Interstate System Conditions and Performance

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Introduction

On February 16, 2006, Secretary of Transportation Norman Y. Mineta forwarded a report to Congress on the *2004 Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance*. In accordance with Section 502(f) of Title 23 and Section 308(e) of Title 49, United States Code, the report provides an objective appraisal of the physical condition, operational performance, and future investment requirements for highways, bridges, and transit as of 2002. (A report based on 2004 conditions and performance is being prepared for transmittal to Congress.)

The report covers all types of highways and bridges, but chapter 16 pulls together information on the Interstate System from the other chapters. The chapter provides a detailed look at the size, condition, performance, and financial needs of what was then the 46-year old Dwight D. Eisenhower National System of Interstate and Defense Highways.

This introduction will summarize chapter 16, but the chapter is available in full on the Federal Highway Administration's (FHWA) Web site at:

https://www.fhwa.dot.gov/policy/2004cpr/chap16a.cfm

The complete 2004 Conditions and Performance report can be found at:

https://www.fhwa.dot.gov/policy/2004cpr/

Interstate Mileage

The Interstate System designated under the Federal-Aid Highway Act of 1956, as amended, is 42,794 miles long. This mileage, which was eligible for Interstate Construction (IC) funds (Federal matching share: 90 percent) on a cost-to-complete basis, cannot be expanded under current law. However, the Interstate System has continued to grow because the FHWA can designate Interstate routes built without IC funds if they meet Interstate standards and would be logical additions or connections to the System. The Conditions and Performance report explains:

> The route miles of the Interstate System in the United States increased from 46,675 in 2000 to 46,747 in 2002. About 70.8 percent (33,107 route miles) were in rural areas, 3.9 percent (1,808 route miles) were in small urban areas, and 25.3 percent (11,832 miles) were in urbanized areas.

(Because of non-IC additions since 2002, the Interstate System is now 46,876 miles long.)

The urban-rural mix of the Interstate System has been changing, mainly because urban boundaries have been extended into formerly rural areas:

> The number of Interstate route miles in rural areas declined from 33,152 to 33,107 in 2002. During the same period, the number of Interstate miles in small urban areas increased from 1,794 in 2000 to 1,808 in 2002 and in urbanized areas the number of route miles increased from 11,729 in 2000 to 11,832 in 2002.

The term "route mile," as used here, refers to a mile of road, regardless of how many lanes it contains. The extent of the Interstate System can also be measured in "lane miles" - for example, 1 mile of road with 8 lanes has 8 lane miles,

where as 1 mile of road with 4 lanes measures 4 lane miles. Using this measure, the Conditions and Performance report states that the Interstate System is 210,896 lane miles long. Since 1993, Interstate lane miles have increased by 8,442 lane miles or 0.5 percent since 1993, when it contained 202,454 lane miles:

> Between 1993 and 2002, rural Interstate lane miles grew by 0.2 percent annually, small urban Interstate lane miles grew at 1.0 percent annually, and urbanized Interstate lane miles grew by 0.9 percent annually. The annual growth rate of lane miles from 1993 to 2002 for the total Interstate System was 0.5 percent annually or almost double the annual growth rate of lane miles for all roads in the United States over the same period.

The report attributes the growth in Interstate lane miles to new construction and the reclassification of some arterials to Interstate status.

Virtually the entire Interstate System in 49 States (not counting Alaska) meets Interstate standards, such as a minimum 12-foot lane width (99.8 percent of rural Interstates and 98.5 percent of urban Interstates). "The vast majority of the Interstate mileage consists of divided highways with a minimum of four lanes and with full control of access." An exception is I-93 through Franconia Notch in New Hampshire. The Federal-Aid Highway Act of 1973 exempted this section from full compliance with Interstate standards for environmental reasons. As a result, it includes sections of Interstate highway, a four-lane parkway, a three-lane parkway, and a two-lane parkway.

Federal law (Section 10 of the Federal-Aid Highway Act of 1981) directed the Federal Highway Administration to designate Interstates in Alaska and Puerto Rico, but specified that the routes did not have to meet Interstate standards. They were to be designed to "standards adequate for current and probable future traffic demands and the needs of the locality of the segment." The Conditions and Performance report summarized this mileage:

> In Alaska, 1,034 miles of rural Interstate are not required to have a minimum of four lanes and full access control. For urban Interstates, 104 miles do not meet the specified criteria for access control; 53 miles are in Puerto Rico and the remaining miles are in Alaska.

