

Performance Measure Summary – Denver, CO

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 Denver-Aurora CO

Inventory Measures	2007	2006	2005	2004	2003	2002
Urban Area Information						
Population (1000s)	2,180	2,130	2,090	2,065	2,050	2,030
Rank	20	20	20	20	19	19
Urban Area (square miles)	865	855	855	855	855	850
Population Density (persons/sq mile)	2,520	2,491	2,444	2,415	2,398	2,388
Peak Travelers (1000s)	1,358	1,325	1,294	1,272	1,257	1,214
Freeway						
Daily Vehicle-Miles of Travel (1000s)	20,395	19,935	19,900	18,815	17,960	17,400
Lane-Miles	1,280	1,280	1,250	1,240	1,140	1,110
Arterial Streets						
Daily Vehicle-Miles of Travel (1000s)	22,925	23,555	23,380	22,820	21,790	20,925
Lane-Miles	3,715	3,700	3,670	3,640	3,510	3,385
Public Transportation						
Annual Psgr-Miles of Travel (millions)	538	473	443	403	383	385
Annual Unlinked Psgr Trips (millions)	94	87	86	82	79	81
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)	3.20	2.60	2.32	1.94	1.51	1.39
System Performance	2007	2006	2005	2004	2003	2002
Congested Travel (% of peak VMT)	67	67	67	66	67	67
Congested System (% of lane-miles)	54	54	54	54	55	55
Congested Time (number of "Rush Hours")	7.4	7.4	7.4	7.2	7.4	7.2
Annual Increase Needed to Maintain Constant Congestion Level:						
Lane-miles	124	143	154	143	144	149
Transit Riders or Carpoolers (millions)	37	43	47	43	43	44
Annual Excess Fuel Consumed						
Total Fuel (1000 gallons)	40,492	40,975	41,663	38,212	36,295	35,015
Rank	17	17	16	17	18	18
Fuel per Peak Traveler (gallons)	30	31	32	30	29	29
Rank	15	15	14	14	16	14
Annual Delay						
Total Delay (1000s of person-hours)	61,345	63,063	64,160	58,924	55,356	53,427
Rank	16	16	16	16	16	16
Delay per Peak Traveler (person-hours)	45	48	50	46	44	44
Rank	13	11	11	13	14	12
Delay due to Incidents (percent)	53	53	53	53	52	52
Travel Time Index	1.31	1.31	1.32	1.30	1.30	1.30
Rank	14	14	12	14	13	10
Congestion Cost						
Total Cost (\$ millions)	1,240	1,218	1,192	1,037	933	880
Rank	17	17	16	17	17	18
Cost per Peak Traveler (\$)	913	920	921	815	743	725
Rank	21	20	16	19	19	15

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 Denver-Aurora CO, Continued

Inventory Measures	2001	2000	1999	1998	1997
Urban Area Information					
Population (1000s)	2,025	1,910	1,860	1,830	1,800
Rank	19	20	20	20	20
Urban Area (square miles)	850	840	830	820	810
Population Density (persons/sq mile)	2,382	2,274	2,241	2,232	2,222
Peak Travelers (1000s)	1,183	1,089	1,034	994	954
Freeway					
Daily Vehicle-Miles of Travel (1000s)	17,250	16,905	16,500	16,120	15,700
Lane-Miles	1,080	1,050	1,030	1,020	1,015
Arterial Streets					
Daily Vehicle-Miles of Travel (1000s)	20,520	20,185	19,520	17,990	16,850
Lane-Miles	3,350	3,300	3,280	3,220	3,175
Public Transportation					
Annual Psgr-Miles of Travel (millions)	391	375	366	325	313
Annual Unlinked Psgr Trips (millions)	80	77	75	72	71
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)	1.70	1.55	1.16	1.10	1.24
System Performance	2001	2000	1999	1998	1997
Congested Travel (% of peak VMT)	67	67	66	61	60
Congested System (% of lane-miles)	52	52	52	47	47
Congested Time (number of "Rush Hours")	7.4	7.4	7.2	7.2	7.0
Annual Increase Needed to Maintain Constant Congestion Level:					
Lane-miles	164	175	186	167	182
Transit Riders or Carpoolers (millions)	48	52	54	47	49
Annual Excess Fuel Consumed					
Total Fuel (1000 gallons)	36,133	34,140	31,562	28,649	26,443
Rank	17	17	17	17	17
Fuel per Peak Traveler (gallons)	31	31	31	29	28
Rank	10	10	10	10	10
Annual Delay					
Total Delay (1000s of person-hours)	54,574	51,654	47,562	43,138	39,489
Rank	17	16	17	17	17
Delay per Peak Traveler (person-hours)	46	47	46	43	41
Rank	10	8	9	10	10
Delay due to Incidents (percent)	52	52	52	52	53
Travel Time Index	1.32	1.30	1.29	1.27	1.26
Rank	9	9	9	9	9
Congestion Cost					
Total Cost (\$ millions)	903	834	726	644	590
Rank	17	17	17	17	17
Cost per Peak Traveler (\$)	763	766	702	648	619
Rank	12	10	10	10	10

