Performance Measure Summary – Tucson, 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 Tucson AZ

Inventory Measures	2007	2006	2005	2004	2003	2002
Urban Area Information						
Population (1000s)	775	775	750	730	720	710
Rank	52	52	52	53	53	53
Urban Area (square miles)	505	505	505	500	460	430
Population Density (persons/sq mile)	1,535	1,535	1,485	1,460	1,565	1,651
Peak Travelers (1000s)	426	424	407	394	387	377
Freeway						
Daily Vehicle-Miles of Travel (1000s)	3,510	3,650	3,540	3,425	3,285	3,000
Lane-Miles	250	250	250	250	245	235
Arterial Streets						
Daily Vehicle-Miles of Travel (1000s)	11,205	11,235	11,100	10,320	10,105	9,620
Lane-Miles	1,745	1,745	1,675	1,640	1,635	1,630
Public Transportation						
Annual Psgr-Miles of Travel (millions)	69.2	65.7	61.7	62.7	62.4	57.8
Annual Unlinked Psgr Trips (millions)	18.2	17.8	16.6	16.9	16.9	15.5
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 ($/gallon)	3.03	2.63	2.42	2.04	1.59	1.47
System Performance	**2007**	**2006**	**2005**	**2004**	**2003**	**2002**
Congested Travel (% of peak VMT)	61	61	57	56	55	54
Congested System (% of lane-miles)	57	57	53	53	53	49
Congested Time (number of "Rush Hours")	7.2	7.4	7.4	7.2	7.2	6.6
Annual Increase Needed to Maintain Constant Congestion Level:						
Lane-miles	62	75	86	74	72	61
Transit Riders or Carpoolers (millions)	16	20	23	19	18	14
Annual Excess Fuel Consumed						
Total Fuel (1000 gallons)	10,883	11,413	10,529	9,541	9,189	8,088
Rank	40	39	41	45	45	46
Fuel per Peak Traveler (gallons)	26	27	26	24	24	21
Rank	31	26	29	32	32	36
Annual Delay						
Total Delay (1000s of person-hours)	17,321	18,186	17,069	15,501	14,833	13,016
Rank	39	38	39	41	44	45
Delay per Peak Traveler (person-hours)	41	43	42	39	38	35
Rank	21	20	25	29	24	28
Delay due to Incidents (percent)	53	54	53	53	53	53
Travel Time Index	1.24	1.25	1.23	1.22	1.22	1.20
Rank	28	26	29	30	30	32
Congestion Cost						
Total Cost ($ millions)	393	396	355	302	277	238
Rank	38	37	38	39	39	44
Cost per Peak Traveler ($)	923	935	873	766	718	631
Rank	19	17	21	23	21	24

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 Tucson AZ, Continued

Inventory Measures	2001	2000	1999	1998	1997
Urban Area Information					
Population (1000s)	705	680	670	660	650
Rank	53	54	54	54	54
Urban Area (square miles)	400	375	350	320	295
Population Density (persons/sq mile)	1,763	1,813	1,914	2,063	2,203
Peak Travelers (1000s)	369	352	342	333	324
Freeway					
Daily Vehicle-Miles of Travel (1000s)	2,750	2,420	2,100	1,955	1,775
Lane-Miles	225	210	195	185	175
Arterial Streets					
Daily Vehicle-Miles of Travel (1000s)	9,610	9,355	9,265	9,135	8,985
Lane-Miles	1,630	1,625	1,615	1,615	1,610
Public Transportation					
Annual Psgr-Miles of Travel (millions)	68.1	66.0	64.1	59.2	62.1
Annual Unlinked Psgr Trips (millions)	15.9	16.0	17.5	16.0	17.5
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 ($/gallon)	1.62	1.52	1.38	1.19	1.32
System Performance	**2001**	**2000**	**1999**	**1998**	**1997**
Congested Travel (% of peak VMT)	52	50	46	45	44
Congested System (% of lane-miles)	49	49	44	44	44
Congested Time (number of "Rush Hours")	6.6	6.2	6.2	6.0	5.8
Annual Increase Needed to Maintain Constant Congestion Level:					
Lane-miles	83	81	83	77	74
Transit Riders or Carpoolers (millions)	19	18	18	16	16
Annual Excess Fuel Consumed					
Total Fuel (1000 gallons)	7,393	6,737	6,079	5,910	5,542
Rank	46	47	50	49	47
Fuel per Peak Traveler (gallons)	20	19	18	18	17
Rank	37	37	41	39	39
Annual Delay					
Total Delay (1000s of person-hours)	12,075	11,026	10,038	9,859	9,323
Rank	46	46	47	46	44
Delay per Peak Traveler (person-hours)	33	31	29	30	29
Rank	30	34	40	32	35
Delay due to Incidents (percent)	53	53	53	53	53
Travel Time Index	1.19	1.18	1.16	1.16	1.16
Rank	32	35	41	41	38
Congestion Cost					
Total Cost ($ millions)	221	197	170	163	153
Rank	45	46	47	43	43
Cost per Peak Traveler ($)	598	560	498	489	474
Rank	25	32	34	30	33

