

Performance Measure Summary – Phoenix, AZ

There are several inventory and performance measures listed in the pages of this Urban Area Report for the years from 1982 to 2007. There is no single performance measure that experts agree “says it all.” The best comparison of congestion levels and trends is done between regions of similar size, over several years, and with a few measures of congestion. Examining a few measures over many years reduces the chance that data variations or the estimating procedures may have caused a “spike” in any single year. A few key points should be recognized by users of the Urban Mobility Report data.

Use the Trends – The multi-year performance measures are better indicators, in most cases, than any single year. (*5 years is 5 times better than 1 year*).

Use several measures – Each performance measure illustrates a different element of congestion. (*The view is more interesting from the top of a few measures*).

Compare to similar regions – Congestion analyses that compare areas with similar characteristics (for example population, growth rate, road and public transportation system design) are usually more insightful than comparisons of different regions. (*Los Angeles is not Peoria*).

Compare ranking changes and performance measure values – In some performance measures a small change in the value may cause a significant change in rank from one year to the next. This is the case when there are several regions with nearly the same value. (*15 hours is only 1 hour more than 14 hours*).

Consider the scope of improvement options – Any improvement project in a corridor within most of the regions will only have a modest effect on the regional congestion level. (*To have an effect on areawide congestion, there must be significant change in the system or service*).

Performance Measures and Definition of Terms

Travel Time Index – A measure of congestion that focuses on each trip and each mile of travel. The ratio of travel time in the peak period to travel time in free-flow. A value of 1.30 indicates a 20-minute free-flow trip takes 26 minutes in the peak.

Peak Travelers – Number of travelers (using any travel mode) who begin a trip during the morning or evening peak travel periods (6 to 9 a.m. and 4 to 7 p.m.).

Annual Delay per Traveler – A yearly sum of all the per-trip delays. This measure illustrates the effect of the per-mile congestion as well as the length of each trip. The extra time required to travel in the peak period is divided by the number of travelers who begin a trip during the peak period (6 to 9 a.m. and 4 to 7 p.m.).

Total Delay – The overall size of the congestion problem. Measured by the total travel time above that needed to complete a trip at free-flow speeds. The ranking of total delay usually follows the population ranking (larger regions usually have more delay).

Free-Flow Speeds (60 mph on freeways and 35 mph on arterials) – These values are used as the national comparison thresholds. Other speed values may be appropriate for urban areas or sub-regions.

Excess Fuel Consumed – Increased fuel consumption due to travel in congested conditions rather than free-flow conditions.

Public Transportation – Regular route service from all public transportation providers in an urban area.

Operations Treatments – Freeway incident management, freeway ramp metering, arterial street signal coordination and arterial street access management.

Congestion Cost – Value of travel delay for 2007 (estimated at \$15.47 per hour of person travel and \$102.12 per hour of truck time) and excess fuel consumption (estimated using state average cost per gallon).

Annual Increase Needed to Maintain Constant Congestion Level – Number of lane-miles that must be added to the road system each year – or – the number of new transit riders or carpoolers that must be added to keep congestion levels the same as the previous year.

Urban Area – The developed area (population density more than 1,000 persons per square mile) within a metropolitan region. The urban area boundaries change frequently (every year for most growing areas). The annual change in miles traveled, therefore, includes both new travel due to growth and travel that previously occurred in areas designated as rural.

Number of Rush Hours – Time when system might have congestion.