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 Denver-Aurora CO, Continued

Inventory Measures	1996	1995	1994	1993	1992
Urban Area Information					
Population (1000s)	1,770	1,730	1,675	1,610	1,600
Rank	22	22	22	22	22
Urban Area (square miles)	800	770	750	735	720
Population Density (persons/sq mile)	2,213	2,247	2,233	2,190	2,222
Peak Travelers (1000s)	915	874	826	774	750
Freeway					
Daily Vehicle-Miles of Travel (1000s)	15,100	14,285	13,475	12,950	12,430
Lane-Miles	1,000	1,000	1,000	1,000	960
Arterial Streets					
Daily Vehicle-Miles of Travel (1000s)	16,410	16,170	15,685	15,170	13,900
Lane-Miles	3,115	3,105	3,050	3,040	3,035
Public Transportation					
Annual Psgr-Miles of Travel (millions)	298	265	236	237	241
Annual Unlinked Psgr Trips (millions)	70	67	63	60	59
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)	1.36	1.22	1.16	1.21	1.23
System Performance	1996	1995	1994	1993	1992
Congested Travel (% of peak VMT)	57	54	49	45	41
Congested System (% of lane-miles)	46	46	45	41	37
Congested Time (number of "Rush Hours")	6.8	6.4	6.0	5.6	5.4
Annual Increase Needed to Maintain Constant Congestion Level:					
Lane-miles	206	216	210	186	137
Transit Riders or Carpoolers (millions)	55	56	52	45	31
Annual Excess Fuel Consumed					
Total Fuel (1000 gallons)	23,929	21,077	17,419	15,548	12,820
Rank	18	19	21	20	22
Fuel per Peak Traveler (gallons)	26	24	21	20	17
Rank	11	13	17	17	25
Annual Delay					
Total Delay (1000s of person-hours)	36,284	31,975	26,975	23,902	19,311
Rank	18	21	21	20	21
Delay per Peak Traveler (person-hours)	40	37	33	31	26
Rank	10	13	16	17	27
Delay due to Incidents (percent)	53	54	54	54	55
Travel Time Index	1.24	1.22	1.19	1.17	1.15
Rank	12	15	18	22	26
Congestion Cost					
Total Cost (\$ millions)	537	457	372	326	259
Rank	17	21	21	20	21
Cost per Peak Traveler (\$)	586	523	450	421	345
Rank	12	14	18	19	28

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 Denver-Aurora CO, Continued