From its conceptual days in the late 1930s (as in the 1939 report to Congress on *Toll Roads and Free Roads*), the Interstate System was expected to be safer than any other road system. That has proven to be the case, as reflected in the Conditions and Performance report. Comparing the number of fatalities in 1994 and 2002, the report states:

> While the number of fatalities has increased on both rural and urban Interstates, these roads are still safer on average than those in other functional classes. The fatality rate on rural Interstates [fatalities per 100 million VMT] has remained lower than any other rural functional class, and the fatality rate on urban Interstates has remained the lowest of any functional class.

In 1994, 4,713 people were killed in crashes on the Interstate System compared with 40,716 fatalities overall. The fatality rate on all roads was 1.7, but 1.19 on rural Interstates and 0.65 on urban Interstates. In 2002, the comparable totals were 5,780 fatalities on the Interstate System out of 43,005 fatalities overall. The national fatality rate was 1.5, but 1.18 on rural Interstates and 0.61 on urban Interstates.

By far, urban Interstates were safer than rural Interstates. "The rural Interstate fatality rate was almost double that of urban Interstates for the period from 1994 to 2002." In this context, the report notes that, "Travel speeds tend to be higher on rural Interstates than urban Interstates." [See chapter 5, p 5-8.]

Vehicle Miles Traveled

The growth in Interstate vehicle miles traveled (VMT) has been significantly higher than expansion of lane miles:

> In 2002, American traveled approximately 282 billion vehicle miles on rural Interstates, 22.6 billion vehicle miles on small urban Interstates, and in excess of 389 billion vehicle miles on urban Interstates.

> Interstate travel continued to represent the fastest growing portion of VMT between 1993 and 2002. Interstate VMT grew at an average annual rate of approximately 3.1 percent between 1993 and 2002, while VMT on all roads grew by about 2.5 percent annually.

The report calculated the percentage of VMT by type of vehicles:

> In 2002, 80.5 percent of travel on rural Interstates was by passenger vehicle; 3.1 percent was by single-unit truck; and 16.4 percent was by combination truck. About 91.9 percent of urban Interstate travel was by passenger vehicle; 2.2 percent was by single-unit truck; and 5.9 percent was by combination truck.

From 1993 to 2002, VMT by combination trucks grew by 4.4 percent annually on urban Interstates and 3.7 percent on rural Interstates.

The FHWA's annual *Highway Statistics* series offers comparable VMT (in millions, i.e., add six zeroes) over time:

Year	Rural	Urban	Total
1960	10,514	13,365	23,879
1970	79,516	81,532	161,048
1980	135,084	161,242	296,326
1990	200,173	278,901	479,074

(The table, VM-203, can be found in *Highway Statistics Summary to 1995*, which is available online at: https://www.fhwa.dot.gov/ohim/summary95/section5.html.)

Pavement Condition

Pavement condition is measured on the basis of the International Roughness Index (IRI) or the Present Serviceability Rating (PSR):

> The IRI measures the cumulative deviation from a smooth surface in inches per mile. The PSR is a subjective rating system based on a scale of 0 to 5. [See chapter 3 of the Conditions and Performance report, page 3-5.]

Based on these measures, the report uses the terms "acceptable" and "not acceptable" to rank ride quality. Within the "acceptable" classification, some pavements qualify as "good." Using these "lay" terms, the report states:

> Since 1995, the number of Interstate miles rated as having "Good" ride quality has increased for all three population subsets of Interstate highways. In 2002, rural area Interstates had the greatest percentage of miles with "Acceptable" or better ride quality. About 98 percent of rural area Interstates met this standard. As a subset of the miles with "Acceptable" ride quality, 71.9 percent of rural Interstate miles met standards required for classification as "Good" ride quality.
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> For small urban Interstate miles, 95.3 percent met the criteria for "Acceptable" ride quality. As a subset of the miles with "Acceptable" ride quality, 64.9 percent met the standards to be classified as "Good" ride quality in the year 2002.
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> In 2002, 91.7 percent of urbanized Interstate miles met the criteria for "Acceptable" ride quality. As a subset of this group meeting "Acceptable" ride quality, 48.7 percent of the urbanized Interstate miles met the standards to be classified as having "Good" ride quality.

