Commission Briefing Paper 2C-01

Highway and Transit Conditions and Performance Beyond the 2006 C&P Report

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Introduction

This paper is part of a series of briefing papers to be prepared for the National Surface Transportation Policy and Revenue Study Commission authorized in Section 1909 of SAFETEA-LU. The papers are intended to synthesize the state-of-the-practice consensus on the issues that are relevant to the Commission's charge outlined in Section 1909, and will serve as background material in developing the analyses to be presented in the final report of the Commission.

This briefing paper presents highway and transit condition and performance information and data beyond that which is presented in the 2006 Conditions and Performance (C&P) report to Congress, including system-wide ratings assigned by the American Society of Civil Engineers. For highways, information on certain indicators is presented in this paper on a state-by-state basis, whereas the C&P report presents data at the national level only. Data on freight shipments by truck are also included. For transit, additional performance indicators drawn from the New York City transit system (beyond those presented at the national level in the 2006 C&P report) are provided.

Background and Key Findings

- In the American Society of Civil Engineers' *2005 Report Card for America's Infrastructure*, the Nation's road infrastructure was assigned a letter grade of D, while bridges and transit received grades of C and D+, respectively.
- The C&P report is the most complete and authoritative source of information about highway and transit conditions and performance, but it focuses on indicators that can be compiled and presented at the national level. FHWA's annual Highway Statistics publication, however, provides highway condition and performance information on a state-by-state basis. In particular, information on the percentage of road miles that meet certain pavement condition (based on IRI) and operational performance (based on volume-to-service flow ratios) are readily available.
- Between 1980 and 2002, the number of freight trucks increased from 5.8 million to 7.9 million, and the average distance traveled by commercial trucks increased from 19,000 miles per truck to 27,000 miles per truck.
- Although the National Transit Database (NTD) provides extensive data on transit agencies that receive Federal funds, several key elements relevant to the condition and performance of the national transportation transit system could supplement existing information. Examples from the New York MTA include on-time performance; mean distance between failures (the number of miles traveled by a subway car before breaking down).

General Condition and Performance Assessments

The American Society of Civil Engineers (ASCE) periodically produces the *Report Card for America's Infrastructure*, which includes letter grades for several different transportation and non-transportation infrastructure types. In the most recent edition of that report, the Nation's road infrastructure was assigned a letter grade of D, while bridges and transit received grades of C and D+, respectively. The road and transit grades were slightly lower than in the 2001 version of the study, while the letter rating for bridges remained the same. The grades assigned by ASCE for these C&P-related infrastructure types were similar to the grades reported for other transportation modes and for other non-transportation infrastructure (Exhibit 1).

Exhibit 1 2005 *Report Card for America's Infrastructure*

Category	2001	2005
C&P Infrastructure Types		
Roads	D+	D
Bridges	C	C
Transit	C-	D+
Other Transportation Infrastructure		
Aviation	D	D+
Navigable Waterways	D+	D-
Rail	--	C-
Other Infrastructure Types		
Dams	D	D
Drinking Water	D	D-
Hazardous Waste	D+	D
Schools	D-	D
Solid Waste	C+	C+
Wastewater	D	D-

Source: American Society of Civil Engineers

Highways

The Conditions and Performance report presents information on highway system characteristics, physical condition, and operating performance at the national level only, occasionally disaggregated for different functional systems. Much of this data is based on the Highway Performance Monitoring System (HPMS), which provides a generally uniform, consistent, statistically valid, and credible national level database built from State-provided data. It is a combination of sample data on the condition, use, performance and physical characteristics of facilities functionally classified as arterials and collectors (except rural minor collectors) and system level data for all public roads within each State. The HPMS is the most comprehensive and accurate database available on the extent and performance of the Nation's highways.