The Mobility Data for Phoenix AZ

Inventory Measures	2007	2006	2005	2004	2003	2002
Urban Area Information						
Population (1000s)	3,425	3,350	3,270	3,130	3,005	2,950
Rank	13	13	13	13	13	13
Urban Area (square miles)	1,165	1,160	1,155	1,150	1,140	1,140
Population Density (persons/sq mile)	2,940	2,888	2,831	2,722	2,636	2,588
Peak Travelers (1000s)	1,829	1,776	1,720	1,634	1,557	1,502
Freeway						
Daily Vehicle-Miles of Travel (1000s)	29,450	29,400	28,370	26,670	25,000	22,550
Lane-Miles	1,535	1,490	1,405	1,350	1,325	1,230
Arterial Streets						
Daily Vehicle-Miles of Travel (1000s)	35,000	34,500	34,105	32,110	31,035	30,515
Lane-Miles	7,165	6,890	6,535	6,230	6,000	5,800
Public Transportation						
Annual Psgr-Miles of Travel (millions)	283	283	260	224	216	182
Annual Unlinked Psgr Trips (millions)	66	64	61	55	54	45
Cost Components						
Value of Time (\$/hour)	15.47	15.06	14.58	14.10	13.73	13.43
Commercial Cost (\$/hour)	102.12	98.77	94.06	86.24	82.38	79.96
Fuel Cost (\$/gallon)	3.03	2.63	2.42	2.04	1.59	1.47
System Performance	2007	2006	2005	2004	2003	2002
Congested Travel (% of peak VMT)	68	69	72	67	63	63
Congested System (% of lane-miles)	50	54	54	49	49	44
Congested Time (number of "Rush Hours")	7.6	7.8	7.8	7.8	7.6	7.6
Annual Increase Needed to Maintain Constant Congestion Level:						
Lane-miles	345	376	412	395	397	356
Transit Riders or Carpoolers (millions)	89	99	112	106	106	94
Annual Excess Fuel Consumed						
Total Fuel (1000 gallons)	57,200	56,442	58,189	47,936	44,055	40,952
Rank	14	14	14	15	15	15
Fuel per Peak Traveler (gallons)	31	32	34	29	28	27
Rank	14	13	11	21	17	18
Annual Delay						
Total Delay (1000s of person-hours)	80,456	79,029	81,677	68,219	63,715	60,176
Rank	14	14	14	15	15	15
Delay per Peak Traveler (person-hours)	44	45	47	42	41	40
Rank	14	14	13	21	17	17
Delay due to Incidents (percent)	50	50	50	50	50	50
Travel Time Index						
	1.30	1.29	1.31	1.27	1.26	1.25
Rank	17	20	15	23	23	23
Congestion Cost						
Total Cost (\$ millions)	1,891	1,785	1,773	1,390	1,241	1,148
Rank	13	13	13	14	14	14
Cost per Peak Traveler (\$)	1,034	1,006	1,031	851	797	765
Rank	11	11	6	14	13	12

Note: System Performance statistics for 2000 through 2007 data reflect the effects of operational treatments.

Note: Zeroes in the table reflect values less than 0.5.

The Mobility Data for Phoenix AZ, Continued

Inventory Measures	2001	2000	1999	1998	1997
Urban Area Information					
Population (1000s)	2,900	2,825	2,700	2,550	2,450
Rank	13	13	13	15	15
Urban Area (square miles)	1,130	1,120	1,110	1,100	1,090
Population Density (persons/sq mile)	2,566	2,522	2,432	2,318	2,248
Peak Travelers (1000s)	1,453	1,393	1,310	1,216	1,149
Freeway					
Daily Vehicle-Miles of Travel (1000s)	21,600	19,425	16,995	15,005	13,925
Lane-Miles	1,140	1,030	960	900	870
Arterial Streets					
Daily Vehicle-Miles of Travel (1000s)	29,725	29,100	28,600	28,025	27,500
Lane-Miles	5,620	5,455	5,315	5,300	5,260
Public Transportation					
Annual Psgr-Miles of Travel (millions)	176	169	169	161	155
Annual Unlinked Psgr Trips (millions)	41	40	41	37	36
Cost Components					
Value of Time (\$/hour)	13.22	12.85	12.43	12.17	11.98
Commercial Cost (\$/hour)	80.88	80.75	74.23	72.61	74.32
Fuel Cost (\$/gallon)	1.62	1.52	1.38	1.19	1.32
System Performance	2001	2000	1999	1998	1997
Congested Travel (% of peak VMT)	65	64	60	57	53
Congested System (% of lane-miles)	45	41	40	39	39
Congested Time (number of "Rush Hours")	7.6	7.6	7.4	7.2	7.2
Annual Increase Needed to Maintain Constant Congestion Level:					
Lane-miles	326	297	268	221	198
Transit Riders or Carpoolers (millions)	86	77	68	53	46
Annual Excess Fuel Consumed					
Total Fuel (1000 gallons)	43,374	38,718	34,673	29,328	27,086
Rank	15	15	15	16	16
Fuel per Peak Traveler (gallons)	30	28	26	24	24
Rank	15	15	19	18	17
Annual Delay					
Total Delay (1000s of person-hours)	62,112	55,069	50,221	43,586	40,237
Rank	14	15	15	16	16
Delay per Peak Traveler (person-hours)	43	40	38	36	35
Rank	14	17	18	18	20
Delay due to Incidents (percent)	50	50	50	51	51
Travel Time Index	1.28	1.26	1.25	1.22	1.21
Rank	13	15	16	19	20
Congestion Cost					
Total Cost (\$ millions)	1,185	1,031	894	759	701
Rank	14	15	15	15	15
Cost per Peak Traveler (\$)	816	740	683	624	610
Rank	10	12	11	12	11