Inventory Measures	1991	1990	1989	1988	1987
Urban Area Information					
Population (1000s)	1,580	1,580	1,565	1,550	1,510
Rank	22	22	22	22	22
Urban Area (square miles)	700	660	630	600	570
Population Density (persons/sq mile)	2,257	2,394	2,484	2,583	2,649
Peak Travelers (1000s)	724	706	693	680	657
Freeway					
Daily Vehicle-Miles of Travel (1000s)	11,425	11,205	10,500	10,315	10,135
Lane-Miles	885	880	860	860	855
Arterial Streets					
Daily Vehicle-Miles of Travel (1000s)	13,240	12,365	12,170	12,120	12,115
Lane-Miles	3,030	3,005	2,995	2,975	2,940
Public Transportation					
Annual Psgr-Miles of Travel (millions)	231	220	202	214	208
Annual Unlinked Psgr Trips (millions)	57	53	52	51	51
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)	1.19	1.11	1.15	1.06	1.06
System Performance	1991	1990	1989	1988	1987
Congested Travel (% of peak VMT)	41	37	33	33	32
Congested System (% of lane-miles)	37	33	32	32	32
Congested Time (number of "Rush Hours")	5.2	5.0	4.4	4.4	4.2
Annual Increase Needed to Maintain Constant Congestion Level:					
Lane-miles	96	65	21	57	66
Transit Riders or Carpoolers (millions)	21	14	4	12	13
Annual Excess Fuel Consumed					
Total Fuel (1000 gallons)	11,567	9,971	8,667	8,169	7,853
Rank	22	23	23	21	20
Fuel per Peak Traveler (gallons)	16	14	13	12	12
Rank	24	31	31	28	26
Annual Delay					
Total Delay (1000s of person-hours)	17,308	14,744	13,028	12,170	11,778
Rank	22	22	23	23	20
Delay per Peak Traveler (person-hours)	24	21	19	18	18
Rank	27	35	34	33	30
Delay due to Incidents (percent)	55	55	55	55	55
Travel Time Index	1.14	1.13	1.12	1.11	1.11
Rank	26	27	25	30	27
Congestion Cost					
Total Cost (\$ millions)	225	185	156	138	128
Rank	22	22	23	23	20
Cost per Peak Traveler (\$)	311	262	225	203	195
Rank	29	35	36	34	30

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.

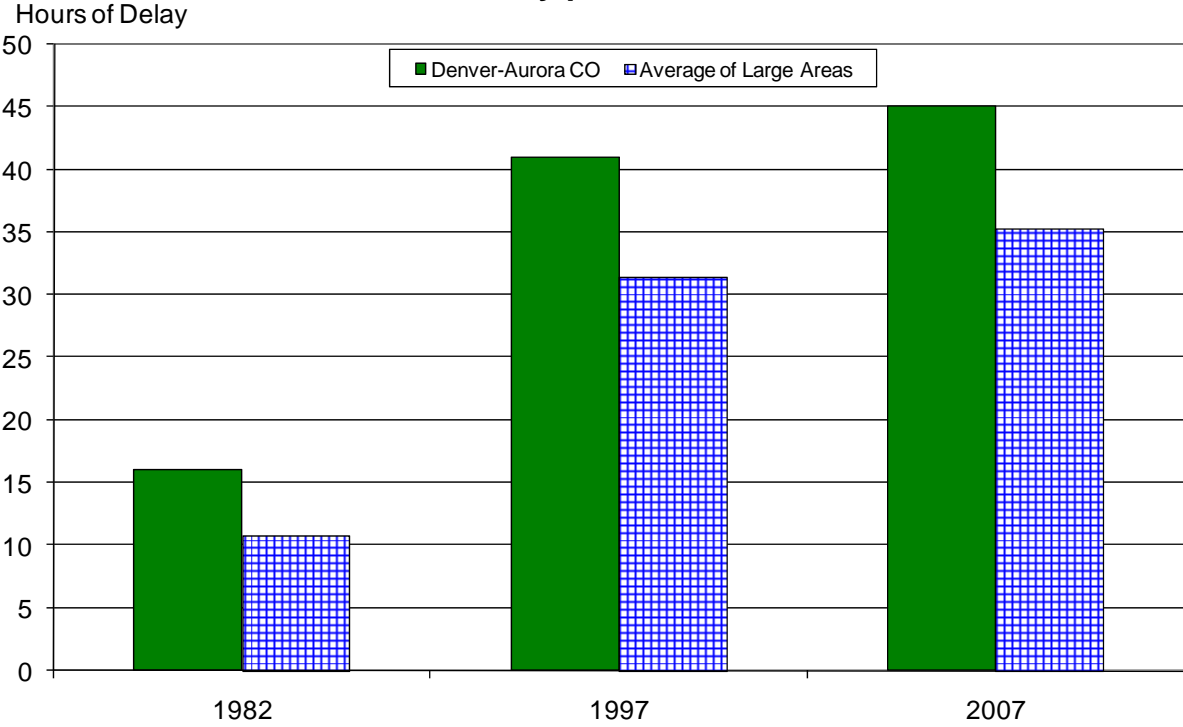
The Mobility Data for Denver-Aurora CO, Continued

