
Smart Growth America
Making Neighborhoods Great Together
TAXPAYERS FOR COMMONSENSE
MAKING GOVERNMENT WORK
Repair Priorities 2014
Transportation spending strategies to save taxpayer dollars and improve roads
March 2014

Smart Growth America is the only national organization dedicated to researching, advocating for and leading coalitions to bring better development to more communities nationwide. From providing more sidewalks to ensuring more homes are built near public transportation or that productive farms remain a part of our communities, smart growth helps make sure people across the nation can live in great neighborhoods.

Taxpayers for Common Sense is a non-partisan budget watchdog serving as an independent voice for American taxpayers. Our mission is to achieve a government that spends taxpayer dollars responsibly and operates within its means. We work with individuals, policymakers and the media to increase transparency, expose and eliminate wasteful government spending, and hold decision-makers accountable.

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Cover photo: Maintenance crews repair potholes in Virginia. Photo by the Virginia Department of Transportation, via Flickr.

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Executive Summary

State departments of transportation (DOTs) are spending more money building new roads than maintaining the ones they have—despite the fact that roads are crumbling, financial liabilities are mounting and conditions are not improving for America's drivers.

Between 2009 and 2011, the latest year with available data, states collectively spent $20.4 billion annually to build new roadways and add lanes to existing roads. America's state-owned road network grew by 8,822 lane-miles of road during that time, accounting for less than 1 percent of the total in 2011.

During that same time, states spent just $16.5 billion annually repairing and preserving the other 99 percent of the system, even while roads across the country were deteriorating. On a scale of good, fair or poor, 21 percent of America's roads were in poor condition in 2011. Just 37 percent of roads were in good condition that year—down from 41 percent in 2008.[i]

$45.2 billion

The amount states would need to spend to bring roads in poor condition into a state of good repair while also maintaining their existing systems.

These spending decisions come with serious implications for DOT finances and taxpayers. In 2008, states would have needed to spend more than $43 billion every year for 20 years to bring roads in poor condition into a state of good repair while also maintaining their existing systems. By 2011, that figure increased to $45.2 billion per year—nearly three times the amount states currently spend on repair.[ii]

If states had put their expansion dollars toward repair instead, they could have been on target to **eliminate the backlog** of roads in poor condition by 2014.

If states spent $20.4 billion annually on repair rather than expansion, they could have cut the number of roads in poor condition in half by 2011—and been on target to eliminate the backlog of roads in poor condition by 2014.[iii]

Repair Priorities: 2014 Update is the latest report by Smart Growth America and Taxpayers for Common Sense analyzing road conditions and spending priorities in all 50 states as well as the District of Columbia. The update also assesses how these priorities have changed since the release of the first edition in 2011.

State leaders—including governors, legislators and DOT officials—have the ability to change these priorities for the better. This report recommends actions that state officials can take to increase the portion of funds

i Calculated based on the Federal Highway Administration's Highway Statistical Series, for years 2009–2011. See Appendix A for full methodology.

ii Calculated based on the Federal Highway Administration's Highway Statistical Series, for years 2009–2011. See Appendix B for full methodology.

iii Calculated based on the Federal Highway Administration's Highway Statistical Series, for years 2009–2011. See Appendix C for full methodology.

going to repair, such as

- raising the public profile of repair projects;
- using asset management practices;
- focusing repair investments on the most heavily used roads;
- setting aggressive targets for pavement conditions; and
- using cost-benefit analysis to prioritize road investments.

These strategies can improve road conditions for drivers and the financial outlook of America's DOTs at the same time.

State leaders have the ability to change these priorities for the better.

Federal taxpayers also have a significant interest in making sure the nation's roads are in a state of good repair, as billions of federal dollars are invested each year on the nation's highway system. This report recommends ways federal agencies can encourage state investments in repair by tying available federal funding to the condition of state highways and modifying current approaches for reporting state road conditions.

Introduction

Our report *Repair Priorities: Transportation spending strategies to save taxpayer dollars and improve roads*, released in 2011, indicated that road conditions were deteriorating and most states were spending far too little to maintain those roads in a state of good repair.[1]

That report found that between 2004 and 2008, states collectively spent $22 billion per year on road expansion and $16 billion per year on repair and preservation. Over this time period the state-owned road network expanded by a total of 23,300 new lane-miles, or 1.3 percent.[2]

Meanwhile, 17 percent of roads were in poor condition by 2008, and state investments in repair were insufficient to improve those conditions; by 2011, the amount of roads in poor condition increased to 21 percent.

To bring all roads in poor condition into a state of good repair and maintain the rest of their road networks, states would have needed collectively to spend more than $43 billion every year for 20 years starting in 2008—$5 billion a year more than they were spending on expansion and repair combined.[3]

The view from 2014: States are still spending on expansion at the expense of repair
Since the release of the first edition of *Repair Priorities,* some states have made changes to their spending strategies and shifted funds away from road expansion to repair and preservation. However, as a whole, states are still spending more on road expansion than on repair and preservation.

The amount states spent on repair was not enough to address the backlog of road repair needs—and falls short of what states would need to spend to preserve the current condition of their full road networks. That's not only bad for America's drivers, it's an enormous liability for state budgets and taxpayers.

Fortunately, there's something state leaders can do about their fiscal priorities. Shifting funds away from road expansion to road repair can help governors, legislators and DOT officials lessen long-term financial liabilities without increasing spending. This report recommends ways for state leaders to invest more strategically by increasing the proportion of state dollars going to repair.

About the data in this report
The analysis in this report uses data from the Federal Highway Administration's (FHWA) "Highway Statistics Series," a collection of reports released annually based on data submitted to FHWA by every state and the District of Columbia.[4] The first edition of *Repair Priorities* examined data covering years 2004 through 2008, the latest year for which data was available at that time. This update looks at spending for years 2009 through 2011, and road conditions as of 2011. The analysis represents a snapshot of state spending decisions over the two-year period, and may not reflect long-term priorities for individual states.

While this report uses data published by FHWA, all conclusions drawn in the report are those of Smart Growth America and Taxpayers for Common Sense. Refer to Appendices A through C beginning on page 14 of this report for detailed methodologies.

States are still investing more in road expansion than repair

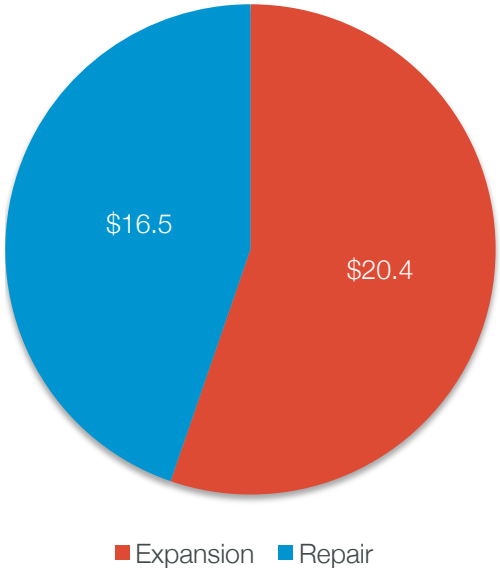
In 2008 states collectively were investing more in expanding their road networks than in repairing existing roads. In the years since, that trend has continued.

Between 2009 and 2011, states collectively spent $20.4 billion each year on road expansion. During that same time states spent $16.5 billion each year on road repair and preservation (see Figure 1 below).[5] Of those two types of spending, 55 percent went to expansion and 45 percent went to repair.

FIGURE 1

Annual state spending on road expansion versus repair, 2009–2011

All dollar figures in billions.



This ratio has modestly improved since 2008. Between 2004 and 2008, states spent $22 billion on road expansion and $16 billion on repair, 57 percent and 43 percent, respectively.

Some individual states are dedicating significant portions of their funds to road repair. **North Dakota** led the pack, investing 94 percent of its highway expansion and repair funds between 2009 and 2011 in road repair and preservation, and just 6 percent in expansion. **Nebraska** proved to be another leader, putting 91 percent of funds toward road repair and preservation, and just 9 percent toward expansion. **Michigan, Maine** and **Wyoming** were other front-runners, devoting 87 percent, 86 percent and 83 percent of their funding, respectively, to road repair (see Table 1 on page 3).

For these steps forward, however, there were also steps back. Half of all states reduced the portion of available funds going to repair between 2008 and 2011. **Mississippi, Utah, Washington** and **Arizona** dedicated the smallest percentages of available funds to repair and preservation between 2009 and 2011, though some of these states have since begun to shift available funds toward repair. See Table A6 in Appendix A for a more detailed comparison of states' spending on expansion versus repair between 2009 and 2011.

TABLE 1

Average annual state expenditures on road expansion versus repair, 2009–2011

All dollar figures in millions. See Appendix A fir a more detailed version of this table.

State	Road expansion and repair	Road expansion	Road expansion as percent of total	Road repair	Road repair as percent of total
Alabama	$556	$252	45%	$304	**55%**
Alaska	$256	$89	35%	$167	**65%**
Arizona	$745	$620	83%	$124	**17%**
Arkansas	$345	$235	68%	$110	**32%**
California	$2,379	$940	40%	$1,438	**60%**
Colorado	$404	$215	53%	$189	**47%**
Connecticut	$313	$176	56%	$137	**44%**
District of Columbia	$106	$0	0%	$106	**100%**
Delaware	$160	$113	70%	$48	**30%**
Florida	$2,535	$1,223	48%	$1,312	**52%**
Georgia	$1,055	$486	46%	$569	**54%**
Hawaii	$151	$88	59%	$63	**41%**
Idaho	$267	$115	43%	$152	**57%**
Illinois	$1,571	$543	35%	$1,028	**65%**
Indiana	$1,028	$735	71%	$293	**29%**
Iowa	$456	$238	52%	$217	**48%**
Kansas	$419	$194	46%	$225	**54%**
Kentucky	$870	$527	61%	$343	**39%**
Louisiana	$1,032	$645	62%	$388	**38%**
Maine	$256	$35	14%	$221	**86%**
Maryland	$381	$257	68%	$123	**32%**
Massachusetts	$293	$52	18%	$241	**82%**
Michigan	$757	$95	13%	$662	**87%**
Minnesota	$627	$377	60%	$250	**40%**