Note: System Performance statistics for 2000 through 2007 data reflect the effects of operational treatments.

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The Mobility Data for Phoenix AZ, Continued

Inventory Measures	1996	1995	1994	1993	1992
Urban Area Information					
Population (1000s)	2,340	2,220	2,130	2,070	2,022
Rank	15	15	16	17	17
Urban Area (square miles)	1,080	1,075	1,070	1,060	1,050
Population Density (persons/sq mile)	2,167	2,065	1,991	1,953	1,926
Peak Travelers (1000s)	1,081	1,008	952	911	876
Freeway					
Daily Vehicle-Miles of Travel (1000s)	13,345	12,000	10,600	9,910	9,800
Lane-Miles	825	790	740	680	675
Arterial Streets					
Daily Vehicle-Miles of Travel (1000s)	27,220	26,800	26,400	26,215	25,545
Lane-Miles	5,185	5,100	5,040	5,020	4,970
Public Transportation					
Annual Psgr-Miles of Travel (millions)	145	157	146	143	152
Annual Unlinked Psgr Trips (millions)	34	38	35	35	34
Cost Components					
Value of Time (\$/hour)	11.71	11.37	11.06	10.78	10.47
Commercial Cost (\$/hour)	74.17	71.54	69.53	67.77	66.19
Fuel Cost (\$/gallon)	1.26	1.20	1.19	1.18	1.22
System Performance	1996	1995	1994	1993	1992
Congested Travel (% of peak VMT)	53	50	48	48	46
Congested System (% of lane-miles)	34	34	34	34	33
Congested Time (number of "Rush Hours")	7.2	6.8	6.4	6.6	6.4
Annual Increase Needed to Maintain Constant Congestion Level:					
Lane-miles	207	197	208	253	275
Transit Riders or Carpoolers (millions)	49	45	46	56	60
Annual Excess Fuel Consumed					
Total Fuel (1000 gallons)	25,223	20,987	21,529	20,688	20,534
Rank	15	20	16	16	16
Fuel per Peak Traveler (gallons)	23	21	23	23	23
Rank	18	21	12	11	10
Annual Delay					
Total Delay (1000s of person-hours)	37,920	32,051	33,045	31,908	31,569
Rank	15	20	15	15	16
Delay per Peak Traveler (person-hours)	35	32	35	35	36
Rank	18	22	13	12	11
Delay due to Incidents (percent)	51	52	52	52	52
Travel Time Index	1.20	1.17	1.18	1.18	1.18
Rank	21	26	20	19	17
Congestion Cost					
Total Cost (\$ millions)	650	535	533	502	484
Rank	15	15	15	15	15
Cost per Peak Traveler (\$)	601	530	560	551	552
Rank	11	13	10	10	8

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The Mobility Data for Phoenix AZ, Continued