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 Tucson AZ, Continued

Inventory Measures	1996	1995	1994	1993	1992
Urban Area Information					
Population (1000s)	640	620	605	590	560
Rank	54	55	55	55	57
Urban Area (square miles)	280	270	260	250	240
Population Density (persons/sq mile)	2,286	2,296	2,327	2,360	2,333
Peak Travelers (1000s)	315	301	290	280	262
Freeway					
Daily Vehicle-Miles of Travel (1000s)	1,670	1,475	1,365	1,330	1,280
Lane-Miles	160	145	135	120	110
Arterial Streets					
Daily Vehicle-Miles of Travel (1000s)	8,250	8,000	7,725	7,675	7,500
Lane-Miles	1,605	1,595	1,550	1,535	1,520
Public Transportation					
Annual Psgr-Miles of Travel (millions)	64.0	59.7	61.6	59.7	51.1
Annual Unlinked Psgr Trips (millions)	17.9	16.2	17.6	18.5	16.6
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 ($/gallon)	1.26	1.20	1.19	1.18	1.22
System Performance	**1996**	**1995**	**1994**	**1993**	**1992**
Congested Travel (% of peak VMT)	38	37	38	39	39
Congested System (% of lane-miles)	40	40	40	40	40
Congested Time (number of "Rush Hours")	5.4	5.2	5.2	5.4	5.4
Annual Increase Needed to Maintain Constant Congestion Level:					
Lane-miles	53	39	30	35	26
Transit Riders or Carpoolers (millions)	10	8	6	7	5
Annual Excess Fuel Consumed					
Total Fuel (1000 gallons)	4,253	3,945	3,760	3,936	3,791
Rank	54	51	49	46	46
Fuel per Peak Traveler (gallons)	14	13	13	14	14
Rank	44	48	44	40	34
Annual Delay					
Total Delay (1000s of person-hours)	7,154	6,675	6,340	6,634	6,287
Rank	51	50	48	43	45
Delay per Peak Traveler (person-hours)	23	22	22	24	24
Rank	44	42	42	34	31
Delay due to Incidents (percent)	53	53	53	53	53
Travel Time Index	1.13	1.13	1.12	1.13	1.13
Rank	45	43	44	34	34
Congestion Cost					
Total Cost ($ millions)	116	104	97	99	91
Rank	49	48	46	42	40
Cost per Peak Traveler ($)	367	346	332	352	346
Rank	41	42	38	29	27