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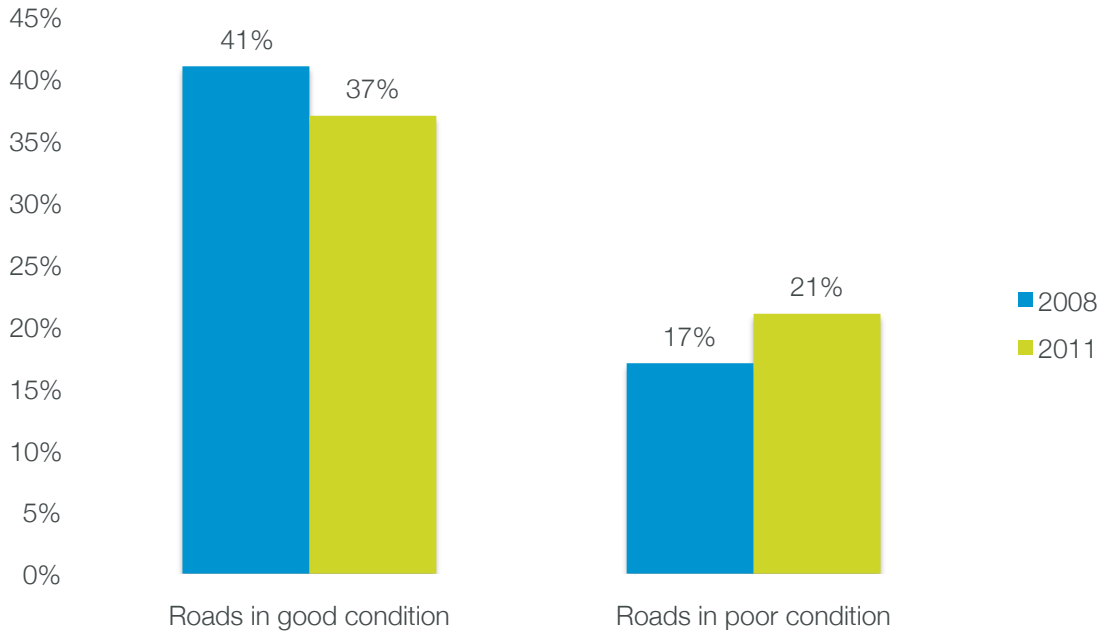
State	Road expansion and repair	Road expansion	Road expansion as percent of total	Road repair	Road repair as percent of total
Mississippi	$619	$603	97%	$16	**3%**
Missouri	$744	$461	62%	$283	**38%**
Montana	$293	$132	45%	$161	**55%**
Nebraska	$216	$20	9%	$196	**91%**
Nevada	$471	$392	83%	$79	**17%**
New Hampshire	$206	$76	37%	$130	**63%**
New Jersey	$1,361	$266	20%	$1,095	**80%**
New Mexico	$225	$53	23%	$172	**77%**
New York	$1,272	$297	23%	$975	**77%**
North Carolina	$1,388	$1,155	83%	$233	**17%**
North Dakota	$254	$14	6%	$240	**94%**
Ohio	$1,032	$404	39%	$628	**61%**
Oklahoma	$779	$500	64%	$279	**36%**
Oregon	$252	$94	37%	$159	**63%**
Pennsylvania	$2,298	$1,421	62%	$877	**38%**
Rhode Island	$25	$5	22%	$19	**78%**
South Carolina	$371	$158	43%	$213	**57%**
South Dakota	$245	$49	20%	$196	**80%**
Tennessee	$584	$421	72%	$163	**28%**
Texas	$3,377	$2,765	82%	$612	**18%**
Utah	$750	$700	93%	$50	**7%**
Vermont	$131	$30	23%	$101	**77%**
Virginia	$595	$402	68%	$192	**32%**
Washington	$1,015	$849	84%	$166	**16%**
West Virginia	$425	$312	73%	$113	**27%**
Wisconsin	$892	$544	61%	$349	**39%**
Wyoming	$270	$46	17%	$224	**83%**
Median	**$470**	**$257**	**55%**	**$213**	**45%**
Total	**$36,942**	**$20,417**	**55%**	**$16,525**	**45%**

Road conditions are getting worse

States' investment in expansion rather than repair is particularly troubling in light of the fact that America's roads are deteriorating from bad to worse.

FIGURE 2

Nationwide change in road conditions, 2008–2011



In 2008, 41 percent of all roads were in good condition.[6] By 2011, that number decreased to 37 percent.[7] Meanwhile, 17 percent of America's roads nationwide were in poor condition in 2008. By 2011, that number increased to 21 percent (see Figure 2 above). In total, an estimated 389,000 lane-miles of state-owned roads were in poor condition as of 2011 (see Tables 2 and 3 below).[8]

TABLE 2

Comparison of roads reported in good condition, 2008 and 2011[9]

State	2008	2011
Alabama	51%	66%
Alaska	21%	32%
Arizona	58%	51%
Arkansas	24%	23%
California	18%	20%
Colorado	42%	29%
Connecticut	44%	12%

TABLE 3

Comparison of roads reported in poor condition, 2008 and 2011[10]

State	2008	2011
Alabama	9%	8%
Alaska	21%	22%
Arizona	10%	12%
Arkansas	24%	31%
California	39%	34%
Colorado	11%	19%
Connecticut	13%	48%

(continued on next page)

State	2008	2011
District of Columbia	0%	0%
Delaware	45%	44%
Florida	64%	60%
Georgia	73%	37%
Hawaii	5%	21%
Idaho	39%	60%
Illinois	49%	32%
Indiana	55%	43%
Iowa	39%	21%
Kansas	47%	34%
Kentucky	35%	45%
Louisiana	33%	38%
Maine	43%	23%
Maryland	31%	37%
Massachusetts	62%	10%
Michigan	47%	34%
Minnesota	60%	44%
Mississippi	20%	27%
Missouri	19%	56%
Montana	64%	57%
Nebraska	58%	53%
Nevada	62%	24%
New Hampshire	35%	43%
New Jersey	10%	18%
New Mexico	39%	43%
New York	29%	29%
North Carolina	45%	48%
North Dakota	55%	65%
Ohio	62%	46%
Oklahoma	23%	25%
Oregon	54%	43%
Pennsylvania	25%	29%
Rhode Island	26%	26%
South Carolina	30%	31%

State	2008	2011
District of Columbia	94%	95%
Delaware	15%	20%
Florida	4%	11%
Georgia	8%	7%
Hawaii	44%	39%
Idaho	34%	17%
Illinois	16%	22%
Indiana	11%	22%
Iowa	16%	14%
Kansas	32%	52%
Kentucky	3%	7%
Louisiana	25%	21%
Maine	21%	30%
Maryland	34%	21%
Massachusetts	14%	13%
Michigan	21%	31%
Minnesota	7%	15%
Mississippi	18%	30%
Missouri	26%	6%
Montana	6%	7%
Nebraska	10%	11%
Nevada	9%	3%
New Hampshire	21%	25%
New Jersey	48%	44%
New Mexico	29%	25%
New York	25%	26%
North Carolina	8%	10%
North Dakota	9%	6%
Ohio	6%	20%
Oklahoma	32%	36%
Oregon	8%	6%
Pennsylvania	26%	26%
Rhode Island	29%	32%
South Carolina	13%	10%

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State	2008	2011
South Dakota	46%	37%
Tennessee	64%	61%
Texas	29%	32%
Utah	30%	28%
Vermont	23%	42%
Virginia	43%	31%
Washington	48%	23%
West Virginia	22%	22%
Wisconsin	35%	36%
Wyoming	47%	54%
Average	**41%**	**37%**

State	2008	2011
South Dakota	18%	14%
Tennessee	8%	8%
Texas	12%	12%
Utah	7%	11%
Vermont	36%	23%
Virginia	8%	18%
Washington	12%	27%
West Virginia	29%	33%
Wisconsin	17%	22%
Wyoming	8%	6%
Average	**17%**	**21%**

These numbers suggest that states' current investments in repair and preservation may not be enough to keep pace with worsening road conditions, let alone to actively reverse this trend and improve road conditions overall.

A looming financial problem

States continue to invest in road expansion despite the fact that roads remain in bad condition—and these spending decisions come with serious implications for state transportation budgets.

States already have a significant backlog of repair work to do (see Table 4 on page 9). Thousands of lane-miles in poor condition represent billions of dollars of needed repair spending. But states' decisions to delay repair while also expanding pose two even more serious financial problems.

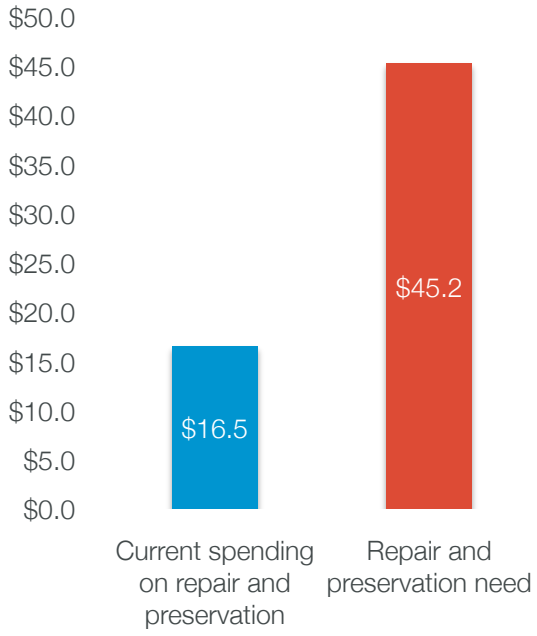
First, costs rise as road conditions decline. Rehabilitating a road in poor condition is substantially more expensive than preserving the same road in good condition over time through regular, preventative maintenance. According to the American Association of State Highway and Transportation Officials, every $1 spent to keep a road in good condition avoids $6–14 needed later to rebuild the same road once it has deteriorated significantly.[11]

Second, costs rise as the road network expands. By continuing to invest in new roads, states are substantially increasing their future repair liabilities. Once a new lane-mile is built, it will require regular maintenance and preservation treatment for its entire lifetime. The more lane-miles a system has, the higher the overall maintenance costs.

FIGURE 3

Outstanding road repair need, nationally

How much do we currently spend on road repair and preservation? How much would we need to spend to get America's roads into a state of good repair and keep them there? All dollar figures in billions.



How deep is this hole?

In 2008, states would have collectively needed to spend $44.5 billion each year for 20 years to bring roads in poor condition into a state of good repair while also preserving the rest of their existing road networks.[12] By 2011, this annual funding deficit increased to $45.2 billion (see Table 4 on page 9).[13]

This annual deficit is nearly **three times** the current level of investment in repair and preservation (see Figure 3). States would need to make significant, dramatic changes to their spending in order to get America's roads into a state of good repair and keep them there.

Much of that shortfall could be addressed by redirecting funds already in state budgets. States collectively spent $20.4 billion on road expansion each year between 2009 and 2011. If they had dedicated that funding to repair instead, they could have brought more than **95,000 lane-miles in poor condition into a state of good repair every year.**[14] If they had done this, states could have cut the number of roads in poor condition in half by 2011—and been on target to eliminate the backlog of roads in poor condition by 2014.[15]

TABLE 4

States' outstanding road maintenance and repair needs, 2011

The amount states would need to spend each year to maintain their current network while bringing all poor-condition roads into a state of good repair over a 20-year period. All dollar figures in millions.