Inventory Measures	1986	1985	1984	1983	1982
Urban Area Information					
Population (1000s)	1,500	1,485	1,460	1,375	1,350
Rank	22	22	22	22	22
Urban Area (square miles)	550	515	485	460	435
Population Density (persons/sq mile)	2,727	2,883	3,010	2,989	3,103
Peak Travelers (1000s)	647	634	618	578	562
Freeway					
Daily Vehicle-Miles of Travel (1000s)	9,765	9,510	9,865	9,180	8,900
Lane-Miles	840	825	810	795	795
Arterial Streets					
Daily Vehicle-Miles of Travel (1000s)	12,100	12,195	12,215	11,665	11,530
Lane-Miles	2,875	2,845	2,825	2,780	2,705
Public Transportation					
Annual Psgr-Miles of Travel (millions)	226	244	239	239	239
Annual Unlinked Psgr Trips (millions)	54	58	51	51	51
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)	1.04	1.36	1.37	1.41	1.47
System Performance	1986	1985	1984	1983	1982
Congested Travel (% of peak VMT)	34	32	35	29	28
Congested System (% of lane-miles)	36	35	35	30	30
Congested Time (number of "Rush Hours")	4.2	4.2	4.6	4.2	4.0
Annual Increase Needed to Maintain Constant Congestion Level:					
Lane-miles	--	--	--	--	--
Transit Riders or Carpoolers (millions)	--	--	--	--	--
Annual Excess Fuel Consumed					
Total Fuel (1000 gallons)	7,959	7,679	9,333	5,797	5,816
Rank	19	19	17	20	18
Fuel per Peak Traveler (gallons)	12	12	15	10	10
Rank	22	17	7	18	14
Annual Delay					
Total Delay (1000s of person-hours)	12,006	11,864	15,016	9,026	9,073
Rank	20	19	17	20	18
Delay per Peak Traveler (person-hours)	19	19	24	16	16
Rank	24	20	10	19	17
Delay due to Incidents (percent)	55	55	56	54	54
Travel Time Index	1.11	1.11	1.13	1.08	1.09
Rank	20	19	11	26	20
Congestion Cost					
Total Cost (\$ millions)	126	126	156	89	88
Rank	20	20	17	20	19
Cost per Peak Traveler (\$)	195	199	253	154	157
Rank	26	22	9	20	16