Inventory Measures	1991	1990	1989	1988	1987
Urban Area Information					
Population (1000s)	1,930	1,895	1,875	1,830	1,820
Rank	18	18	18	18	18
Urban Area (square miles)	985	975	970	970	890
Population Density (persons/sq mile)	1,959	1,944	1,933	1,887	2,045
Peak Travelers (1000s)	822	794	780	756	744
Freeway					
Daily Vehicle-Miles of Travel (1000s)	9,015	7,850	6,705	5,065	4,440
Lane-Miles	660	580	500	400	340
Arterial Streets					
Daily Vehicle-Miles of Travel (1000s)	25,220	25,055	24,310	24,000	23,435
Lane-Miles	4,915	4,820	4,710	4,575	4,440
Public Transportation					
Annual Psgr-Miles of Travel (millions)	156	138	107	84	74
Annual Unlinked Psgr Trips (millions)	31	32	27	22	19
Cost Components					
Value of Time (\$/hour)	10.17	9.75	9.25	8.83	8.48
Commercial Cost (\$/hour)	64.55	62.47	59.16	56.03	54.62
Fuel Cost (\$/gallon)	1.06	1.07	1.11	1.02	1.03
System Performance	1991	1990	1989	1988	1987
Congested Travel (% of peak VMT)	44	46	46	44	43
Congested System (% of lane-miles)	33	37	36	36	32
Congested Time (number of "Rush Hours")	6.2	6.2	6.0	6.0	6.2
Annual Increase Needed to Maintain Constant Congestion Level:					
Lane-miles	289	271	225	185	143
Transit Riders or Carpoolers (millions)	62	57	46	38	29
Annual Excess Fuel Consumed					
Total Fuel (1000 gallons)	18,189	17,569	17,616	15,679	14,252
Rank	16	17	16	16	16
Fuel per Peak Traveler (gallons)	22	22	23	21	19
Rank	11	11	10	11	8
Annual Delay					
Total Delay (1000s of person-hours)	28,450	28,018	28,748	26,645	23,290
Rank	18	17	16	16	15
Delay per Peak Traveler (person-hours)	35	35	37	35	31
Rank	10	10	9	9	8
Delay due to Incidents (percent)	52	53	53	53	53
Travel Time Index	1.16	1.16	1.18	1.17	1.16
Rank	21	19	15	14	12
Congestion Cost					
Total Cost (\$ millions)	423	403	393	347	293
Rank	16	16	15	14	15
Cost per Peak Traveler (\$)	514	508	504	460	394
Rank	8	7	7	5	4

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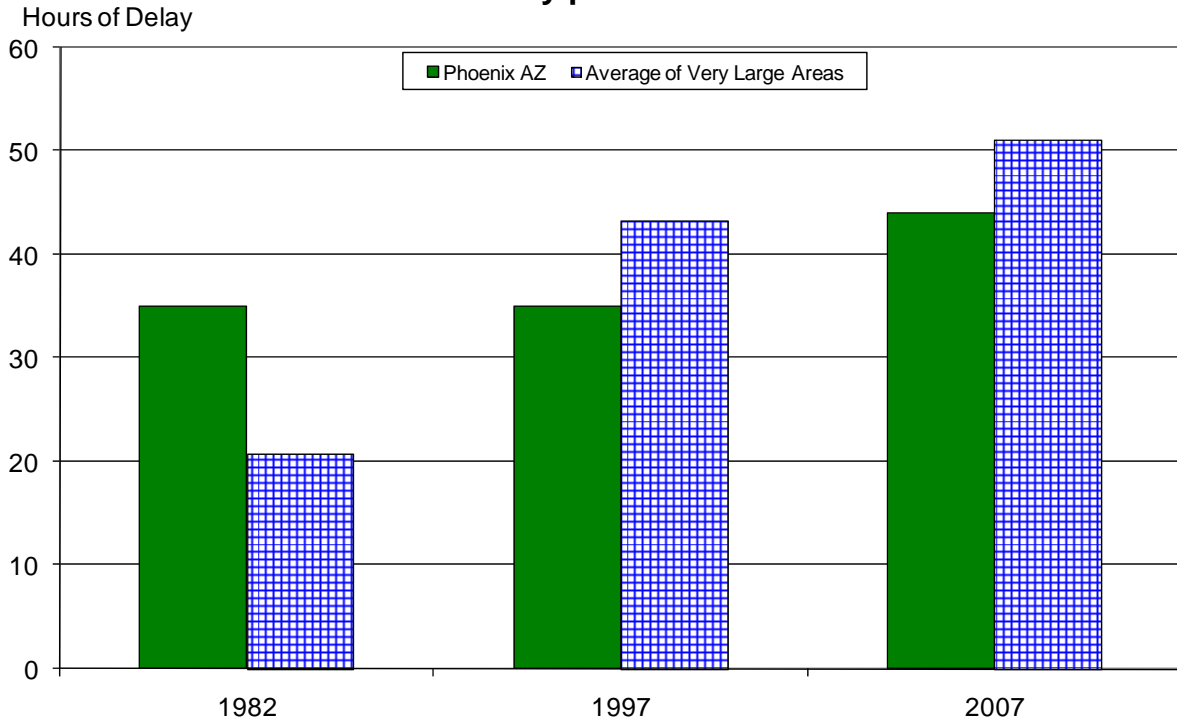
The Mobility Data for Phoenix AZ, Continued