Bridge Condition

As of 2002, the Interstate System included 55,245 bridges, including 27,929 bridges in urban areas. The report discusses the age of these bridges:

> About 47.9 percent of rural Interstate bridges were built during the early years of the Interstate System, from 1961 to 1970. More than 68.2 percent of all rural Interstate bridges in 2002 were at least 30 years old.
>
> About 41.2 percent of urban Interstate bridges were built between 1961 and 1970. Over 61.5 percent of all urban Interstate bridges in 2002 were at least 30 years old.

In any discussion of bridge conditions, whether on the Interstate System or not, a distinction must be made between "deficiency" and "unsafe." "Deficiency" applies to bridges that are "functionally obsolete" (current use exceeds the design standards - e.g., a bridge has too few lanes or lacks shoulders) or "structurally deficient" (reflecting the condition of the structure, namely the substructure, superstructure, and deck or riding surface). The fact that a bridge is deficient does not mean it is likely to collapse. All bridges on public roads are inspected regularly (usually once every 2 years) and are in no danger of collapse due to structural condition. If warranted, bridges are load-posted to eliminate heavy traffic, but are safe if used in accordance with the restriction.

(Few bridges collapse in any year - the number is usually less than a hundred, compared with approximately 591,707 bridges nationwide in 2002. By a wide margin, most bridges that collapse do so during floods. Overweight vehicles, usually crossing a bridge in violation of posted weight limits, are the second biggest cause of bridge collapses. A third cause of bridge failure is collision damage when a vehicle or a vessel hits a bridge. By comparison with these three causes, collapse due to structural failure is rare.)

For the Interstate System, 84.2 percent of rural bridges were not deficient. Moreover, the number of deficient Interstate bridges has declined since the mid-1990s:

> In 1994, for example, 18.5 percent of rural Interstate bridges were deficient. That number has declined to 15.8 percent. The number of deficient urban Interstate bridges also declined, from 30.6 percent in 1994 to 26.3 percent.

Of the deficient Interstate bridges, 1,104 (4 percent of the total) were structurally deficient while 3,210 (11.8 percent) were functionally obsolete.

The condition of bridge decks - the surface on which vehicles ride - has also improved:

> Approximately 17.9 percent of rural Interstate bridge deck area was deficient in 1996. This has decreased to 14.6 percent in 2002. This is the lowest percent deficient deck area for all rural functional classes. The percent of deficient deck area on urban Interstate bridges was 34.2 percent in 1996. By 2002, this had decreased to 31.0 percent.

Finance

Secretary Mineta, in his transmittal letter, stated that the improved condition of pavements and bridges, Interstate and non-Interstate, is "dramatic evidence" of the impact of increased investment by all levels of government, but especially since the Transportation Equity Act for the 21st Century was enacted on June 9, 1998:

> Significant increases in Federal assistance, combined with large increases in State and local investment have led to unprecedented transportation enhancements, improvements, and expansions.

Secretary Mineta was speaking generally of highways and bridges. The report describes the investment in the Interstate System:

> All levels of government spent $17.1 billion for capital improvements on Interstate highways and bridges in 2000, which constituted 25.1 percent of the $68.2 billion of capital outlay on all functional classes.

The funding for improvements was distributed among system preservation, expansions, and enhancements:

- 53 percent - $9.1 billion for preservation (activities include capital improvements on existing roads and bridges to preserve the existing pavement and bridge infrastructure, but not including routine maintenance.
- 38.2 percent - $6.5 billion for expansion (construction of new roads and bridges and additional lanes on existing roads).
- 8.8 percent - $1.5 billion for enhancements (safety enhancements, traffic operations improvements, and environmental enhancements).

The report contrasts the 2002 funding with 2000:

> Capital investment on Interstate highways increased sharply between 2000 and 2002, rising 21.6 percent; while total capital investment on all functional classes rose by only 11.2 percent.

The increase was especially high on rural Interstates, which experienced a 48.2 increase between these 2 years, "driven by an increase in rural Interstate bridge preservation of 181.5 percent and rural Interstate widening of 137.3 percent."

The report adds that the 2-year change is an unusual contrast that does not necessarily represent a long-term trend. Whether it is a trend or an aberration affects attempts to project financial needs for the Interstate System.