State	Current annual spending on repair and preservation	Annual investment needed in repair and preservation
Alabama	$304	$674
Alaska	$167	$289
Arizona	$124	$456
Arkansas	$110	$946
Average	$324	$887
California	$1,438	$1,299
Colorado	$189	$559
Connecticut	$137	$267
District of Columbia	$106	$102
Delaware	$48	$287
Florida	$1,312	$986
Georgia	$569	$1,103
Hawaii	$63	$66
Idaho	$152	$289
Illinois	$1,028	$1,036
Indiana	$293	$685
Iowa	$217	$555
Kansas	$225	$668
Kentucky	$343	$1,421
Louisiana	$388	$980
Maine	$221	$445
Maryland	$123	$362
Massachusetts	$241	$219
Michigan	$662	$703
Minnesota	$250	$700
Mississippi	$16	$731
Missouri	$283	$1,744

State	Current annual spending on repair and preservation	Annual investment needed in repair and preservation
Montana	$161	$573
New Carolina	$233	$3,959
New Hampshire	$130	$210
Nebraska	$196	$529
Nevada	$79	$300
New Jersey	$1,095	$225
New Mexico	$172	$721
New York	$975	$951
North Dakota	$240	$389
Ohio	$628	$1,262
Oklahoma	$279	$789
Oregon	$159	$425
Pennsylvania	$877	$2,203
Rhode Island	$19	$73
South Carolina	$213	$2,099
South Dakota	$196	$469
Tennessee	$163	$850
Texas	$612	$4,636
Utah	$50	$369
Vermont	$101	$148
Virginia	$192	$3,089
Washington	$166	$461
West Virginia	$113	$1,839
Wisconsin	$349	$730
Wyoming	$224	$361
Total	**$16,525**	**$45,233**

Spending billions for marginal benefit

States spent $20.4 billion on road expansion each year between 2009 and 2011. During that time America's state-owned road network increased by 8,822 lane-miles, less than 1 percent.[16] America's driving, measured in vehicle-miles traveled, remained fairly stable during this two-year period, yet traffic congestion in urban areas did not change.[17] States' investments in expansion are yielding little gain for drivers despite the substantial cost.

Meanwhile roads in poor condition are increasing costs for drivers. Motorists are losing nearly $67 billion annually due to additional vehicle repair and operating costs from driving on poor roads.[18] Investing in road repair reduces these costs, a clear benefit to the traveling public.

Recommendations

The good news is states can make a significant dent in the current backlog of roads in poor condition simply by reallocating funds within their existing capital budgets.

Shifting capital funds to repair rather than expansion is easy in theory, but tough in practice. These recommendations are designed to help state and federal leaders make more informed, strategic spending decisions.

Recommendations for state policymakers

In order to address their backlog of repair needs while also maintaining their current road systems, many states will need to reconsider spending on expansion and redirect significant portions of their existing capital budgets toward repair and preservation.

For instance, Wyoming devoted 83 percent of its expenditures from 2009 to 2011 on road repair—one of the highest amounts among states. However, concerns about financial commitments have prompted the Wyoming Department of Transportation (WYDOT) to take its priorities one step further, making a decision in late 2011 to halt road expansion altogether and focus investments exclusively on repair. The Wyoming state legislature recently passed a fuel tax increase to fund a number of road and bridge repair projects, with the goal of maintaining WYDOT's roads in their current condition at the time of the bill's passage.[19]

The following strategies are specific ways state leaders can make investment in repair more attractive, popular and effective.

1. Raise the profile of repair and preservation projects.
In many cases shifting available funding to repair will require leadership on the part of state legislators. Legislative priorities in a given year can impact transportation investments for years following and a single large capital improvement project can make up a substantial portion of state DOT spending during construction years.

Washington state spent the majority (84 percent) of the combined funds allocated to road expansion and repair on expansion between 2009 and 2011, and much of that investment resulted

from two large revenue packages passed by the legislature in 2003 and 2005. Washington's road conditions reflect those spending priorities, with the percentage of the state's roads in poor condition increasing from 12 percent to 27 percent between 2008 and 2011. Road expansion projects tend to be popular because of their high visibility, so elevating road repair as an important issue at the legislature can help ensure that funding for road repair and preservation is included in major transportation revenue packages.

2. Use asset management to get the most out of investments in repair.
Asset management is a data-driven practice that allows state DOTs to predict the rate at which roads will deteriorate, consider the tradeoffs of different investments and make repairs at the point in road lifecycles when they will be the least costly or provide the greatest benefit. Asset management can also help state DOTs spread major repairs out over time to prevent large surges in spending.

All state DOTs engage in some level of asset management, but many should establish more aggressive programs. Doing so would help reduce the need for costly repairs when roads fall into poor condition and ensure that states get the greatest possible return on their investments in road repair.

The Michigan Department of Transportation (MDOT) was a pioneer in the development of asset management practices and continues to be a national leader. As a result of state legislation passed in 2002, MDOT and local agencies now engage in asset management for all roads eligible for federal aid, and MDOT currently releases an annual report on the condition of its system in terms of the remaining service life of its roads.[20] Michigan's spending priorities reflect this approach: It devoted 87 percent of the combined funds spent on road expansion and repair to repair between 2009 and 2011.

3. Establish high but achievable pavement condition targets and report progress in meeting them.
State DOTs can set targets for pavement condition and measure progress in meeting those targets over time to keep roads in good repair and determine where to allocate funds based on the greatest need. Many states have established pavement condition targets, but some fail to effectively use those targets to improve road conditions, because targets are too low or are not directly tied to decision-making. States should establish road condition targets that set a high bar and connect project selection and funding decisions to those targets.

A number of states have performance targets but do not make information about those targets or progress in meeting them available to the public. Performance targets demonstrate a commitment to improving road conditions; making those targets easily accessible is an opportunity to show taxpayers that funds are spent effectively and rally support for repair and preservation.

A survey of state-by-state pavement condition performance targets is available in the 2011 edition of *Repair Priorities*.

4. Focus repair and preservation spending on heavily used roads.
Roads with higher traffic volumes require more frequent repair and continue to account for some of the worst surface conditions in the country. When left in poor condition these roads also have the greatest cumulative impact on the individuals and businesses that rely on them. Drivers in urban

areas lose an average of $337 annually due to additional vehicle operating costs from driving on roads in poor condition.[21] Many high-volume roads are also important freight corridors, and poor road conditions can drive up delivery costs and ultimately affect regional economic competitiveness. Focusing repair and preservation investments strategically on high-volume roads provides a high return on investment by reducing costs for a large number of drivers and businesses.

5. Use cost-benefit analysis to compare potential road investments.
With limited funds, all transportation investments involve tradeoffs. In some cases, building a new road or expanding an existing one may provide enough substantial benefits to warrant the large price tag, but in other cases the same funds could likely produce a greater return if spent on repairing existing roads. Many states conduct cost-benefit analyses during project development, but relatively few use them to make decisions about which projects to approve and fund. By building cost-benefit analyses into decision-making, states can weigh tradeoffs and prioritize investments based on which will provide the greatest value per dollar spent.

Recommendations for federal policymakers

Federal taxpayers have a significant interest in making sure the nation's roads are in a state of good repair, as billions of federal dollars are invested each year on the nation's highway system. Federal tax dollars were also used to build a large portion of these roads; allowing states to underfund preservation and repair greatly reduces the value of these federal investments.

The following strategies can help federal lawmakers support and encourage state investment in repair and preservation.

1. Tie available federal highway funding to the condition of state highways.
The U.S. Department of Transportation should establish criteria and performance standards for the condition of federal-aid highways. States meeting the established standards would be allowed more flexibility in the use of federal funds, such as those under MAP-21's National Highway Performance Program, or would be allowed to transfer those funds to other programs. States that fail to meet the established standards would be required to invest program funds in repair and preservation until they achieve a state of good repair. These practices would ensure that federal highway funds are prioritized for repair, while allowing states with properly maintained roads and bridges to use these funds for other purposes. It would also help inform decision-makers and citizens about progress in improving the condition of state highways.

2. Report pavement conditions data according to road ownership.
FHWA currently reports pavement conditions for public roads, a category that includes roads owned and maintained by states as well as those owned by counties, federal agencies and towns and municipalities. While reporting pavement conditions data in this way provides a useful picture of the state of the nation's roads overall, it prevents determining how roads built and maintained through different funding sources are performing.

State-owned roads receive funding from both federal and state sources, so federal and state taxpayers should have access to transparent information about the condition of the roads they help fund. FHWA should modify the way it reports data on pavement conditions to include information about road ownership.

Conclusion

States continue to invest disproportionally in road expansion and defer investments in road repair and preservation. As a result, the country's roads are deteriorating—contributing to a large and growing financial burden for states and taxpayers.

Many states are realizing that they will not be able to reverse this trend unless they shift available funding toward repair and preservation. Doing so would improve road conditions, reduce long-term costs and make America's roads better for drivers. Fortunately, states can make significant headway without increasing overall spending by devoting funds currently spent on expansion to repair.

States can start by elevating repair as an issue among key state decision-makers; setting high but achievable performance targets for road conditions; developing aggressive asset management programs; and using cost-benefit analysis to invest repair where it will provide the greatest economic benefit. These practices can help states devote available funds to repair and ensure these investments produce the greatest return possible.

Appendix A
State road conditions, lane-miles added and spending

This appendix presents the methodology and detailed state data for three major calculations used in this report:

- total lane-miles and change in them between 2008 and 2011 for each state (Table A1, below);
- pavement conditions for public roads in 2011 and 2008 (Tables A2 and A3, beginning on page 17) and estimated pavement conditions for state-owned roads in 2011 and 2008 (Tables A4 and A5, beginning on page 22);
- average annual capital spending on road expansion and repair by state for 2009–2011 (Table A6, beginning on page 27).

An outside advisory team of former state DOT chief executives, senior infrastructure system managers and engineers at the Pennsylvania Department of Transportation (PennDOT) reviewed this methodology for the first edition of *Repair Priorities* published in 2011. All modifications made to the methodology for this edition are noted in the text below.

Determining lane-miles added

The extent to which states expanded their road networks between 2008 and 2011, the last year for which a full dataset is available, was determined by calculating the difference between the total miles of road owned by each state in 2008 and the total miles of road owned by each state in 2011. For this calculation, data in FHWA's "Highway Statistics Series" (FHWA Table HM-81) was used; see Table A1 below.

FHWA reports the size of state road networks in lane-miles, a measure of road length that takes road capacity into account (for example, one mile of a four-lane highway is reported as four lane-miles), and also reports the size of state road networks in terms of centerline miles, a measure that only accounts for road length (one mile of a four-lane highway is reported as one centerline mile). This analysis uses the total lane-miles—rather than centerline miles—added to each state's road network between 2008 and 2011 to capture additional lanes added to existing roads as well as new roads constructed. In some situations, lane-miles were added to or subtracted from the total state road network through transfer of responsibility to/from other jurisdictions. As a result, Table A1 shows some negative lane-mile changes from 2008 to 2011 and some major increases that may not be a result of new construction.