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 Tucson AZ, Continued

Inventory Measures	1991	1990	1989	1988	1987
Urban Area Information					
Population (1000s)	550	530	510	500	490
Rank	57	57	59	59	59
Urban Area (square miles)	230	220	210	200	190
Population Density (persons/sq mile)	2,391	2,409	2,429	2,500	2,579
Peak Travelers (1000s)	254	242	231	225	218
Freeway					
Daily Vehicle-Miles of Travel (1000s)	1,250	1,275	1,200	1,070	1,130
Lane-Miles	105	105	105	105	105
Arterial Streets					
Daily Vehicle-Miles of Travel (1000s)	7,320	7,190	7,110	7,050	6,980
Lane-Miles	1,505	1,490	1,485	1,475	1,460
Public Transportation					
Annual Psgr-Miles of Travel (millions)	62.7	43.6	44.3	41.1	41.0
Annual Unlinked Psgr Trips (millions)	18.7	13.4	12.5	10.7	10.5
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 ($/gallon)	1.06	1.07	1.11	1.02	1.03
System Performance	**1991**	**1990**	**1989**	**1988**	**1987**
Congested Travel (% of peak VMT)	39	39	35	30	30
Congested System (% of lane-miles)	40	40	35	30	30
Congested Time (number of "Rush Hours")	5.4	5.4	5.2	5.0	5.0
Annual Increase Needed to Maintain Constant Congestion Level:					
Lane-miles	24	23	19	20	25
Transit Riders or Carpoolers (millions)	4	4	3	4	4
Annual Excess Fuel Consumed					
Total Fuel (1000 gallons)	3,657	3,700	3,212	2,656	2,613
Rank	43	42	42	41	38
Fuel per Peak Traveler (gallons)	14	15	14	12	12
Rank	31	26	24	28	26
Annual Delay					
Total Delay (1000s of person-hours)	6,148	6,193	5,503	4,566	4,444
Rank	42	40	39	40	37
Delay per Peak Traveler (person-hours)	24	26	24	20	20
Rank	27	20	22	27	25
Delay due to Incidents (percent)	53	53	53	53	53
Travel Time Index	1.13	1.13	1.12	1.10	1.10
Rank	29	27	25	35	33
Congestion Cost					
Total Cost ($ millions)	86	83	70	55	52
Rank	40	38	36	38	37
Cost per Peak Traveler ($)	337	343	304	246	238
Rank	25	20	20	24	23

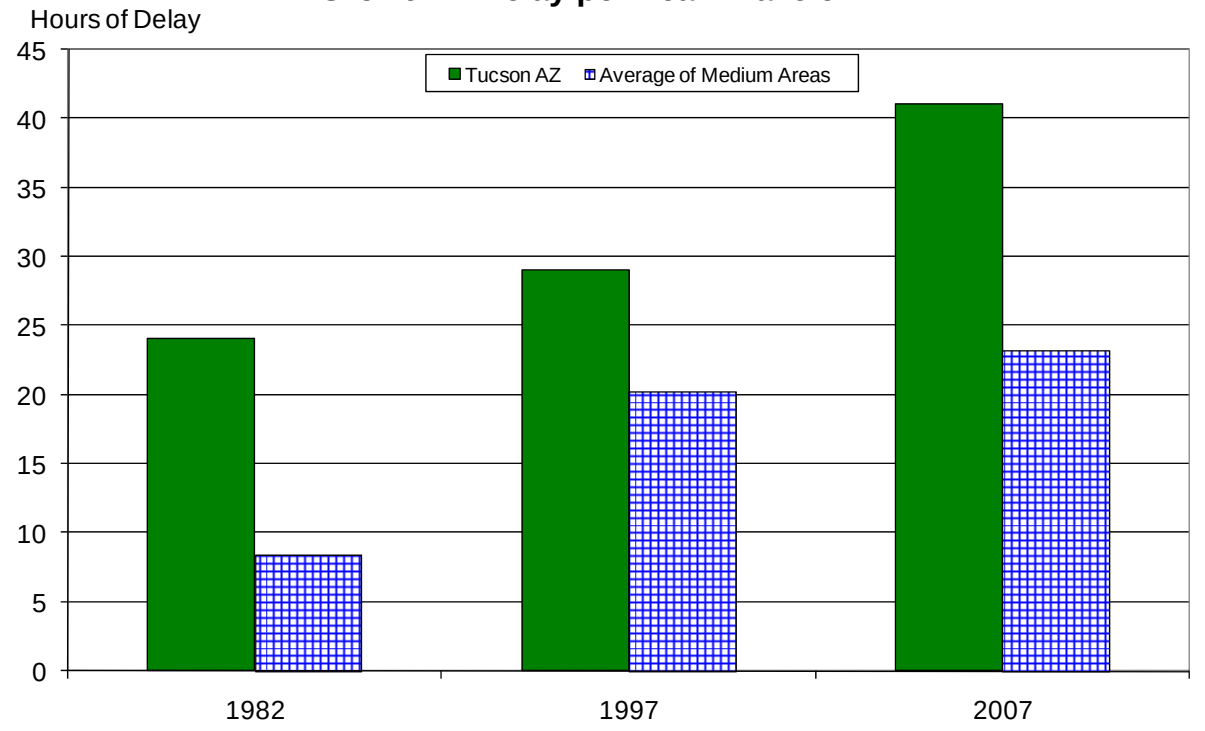
Note: System Performance statistics for 2000 through 2007 data reflect the effects of operational treatments.
Note: Zeroes in the table reflect values less than 0.5.