While aggregate data at the national level from the HPMS has been used in the preparation of the Conditions and Performance report, FHWA's annual *Highway Statistics* publication includes similar data for each state. Information from two such tables is shown in Exhibit 2 and Exhibit 3. However, when comparing states in such tables, it is important to recognize that other factors can be important in explaining any variation. As is noted in *Highway Statistics 2005*,

> Even when data are consistently collected and reported, users need to recognize that highway statistical information is not necessarily comparable across all States. For many of the data items reported in *Highway Statistics*, a user should not expect to find consistency among all States, due to many State-to-State differences. When making State level comparisons, it is inappropriate to use these statistics without recognizing those differences that impact comparability…

Differences that the user needs to consider in determining suitability of peer States for data comparison purposes include characteristics such as urban/rural similarities, population density, degree of urbanization, climate, geography, differing State laws and practices that influence data definitions, administrative control of the public road system, similarity of the basic State economies, traffic volume similarities, and the degree of State functional centralization.

Physical Condition

Exhibit 2 shows the percentage of miles on the National Highway System (NHS) in each state that fall below certain International Roughness Index (IRI) thresholds, disaggregated between rural and urban areas and between Interstate highways and other NHS routes. Roads with IRI levels below 95 inches per mile are referred to as having "good ride quality", while IRI levels below 170 represent "acceptable ride quality."

The IRI is a mechanically measured equipment-based rating reported in the HPMS. It is a measure only of pavement roughness and is shown as an accumulation of the inches (meters) of vertical movement of a vehicle over a roadway surface, adjusted to reflect a rate per mile (kilometer). Variability in IRI measurements can arise from differences in the equipment used to measure IRI, and differences in the measurement protocols used. Calibration of the equipment used and the protocols may be required to insure acceptable levels of accuracy. Low values indicate a smooth riding quality, while higher values are indicative of a rough road. In order to have a comprehensive measure of pavement condition, data on other pavement distresses such as rutting, cracking, and faulting would be needed. FHWA is currently considering adding these items to the HPMS data reporting requirements for the States.

Exhibit 2 Percent of Miles by Measured Pavement Roughness on the National Highway System, 2005

