Appendix PDX – Portland, Oregon
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 PDX-1: Current Measures and Trends

Measures	Current Year	Last Year		Two Years Ago	
	2003	2002	Change	2001	Change
Performance Measures					
Travel Time Index	1.30	1.33	-2% ↓	1.37	-5% ↓
Planning Time Index	1.53	1.62	-6% ↓	1.67	-9% ↓
Buffer Index	16%	20%	-4% ↓	20%	-4% ↓
% Congested Travel	80%	83%	-3% ↓	88%	-8% ↓
Total Delay (veh-hours) per 1000 VMT	5.01	5.55	-10% ↓	6.05	-17% ↓
Explanatory Measures					
Peak Period VMT (000)	1,530	1,180	+30% ↑	1,470	+4% ↑
Avg. Annual DVMT (000)	5,670	5,830	-3% ↓	5,510	+3% ↑
Data Quality Measures					
% complete	83%	56%	+27% ↑	66%	+17% ↑
% valid	62%	76%	-14% ↓	98%	-36% ↓
% of VMT covered	43%	45%	-2% ↓	43%	0% —
% of freeway miles	39%	39%	0% —	39%	0% —

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

Exhibit PDX-2: 2000 to 2003 Annual Trends

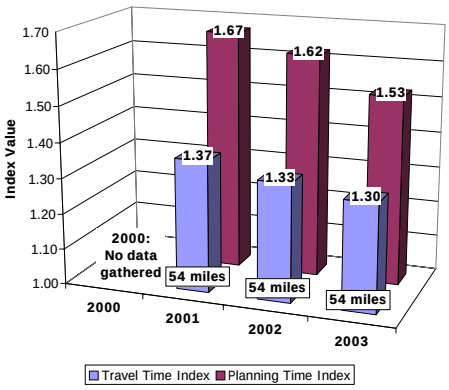
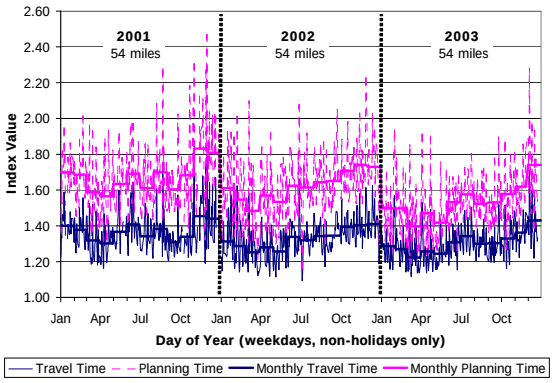


Exhibit PDX-3: Daily and Monthly Trends



Comments

- All 2003 congestion and reliability measures show steady but continuing improvements over 2001 and 2002 levels.
- The trends in vehicle travel are mixed – it appears that travel may be down as compared to 2002, but up by 3-4% compared to 2001 levels.

Data Source(s): Oregon Department of Transportation (http://www.tripcheck.com)
Includes 54 of 139 (39%) total freeway miles in Portland; collected using loop detectors; see page 7 for additional information on the data source

Data Analysis: Cambridge Systematics, Inc., analysis completed October 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.

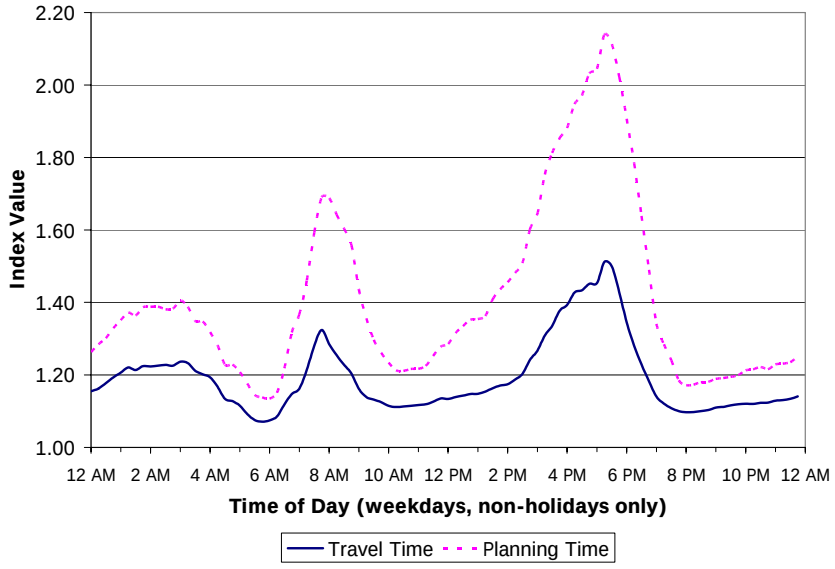


Exhibit PDX-4: Mobility and Reliability by Time of Average Weekday

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 is higher and longer than in the morning.
- Travelers must add 30-40% additional buffer time during peak times to account for traffic unreliability.