The Mobility Data for Tucson AZ, Continued

Inventory Measures	1986	1985	1984	1983	1982
Urban Area Information					
Population (1000s)	480	470	455	450	450
Rank	59	59	59	59	58
Urban Area (square miles)	180	170	160	155	150
Population Density (persons/sq mile)	2,667	2,765	2,844	2,903	3,000
Peak Travelers (1000s)	212	206	198	194	192
Freeway					
Daily Vehicle-Miles of Travel (1000s)	1,040	970	950	810	750
Lane-Miles	100	95	95	90	90
Arterial Streets					
Daily Vehicle-Miles of Travel (1000s)	6,940	6,910	6,885	6,800	6,750
Lane-Miles	1,455	1,410	1,395	1,390	1,380
Public Transportation					
Annual Psgr-Miles of Travel (millions)	42.6	40.6	40.9	40.9	40.9
Annual Unlinked Psgr Trips (millions)	10.8	10.3	10.0	10.0	10.0
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 ($/gallon)	1.00	1.31	1.33	1.36	1.42
System Performance	**1986**	**1985**	**1984**	**1983**	**1982**
Congested Travel (% of peak VMT)	29	33	29	29	29
Congested System (% of lane-miles)	29	34	29	29	29
Congested Time (number of "Rush Hours")	5.0	5.2	5.2	5.0	5.0
Annual Increase Needed to Maintain Constant Congestion Level:					
Lane-miles	- -	- -	- -	- -	- -
Transit Riders or Carpoolers (millions)	- -	- -	- -	- -	- -
Annual Excess Fuel Consumed					
Total Fuel (1000 gallons)	2,624	2,978	2,720	2,595	2,541
Rank	38	34	32	32	31
Fuel per Peak Traveler (gallons)	12	14	14	13	13
Rank	22	11	10	8	8
Annual Delay					
Total Delay (1000s of person-hours)	4,608	5,212	4,856	4,661	4,574
Rank	36	33	31	31	28
Delay per Peak Traveler (person-hours)	22	25	25	24	24
Rank	18	10	8	7	4
Delay due to Incidents (percent)	53	53	52	52	52
Travel Time Index	1.10	1.11	1.10	1.10	1.10
Rank	24	19	20	17	15
Congestion Cost					
Total Cost ($ millions)	52	60	54	50	48
Rank	35	31	31	31	27
Cost per Peak Traveler ($)	244	289	273	257	249
Rank	14	8	7	6	4