STATE	Rural				Urban			
	Interstate		Other NHS		Interstate System		Other NHS	
	IRI<95	IRI≤170	IRI<95	IRI≤170	IRI<95	IRI≤170	IRI<95	IRI≤170
Alabama	71.0%	87.5%	59.6%	97.8%	53.2%	81.8%	49.9%	94.1%
Alaska	30.0%	95.8%	22.8%	68.3%	60.9%	100.0%	23.4%	88.3%
Arizona	98.0%	100.0%	78.2%	99.2%	80.6%	100.0%	51.7%	96.7%
Arkansas	82.6%	97.4%	45.1%	97.6%	62.2%	94.1%	29.4%	81.5%
California	61.1%	96.3%	62.8%	99.2%	37.6%	86.7%	32.2%	84.5%
Colorado	54.5%	98.8%	60.4%	97.0%	41.5%	93.0%	34.0%	86.1%
Connecticut	79.5%	100.0%	30.4%	96.8%	53.6%	96.0%	24.4%	85.0%
Delaware	NA	NA	58.2%	100.0%	52.5%	95.0%	45.3%	93.0%
Dist. of Columbia	NA	NA	NA	NA	0.0%	41.7%	0.0%	8.6%
Florida	99.5%	100.0%	92.6%	100.0%	94.1%	99.9%	80.9%	97.9%
Georgia	96.6%	100.0%	94.9%	99.9%	94.7%	100.0%	88.6%	99.5%
Hawaii	0.0%	100.0%	11.4%	89.5%	12.0%	72.0%	17.7%	76.0%
Idaho	76.0%	99.6%	63.9%	99.4%	76.1%	90.2%	33.0%	84.8%
Illinois	70.6%	99.8%	40.4%	91.7%	39.3%	94.3%	12.5%	69.2%
Indiana	81.0%	100.0%	62.6%	96.9%	53.2%	98.1%	29.4%	83.6%
Iowa	54.8%	97.9%	44.3%	91.3%	39.9%	83.0%	27.6%	76.1%
Kansas	76.9%	100.0%	90.7%	99.7%	54.1%	100.0%	72.4%	93.4%
Kentucky	78.3%	100.0%	80.4%	99.9%	67.5%	98.6%	62.7%	96.4%
Louisiana	57.4%	98.5%	49.3%	89.9%	44.0%	92.4%	29.8%	67.6%
Maine	84.6%	100.0%	58.7%	93.8%	69.1%	98.5%	35.3%	77.9%
Maryland	80.2%	99.5%	72.2%	99.1%	61.0%	92.3%	41.1%	80.6%
Massachusetts	56.7%	100.0%	27.1%	98.8%	64.9%	99.2%	18.1%	65.8%
Michigan	42.0%	92.3%	64.3%	97.3%	40.7%	87.2%	23.6%	70.6%
Minnesota	54.1%	100.0%	67.4%	99.3%	53.8%	97.4%	44.2%	95.7%
Mississippi	85.4%	97.7%	62.7%	97.2%	64.1%	96.4%	38.6%	87.0%
Missouri	71.2%	99.4%	48.2%	91.9%	63.4%	94.5%	28.7%	87.4%
Montana	91.9%	99.5%	79.0%	99.5%	78.3%	88.3%	33.8%	80.0%
Nebraska	83.3%	97.9%	46.8%	91.1%	52.6%	86.0%	2.9%	48.6%
Nevada	95.1%	100.0%	99.1%	99.9%	59.5%	98.2%	70.7%	96.0%
New Hampshire	99.3%	100.0%	57.5%	90.8%	90.5%	100.0%	66.9%	96.4%
New Jersey	35.9%	90.6%	19.5%	90.8%	26.1%	87.2%	10.7%	73.4%
New Mexico	95.4%	100.0%	81.9%	99.8%	78.7%	97.4%	52.2%	90.7%
New York	56.4%	86.7%	56.3%	89.8%	45.4%	83.5%	20.3%	65.3%
North Carolina	64.9%	97.3%	61.3%	96.1%	54.6%	90.0%	44.7%	91.5%
North Dakota	76.2%	100.0%	56.3%	96.2%	76.5%	100.0%	11.9%	80.6%
Ohio	89.9%	100.0%	68.4%	98.8%	76.8%	98.6%	47.9%	91.1%
Oklahoma	73.4%	98.8%	49.8%	92.7%	53.9%	85.9%	41.6%	83.7%
Oregon	89.2%	100.0%	46.2%	98.0%	84.8%	100.0%	36.5%	82.6%
Pennsylvania	70.1%	98.6%	53.1%	96.6%	59.9%	97.6%	30.4%	85.3%
Rhode Island	100.0%	100.0%	4.2%	58.3%	69.4%	100.0%	23.2%	78.1%
South Carolina	76.6%	100.0%	70.4%	99.4%	78.9%	99.6%	39.9%	89.7%
South Dakota	60.4%	100.0%	50.9%	88.1%	53.6%	98.6%	15.6%	73.4%
Tennessee	96.4%	100.0%	87.0%	99.4%	87.2%	98.3%	66.5%	93.5%
Texas	79.1%	99.9%	60.6%	99.3%	47.9%	97.4%	28.0%	82.5%
Utah	74.7%	95.8%	58.1%	99.0%	65.3%	100.0%	62.5%	95.9%
Vermont	87.1%	98.6%	65.2%	91.6%	65.9%	100.0%	26.8%	73.2%
Virginia	95.5%	100.0%	61.9%	97.5%	44.3%	96.0%	30.6%	84.6%
Washington	66.4%	97.2%	74.5%	97.9%	65.7%	93.6%	50.7%	85.9%
West Virginia	74.8%	97.7%	53.4%	97.5%	68.6%	95.6%	56.5%	92.1%
Wisconsin	67.6%	97.7%	62.9%	96.8%	64.1%	96.1%	25.9%	76.0%
Wyoming	85.4%	98.7%	81.2%	99.6%	61.1%	87.8%	62.2%	92.7%
U.S. Total	75.1%	98.3%	63.4%	96.6%	58.6%	94.0%	36.0%	82.4%

Exhibit 3 Percent of Miles by Volume-Service Flow (V/SF) Ratio National Highway System In Urban Areas - 2005