Inventory Measures	1986	1985	1984	1983	1982
Urban Area Information					
Population (1000s)	1,735	1,650	1,590	1,520	1,430
Rank	20	20	20	20	20
Urban Area (square miles)	855	825	730	630	550
Population Density (persons/sq mile)	2,029	2,000	2,178	2,413	2,600
Peak Travelers (1000s)	704	665	636	603	562
Freeway					
Daily Vehicle-Miles of Travel (1000s)	4,050	3,715	3,625	3,035	2,975
Lane-Miles	300	275	260	220	210
Arterial Streets					
Daily Vehicle-Miles of Travel (1000s)	22,525	22,040	21,500	21,185	21,070
Lane-Miles	4,310	4,205	4,185	4,100	4,040
Public Transportation					
Annual Psgr-Miles of Travel (millions)	67	88	78	78	78
Annual Unlinked Psgr Trips (millions)	19	20	19	19	19
Cost Components					
Value of Time (\$/hour)	8.18	8.03	7.75	7.43	7.20
Commercial Cost (\$/hour)	52.63	55.80	54.65	52.70	52.13
Fuel Cost (\$/gallon)	1.00	1.31	1.33	1.36	1.42
System Performance	1986	1985	1984	1983	1982
Congested Travel (% of peak VMT)	43	43	43	43	43
Congested System (% of lane-miles)	32	32	32	31	31
Congested Time (number of "Rush Hours")	6.2	6.4	6.2	6.2	6.4
Annual Increase Needed to Maintain Constant Congestion Level:					
Lane-miles	--	--	--	--	--
Transit Riders or Carpoolers (millions)	--	--	--	--	--
Annual Excess Fuel Consumed					
Total Fuel (1000 gallons)	14,085	13,014	12,230	11,283	11,586
Rank	15	14	12	12	10
Fuel per Peak Traveler (gallons)	20	20	19	19	21
Rank	6	5	5	3	2
Annual Delay					
Total Delay (1000s of person-hours)	23,037	21,388	20,077	19,022	19,636
Rank	14	13	12	10	10
Delay per Peak Traveler (person-hours)	33	32	32	32	35
Rank	5	5	3	3	2
Delay due to Incidents (percent)	53	53	53	53	53
Travel Time Index	1.16	1.15	1.15	1.14	1.15
Rank	8	8	7	6	4
Congestion Cost					
Total Cost (\$ millions)	280	267	243	222	225
Rank	12	11	9	8	8
Cost per Peak Traveler (\$)	397	401	382	369	401
Rank	4	4	3	2	2