TABLE A1
State-owned lane-miles added, 2008–2011

State	2011	2008	Change, 2008–2011
Alabama	29,324	28,121	1,203
Alaska	11,653	11,699	–46
Arizona	19,341	18,819	522

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State	2011	2008	Change, 2008-2011
Arkansas	37,357	37,119	238
California	49,598	50,541	–943
Colorado	22,934	22,948	–14
Connecticut	9,838	9,800	38
Delaware	11,797	11,693	104
District of Columbia	3,144	3,274	–130
Florida	42,956	42,439	517
Georgia	48,397	47,498	899
Hawaii	2,492	2,477	15
Idaho	12,225	12,137	88
Illinois	42,097	42,150	-53
Indiana	27,879	28,458	-579
Iowa	22,740	23,036	–296
Kansas	23,988	23,988	0
Kentucky	61,799	61,499	300
Louisiana	39,375	38,501	874
Maine	17,617	18,115	–498
Maryland	14,762	14,671	91
Massachusetts	9,570	8,659	911
Michigan	27,442	27,459	–17
Minnesota	29,306	29,266	40
Mississippi	27,294	27,743	–449
Missouri	75,999	75,656	343
Montana	25,049	24,490	559
Nebraska	22,474	22,487	–13
Nevada	13,360	13,055	305
New Hampshire	8,410	8,825	–415
New Jersey	8,480	8,480	0
New Mexico	29,160	29,237	–77
New York	38,216	38,142	74
North Carolina	170,221	170,084	137
North Dakota	16,996	16,986	10
Ohio	49,349	49,034	315
Oklahoma	30,252	30,114	138
Oregon	18,606	18,264	342

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State	2011	2008	Change, 2008-2011
Pennsylvania	88,450	88,475	–25
Rhode Island	2,916	2,923	–7
South Carolina	90,233	89,976	257
South Dakota	18,210	18,071	139
Tennessee	36,858	36,521	337
Texas	194,763	193,188	1,575
Utah	15,812	15,699	113
Vermont	6,037	6,038	–1
Virginia	126,124	125,281	843
Washington	18,397	18,443	–46
West Virginia	71,588	70,792	796
Wisconsin	29,593	29,481	112
Wyoming	15,794	15,594	200
Average	**36,593**	**36,421**	**173**
Total	**1,866,268**	**1,857,446**	**8,822**

Sources: Calculated based on data in the following tables:

- Federal Highway Administration Highway Statistics. (2011). "State Highway Agency-Owned Public Roads - 2011 1/Rural and Urban Miles; Estimated Lane-Miles and Daily Travel." Table HM-81. http://www.fhwa.dot.gov/policyinformation/statistics/2011/hm81.cfm.
- Federal Highway Administration Highway Statistics. (2008). "State Highway Agency-Owned Public Roads - 20081/Rural and Urban Miles; Estimated Lane-Miles and Daily Travel." Table HM-81. http://www.fhwa.dot.gov/policyinformation/statistics/2008/hm81.cfm.

Determining road conditions

FHWA's "Highway Statistics Series" includes data on pavement conditions reported for public roads in terms of centerline miles, broken up by state and by road functionality type. FHWA reports data on conditions in raw form but provides definitions for good, fair and poor pavement conditions. The research team applied these definitions to FHWA's data to calculate the percentage of states' road networks in each condition bracket for 2011 and 2008; see Tables A2 and A3 beginning on page 17.[22]

Determining pavement condition for public roads

States report pavement conditions to FHWA using two condition metrics: International Roughness Index (IRI), a measure of pavement smoothness based on assessments conducted using laser technology; and Pavement Serviceability Rating (PSR), a subjective evaluation of ride quality. FHWA requires that pavement conditions for states' roads above a certain size be reported in terms of IRI; these larger roads include rural interstates, rural minor arterials, rural other principal arterials, urban interstates, urban other freeways and expressways and urban other principal arterials. For smaller roads, states can report centerline-mile conditions in terms of either IRI or PSR. Centerline miles of pavement receive an IRI score based on deviation from a smooth surface in inches per mile, with lower scores indicating smoother pavement. PSR scores range from zero

to five and higher scores indicate smoother ride quality. FHWA defines good, acceptable and poor for both metrics:

Ride Quality Terms	IRI Rating	PSR Rating
Good	< 95	≥ 3.5
Acceptable	≤ 170	≥ 2.5
Poor	> 170	< 2.5
Source: Federal Highway Administration. (2011). "Pavement Terminology and Measurements. Conditions and Performance: 2010 Status of the Nation's Highways, Bridges, and Transit." Exhibit 3-1. Available at http://www.fhwa.dot.gov/policy/2010cpr/chap3.htm.		

FHWA's raw data on pavement conditions (as reported in FHWA Tables HM-63 and HM-64) were used to calculate the number of centerline miles of public roads in good, fair, poor or unreported condition and the percentage of public roads in each condition. This calculation required summing the data from Tables HM-63 and HM-64 for all functionality types by pavement condition (good, fair, poor and unreported) for 2008 and 2011. It should be noted that only FHWA Table HM-64 includes unreported centerline miles.

FHWA does not report condition data for several smaller road functionality types including local roads and rural minor collectors, so these roads were excluded from this analysis. For the purposes of this analysis and in Table A2 below, roads included in FHWA's conditions datasets are referred to as "major roads" to indicate that local roads and rural minor collectors are excluded.

TABLE A2

Public road conditions 2011 (in centerline miles)

State	Major roads	Good condition	Percent good	Fair condition	Percent fair	Poor condition	Percent poor	Unreported conditions	Percent unreported
Alabama	22,991	15,241	66%	5,749	25%	1,954	8%	47	0%
Alaska	3,840	1,246	32%	1,454	38%	852	22%	288	8%
Arizona	12,202	6,190	51%	3,011	25%	1,513	12%	1,488	12%
Arkansas	21,766	5,033	23%	9,943	46%	6,653	31%	137	1%
California	53,724	10,601	20%	21,479	40%	18,506	34%	3,138	6%
Colorado	16,605	4,825	29%	8,386	51%	3,160	19%	233	1%
Connecticut	6,138	730	12%	2,467	40%	2,942	48%	0	0%
Delaware	1,525	667	44%	544	36%	306	20%	8	0%
District of Columbia	453	2	0%	13	3%	431	95%	8	2%
Florida	26,251	15,747	60%	7,179	27%	2,829	11%	496	2%
Georgia	30,975	11,376	37%	12,945	42%	2,214	7%	4,440	14%
Hawaii	1,521	319	21%	607	40%	586	39%	9	1%
Idaho	10,995	6,574	60%	2,213	20%	1,884	17%	324	3%
Illinois	35,405	11,312	32%	15,960	45%	7,962	22%	171	0%

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State	Major roads	Good condition	Percent good	Fair condition	Percent fair	Poor condition	Percent poor	Unreported conditions	Percent unreported
Indiana	22,599	9,624	43%	7,753	34%	5,037	22%	185	1%
Iowa	10,444	2,212	21%	2,557	24%	1,466	14%	4,209	40%
Kansas	34,740	11,887	34%	4,731	14%	18,080	52%	42	0%
Kentucky	12,517	5,625	45%	5,343	43%	938	7%	611	5%
Louisiana	13,309	4,992	38%	5,422	41%	2,808	21%	87	1%
Maine	6,317	1,455	23%	2,966	47%	1,897	30%	0	0%
Maryland	7,355	2,722	37%	2,800	38%	1,569	21%	263	4%
Massachusetts	11,044	1,068	10%	8,051	73%	1,405	13%	520	5%
Michigan	36,440	12,475	34%	12,379	34%	11,431	31%	155	0%
Minnesota	28,853	12,589	44%	11,404	40%	4,321	15%	539	2%
Mississippi	21,524	5,828	27%	9,049	42%	6,354	30%	293	1%
Missouri	10,757	5,998	56%	3,813	35%	665	6%	281	3%
Montana	12,484	7,055	57%	4,543	36%	886	7%	0	0%
Nebraska	15,729	8,306	53%	5,650	36%	1,657	11%	116	1%
Nevada	4,907	1,154	24%	1,290	26%	167	3%	2,296	47%
New Hampshire	3,410	1,453	43%	1,103	32%	854	25%	0	0%
New Jersey	10,143	1,849	18%	3,677	36%	4,457	44%	159	2%
New Mexico	9,970	4,288	43%	3,070	31%	2,488	25%	124	1%
New York	27,338	7,968	29%	12,239	45%	7,088	26%	43	0%
North Carolina	21,061	10,184	48%	8,259	39%	2,071	10%	548	3%
North Dakota	14,104	9,128	65%	4,147	29%	827	6%	2	0%
Ohio	28,986	13,425	46%	9,777	34%	5,775	20%	10	0%
Oklahoma	31,069	7,898	25%	11,982	39%	11,182	36%	6	0%
Oregon	10,787	4,607	43%	4,089	38%	638	6%	1,453	13%
Pennsylvania	20,890	6,151	29%	8,730	42%	5,449	26%	560	3%
Rhode Island	1,748	454	26%	712	41%	565	32%	16	1%
South Carolina	21,213	6,628	31%	12,139	57%	2,188	10%	258	1%
South Dakota	19,285	7,100	37%	9,274	48%	2,671	14%	241	1%
Tennessee	17,456	10,689	61%	5,160	30%	1,315	8%	292	2%
Texas	69,241	22,142	32%	38,370	55%	8,305	12%	425	1%
Utah	8,631	2,403	28%	5,228	61%	980	11%	21	0%
Vermont	2,651	1,111	42%	912	34%	616	23%	12	0%
Virginia	21,009	6,544	31%	10,644	51%	3,746	18%	76	0%
Washington	19,919	4,631	23%	9,839	49%	5,382	27%	67	0%

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State	Major roads	Good condition	Percent good	Fair condition	Percent fair	Poor condition	Percent poor	Unreported conditions	Percent unreported
West Virginia	10,403	2,290	22%	4,638	45%	3,459	33%	16	0%
Wisconsin	28,094	10,194	36%	11,574	41%	6,246	22%	80	0%
Wyoming	6,970	3,787	54%	2,684	39%	419	6%	80	1%
Average	**17,604**	**6,427**	**37%**	**7,019**	**40%**	**3,670**	**21%**	**488**	**3%**
Total	**897,787**	**327,773**	**37%**	**357,944**	**40%**	**187,195**	**21%**	**24,875**	**3%**

Sources: Calculated based on data in the following tables:

- Federal Highway Administration Highway Statistics. (2011). "Functional System Length - 2011 Miles By Measured Pavement Roughness." Table HM-64. http://www.fhwa.dot.gov/policyinformation/statistics/2011/hm64.cfm.
- Federal Highway Administration Highway Statistics. (2011). "Functional System Length - 2011 Miles By Measured Pavement Roughness/Present Serviceability Rating." Table HM-63. http://www.fhwa.dot.gov/policyinformation/statistics/2011/hm63.cfm.