STATE	Interstate System		Other NHS	
	0.80-0.95	> 0.95	0.80-0.95	> 0.95
Alabama	14.7%	24.4%	2.2%	3.6%
Alaska	5.8%	0.0%	6.7%	9.3%
Arizona	13.8%	23.4%	10.6%	9.7%
Arkansas	15.4%	20.7%	5.7%	6.1%
California	29.7%	43.4%	20.0%	23.6%
Colorado	14.5%	15.2%	9.5%	4.5%
Connecticut	35.4%	16.6%	11.2%	10.5%
Delaware	12.2%	22.0%	4.8%	1.6%
Dist. of Columbia	38.5%	23.1%	13.0%	13.0%
Florida	29.7%	22.9%	10.4%	12.8%
Georgia	23.1%	22.9%	4.5%	3.1%
Hawaii	14.3%	10.2%	4.4%	6.0%
Idaho	4.4%	17.6%	6.1%	1.7%
Illinois	16.5%	26.9%	8.8%	1.5%
Indiana	9.3%	5.4%	5.3%	2.6%
Iowa	20.3%	9.2%	0.0%	0.0%
Kansas	3.7%	12.6%	5.3%	3.3%
Kentucky	25.8%	31.1%	5.2%	10.9%
Louisiana	12.6%	16.7%	11.4%	15.3%
Maine	1.5%	0.0%	3.0%	0.7%
Maryland	27.7%	23.0%	15.4%	5.5%
Massachusetts	12.8%	24.1%	16.1%	5.2%
Michigan	20.0%	23.8%	9.3%	8.3%
Minnesota	18.8%	51.3%	7.4%	20.0%
Mississippi	14.3%	9.2%	6.3%	6.5%
Missouri	12.3%	7.9%	8.3%	11.1%
Montana	0.0%	0.0%	1.6%	0.0%
Nebraska	15.5%	8.6%	5.1%	2.2%
Nevada	18.8%	18.8%	15.2%	14.5%
New Hampshire	27.0%	13.5%	8.0%	2.5%
New Jersey	16.2%	41.8%	14.6%	19.7%
New Mexico	5.8%	7.7%	2.2%	0.4%
New York	9.9%	27.5%	7.7%	18.1%
North Carolina	26.3%	31.4%	12.7%	7.8%
North Dakota	0.0%	0.0%	0.0%	0.0%
Ohio	26.0%	26.7%	3.7%	2.2%
Oklahoma	15.3%	11.3%	5.0%	2.8%
Oregon	21.5%	10.5%	8.9%	5.9%
Pennsylvania	11.8%	18.0%	9.3%	4.1%
Rhode Island	12.0%	42.0%	11.4%	3.4%
South Carolina	21.1%	18.6%	11.4%	7.0%
South Dakota	0.0%	0.0%	0.0%	0.0%
Tennessee	11.8%	25.1%	8.8%	8.1%
Texas	24.3%	27.0%	10.8%	13.6%
Utah	19.6%	8.4%	4.1%	4.5%
Vermont	5.0%	0.0%	5.4%	3.6%
Virginia	21.6%	7.6%	7.0%	5.0%
Washington	20.8%	5.4%	10.3%	5.4%
West Virginia	0.6%	0.0%	5.3%	1.6%
Wisconsin	14.8%	14.4%	5.1%	4.7%
Wyoming	0.0%	0.0%	0.0%	0.0%
U.S. Total	18.8%	22.3%	9.3%	8.9%

Operational Performance

Highway Statistics includes information on traffic volume-service flow ratios (V/SF), a measure of congestion in Highway Statistics. The V/SF is a computed numerical value based upon traffic volume information and roadway capacity calculated for each sampled section of roadway. The V/SF is a product of complex estimating procedures and is more susceptible to State-to-State and year-to-year variability than a measured congestion parameter such as measured travel time or AADT/lane might be. Also, as a measure of congestion, the V/SF metric does not adequately reflect the effects of peak spreading. Also, periodic changes to the HCM calculation procedures used in the estimate of service flow may mask the actual congestion experienced by the highway user to some degree (or at least make year-to-year comparisons more difficult). Exhibit 3 shows the percentage of miles in each state with V/SF ratios between 0.80 and 0.95 (often referred to as "congested") and the percentage of road miles with V/SF above 0.95 (referred to as "severely congested").