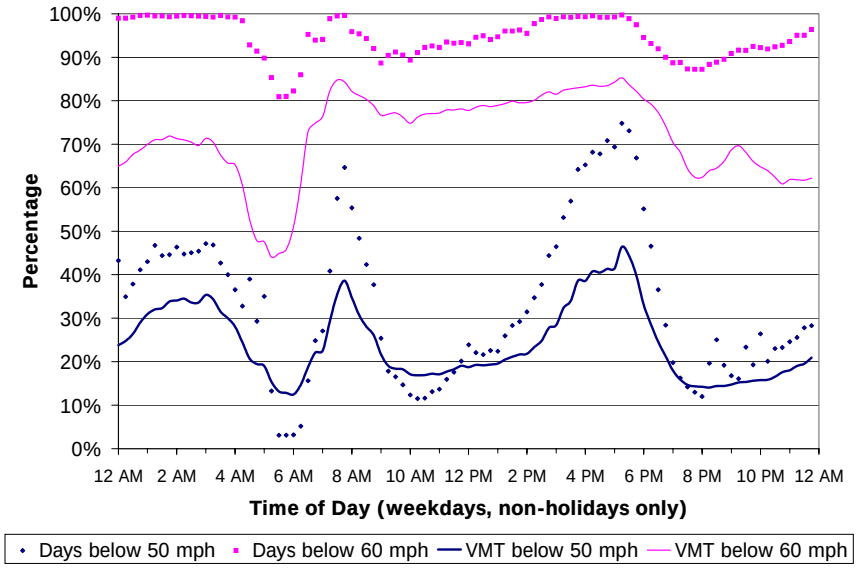


Exhibit PDX-5: Frequency and Percentage of Congested Travel by Time of Average Weekday

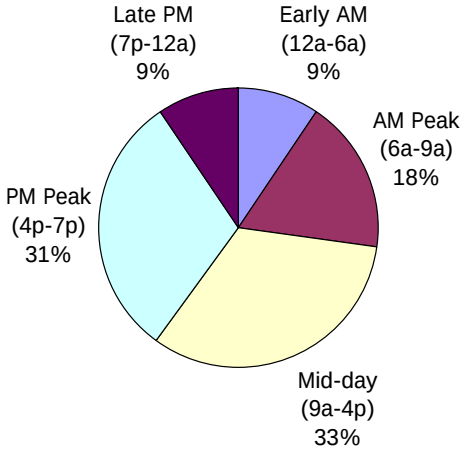
Comments

- 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.
- Nearly all off-peak (early morning and mid-day times) speeds appear to be in the 50 to 60 mph range.
- Peak period trends are more evident when using 50 mph as the congestion threshold.

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:

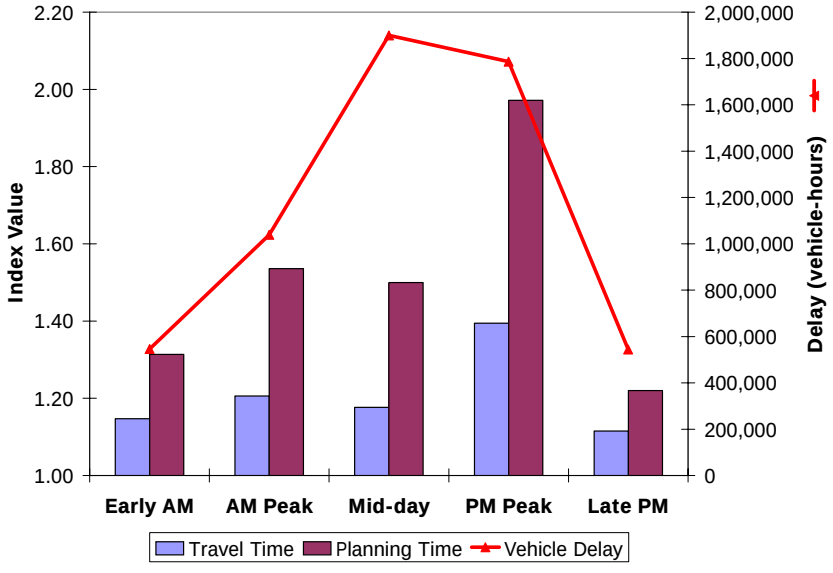
- Early AM: 12 to 6 am
- AM Peak: 6 to 9 am
- Mid-day: 9 am to 4 pm
- PM Peak: 4 to 7 pm
- Late PM: 7 pm to 12 am



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.
- These results are affected by slow speeds in off-peak periods and the use of a 60 mph congestion threshold (see Exhibit 5).