TABLE A3

Public road conditions 2008 (in centerline miles)

State	Major roads	Good condition	Percent good	Fair condition	Percent fair	Poor condition	Percent poor	Unreported conditions	Percent unreported
Alabama	24,037	12,222	51%	9,476	39%	2,241	9%	98	0%
Alaska	3,786	792	21%	1,751	46%	786	21%	457	12%
Arizona	12,730	7,336	58%	3,729	29%	1,251	10%	414	3%
Arkansas	21,528	5,127	24%	11,179	52%	5,200	24%	22	0%
California	54,967	9,691	18%	23,500	43%	21,531	39%	245	0%
Colorado	16,560	6,990	42%	7,627	46%	1,759	11%	184	1%
Connecticut	6,141	2,699	44%	2,613	43%	829	13%	-	0%
Delaware	1,534	688	45%	613	40%	231	15%	2	0%
District of Columbia	453	-	0%	25	6%	428	94%	-	0%
Florida	25,869	16,500	64%	8,173	32%	1,147	4%	49	0%
Georgia	30,601	22,283	73%	5,825	19%	2,406	8%	87	0%
Hawaii	1,556	85	5%	780	50%	691	44%	-	0%
Idaho	9,618	3,706	39%	2,500	26%	3,302	34%	110	1%
Illinois	34,823	16,893	49%	12,287	35%	5,643	16%	-	0%
Indiana	22,557	12,491	55%	7,679	34%	2,385	11%	2	0%
Iowa	24,510	9,520	39%	11,052	45%	3,850	16%	88	0%
Kansas	24,574	11,612	47%	4,936	20%	7,921	32%	105	0%
Kentucky	13,873	4,904	35%	8,573	62%	396	3%	-	0%
Louisiana	13,353	4,471	33%	5,386	40%	3,344	25%	152	1%
Maine	6,320	2,705	43%	2,317	37%	1,298	21%	-	0%
Maryland	7,728	2,364	31%	2,694	35%	2,636	34%	34	0%

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State	Major roads	Good condition	Percent good	Fair condition	Percent fair	Poor condition	Percent poor	Unreported conditions	Percent unreported
Massachusetts	11,105	6,901	62%	2,673	24%	1,524	14%	7	0%
Michigan	33,634	15,783	47%	10,767	32%	7,083	21%	1	0%
Minnesota	32,398	19,322	60%	10,660	33%	2,296	7%	120	0%
Mississippi	21,364	4,335	20%	13,257	62%	3,772	18%	-	0%
Missouri	30,545	5,822	19%	16,499	54%	8,036	26%	188	1%
Montana	12,639	8,146	64%	3,719	29%	768	6%	6	0%
Nebraska	15,885	9,215	58%	5,051	32%	1,594	10%	25	0%
Nevada	6,261	3,901	62%	1,773	28%	564	9%	23	0%
New Hampshire	3,409	1,190	35%	1,501	44%	701	21%	17	0%
New Jersey	10,316	1,035	10%	4,219	41%	4,966	48%	96	1%
New Mexico	10,896	4,267	39%	3,330	31%	3,131	29%	168	2%
New York	26,958	7,829	29%	12,256	45%	6,658	25%	215	1%
North Carolina	21,903	9,763	45%	10,426	48%	1,714	8%	-	0%
North Dakota	13,990	7,642	55%	5,092	36%	1,256	9%	-	0%
Ohio	28,973	18,083	62%	9,162	32%	1,698	6%	30	0%
Oklahoma	29,420	6,623	23%	13,375	45%	9,418	32%	4	0%
Oregon	17,133	9,250	54%	6,462	38%	1,419	8%	2	0%
Pennsylvania	28,178	7,020	25%	13,910	49%	7,219	26%	29	0%
Rhode Island	1,755	461	26%	788	45%	506	29%	-	0%
South Carolina	20,940	6,243	30%	12,069	58%	2,628	13%	-	0%
South Dakota	15,069	6,919	46%	5,483	36%	2,645	18%	22	0%
Tennessee	17,657	11,277	64%	5,015	28%	1,364	8%	1	0%
Texas	82,503	23,914	29%	48,594	59%	9,754	12%	241	0%
Utah	8,262	2,499	30%	5,171	63%	568	7%	24	0%
Vermont	3,859	906	23%	1,554	40%	1,399	36%	-	0%
Virginia	21,364	9,293	43%	10,407	49%	1,616	8%	48	0%
Washington	19,384	9,339	48%	7,721	40%	2,323	12%	1	0%
West Virginia	10,405	2,304	22%	5,106	49%	2,995	29%	-	0%
Wisconsin	28,248	9,796	35%	13,309	47%	4,846	17%	297	1%
Wyoming	7,832	3,708	47%	3,491	45%	615	8%	18	0%
Average	**18,616**	**7,566**	**41%**	**7,756**	**42%**	**3,223**	**17%**	**71**	**0%**
Total	**949,403**	**385,865**	**41%**	**395,555**	**42%**	**164,351**	**17%**	**3,632**	**0%**

Sources: Calculated based on data in the following tables:

- Federal Highway Administration Highway Statistics. (2008). "Functional System Length - 2008 Miles By Measured Pavement Roughness." Table HM-64. http://www.fhwa.dot.gov/policyinformation/statistics/2008/hm64.cfm.
- Federal Highway Administration Highway Statistics. (2008). "Functional System Length - 2008 Miles By Measured Pavement Roughness/Present Serviceability Rating." Table HM-63. http://www.fhwa.dot.gov/policyinformation/statistics/2008/hm63.cfm.

Estimating pavement condition for state-owned lane-miles of road

FHWA reports pavement conditions data for public roads, a category that includes and does not distinguish between roads owned by states, federal agencies, counties or towns and municipalities. To estimate the backlog of state-owned roads in poor condition as of 2011 and 2008, the project team applied the percentage of centerline miles of public road in poor condition for each state, calculated using the methodology described on page 17, to the total lane-miles of road owned by each state reported by FHWA (in FHWA Table HM-81; see Tables A4 and A5). This calculation assumes that the percentage of public centerline miles in poor condition for 2011 and 2008 were equivalent to the percentage of state-owned lane-miles of road in poor condition for each year.

The methodology for estimating state-owned lane-miles in poor condition was modified from the original methodology in the 2011 edition of *Repair Priorities*. In the first edition, state-owned lane-miles of road in good, fair, poor and unreported condition were estimated through a complex conversion methodology developed by the project team. We chose to simplify this conversion in an effort to make the methodology clearer and more transparent. A detailed description of the calculations in the original report can be found in Appendix A.

Estimating the percentage of roads with reported pavement condition that are state-owned

FHWA reports pavement conditions for public roads. While this pavement condition data is not categorized according to road ownership, FHWA does provide data on the number of centerline miles of public roads owned by various jurisdictions, including state highway agencies as well as federal agencies, counties, townships and municipalities and other jurisdictions (in FHWA Table HM-50). This table also categorizes centerline miles of public road by functionality type; in order to determine the percentage of public roads with reported pavement conditions that are owned by state highway agencies, the state-owned centerline miles of road were summed for each state and road functionality type. Local roads and rural minor collectors were omitted from the summation, as those functionality types are not included in FHWA's pavement condition datasets. Based on this calculation, an estimated 56 percent of roads with reported pavement conditions were state-owned as of 2011.

TABLE A4

Estimated lane-miles of state-owned roads in poor condition, 2011[23]

State	Public centerline miles of major roads	Percent of public centerline miles in poor condition	State-owned lane-miles	Estimated state-owned lane-miles in poor condition
Alabama	22,991	8%	29,324	2,492
Alaska	3,840	22%	11,653	2,584
Arizona	12,202	12%	19,341	2,399
Arkansas	21,766	31%	37,357	11,419
California	53,724	34%	49,598	17,085
Colorado	16,605	19%	22,934	4,365
Connecticut	6,138	48%	9,838	4,715

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State	Public centerline miles of major roads	Percent of public centerline miles in poor condition	State-owned lane-miles	Estimated state-owned lane-miles in poor condition
Delaware	1,525	20%	11,797	2,369
District of Columbia	453	95%	3,144	2,988
Florida	26,251	11%	42,956	4,628
Georgia	30,975	7%	48,397	3,460
Hawaii	1,521	39%	2,492	960
Idaho	10,995	17%	12,225	2,095
Illinois	35,405	22%	42,097	9,467
Indiana	22,599	22%	27,879	6,214
Iowa	10,444	14%	22,740	3,192
Kansas	34,740	52%	23,988	12,484
Kentucky	12,517	7%	61,799	4,634
Louisiana	13,309	21%	39,375	8,308
Maine	6,317	30%	17,617	5,290
Maryland	7,355	21%	14,762	3,150
Massachusetts	11,044	13%	9,570	1,217
Michigan	36,440	31%	27,442	8,608
Minnesota	28,853	15%	29,306	4,389
Mississippi	21,524	30%	27,294	8,057
Missouri	10,757	6%	75,999	4,697
Montana	12,484	7%	25,049	1,778
Nebraska	15,729	11%	22,474	2,368
Nevada	4,907	3%	13,360	456
New Hampshire	3,410	25%	8,410	2,106
New Jersey	10,143	44%	8,480	3,727
New Mexico	9,970	25%	29,160	7,275
New York	27,338	26%	38,216	9,909
North Carolina	21,061	10%	170,221	16,737
North Dakota	14,104	6%	16,996	997
Ohio	28,986	20%	49,349	9,832
Oklahoma	31,069	36%	30,252	10,889
Oregon	10,787	6%	18,606	1,101
Pennsylvania	20,890	26%	88,450	23,073
Rhode Island	1,748	32%	2,916	943
South Carolina	21,213	10%	90,233	9,306

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State	Public centerline miles of major roads	Percent of public centerline miles in poor condition	State-owned lane-miles	Estimated state-owned lane-miles in poor condition
South Dakota	19,285	14%	18,210	2,522
Tennessee	17,456	8%	36,858	2,776
Texas	69,241	12%	194,763	23,360
Utah	8,631	11%	15,812	1,795
Vermont	2,651	23%	6,037	1,402
Virginia	21,009	18%	126,124	22,488
Washington	19,919	27%	18,397	4,971
West Virginia	10,403	33%	71,588	23,801
Wisconsin	28,094	22%	29,593	6,579
Wyoming	6,970	6%	15,794	950
Average	**17,604**	**21%**	**36,593**	**7,630**
Total	**897,787**	**21%**	**1,866,268**	**389,131**

TABLE A5

Estimated lane-miles of state-owned roads in poor condition, 2008[24]

State	Public centerline miles of major road	Percent of public centerline miles in poor condition	State-owned lane-miles	Estimated state-owned lane-miles in poor condition
Alabama	24,037	9%	28,121	2,622
Alaska	3,786	21%	11,699	2,429
Arizona	12,730	10%	18,819	1,849
Arkansas	21,528	24%	37,119	8,966
California	54,967	39%	50,541	19,797
Colorado	16,560	11%	22,948	2,438
Connecticut	6,141	13%	9,800	1,323
Delaware	1,534	15%	11,693	1,761
District of Columbia	453	94%	3,274	3,093
Florida	25,869	4%	42,439	1,882
Georgia	30,601	8%	47,498	3,735
Hawaii	1,556	44%	2,477	1,100
Idaho	9,618	34%	12,137	4,167
Illinois	34,823	16%	42,150	6,830
Indiana	22,557	11%	28,458	3,009
Iowa	24,510	16%	23,036	3,618