Freight

Reports prepared by other offices and agencies may provide additional insight to the Nation's highway system. One recent FHWA report[1] provided information on the increase in the nation's freight ton-miles by all freight modes between 1980 and 2004. As an example, this report showed that between 1980 and 2002, the number of freight trucks increased from 5.8 to 7.9 million and that the average distance traveled by commercial trucks increased from 19,000 miles per truck to 27,000 miles per truck in 2002. Exhibit 4

[1] Freight in America: A New National Picture. USDOT Research and Innovative Technology Administration, Bureau of Transportation Statistics. January 2006.

provides a comparison based on information available from other sources.

Exhibit 4 Comparison of Shipments by Truck: 1993 and 2002

Transportation mode	Tons (millions)			Ton-miles (billions)			Value (billion $)		
	1993	2002	% change	1993	2002	% change	1993	2002	% change
Truck	6,385	7,843	22.8	869	1,256	44.5	4,414	6,224	41.1
Single modes	8,923	11,087	24.2	2,138	2,868	34.2	4,953	7,037	42.1
Multiple modes	223	217	-2.8	191	226	18.0	662	1,077	62.6
All modes	9,688	11,668	20.4	2,421	3,138	29.6	5,862	8,82	43.0

Source: Freight in America: A New National Picture (Table 10). USDOT Research and Innovative Technology Administration, Bureau of Transportation Statistics. January 2006.

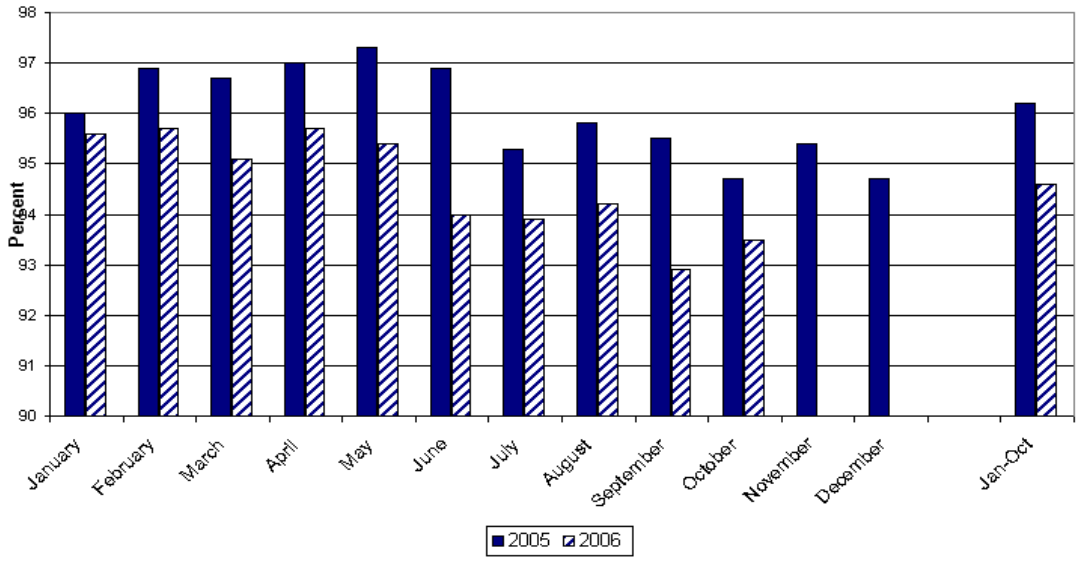
Also, another FHWA report[2] indicated that the demand for trucking services has grown rapidly in the 1990s. Between 1980 and 1990 intercity truck ton-miles grew an average rate of 2.8% per year, and between 1990 and 1998 the ton-mile growth rate was 4.3%.