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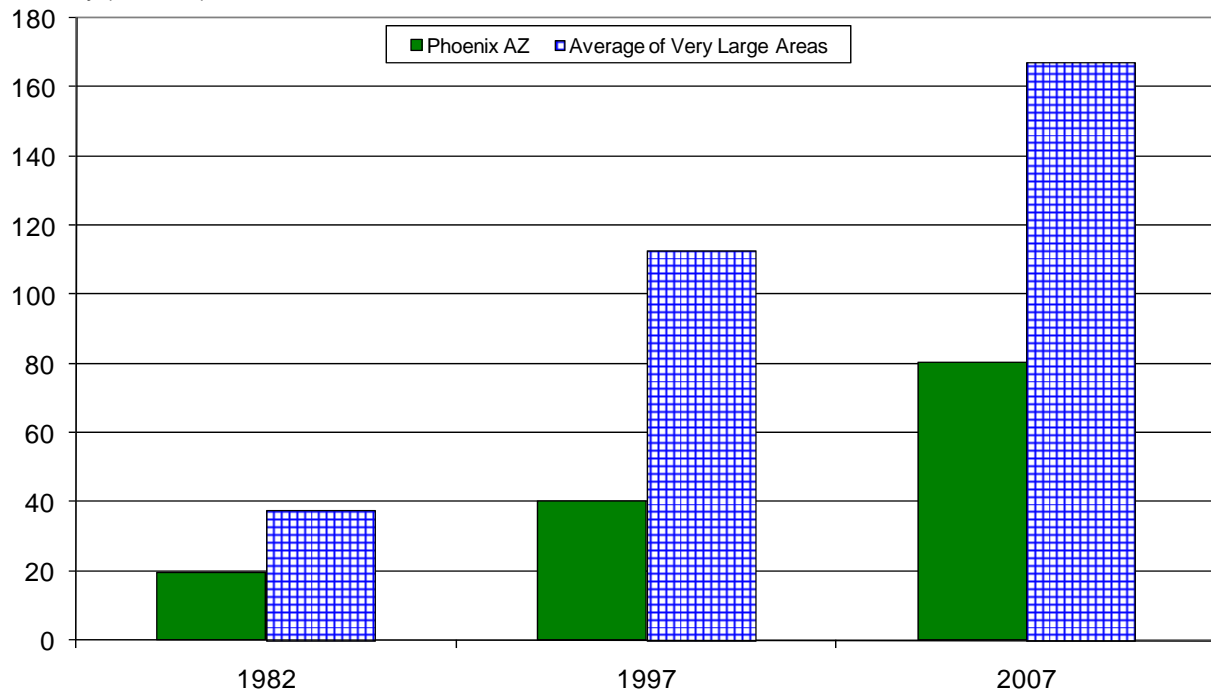
Growth in Delay per Peak Traveler



Note: Very Large areas have populations over 3 million

Annual Hours of Delay (millions)

Growth in Total Delay



Note: Very Large areas have populations over 3 million

**Benefits from Public Transportation Service and Operations Strategies in
Phoenix AZ**

Operations Strategies	2007	2006	2005	2004
Freeway Ramp Metering				
Percent of Roadway Miles	53	50	53	40
Annual Delay Reduction (1000 hours)	1,294	1,377	1,356	1,114
Freeway Incident Management				
Cameras				
Percent of Roadway Miles	63	57	61	63
Service Patrols				
Percent of Roadway Miles	85	86	91	95
Annual Delay Reduction (1000 hours)	2,514	2,470	2,572	2,083
Arterial Signal Coordination				
Percent of Roadway Miles	77	76	78	79
Annual Delay Reduction (1000 hours)	401	500	588	548
Arterial Access Management				
Percent of Roadway Miles	22	22	23	22
Annual Delay Reduction (1000 hours)	621	687	817	667
HOV Lanes				
Daily Passenger-miles of travel (1000s)	302	296	293	287
HOV User Delay Savings	530	513	521	427
Total Effect of Operations Treatments				
Annual Delay Reduction (1000 hours)	5,359	5,547	5,855	4,839
Annual Delay Saved per Peak Traveler (hours)	3	3	3	3
Annual Congestion Cost Savings (\$million)	121.4	121.3	123.4	95.9
Travel Time Index with Strategies	1.296	1.295	1.312	1.268
Travel Time Index (Base)	1.316	1.315	1.334	1.287
Public Transportation Service	2007	2006	2005	2004
Existing Service				
Annual Passenger-miles of travel (million)	283	283	260	224
Unlinked Passenger Trips (million)	66	64	60	55
Travel Time Index (combined road and transit)	1.311	1.310	1.330	1.283
Condition if Public Transportation Service were Discontinued				
Travel Time Index	1.321	1.319	1.339	1.290
Annual Increase				
Delay (1000 hours)	2,566	2,375	2,485	1,852
Delay per Peak Traveler (hours)	1	1	1	1
Congestion Cost (\$million)	59.8	53.1	53.6	37.4