Financial Needs

During the congressional debate in 1955 and 1956 leading to the Federal-Aid Highway Act of 1956, no one questioned the need for the Interstate System. The key question was how to pay for this vitally needed highway network that was to be built, as everyone believed, in about 10 years at a cost of $27 billion.

Beginning in the 1970s, as attention turned to the deteriorating condition of the aging Interstate routes built early in the program, no one questioned the need to protect the taxpayers' investment. Again, the key question was how to pay for this vitally needed work. The answer has been a series of funding programs, beginning with Interstate 3R (resurfacing, restoring, rehabilitating) and continuing with today's Interstate Maintenance (IM) Program. Under the Safe, Accountable, Flexible, Efficient Transportation Equity Act: A Legacy for Users, approved August 10, 2005, funding for the IM Program increases from $4.884 billion in Fiscal Year (FY) 2005 to $5.199 billion in FY 2009.

To continue this commitment, the Conditions and Performance report examines financial needs of the Interstate System under two scenarios that are described in chapter 7:

- Maximum Economic Investment (Cost to Improve Highways and Bridges) - The level of investment that would be required to significantly improve system performance in an economically justifiable manner.
- Cost to Maintain Highways and Bridges for 2003-2022 - The annual investment necessary to maintain the current level of highway system performance.

The report describes investment requirements based on the Highway Economic Requirements System (HERS), a simulation model that employs incremental benefit cost analysis to evaluate highway improvements. Based on HERS, the report estimates average annual expenditures of $6.4 billion for the rural Interstates (5.4 percent of total highway and bridge expenditures) under the Maximum Economic Investment scenario:

- System Preservation - $3.3 billion ($2.6 billion for highways, $0.7 billion for bridges)
- System Expansion - $2.5 billion
- System Enhancements - $0.7 billion.

For urban Interstates, the Maximum Economic Investment scenario calls for average annual expenditures of $24.9 billion (20.9 percent of total):

- System Preservation - $7.0 billion ($4.9 billion for highways, $2.1 billion for bridges)
- System Expansion - $15.9 billion
- System Enhancements - $1.9 billion

At these funding levels, "all cost-beneficial improvements would be implemented."

For the second scenario, Cost to Maintain Highways and Bridges, the report estimates average annual expenditures of $5.0 billion for the rural Interstates (6.7 percent of total highway and bridge expenditures):

- System Preservation - $2.7 billion ($2.2 billion for highways, $0.5 billion for bridges)
- System Expansion - $1.8 billion
- System Enhancements - $0.4 billion.

For urban Interstates, the Cost to Maintain scenario calls for average annual expenditures of $13.8 billion (18.7 percent of total):

- System Preservation - $5.5 billion ($3.8 billion for highways, $1.6 billion for bridges)
- System Expansion - $7.1 billion
- System Enhancements - $1.2 billion

At these funding levels, "average user costs on all highways in 2022 would be maintained at their 2002 levels." The report compared this scenario for the Interstate System with all highways:

> At this level of investment, average user costs on all highways in 2022 would be maintained at their 2002 levels. User costs would increase on some sections and functional classes and would decrease on others. In the case of Interstate highways, average user costs in both urban and rural areas would decrease slightly.

For comparison, the report projects continuation of 2002 funding levels. For rural Interstates, "the 2002 preservation and expansion investment level of $4.99 billion on rural highways is only slightly below the maximum economic investment level of $5.12 billion estimated by HERS" for maximum improvement in IRI measurement of pavement condition. With that in mind, the report states:

> If current funding levels were sustained, and the mix of highway preservation and widening investments recommended by HERS were implemented, then average IRI would be projected to decline by 12.3 percent over 20 years, and the percentage of travel on roads with good pavement quality would rise to 86 percent. Virtually all travel on rural Interstates would occur on roads with at least acceptable ride quality. The annual level of funding required to maintain Average IRI is below $3.66 billion...
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> Average user costs on rural Interstates would be maintained at an average annual investment level of $3.66 billion, while average travel time costs would decrease at that funding level. Average delay on rural Interstates would be maintained at an investment level between $3.96 and $4.10 billion, and would decline by over 20 percent at 2002 preservation and expansion expenditure levels.
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> If current funding levels were sustained, and the mix of highway preservation and widening investments recommended by HERS were implemented, then significant reductions could be achieved in average total delay, total user costs and total travel time costs. However... spending for additions to existing rural Interstates rose 137.3 percent between 2000 and 2002. If future spending reverts back to a level more in line with what was observed in 2000, then average total delay would be expected to increase.