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State	Public centerline miles of major road	Percent of public centerline miles in poor condition	State-owned lane-miles	Estimated state-owned lane-miles in poor condition
Kansas	24,574	32%	23,988	7,732
Kentucky	13,873	3%	61,499	1,755
Louisiana	13,353	25%	38,501	9,642
Maine	6,320	21%	18,115	3,720
Maryland	7,728	34%	14,671	5,004
Massachusetts	11,105	14%	8,659	1,188
Michigan	33,634	21%	27,459	5,783
Minnesota	32,398	7%	29,266	2,074
Mississippi	21,364	18%	27,743	4,898
Missouri	30,545	26%	75,656	19,904
Montana	12,639	6%	24,490	1,488
Nebraska	15,885	10%	22,487	2,256
Nevada	6,261	9%	13,055	1,176
New Hampshire	3,409	21%	8,825	1,815
New Jersey	10,316	48%	8,480	4,082
New Mexico	10,896	29%	29,237	8,401
New York	26,958	25%	38,142	9,420
North Carolina	21,903	8%	170,084	13,310
North Dakota	13,990	9%	16,986	1,525
Ohio	28,973	6%	49,034	2,874
Oklahoma	29,420	32%	30,114	9,640
Oregon	17,133	8%	18,264	1,513
Pennsylvania	28,178	26%	88,475	22,667
Rhode Island	1,755	29%	2,923	843
South Carolina	20,940	13%	89,976	11,292
South Dakota	15,069	18%	18,071	3,172
Tennessee	17,657	8%	36,521	2,821
Texas	82,503	12%	193,188	22,840
Utah	8,262	7%	15,699	1,079
Vermont	3,859	36%	6,038	2,189
Virginia	21,364	8%	125,281	9,476
Washington	19,384	12%	18,443	2,210
West Virginia	10,405	29%	70,792	20,377
Wisconsin	28,248	17%	29,481	5,058

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State	Public centerline miles of major road	Percent of public centerline miles in poor condition	State-owned lane-miles	Estimated state-owned lane-miles in poor condition
Wyoming	7,832	8%	15,594	1,225
Average	**18,616**	**17%**	**36,421**	**6,305**
Total	**949,403**	**17%**	**1,857,446**	**321,542**

Sources: The percentages of public centerline miles in poor condition for each state were calculated based on the following tables:

- Federal Highway Administration Highway Statistics. (2011). "Functional System Length - 2011 Miles By Measured Pavement Roughness." Table HM-64. http://www.fhwa.dot.gov/policyinformation/statistics/2011/hm64.cfm.
- Federal Highway Administration Highway Statistics. (2011). "Functional System Length - 2011 Miles By Measured Pavement Roughness/Present Serviceability Rating." Table HM-63. http://www.fhwa.dot.gov/policyinformation/statistics/2011/hm63.cfm.

Lane-miles of state-owned road were found in the following table:

- Federal Highway Administration Highway Statistics. (2011). "State Highway Agency-Owned Public Roads - 2011 1/Rural and Urban Miles; Estimated Lane-Miles and Daily Travel." Table HM-81. http://www.fhwa.dot.gov/policyinformation/statistics/2011/hm81.cfm.

The estimated percentage of roads with reported pavement conditions that are state-owned was calculated using the following table:

- Federal Highway Administration Highway Statistics. (2011). "Functional System Length - 2011." Table HM-50. http://www.fhwa.dot.gov/policyinformation/statistics/2011/hm50.cfm.

Determining state spending on road repair and preservation and expansion

FHWA's "Highway Statistical Series" was used to determine state-by-state spending on road repair and preservation and road expansion for 2009–2011 (see Table A6). FHWA includes these expenditures under the category of highway capital spending, a subset of total state spending on roads. Types of expenditures not considered capital spending include: maintenance and highway services; administration, research and planning; highway law enforcement and safety; interest; and bond retirement. Maintenance and highway services typically refers to road upkeep such as salting and snow plowing rather than to pavement preservation and repair treatments.

FHWA reports capital spending in two ways: as a portion of total spending on roads (as reported in FHWA Table SF-4) and broken down into categories of expenditure types (as reported in FHWA Table SF-12A). These expenditure categories were reviewed and classified as one of the following: 1) road expansion projects (comprised of spending in FHWA-defined categories, including: right of way; new construction; reconstruction—added capacity; and major widening); 2) road repair and preservation projects (comprised of spending in FHWA-defined categories, including: reconstruction—no added capacity; minor widening; restoration and rehabilitation; and resurfacing); or 3) other expenditures, including spending on bridge repair and construction; safety expenditures; engineering expenditures; traffic operation expenditures; and environmental enhancements. Expenditures in each of these categories were totaled for each state and then averaged over the years 2009–2011 to determine average annual spending on repair and preservation and expansion.

In FHWA's capital spending dataset, there is a discrepancy between the capital outlay "total" for each year that comes from summing all capital expenditure categories in FHWA Table SF-12A and the reported total reflected in the full highway budget reported in FHWA Table SF-4. The magnitude of the discrepancy varies from state to state and from year to year. It is due to the fact

that states typically do not categorize every capital dollar when reporting totals to FHWA. This discrepancy was addressed by calculating the percentage of capital spending for each state that went to road repair and preservation projects and to road expansion projects for 2009–2011 using FHWA Table SF-12A. These percents were then applied to the capital spending reported in the full state highway budgets in FHWA Table SF-4. This analysis assumes that the percentages of capital expenditures for each state that went to repair and preservation projects and to expansion projects would also apply to the total capital dollars with unreported expenditure categories.

TABLE A6

Average annual state highway capital expenditures, 2009–2011

		Spending on expansion			Spending on repair and preservation		
State	**Total annual expenditures (millions)**	**Annual capital spending (millions)**	**Percent of total capital spending**	**Percent of total spent on road expansion and repair**	**Annual capital spending (millions)**	**Percent of total capital spending**	**Percent of total spent on road expansion and repair**
Alabama	$900	$252	28%	45%	$304	34%	55%
Alaska	$465	$89	19%	35%	$167	36%	65%
Arizona	$1,121	$620	55%	83%	$124	11%	17%
Arkansas	$593	$235	40%	68%	$110	19%	32%
California	$5,280	$940	18%	40%	$1,438	27%	60%
Colorado	$688	$215	31%	53%	$189	27%	47%
Connecticut	$746	$176	24%	56%	$137	18%	44%
Delaware	$359	$113	31%	70%	$48	13%	30%
District of Columbia	$266	$0	0%	0%	$106	40%	100%
Florida	$4,365	$1,223	28%	48%	$1,312	30%	52%
Georgia	$1,701	$486	29%	46%	$569	33%	54%
Hawaii	$247	$88	36%	59%	$63	25%	41%
Idaho	$481	$115	24%	43%	$152	32%	57%
Illinois	$2,658	$543	20%	35%	$1,028	39%	65%
Indiana	$1,421	$735	52%	71%	$293	21%	29%
Iowa	$677	$238	35%	52%	$217	32%	48%
Kansas	$688	$194	28%	46%	$225	33%	54%
Kentucky	$1,291	$527	41%	61%	$343	27%	39%
Louisiana	$2,107	$645	31%	62%	$388	18%	38%
Maine	$344	$35	10%	14%	$221	64%	86%
Maryland	$1,252	$257	21%	68%	$123	10%	32%
Massachusetts	$960	$52	5%	18%	$241	25%	82%
Michigan	$1,298	$95	7%	13%	$662	51%	87%

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		Spending on expansion			Spending on repair and preservation		
State	**Total annual expenditures (millions)**	**Annual capital spending (millions)**	**Percent of total capital spending**	**Percent of total spent on road expansion and repair**	**Annual capital spending (millions)**	**Percent of total capital spending**	**Percent of total spent on road expansion and repair**
Minnesota	$1,021	$377	37%	60%	$250	25%	40%
Mississippi	$758	$603	79%	97%	$16	2%	3%
Missouri	$1,390	$461	33%	62%	$283	20%	38%
Montana	$477	$132	28%	45%	$161	34%	55%
Nebraska	$392	$20	5%	9%	$196	50%	91%
Nevada	$612	$392	64%	83%	$79	13%	17%
New Hampshire	$287	$76	26%	37%	$130	45%	63%
New Jersey	$2,325	$266	11%	20%	$1,095	47%	80%
New Mexico	$497	$53	11%	23%	$172	35%	77%
New York	$2,861	$297	10%	23%	$975	34%	77%
North Carolina	$2,210	$1,155	52%	83%	$233	11%	17%
North Dakota	$356	$14	4%	6%	$240	68%	94%
Ohio	$1,751	$404	23%	39%	$628	36%	61%
Oklahoma	$1,299	$500	38%	64%	$279	21%	36%
Oregon	$688	$94	14%	37%	$159	23%	63%
Pennsylvania	$4,258	$1,421	33%	62%	$877	21%	38%
Rhode Island	$213	$5	3%	22%	$19	9%	78%
South Carolina	$803	$158	20%	43%	$213	27%	57%
South Dakota	$332	$49	15%	20%	$196	59%	80%
Tennessee	$1,170	$421	36%	72%	$163	14%	28%
Texas	$5,745	$2,765	48%	82%	$612	11%	18%
Utah	$1,140	$700	61%	93%	$50	4%	7%
Vermont	$212	$30	14%	23%	$101	48%	77%
Virginia	$1,110	$402	36%	68%	$192	17%	32%
Washington	$1,975	$849	43%	84%	$166	8%	16%
West Virginia	$818	$312	38%	73%	$113	14%	27%
Wisconsin	$1,307	$544	42%	61%	$349	27%	39%
Wyoming	$409	$46	11%	17%	$224	55%	83%
Average	**$1,295**	**$400**	**31%**	**55%**	**$324**	**25%**	**45%**
Total	**$66,061**	**$20,417**	**31%**	**55%**	**$16,525**	**25%**	**45%**

Sources: Total annual spending on capital projects calculated using the following tables:

- Federal Highway Administration. (2011). "Disbursements for State-Administered Highways." Table SF-4. http://www.fhwa.dot.gov/policyinformation/statistics/2011/sf4.cfm.
- Federal Highway Administration. (2010). "Disbursements for State-Administered Highways." Table SF-4.

http://www.fhwa.dot.gov/policyinformation/statistics/2010/sf4.cfm.

- FHWA. (2009). "Disbursements for State-Administered Highways." Table SF-4. http://www.fhwa.dot.gov/policyinformation/statistics/2009/sf4.cfm.

Annual capital spending on road expansion projects and repair and preservation projects calculated using the following tables:

- Federal Highway Administration. (2011). "State Highway Agency Capital Outlay – Classified by Improvement Type." Table SF-12A. http://www.fhwa.dot.gov/policyinformation/statistics/2011/sf12a.cfm.
- Federal Highway Administration. (2010). "State Highway Agency Capital Outlay – Classified by Improvement Type." Table SF-12A. http://www.fhwa.dot.gov/policyinformation/statistics/2010/sf12a.cfm.
- Federal Highway Administration. (2009). "State Highway Agency Capital Outlay – Classified by Improvement Type." Table SF-12A. http://www.fhwa.dot.gov/policyinformation/statistics/2009/sf12a.cfm.