Transit

Although the National Transit Database (NTD) provides extensive data on transit agencies that receive Federal funds, several key elements relevant to the condition and performance of the national transportation transit system could supplement existing information. Examples from the New York MTA include:

On-time Performance – On-time performance is collected by a number of transit agencies. Though not reported at a national level, on-time performance could serve as a proxy for system condition and indicate the degree to which investment is able to maintain service reliability. Exhibit 5 compares on-time performance for 2005 and 2006.

Exhibit 5 New York City Transit Subway: Weekday 24-Hour Terminal On-Time Performance



Oct 2005: 94.7%
Oct 2006: 93.5%

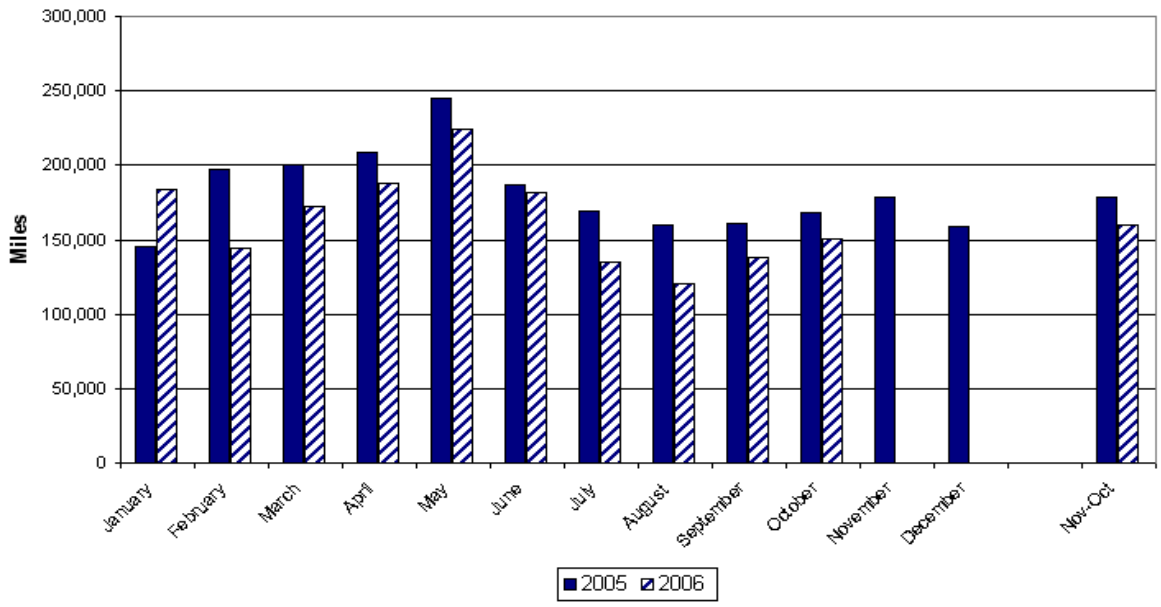
Jan — Oct 2005: 96.2%
Jan — Oct 2006: 94.6%

Source: NYC Transit; information contained in NYC Transit Committee Books is reported in a different format.

[2] Freight Transportation: Improvements and the Economy. FHWA, Washington DC. June 2004

Mean Distance Between Failures (MDBF) – This is the number of miles traveled by a subway car before breaking down. The higher the mileage for the MDBF, the more reliable the subway car and the service. Transit agencies including the MTA in New York track MDBF as a measure of both condition and reliability. Exhibit 6 compares MDBF for 2005 and 2006.

Exhibit 6 New York City Transit Subway: Mean Distance Between Failures



Oct 2005: 168,298 miles **Nov 2004 — Oct 2005:** 178,972 miles
Oct 2006: 150,800 miles **Nov 2005 — Oct 2006:** 160,215 miles