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

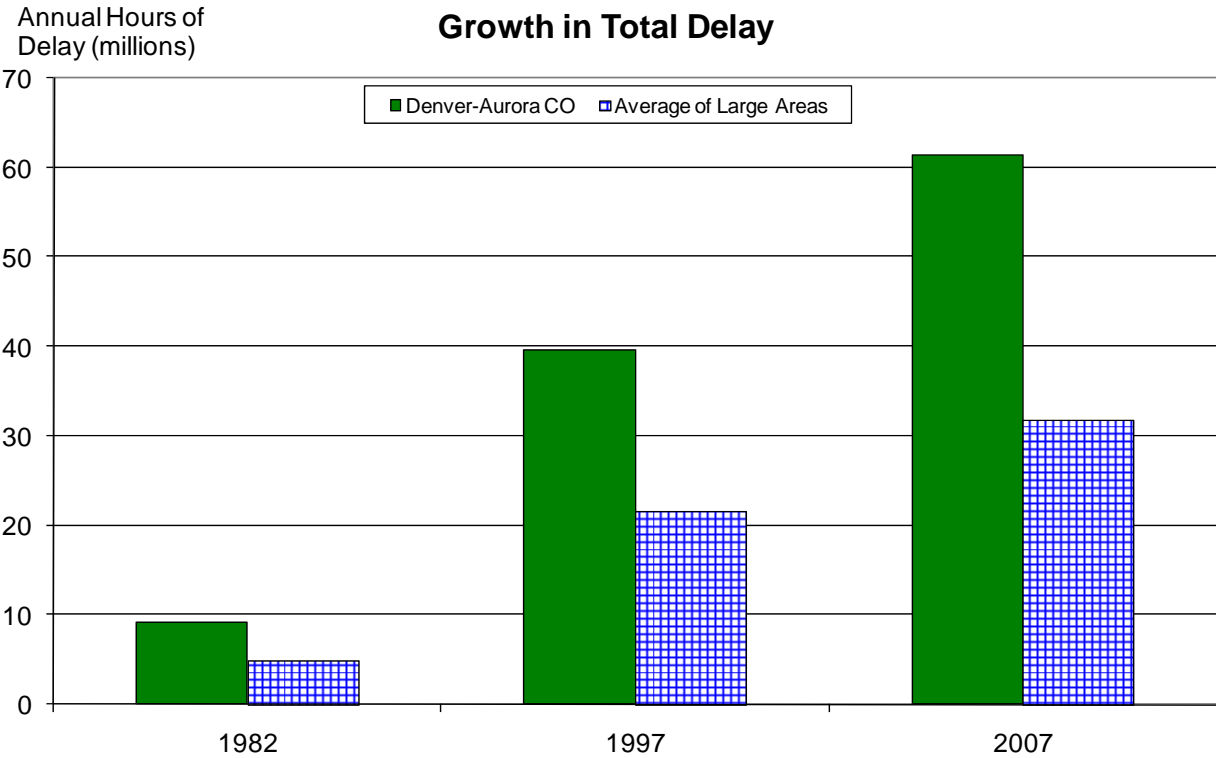
Note: Zeroes in the table reflect values less than 0.5.

Growth in Delay per Peak Traveler



Note: Large areas have populations between 1 and 3 million

Growth in Total Delay



Note: Large areas have populations between 1 and 3 million

**Benefits from Public Transportation Service and Operations Strategies in
Denver-Aurora CO**

Operations Strategies	2007	2006	2005	2004
Freeway Ramp Metering				
Percent of Roadway Miles	14	14	14	15
Annual Delay Reduction (1000 hours)	220	211	205	176
Freeway Incident Management				
Cameras				
Percent of Roadway Miles	15	15	15	15
Service Patrols				
Percent of Roadway Miles	46	46	47	48
Annual Delay Reduction (1000 hours)	1,345	1,369	1,142	963
Arterial Signal Coordination				
Percent of Roadway Miles	67	68	68	63
Annual Delay Reduction (1000 hours)	396	387	371	382
Arterial Access Management				
Percent of Roadway Miles	52	52	53	52
Annual Delay Reduction (1000 hours)	1,400	1,433	1,271	1,363
HOV Lanes				
Daily Passenger-miles of travel (1000s)	165	145	136	133
HOV User Delay Savings	194	172	167	146
Total Effect of Operations Treatments				
Annual Delay Reduction (1000 hours)	3,554	3,572	3,156	3,030
Annual Delay Saved per Peak Traveler (hours)	3	3	2	2
Annual Congestion Cost Savings (\$million)	71.3	68.6	58.3	53.0
Travel Time Index with Strategies	1.311	1.313	1.321	1.304
Travel Time Index (Base)	1.327	1.329	1.335	1.318
Public Transportation Service	2007	2006	2005	2004
Existing Service				
Annual Passenger-miles of travel (million)	538	473	443	402
Unlinked Passenger Trips (million)	94	87	86	82
Travel Time Index (combined road and transit)	1.315	1.319	1.325	1.309
Condition if Public Transportation Service were Discontinued				
Travel Time Index	1.340	1.339	1.345	1.327
Annual Increase				
Delay (1000 hours)	5,033	4,092	3,910	3,717
Delay per Peak Traveler (hours)	4	3	3	3
Congestion Cost (\$million)	101.6	78.8	72.4	65.3