Exhibit PDX-6: Percent of Delay by Time Period



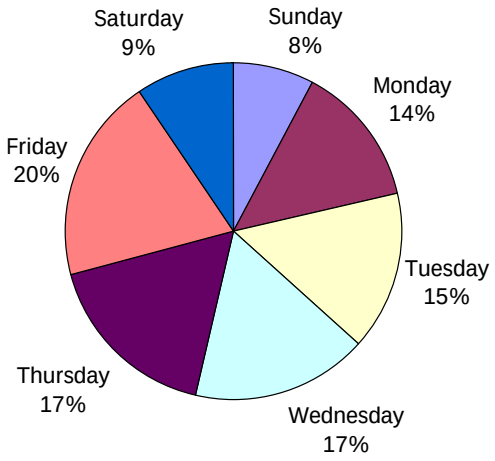
Comments

- 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.
- These results are affected by slow speeds in off-peak periods and the use of a 60 mph congestion threshold (see Exhibit 5).

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

Day of Week Patterns and Trends

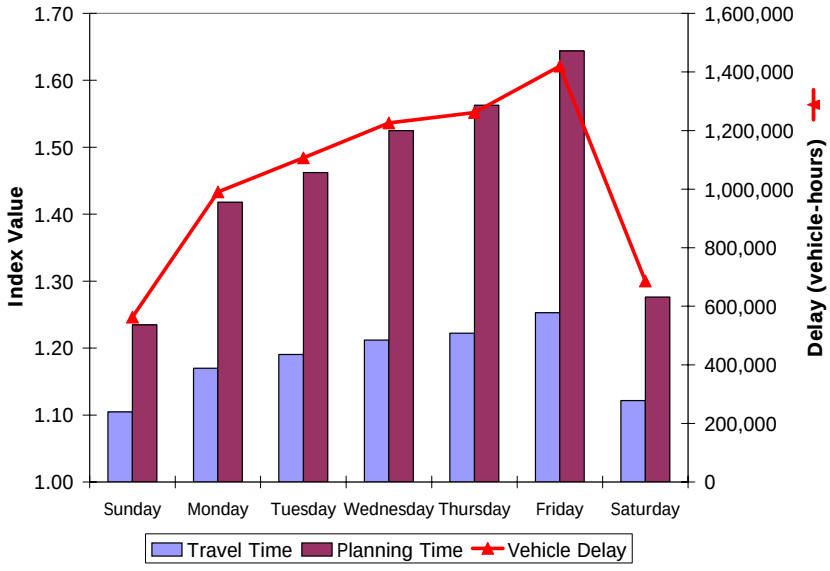
The charts on this page illustrate average traffic patterns and trends that were measured on the freeway sections instrumented with operations-based traffic sensors. Because of different peak period times and lengths on weekdays and weekends, the statistics presented on this page are 24-hour daily totals 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.
- Each of the weekend days has about half of the normal weekday delay.

Exhibit PDX-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 is the least reliable day (highest planning time index).

Exhibit PDX-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.

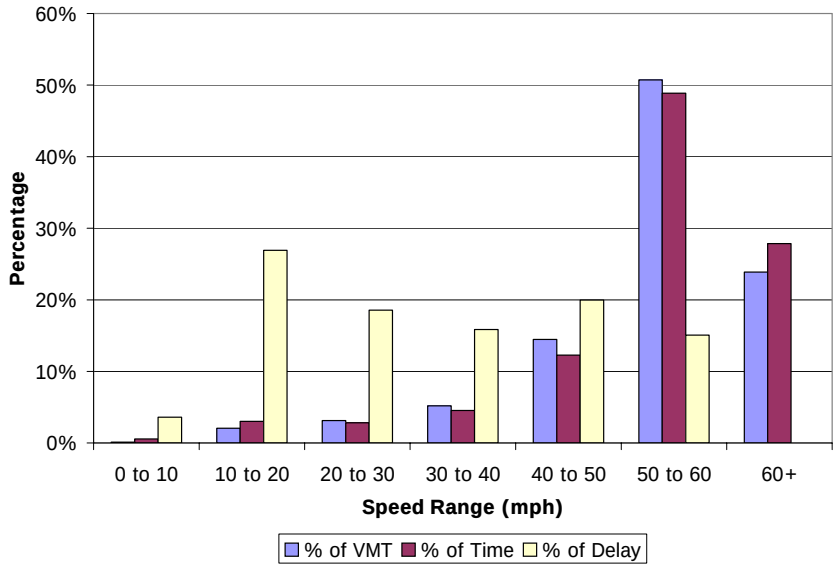


Exhibit PDX-10: Percent of VMT, Delay and Time Periods in Different Speed Ranges

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.
- Only 24% of the VMT occurred above 60 mph, with another 51% of the VMT in the 50 to 60 mph range.
- About 30% of the delay is below 20 mph, but only 2% of the VMT is below 20 mph.