**Benefits from Public Transportation Service and Operations Strategies in
Phoenix AZ, Continued**

Operations Strategies	2003	2002	2001	2000
Freeway Ramp Metering				
Percent of Roadway Miles	38	40	44	49
Annual Delay Reduction (1000 hours)	883	486	787	712
Freeway Incident Management				
Cameras				
Percent of Roadway Miles	64	67	57	44
Service Patrols				
Percent of Roadway Miles	78	81	88	95
Annual Delay Reduction (1000 hours)	1,687	1,544	1,834	1,591
Arterial Signal Coordination				
Percent of Roadway Miles	78	78	78	79
Annual Delay Reduction (1000 hours)	461	528	603	528
Arterial Access Management				
Percent of Roadway Miles	23	20	21	21
Annual Delay Reduction (1000 hours)	614	648	698	595
HOV Lanes				
Daily Passenger-miles of travel (1000s)	281	276	270	265
HOV User Delay Savings	397	379	457	445
Total Effect of Operations Treatments				
Annual Delay Reduction (1000 hours)	4,042	3,584	4,378	3,870
Annual Delay Saved per Peak Traveler (hours)	3	2	3	3
Annual Congestion Cost Savings (\$million)	76.8	66.9	81.5	70.8
Travel Time Index with Strategies	1.258	1.252	1.281	1.264
Travel Time Index (Base)	1.273	1.266	1.299	1.282
Public Transportation Service	2003	2002	2001	2000
Existing Service				
Annual Passenger-miles of travel (million)	216	182	176	169
Unlinked Passenger Trips (million)	54	44	41	40
Travel Time Index (combined road and transit)	1.270	1.264	1.296	1.279
Condition if Public Transportation Service were Discontinued				
Travel Time Index	1.276	1.269	1.304	1.285
Annual Increase				
Delay (1000 hours)	1,645	1,491	1,718	1,385
Delay per Peak Traveler (hours)	1	1	1	1
Congestion Cost (\$million)	31.7	28.2	32.3	25.6

**Comparison of Several Key Mobility Performance Measures
Very Large Group – over 3 million population urban areas**

Urban Area	Delay per Traveler	Travel Time Index	Total Delay	1982 to 2007	
				Delay per Traveler	Total Delay
New York-Newark, NY-NJ-CT	L	0	H+	0	F+
Los Angeles-Long Beach-Santa Ana, CA	H+	H+	H+	S	F+
Chicago, IL-IN	L-	H	H	S	F+
Miami, FL	L	0	L	0	S
Philadelphia, PA-NJ-DE-MD	L-	L-	L-	S-	S-
San Francisco-Oakland, CA	H	H	L	0	S-
Dallas-Fort Worth-Arlington, TX	0	L	L	F+	0
Atlanta, GA	H	0	L	F+	S
Washington, DC-VA-MD	H+	0	L	F+	S-
Boston, MA-NH-RI	L-	L-	L-	0	S-
Detroit, MI	0	L-	L-	0	S-
Houston, TX	H	L	L	S	S-
Phoenix, AZ	L	L	L-	S-	S-
Seattle, WA	L-	L-	L-	0	S-

0 – Average congestion levels or average congestion growth

H Higher congestion; H+ Much higher congestion; F Faster congestion growth; F+ Much faster growth

L Lower congestion; L- Much lower congestion; S Slower congestion growth; S- Much slower growth

Key Mobility Performance Measure Labels

Note: Designation of an urban area congestion problem as “Much higher”, “Much faster growth”, etc. is determined using a general indicator of the accuracy of the congestion estimates. For regions with the same indicator label, there may be no difference in congestion levels. Different values are used for the indicators in regions over 1 million population and below 1 million population.

Measures	Differences Within These Values May Not Indicate a Difference in Congestion Level	
	Above 1M Population	Below 1M Population
2007 Values Delay per Traveler - Travel Time Index - Total Delay -	Above 1M Population 5 Hours 5 Index Points 5 Hours x Average Population	Below 1M Population 3 Hours 3 Index Points 3 Hours x Average Population
1982 to 2007 Trends Delay per Traveler - Total Delay -	5 Hours 5 Hours x Average Population	3 Hours 3 Hours x Average Population