**Benefits from Public Transportation Service and Operations Strategies in
Denver-Aurora CO, Continued**

Operations Strategies	2003	2002	2001	2000
Freeway Ramp Metering				
Percent of Roadway Miles	13	14	--	--
Annual Delay Reduction (1000 hours)	137	135	--	--
Freeway Incident Management				
Cameras				
Percent of Roadway Miles	17	17	--	--
Service Patrols				
Percent of Roadway Miles	55	55	--	--
Annual Delay Reduction (1000 hours)	872	855	--	--
Arterial Signal Coordination				
Percent of Roadway Miles	47	44	42	41
Annual Delay Reduction (1000 hours)	265	323	388	398
Arterial Access Management				
Percent of Roadway Miles	51	50	50	50
Annual Delay Reduction (1000 hours)	934	928	620	517
HOV Lanes				
Daily Passenger-miles of travel (1000s)	131	128	125	123
HOV User Delay Savings	141	139	156	146
Total Effect of Operations Treatments				
Annual Delay Reduction (1000 hours)	2,349	2,380	1,165	1,061
Annual Delay Saved per Peak Traveler (hours)	2	2	1	1
Annual Congestion Cost Savings (\$million)	39.7	39.3	18.6	16.5
Travel Time Index with Strategies	1.302	1.302	1.317	1.304
Travel Time Index (Base)	1.314	1.315	1.323	1.310
Public Transportation Service	2003	2002	2001	2000
Existing Service				
Annual Passenger-miles of travel (million)	383	385	391	375
Unlinked Passenger Trips (million)	79	81	80	77
Travel Time Index (combined road and transit)	1.305	1.306	1.314	1.301
Condition if Public Transportation Service were Discontinued				
Travel Time Index	1.325	1.326	1.336	1.321
Annual Increase				
Delay (1000 hours)	3,618	3,664	3,730	3,511
Delay per Peak Traveler (hours)	3	3	3	3
Congestion Cost (\$million)	60.9	60.3	61.7	56.5

**Comparison of Several Key Mobility Performance Measures
Large Group – 1 million to 3 million population urban areas**

Urban Area	Delay per Traveler	Travel Time Index	Total Delay	1982 to 2007	
				Delay per Traveler	Total Delay
San Diego, CA	H+	H+	H+	F+	F+
Minneapolis-St., Paul MN	H	0	H+	F+	F+
Baltimore, MD	H+	H+	H+	F+	F+
Tampa-St. Petersburg, FL	H+	H+	H+	0	F+
St. Louis, MO-IL	L-	L-	0	S-	S
Denver-Aurora, CO	H+	H+	H+	F	F+
Riverside-San Bernardino, CA	H+	H+	H+	F+	F+
Sacramento, CA	H	H+	H	0	F+
Pittsburgh, PA	L-	L-	L-	S-	S-
Portland, OR-WA	0	H	0	0	F
Cleveland, OH	L-	L-	L-	S-	S-
San Jose, CA	H+	H+	H+	F	F+
Cincinnati, OH-KY-IN	L-	L	L	S	S-
Virginia Beach, VA	L	L	L	S-	S-
Kansas City, MO-KS	L-	L-	L-	S-	S-
Milwaukee, WI	L-	L-	L-	S-	S-
San Antonio, TX	H	0	0	F+	F
Las Vegas, NV	H+	H	0	F+	F+
Orlando, FL	H+	H	H	F+	F+
Providence, RI-MA	L	L	L	0	S-
Columbus, OH	L	L	L	0	S-
Buffalo, NY	L-	L-	L-	S-	S-
New Orleans, LA	L-	L	L-	S-	S-
Charlotte, NC-SC	H	0	L	F	S-
Indianapolis, IN	H	0	L	S	S-
Jacksonville, FL	H	0	L	0	S-
Austin, TX	H	H	L	F	S-
Memphis, TN-MS-AR	L-	L-	L-	S	S-
Raleigh-Durham, NC	0	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