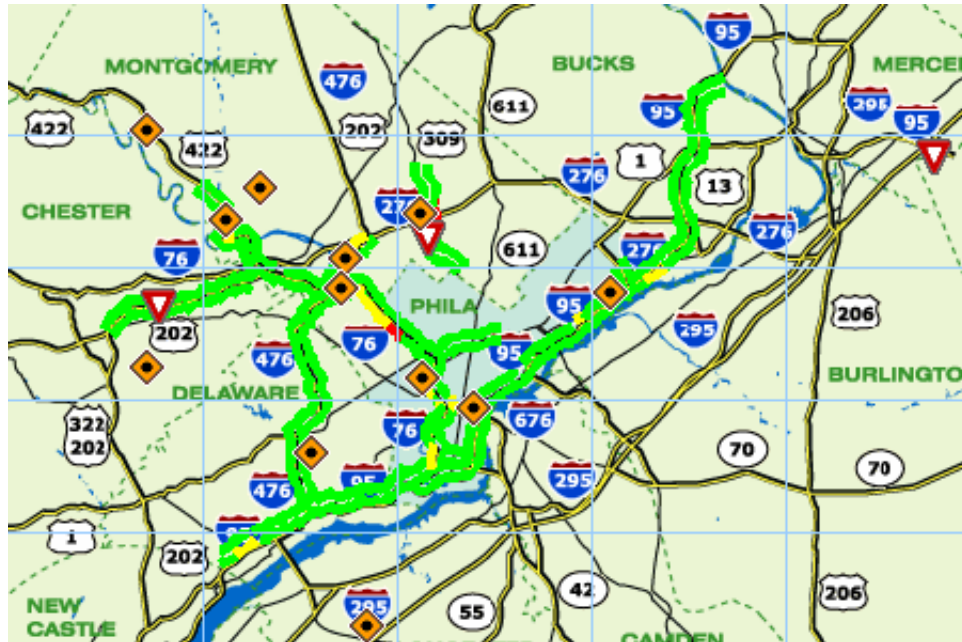


Exhibit PHL-12: Freeway Routes with Traffic Sensors in Philadelphia
 (Source of graphic: Mobility Technologies, <http://traffic.com>)

Exhibit PHL-13: Instrumented Freeway Coverage in Philadelphia

Coverage Measures	Year	Instrumented Freeway Routes	Total Freeway System ¹	Percent Coverage
Lane-miles	2000	0	2,065	n.a.
	2001	690	2,070	33%
	2002	688	2,085	33%
	2003	687	2,095	33%
Centerline-miles	2000	0	347	n.a.
	2001	128	347	37%
	2002	128	350	37%
	2003	126	352	36%
Average annual daily vehicle-miles of travel (DVMT) (1000)	2000	0	28,930	n.a.
	2001	7,080	30,050	24%
	2002	11,410	30,770	37%
	2003	11,445	31,690	36%

¹Source is FHWA's Highway Performance Monitoring System and the Texas Transportation Institute's Urban Mobility Study (<http://mobility/tamu.edu/ums>).

Documentation and Definitions

Performance Measures

- **Travel Time Index:** ratio of the average peak period travel time to an off-peak travel time. For example, a value of 1.20 means that average peak travel times are 20% longer than off-peak travel times. In this report, the morning peak period is from 6 to 9 a.m. and the evening peak period is from 4 to 7 p.m. The off-peak travel time is calculated by assuming a free-flow speed of 60 mph.
- **Planning Time Index:** statistically defined as the 95th percentile Travel Time Index, this measure also represents the extra time most travelers include when planning peak period trips. For example, a value of 1.60 means that travelers plan for an additional 60% travel time above the off-peak travel times to ensure 95% on-time arrival.
- **Buffer Index:** the extra time (or buffer) needed to ensure on-time arrival for most trips. For example, a value of 40% means that a traveler should budget an additional 8 minute buffer for a 20-minute average peak trip time to ensure 95% on-time arrival. In this report, the buffer index is a VMT-weighted average of the buffer index for each route for the morning and evening peak period. The buffer index is calculated for each route and time period as follows: $\text{buffer index} = (95^{\text{th}} \text{ percentile travel time} - \text{average travel time}) / \text{average travel time}$.
- **% Congested Travel:** the congested peak period vehicle-miles of travel (VMT) divided by total VMT in the peak period. This is a relative measure of the amount of peak period travel affected by congestion.
- **Total Delay per 1000 VMT:** the total vehicle delay (in vehicle-hours) divided by the amount of VMT. This is a relative measure of the total delay and will not be as affected by changes in the level of sensor instrumentation for a particular city.
- **Vehicle Delay:** the delay (in vehicle-hours) experienced by vehicles traveling less than free-flow speeds (assumed to be 60 mph in this report).

Explanatory Measures

- **Peak Period VMT:** the average amount of VMT within the defined peak periods (weekdays from 6 to 9 a.m. and 4 to 7 p.m.) for the year. Peak period VMT is reported by 1000s.
- **Average Annual DVMT (000):** the average annual amount of daily VMT (DVMT) for all days and times for the year. Average annual DVMT is reported by 1000s.

Data Quality Measures

- **% complete:** the number of valid reported data values divided by the number of total expected data values (given the number of active sensors and time periods). In this report, % complete is reported as the lowest value of either traffic volume or speed data.
- **% valid:** the number of reported data values that passed defined acceptance criteria divided by the total number of reported data values. In this report, % valid is reported as the lowest value of either traffic volume or speed data.
- **% of DVMT covered:** the amount of average annual DVMT reported by sensors divided by the areawide average annual DVMT as estimated in FHWA's Highway Performance Monitoring System and TTI's Urban Mobility Study. This measure characterizes the relative amount of areawide travel that has the performance indicated in this report.
- **% coverage of freeway mileage:** the amount of freeway lane-miles containing sensors divided by the areawide freeway lane-miles as estimated in FHWA's Highway Performance Monitoring System and TTI's Urban Mobility Study. This measure characterizes the relative amount of areawide freeways that has the performance indicated in this report.