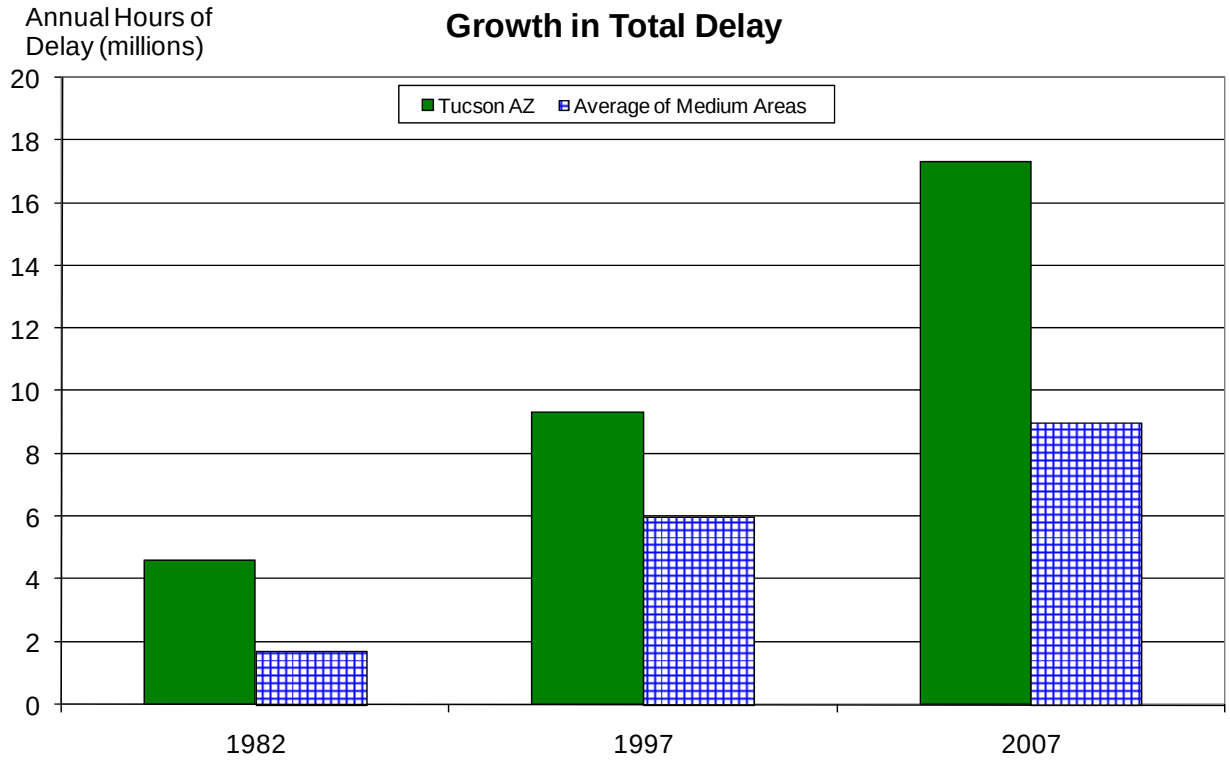
Note: System Performance statistics for 2000 through 2007 data reflect the effects of operational treatments.
Note: Zeroes in the table reflect values less than 0.5.

Growth in Delay per Peak Traveler



Note: Medium areas have populations between 0.5 and 1 million

Growth in Total Delay



Note: Medium areas have populations between 0.5 and 1 million

Benefits from Public Transportation Service and Operations Strategies in Tucson AZ

Operations Strategies	2007	2006	2005	2004
Freeway Ramp Metering				
Percent of Roadway Miles	--	--	--	--
Annual Delay Reduction (1000 hours)	--	--	--	--
Freeway Incident Management				
Cameras				
Percent of Roadway Miles	30	29	29	27
Service Patrols				
Percent of Roadway Miles	10	10	10	10
Annual Delay Reduction (1000 hours)	36	44	37	32
Arterial Signal Coordination				
Percent of Roadway Miles	67	67	67	68
Annual Delay Reduction (1000 hours)	117	111	105	105
Arterial Access Management				
Percent of Roadway Miles	45	43	45	45
Annual Delay Reduction (1000 hours)	842	808	758	718
HOV Lanes				
Daily Passenger-miles of travel (1000s)	--	--	--	--
HOV User Delay Savings	--	--	--	--
Total Effect of Operations Treatments				
Annual Delay Reduction (1000 hours)	994	963	900	855
Annual Delay Saved per Peak Traveler (hours)	2	2	2	2
Annual Congestion Cost Savings ($million)	22.3	20.7	18.5	16.4
Travel Time Index with Strategies	1.237	1.246	1.229	1.221
Travel Time Index (Base)	1.249	1.258	1.240	1.231
Public Transportation Service	**2007**	**2006**	**2005**	**2004**
Existing Service				
Annual Passenger-miles of travel (million)	69.2	65.7	61.7	62.7
Unlinked Passenger Trips (million)	18.2	17.8	16.6	16.9
Travel Time Index (combined road and transit)	1.245	1.254	1.237	1.228
Condition if Public Transportation Service were Discontinued				
Travel Time Index	1.252	1.260	1.242	1.234
Annual Increase				
Delay (1000 hours)	571	511	452	468
Delay per Peak Traveler (hours)	1	1	1	1
Congestion Cost ($million)	12.9	11.1	9.4	9.1