Source: NYC Transit Committee Books

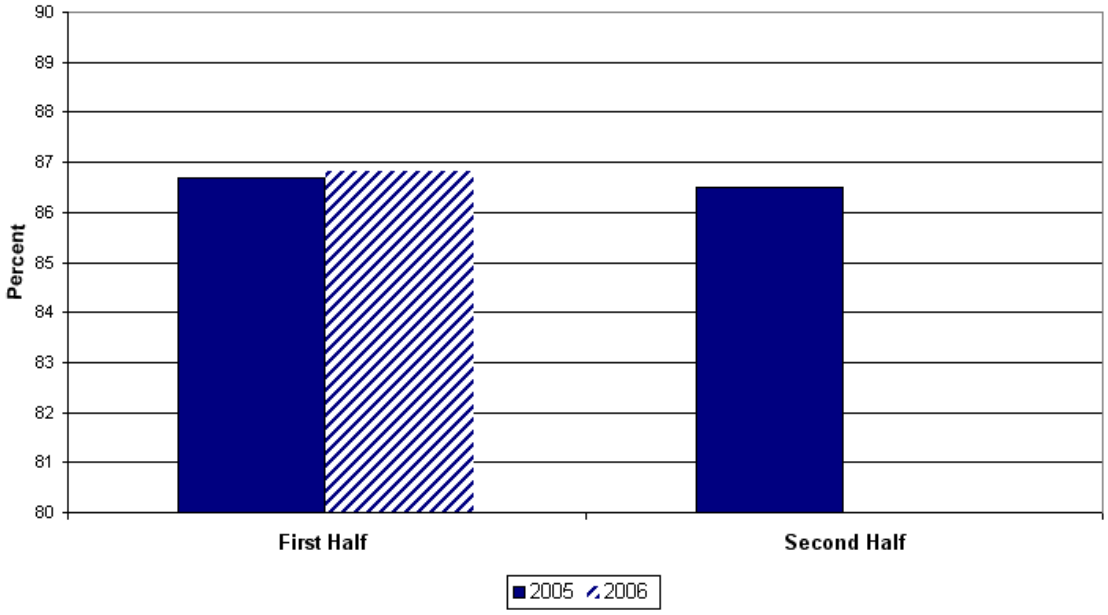
Wait Assessment – The New York MTA compiles information on the weekday percentage of time that vehicles arrive within an acceptable time. Subway wait assessment measures daytime (6 a.m. to 9 p.m.) service reliability. This indicator is the percentage of instances that the time between trains falls within acceptable limits. The higher the percentage is, the more reliable the service. Exhibit 7 compares subway wait assessment for 2005 and 2006.

An "acceptable limit" is the scheduled time between trains plus:

- No more than two minutes during the peak period (6 a.m. to 9 a.m. and 4 p.m. to 7 p.m.); or
- No more than four minutes during the off-peak period (9 a.m. to 4 p.m. and 7 p.m. to 9 p.m.)

For example, if the scheduled time between off-peak trains is six minutes, and trains arrive nine minutes apart, then customers have waited three minutes longer than the scheduled time. Since this is less than four minutes over the scheduled time between trains, customers have not waited too long for the train. Wait time is acceptable for this example11/23/2007.

Exhibit 7 New York City Transit Subway: Wait Assessment



First Half 2005: 86.7% **Second Half 2005:** 86.5% **First Half 2006:** 86.8%

Source: NYC Transit Committee Books

CONSOLIDATED COMMENTS FROM MEMBERS OF THE BLUE RIBBON PANEL OF TRANSPORTATION EXPERTS - PAPER 2C-01

One reviewer commented as follows:

- This paper proposes additional National Transportation measures to assist states with evaluation of the condition of their transportation system.

- The background adequately details some of the measures currently used.

- IRI, a pavement condition, is discussed. This is a measure of such pavement distresses as rutting, cracking and faulting. This is a measure used by many states to evaluate the condition of their infrastructure and it can be used to help determine maintenance schedules. This measure can be influenced by many factors such as weather, dollars dedicated to maintenance, each state criteria for making improvements and the like. While this is a good evaluation tool, it may be a difficult measure to use for comparison of various states due to the many factors influencing it.

- The paper proposes a transit measure that would evaluate the percentage of time that the vehicles arrive within an "acceptable time". This measure is a good customer service measure to determine how responsive a transit system is to its customers. However, an

"acceptable time" can vary from state to state or even between systems within the same state. It will be difficult to use this measure as a national comparison among states.