Appendix B
Annual cost of repairing and maintaining states' roads

TABLE B1

Estimated annual funding need for repair and preservation of state-owned roads (in 2010 dollars)

State	State road network preservation need	Repair need for major state roads in poor condition	State road preservation and major road repair need
Alabama	$647,550,906	$26,231,393	$673,782,298
Alaska	$255,612,283	$33,684,428	$289,296,711
Arizona	$432,364,079	$23,730,564	$456,094,643
Arkansas	$827,930,890	$118,276,270	$946,207,160
California	$1,126,173,979	$172,581,802	$1,298,755,781
Colorado	$512,916,187	$46,221,906	$559,138,093
Connecticut	$220,219,745	$46,552,596	$266,772,340
Delaware	$262,550,131	$24,880,688	$287,430,818
District of Columbia	$69,989,567	$32,036,567	$102,026,134
Florida	$940,144,185	$45,782,412	$985,926,597
Georgia	$1,068,017,532	$35,311,645	$1,103,329,177
Hawaii	$56,189,382	$9,811,870	$66,001,252
Idaho	$267,872,316	$21,024,804	$288,897,120
Illinois	$934,724,720	$100,917,192	$1,035,641,911
Indiana	$621,648,891	$63,154,295	$684,803,186
Iowa	$510,216,981	$45,229,754	$555,446,735
Kansas	$536,572,182	$131,345,898	$667,918,080
Kentucky	$1,374,470,628	$46,931,333	$1,421,401,962
Louisiana	$884,987,878	$95,125,341	$980,113,219
Maine	$392,911,512	$51,947,723	$444,859,235
Maryland	$330,449,122	$31,085,024	$361,534,146
Massachusetts	$207,271,767	$11,989,378	$219,261,145
Michigan	$608,902,124	$94,594,631	$703,496,755
Minnesota	$653,772,987	$45,822,336	$699,595,323
Mississippi	$607,415,423	$123,647,772	$731,063,195
Missouri	$1,693,497,222	$50,064,893	$1,743,562,115
Montana	$555,862,591	$17,608,976	$573,471,567
Nebraska	$502,646,152	$26,791,482	$529,437,633

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State	State road network preservation need	Repair need for major state roads in poor condition	State road preservation and major road repair need
Nevada	$295,235,692	$4,577,589	$299,813,282
New Hampshire	$189,058,295	$20,678,114	$209,736,409
New Jersey	$188,500,504	$36,884,161	$225,384,665
New Mexico	$649,093,448	$72,017,798	$721,111,246
New York	$849,819,524	$100,778,943	$950,598,467
North Carolina	$3,789,336,106	$169,197,272	$3,958,533,378
North Dakota	$378,864,290	$10,391,994	$389,256,284
Ohio	$1,118,840,130	$142,946,333	$1,261,786,463
Oklahoma	$673,572,081	$115,878,167	$789,450,248
Oregon	$413,933,660	$11,031,965	$424,965,625
Pennsylvania	$1,966,458,650	$236,482,389	$2,202,941,040
Rhode Island	$64,216,401	$9,271,255	$73,487,657
South Carolina	$2,006,642,342	$92,241,464	$2,098,883,807
South Dakota	$417,031,191	$51,523,561	$468,554,752
Tennessee	$822,938,545	$27,365,827	$850,304,372
Texas	$4,381,245,467	$254,695,540	$4,635,941,007
Utah	$350,586,920	$18,525,612	$369,112,533
Vermont	$134,171,513	$13,794,932	$147,966,445
Virginia	$2,809,312,756	$279,731,298	$3,089,044,054
Washington	$409,964,720	$50,642,099	$460,606,818
West Virginia	$1,592,385,145	$246,701,598	$1,839,086,742
Wisconsin	$657,651,508	$72,090,303	$729,741,810
Wyoming	$351,700,187	$9,719,504	$361,419,690
Average	**$815,949,813**	**$70,971,582**	**$886,921,395**
Total	**$41,613,440,439**	**$3,619,550,687**	**$45,232,991,126**

Determining road preservation and repair costs

This analysis evaluates the funding need based on the average cost of various construction activities compiled by FHWA from DOTs around the country. This study examines the cost and timing of repair and preservation to see how much states would need to spend annually to 1) keep their roads from deteriorating to poor condition; and 2) bring roads in poor condition into good repair over a 20-year period. While it does not capture regional variations attributable to climate or topography, among others, it does offer a big picture assessment.

Preserving the existing network in good condition

Determining the annualized pavement management cost

Once a road is built, a combination of regular repair and preservation along with periodic major rehabilitation is required to keep it in a state of good repair. This section calculates the annualized cost of keeping a state's road network in a state of good repair based on its current asset inventory. The following assumptions went into calculating this cost:

- Asphalt and concrete roads have a 50-year lifecycle from initial construction, a figure based on conversations with representatives from PennDOT and other industry experts. A national approximation is used for this analysis, but road lifecycles actually vary based on a number of factors including traffic flow, climate and pavement type.
- Over the course of 50 years, a regular preventative treatment schedule is required, as outlined in Table B2 below.
- At the end of 50 years, all pavement requires major rehabilitation to address shifting or weakened foundations and other problems.

The treatment schedules below do not include all the techniques that may be used under all situations and different geographic conditions. Though the schedules assume a major rehabilitation at the end of 50 years, a road often needs to be completely reconstructed at the end of its lifecycle, which is significantly more costly than major rehabilitation. Thus, the calculation here for whole network management represents a minimum cost based on a minimum universal treatment schedule applied across all 50 states. A state-customized treatment schedule would yield a more precise network repair and preservation price tag, but this standardized approach is designed to provide a national comparative snapshot.

TABLE B2

Pavement treatment schedules for asphalt and concrete (in 2010 dollars)

Asphalt Treatment Schedule (over 50-year lifecycle)		
Year Applied	**Treatment Type**	**Cost per lane-mile**
0	(Initial Construction)	N/A
5	Crack Sealing	$2,211
6	Microsurfacing	$26,654
10	Crack Sealing	$2,211
14	Mill and Resurfacing	$220,212
14	Chip Seal	$44,124
18	Crack Sealing	$2,211
19	Microsurfacing	$26,654
23	Crack Sealing	$2,211
26	Mill and Resurfacing	$220,212

Concrete Treatment Schedule (over 50-year lifecycle)		
Year Applied	**Treatment Type**	**Cost per lane-mile**
0	Initial Construction	N/A
8	Joint Sealing	$8,375
15	Partial Depth Repair	$25,459
15	Diamond Grinding	$76,892
15	Joint Sealing	$8,375
25	Partial Depth Repair	$25,459
25	Diamond Grinding	$76,892
25	Joint Sealing	$8,375
35	Partial Depth Repair	$25,459
35	Joint Sealing	$8,375

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Asphalt Treatment Schedule (over 50 year life cycle)		
Year Applied	**Treatment Type**	**Cost per lane-mile**
26	Chip Seal	$44,124
30	Crack Sealing	$2,211
31	Microsurfacing	$26,654
34	Crack Sealing	$2,210
38	Mill and Resurfacing	$220,212
38	Chip Seal	$44,124
42	Crack Sealing	$2,211
43	Microsurfacing	$26,654
50	Major Rehabilitation	$196,415
Total life cost per lane-mile		**$1,111,516**
Annualized cost per lane-mile		**$22,230**

Concrete Treatment Schedule (over 50 year life cycle)		
Year Applied	**Treatment Type**	**Cost per lane-mile**
35	HMA Overlay	$79,313
36	Chip Seal	$44,124
40	Crack Sealing	$2,211
41	Microsurfacing	$26,654
47	Partial Depth Repair	$25,459
47	Joint Sealing	$8,375
47	Mill and Resurfacing	$220,212
47	Chip Seal	$44,124
50	Major Rehabilitation	$436,933
Total life cost per lane-mile		**$1,150,066**
Annualized cost per lane-mile		**$23,021**

The per-lane-mile cost for each pavement treatment included in the lifecycles above were determined by averaging the costs from different application samples made available in FHWA's 2010 report "Performance Evaluation of Various Rehabilitation and Preservation Treatments." Sample applications were provided from six states (California, Kansas, Michigan, Minnesota, Texas and Washington). Only a subset of the basic preventative treatments provided in the report (see Table B3 below) was used to represent a minimal preservation schedule. It should be noted that FHWA provides cost data for several other treatment types. For concrete roads, FHWA provided cost data for joint sealing, partial depth repair, diamond grinding, hot-mix asphalt (HMA) overlay, chip sealing, crack sealing, microsurfacing, mill and resurfacing, HMA overlay without slab fracturing, crack and seal and unbonded overlays. For asphalt roads, treatment types included chip sealing, crack sealing, microsurfacing, mill and resurfacing, full depth reclamation, structural overlay and whitetopping.

TABLE B3

Per-lane-mile cost of sample pavement treatments (in 2010 dollars)

Preventative preservation treatments (number of cost samples available)	**Average per-lane-mile cost**
HMA overlays (13)	$79,313
Chip seal (15)	$44,124
Microsurfacing (9)	$26,654
Crack sealing (11)	$2,211
Mill and Resurfacing (10)	$220,212
Diamond grinding (8)	$76,892
Partial depth repair (4)	$25,459
Joint sealing (3)	$8,375

Major rehabilitation treatments (number of cost samples)	**Average per-lane-mile cost**
Concrete	
HMA overlay without slab fracturing (rubblization or crack-and-seal) (7)	$461,805
Crack-and-seal or rubblize and overlay (with HMA) (7)	$332,558
Unbonded Overlay (7)	$516,435
Average concrete major rehabilitation cost	**$436,933**
Asphalt	
Full-Depth Reclamation (12)	$166,058
Structural overlay (mill and fill) (9)	$145,053
Whitetopping (5)	$278,134
Average asphalt major rehabilitation cost	**$196,415**

Source: Costs for preservation, minor rehabilitation and major rehabilitation were found in tables C.1–C.20 from FHWA's 2010 report titled "Performance Evaluation of Various Rehabilitation and Preservation Treatments." (http://www.fhwa.dot.gov/PAVEMENT/pub_details.cfm?id=666).

Treatment costs from sample states were presented as a per-lane-mile dollar figure. These figures varied among sample applications due to geographic, economic and other factors.

Major rehabilitation costs for concrete and asphalt treatments were calculated by averaging sample application cost data from the same FHWA report. The major rehabilitation treatments were aggregated and averaged for an overall major rehabilitation cost (in 2010 dollars).

The per-lane-mile costs for all treatment applications were summed to calculate the total life cost for keeping one lane-mile of pavement in a state of good repair. The total was divided by 50 years (representing the assumed life of a road) to yield the annual cost figure. The annual concrete and asphalt state of good repair costs were then applied to the lane-miles owned by state highway agencies.

Calculating number of asphalt and concrete lane-miles

FHWA does not report state highway agency-owned lane-miles by surface type (concrete versus asphalt) within the publicly available FHWA Highway Statistics dataset. To calculate the total asphalt and concrete lane-miles owned by each state, the percentages of public centerline miles in each state (regardless of owner) that are asphalt versus concrete were calculated and then applied to the total centerline miles in the state-owned road network (as reported in FHWA Table HM-80) to estimate how much of the state-owned network is concrete and how much is asphalt.