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

Operations Strategies	2003	2002	2001	2000
Freeway Ramp Metering				
Percent of Roadway Miles	--	--	--	--
Annual Delay Reduction (1000 hours)	--	--	--	--
Freeway Incident Management				
Cameras				
Percent of Roadway Miles	28	36	26	17
Service Patrols				
Percent of Roadway Miles	9	10	--	--
Annual Delay Reduction (1000 hours)	28	24	4	2
Arterial Signal Coordination				
Percent of Roadway Miles	64	64	64	64
Annual Delay Reduction (1000 hours)	84	86	88	75
Arterial Access Management				
Percent of Roadway Miles	45	45	46	46
Annual Delay Reduction (1000 hours)	653	547	569	500
HOV Lanes				
Daily Passenger-miles of travel (1000s)	--	--	--	--
HOV User Delay Savings	--	--	--	--
Total Effect of Operations Treatments				
Annual Delay Reduction (1000 hours)	765	657	661	576
Annual Delay Saved per Peak Traveler (hours)	2	2	2	2
Annual Congestion Cost Savings ($million)	14.1	11.9	12.0	10.2
Travel Time Index with Strategies	1.218	1.202	1.188	1.178
Travel Time Index (Base)	1.227	1.211	1.196	1.186
Public Transportation Service	**2003**	**2002**	**2001**	**2000**
Existing Service				
Annual Passenger-miles of travel (million)	62.4	57.8	68.1	66.0
Unlinked Passenger Trips (million)	16.9	15.5	15.9	16.0
Travel Time Index (combined road and transit)	1.224	1.208	1.193	1.183
Condition if Public Transportation Service were Discontinued				
Travel Time Index	1.230	1.216	1.202	1.192
Annual Increase				
Delay (1000 hours)	479	585	633	573
Delay per Peak Traveler (hours)	1	2	2	2
Congestion Cost ($million)	8.9	10.7	11.6	10.2

Comparison of Several Key Mobility Performance Measures
Medium Group – 500,000 to 1 million population urban areas

Urban Area	Delay per Traveler	Travel Time Index	Total Delay	1982 to 2007	
				Delay per Traveler	Total Delay
Nashville-Davidson, TN	H+	0	H+	F	F+
Salt Lake City, UT	H	H+	H+	F	F+
Richmond ,VA	L	L-	H	0	F+
Louisville, KY-IN	H+	H+	H+	F+	F+
Hartford, CT	L	L	H	F	F+
Bridgeport-Stamford, CT-NY	H+	H+	H+	F+	F+
Oklahoma City, OK	H	L	H+	F+	F+
Tulsa, OK	0	L	0	0	F
Tucson, AZ	H+	H+	H+	F	F+
Dayton, OH	L-	L-	L-	S-	S-
Rochester, NY	L-	L-	L-	S-	S-
Birmingham, AL	H+	0	H+	F+	F+
Lancaster-Palmdale, CA	L-	L	L-	S-	S-
Honolulu, HI	H	H+	H	S	S
El Paso, TX-NM	L	L	L	0	S
Oxnard-Ventura, CA	H+	H+	H+	F+	F+
Sarasota-Bradenton ,FL	H	H+	0	S-	0
Springfield, MA-CT	L-	L-	L-	S-	S-
Omaha, NE-IA	H	H	0	F+	F
Fresno, CA	L	0	L	S-	S-
Allentown-Bethlehem, PA-NJ	0	0	L	S	S-
Akron, OH	L-	L-	L-	S-	S-
Grand Rapids, MI	0	L	L	0	S
Albany-Schenectady, NY	L	L	L	0	S-
Albuquerque, NM	H+	H	H	F+	F+
New Haven, CT	L	L	L-	0	S-
Indio-Cathedral City-Palm Springs, CA	L-	0	L-	S-	S-
Toledo, OH-MI	L-	L-	L-	S	S-
Poughkeepsie-Newburgh, NY	L-	L-	L-	S-	S-
Bakersfield, CA	L-	L-	L-	S-	S-
Colorado Springs, CO	0	0	L	F	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	
2007 Values	**Above 1M Population**	**Below 1M Population**
Delay per Traveler -	5 Hours	3 Hours
Travel Time Index -	5 Index Points	3 Index Points
Total Delay -	5 Hours x Average Population	3 Hours x Average Population
1982 to 2007 Trends		
Delay per Traveler -	5 Hours	3 Hours
Total Delay -	5 Hours x Average Population	3 Hours x Average Population