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 PDX-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
US 26 WB: Skyline Road to Murray Street	7.20	1.28	1.24	1.63	1.46	26%	31%	29%	27%
I-5 NB: Stafford Road to Jantzen Beach	21.81	1.25	1.25	1.63	1.44	28%	46%	54%	41%
I-5 SB: Jantzen Beach to Nyberg Road	18.50	1.31	1.28	1.46	1.39	16%	22%	34%	26%
US 26 EB: Helvetia Road to Skyline Road	10.10	1.32	1.21	1.39	1.35	59%	48%	69%	64%
I-205 NB: Stafford Road to Division	16.78	1.14	1.14	1.37	1.26	14%	19%	42%	29%
OR-217 SB: Walker Road to 72nd Ave.	6.01	1.18	1.13	1.28	1.23	42%	26%	44%	43%
OR-217 NB: 72nd Ave. to Walker Road	5.95	1.13	1.11	1.29	1.21	21%	11%	32%	27%
I-205 SB: Airportway to Stafford	21.91	1.09	1.05	1.15	1.12	32%	17%	31%	31%
I-84 EB: 39th Street to Morrison/I-84									
I-84 WB: 33rd Street to 207th Street									
Average for all Sections		1.21	1.18	1.39	1.30	27%	27%	41%	34%

Comments

- This table shows average weekday congestion (travel time index) and reliability (buffer index) for specific routes for different time periods of the day.
- No data were available for two freeway sections on I-84.

Source and Coverage of Data

This report was produced using data collected and archived by the Oregon Department of Transportation (http://www.tripcheck.com). A map of the freeway routes on which traffic data was collected is shown below.

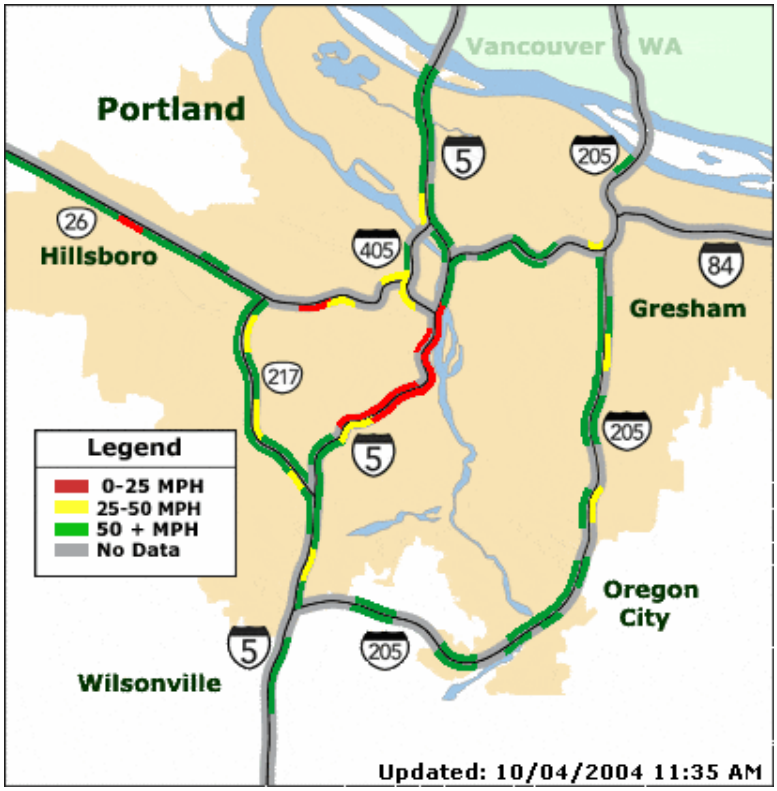


Exhibit PDX-12: Freeway Routes with Traffic Sensors in Portland
(Source of graphic: Oregon DOT, http://www.tripcheck.com)

Exhibit PDX-13: Instrumented Freeway Coverage in Portland

Coverage Measures	Year	Instrumented Freeway Routes	Total Freeway System[1]	Percent Coverage
Lane-miles	2000	n.a.	710	n.a.
	2001	210	715	29%
	2002	295	720	41%
	2003	245	725	34%
Centerline-miles	2000	n.a.	137	n.a.
	2001	54	137	39%
	2002	54	138	39%
	2003	54	139	39%
Average annual daily vehicle-miles of travel (DVMT) (1000)	2000	n.a.	12,595	n.a.
	2001	5,510	12,670	43%
	2002	5,830	12,905	45%
	2003	5,670	13,060	43%

[1]Source 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: buffer index = (95^{th} percentile travel time – average travel time) / 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.