For urban Interstates, the report states:

> [An] average annual highway preservation investment of approximately $10.0 billion would be required to maintain average IRI at 2002 levels. As with rural Interstates, the percentage of travel on urban Interstate pavements with good ride quality would increase at this level of investment, while investment would need to increase to over $12 billion to maintain the percentage of VMT on roads with acceptable ride quality.
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> If current funding levels were sustained, and the mix of highway preservation and widening investments recommended by HERS were implemented, then average IRI on urban Interstates would be expected to increase by 10.1 percent, and the percent of VMT on roads with acceptable ride quality would fall to 81.8 percent. The results suggest that a substantial increase in urban Interstate investment would be necessary to prevent average pavement condition on urban Interstates from deteriorating in the future.
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> [An] average annual investment level in highway preservation and capacity expansion of between $9.75 and $10.18 billion would be needed to maintain average delay on urban Interstates. Total user costs would be maintained at investment levels up to $10.96 billion, and travel time costs on urban Interstates would be maintained at funding levels over $12 billion. These amounts are 30 to 70 percent higher than the comparable 2002 funding level of $7.5 billion. The results suggest that, if average annual funding were maintained (in constant dollars) at 2002 levels through 2022, average delay on urban Interstates would increase by 9.6 percent, total user costs would increase by 4.1 percent, and travel time costs would increase by 9.6 percent.

For Interstate bridges, the backlog of preservation needs totals $14.2 billion. Eliminating this backlog would not mean that all Interstate bridges would be in satisfactory condition; as current deficiencies are addressed, other Interstate bridge will deteriorate, adding to Interstate bridge needs. To keep the backlog at its current level over a 20-year period, an average annual investment level of $2.13 billion would be required. To eliminate the backlog and correct other deficiencies as they develop over the next 20 years (where it is cost-beneficial to do so) would require an average annual investment of $2.82 billion.

If Interstate bridge preservation expenditures of $3.2 billion in 2002 were maintained in constant dollars over 20 years, the Interstate bridge backlog could be eliminated. This level was an increase of 93.7 percent over Interstate bridge preservation expenditures in 2000 ($1.6 billion). "If future spending reverts back to a level more in line with what was observed in 2000, then the Interstate bridge preservation backlog would increase significantly."

In summary, if 2002 funding levels were maintained for Interstate highway preservation and expansion, funding would be sufficient to maintain conditions and performance in rural areas, although "significant opportunities for cost-beneficial improvement to the system" would remain to be addressed. In urban areas, "significant increases in funding for preservation and expansion above current levels would be required to prevent both average physical conditions and operational performance from becoming degraded.

Conclusion

One aspect of the Interstate System that is sometimes overlooked is the 50-year old bipartisan commitment to its completion and preservation of the taxpayers' investment in it. Whatever the economic or political times, the Federal and State governments have understood the importance of the Interstate System to our economy, mobility, national defense, safety, and the American way of life. The Federal and State governments have maintained their commitment to the Interstate System over 5 decades despite the inevitable ups and downs of the economy, changing attitudes about the impacts of the Interstate System, and the role of the Federal Government.

The *2004 Status of the Nation's Highways, Bridges, and Transit: Conditions and Performance* reflects this commitment. The Interstate program launched by the Federal-Aid Highway Act of 1956 is essentially complete, but the Interstate System continues to grow to meet changing needs. State and Federal officials are continuing to invest in the

Interstate System - its preservation and expansion - so it will continue to serve as the backbone of our intermodal transportation network. The investment is shown in the condition of the Interstate pavements and bridges, while its growing use demonstrates that the American people are making full use of the network launched 50 years ago.

To ensure the Interstate System meets 21st century needs, the bipartisan Federal and State commitment that has survived 5 decades of change will have to continue if the country is to provide the necessary resources. Francis C. "Frank" Turner, a former Federal Highway Administrator (1969-1972) who served in the 1950s as agency liaison to the Senate and House Subcommittees on Roads during development of the 1956 Act, understood the need for this commitment as well as anyone. On the 40th anniversary of the Interstate System in 1996, he told a reporter for the *Richmond Times-Dispatch*:

> [The Interstate System] will never be finished because America will never be finished.