FHWA reports road surface type characterized by functional system type in FHWA Table HM-51. The percentages of asphalt versus concrete roads within the public road network were determined for each functional system type with the exception of rural minor collectors, rural locals and urban locals, which are excluded from this FHWA dataset. These lower functionality roads were assumed to be asphalt in order to maintain a more financially conservative estimate of total cost. Asphalt roads included the surface type categories bituminous and composite. Unpaved roads were not taken into account.

The percentages for each road functionality type that were asphalt versus concrete were applied to the number of state highway agency–owned centerline miles to create the number of state highway agency–owned asphalt and concrete centerline miles.

Converting state-owned centerline miles to lane-miles

Next, the asphalt and concrete state-owned centerline miles calculated using the methodology described above were converted into lane-miles. To do this, multipliers were created for each functionality type using public roads data on total centerline miles (as reported in FHWA Table HM-20) and total lane-miles (as reported in FHWA Table HM-60). For each functionality type of public road, the number of lane-miles in each state was divided by the number of centerline miles. These numbers represented the approximate number of lane-miles that exist for every centerline mile within each functionality type. This calculation assumes that the estimate would also be similar for the state-owned network. Using these multipliers, the number of state-owned asphalt and concrete centerline miles were converted to asphalt and concrete lane-miles.

Generating the road network management cost

The number of asphalt lane-miles was multiplied by the annual pavement management cost for asphalt roads ($22,230), and the number of concrete lane-miles was multiplied by the average annual preservation cost for concrete roads ($23,021) for each functionality type. These costs were summed to create a total pavement management cost for each functionality type. The annual preservation cost for state highway agency-owned roads was then generated by the sum of each functionality type cost.

Data sources

Costs for preservation and major rehabilitation of asphalt and concrete roads were determined based on the following report:

- FHWA. (2010). "Performance Evaluation of Various Rehabilitation and Preservation Treatments." Tables C.1 – C.20. http://www.fhwa.dot.gov/PAVEMENT/pub_details.cfm?id=666.

The portions of public centerline miles that are asphalt versus concrete for each state were calculated based on the following table:

- FHWA Highway Statistics. (2011). "Functional System Length - 2011 Miles by Type of Surfaces." Table HM-51. http://www.fhwa.dot.gov/policyinformation/statistics/2011/hm51.

Centerline miles of state-owned road were calculated based on the following table:

- FHWA Highway Statistics. (2011). "State Highway Agency-Owned Public Roads – 2011 Miles by Functional System." Table HM-80. http://www.fhwa.dot.gov/policyinformation/statistics/2011/hm80.cfm.

Multipliers for the conversion from centerline miles to lane-miles were calculated based on the following tables:

- FHWA Highway Statistics. (2011). "Public Road Length - 2011 Miles by Functional System." Table HM-20. http://www.fhwa.dot.gov/policyinformation/statistics/2011/hm20.cfm.
- FHWA Highway Statistics. (2011). "Functional System Lane-Length - 2011 Lane-Miles." Table HM-60. http://www.fhwa.dot.gov/policyinformation/statistics/2011/hm60.cfm.

Backlog of state-owned roads in poor condition

Creating a lane-mile cost for major rehabilitation

The unfortunate consequence of deferred preservation and repair is that roads will eventually deteriorate to the point that they need to be majorly rehabilitated or reconstructed. Roads in poor condition as of 2011 were assumed to require major rehabilitation in order to bring them up to a state of good repair.

FHWA identifies six major rehabilitation treatments in its 2010 report "Performance Evaluation of Various Rehabilitation and Preservation Treatments." These treatments are applied to either "hot mix asphalt" pavement or "Portland cement concrete" pavement. FHWA provides cost data from sample applications of the six types of major rehabilitation treatments in six states (California, Kansas, Michigan, Minnesota, Texas and Washington). For each of the treatment types, the average cost per lane-mile was calculated. Next, the average costs of all three asphalt treatment types and all three concrete treatment types were averaged to generate a per-lane-mile cost for the major rehabilitation of poor asphalt and concrete roads (see Table B3 on page 32 for more information). Note that these major rehabilitation costs are in 2010 dollars. This number was later applied to the sum of state-owned roads in poor condition to determine what it would cost to bring the poor roads back to a state of good repair.

Generating annualized cost to rehabilitate state-owned major roads in poor condition

The state-owned lane-miles of road in poor condition were estimated as of 2011 (see Appendix A, Table A4). Then the numbers of these poor roads that were asphalt versus concrete were estimated based on the percentage of all public roads that were asphalt versus concrete. FHWA does not publicly report pavement condition data categorized by surface type, so this required making the assumption that the percentage of total public roads that are asphalt versus concrete (based on FHWA Table HM-51) would also apply to state-owned lane-miles of road in poor condition.

The total centerline miles of public roads that are asphalt and the total centerline miles of public roads that are concrete were calculated by summing asphalt and concrete roads for each state and functionality type in FHWA Table HM-51. Based on these calculations, 93 percent of all public roads were found to be asphalt and 7 percent were found to be concrete as of 2011. These percentages were then applied to the estimated state-owned lane-miles of road in poor condition to determine the number of asphalt and concrete lane-miles of road in poor condition as of 2011.

The calculated costs for asphalt and concrete major rehabilitation were applied to the estimated number of lane-miles of asphalt and concrete roads in poor condition. The resulting costs were summed to determine the total cost to rehabilitate all the roads in poor condition owned by each state. Recognizing that states would be unable to rehabilitate all of these roads at once, it was assumed that states would rehabilitate these roads over a 20-year period. The total cost, therefore, was divided by 20 years to create an annualized cost to bring major road lane-miles currently in poor condition to a state of good repair.

The calculations described above required two assumptions:

- The ratio of asphalt roads versus concrete roads for all public roads would also apply to state-owned lane-miles of road in poor condition.

- These calculations do not take into account that the number of roads in poor condition is likely to change over this 20-year period.

Data sources

Costs for major rehabilitation of asphalt and concrete roads were determined based on the following report:

- FHWA. (2010). "Performance Evaluation of Various Rehabilitation and Preservation Treatments." Tables C.1 – C.20. http://www.fhwa.dot.gov/PAVEMENT/pub_details.cfm?id=666.

The percentages of public centerline miles in poor condition for each state were calculated based on the following tables:

- FHWA Highway Statistics. (2011). "Functional System Length - 2011 Miles By Measured Pavement Roughness." Table HM-64. http://www.fhwa.dot.gov/policyinformation/statistics/2011/hm64.cfm.
- FHWA Highway Statistics. (2011). "Functional System Length - 2011 Miles By Measured Pavement Roughness/Present Serviceability Rating." Table HM-63. http://www.fhwa.dot.gov/policyinformation/statistics/2011/hm63.cfm.

Lane-miles of state-owned road were found in the following table:

- FHWA Highway Statistics. (2011). "State Highway Agency-Owned Public Roads - 2011 1/Rural and Urban Miles; Estimated Lane-Miles and Daily Travel." Table HM-81. http://www.fhwa.dot.gov/policyinformation/statistics/2011/hm81.cfm.

The percentage of public centerline miles that are asphalt versus concrete were calculated based on the following table:

- FHWA Highway Statistics. (2011). "Functional System Length - 2011 Miles by Type of Surfaces." Table HM-51. http://www.fhwa.dot.gov/policyinformation/statistics/2011/hm51.

Appendix C

Lane-miles in poor condition that could be brought into good repair by redirecting annual investment from expansion

States collectively spent an average of $20.4 billion per year on road expansion for 2009–2011 based on the analysis in this report (see Table A6 beginning on page 26). To determine how many roads in poor condition could be brought into a state of good repair per year if those funds were instead invested in repair, the cost of bringing a lane-mile of road in poor condition into good repair through major rehabilitation treatment was estimated. That cost was then used to determine the number of lane-miles that could be rehabilitated with an investment of $20.4 billion per year. The methodology below contains some repetition of the calculations described in previous appendices.

Cost of bringing a lane-mile of road in poor condition into good repair
The average costs of major rehabilitation for a single lane-mile of asphalt road ($196,405) and a single lane-mile of concrete road ($436,933) were estimated. These cost estimates were developed using a methodology described in Appendix B and were reviewed by an advisory team of former state DOT chief executives, senior infrastructure system managers and engineers at PennDOT.

Lane-miles that could be brought into good repair with an investment of $20.4 billion
Determining how many lane-miles in poor condition could be brought into good repair annually with an investment of $20.4 billion assumed the percentage of lane-miles repaired each year that would be asphalt versus concrete. FHWA does not publicly report pavement condition data categorized by surface type; it was assumed that the percentage of total public roads that are asphalt versus concrete (as reported in FHWA Table HM-51) would also apply to the public roads in poor condition that would be repaired each year. These costs were developed based on a report released by FHWA in 2010 and are in 2010 dollars.

The total centerline miles of public roads that are asphalt and the total centerline miles of public roads that are concrete were calculated by summing asphalt and concrete roads for each state and functionality type in FHWA Table HM-51. Asphalt roads included the surface type categories bituminous and composite. Based on these calculations, 93 percent of all public roads were found to be asphalt and 7percent were found to be concrete as of 2011.

The number of roads in poor condition that could be brought into a state of good repair each year through major rehabilitation was determined by assuming that 93 percent of the roads were asphalt (requiring major rehabilitation costing $196,405 per lane-mile) and 7 percent were concrete (requiring major rehabilitation costing $436,933). Based on an investment of $20.4 billion per year in major rehabilitation, 95,742 lane-miles in poor condition could be brought into a state of good repair per year.

Estimating impact on the backlog of state-owned roads in poor condition
The time it would take to eliminate the backlog of state-owned roads in poor condition was estimated based on an additional investment of $20.4 billion in repair per year. As described in Appendix A, FHWA reports pavement conditions data for public roads, a category that includes and does not distinguish between roads owned by states, federal agencies, counties and towns and municipalities. To estimate the backlog of state-owned lane-miles in poor condition, the

percentage of centerline miles of public road in poor condition as of 2008 (17 percent), calculated using the methodology described in Appendix A, was applied to the total lane-miles of road owned by the states (see Table A4 beginning on page 21). This calculation required making the assumption that the percentage of public centerline miles in poor condition as of 2008 was equivalent to the percentage of state-owned lane-miles of road in poor condition. Based on these assumptions, an estimated 321,542 lane-miles of state-owned road were in poor condition as of 2008, and this backlog of roads in poor condition could have been brought into a state of good repair in less than four years with a $20.4 billion annual investment in repair.

Data sources

Costs for major rehabilitation of asphalt and concrete roads were determined based on the following report:

- FHWA. (2010). "Performance Evaluation of Various Rehabilitation and Preservation Treatments." Tables C.1 – C.20. http://www.fhwa.dot.gov/PAVEMENT/pub_details.cfm?id=666.

The portion of public centerline miles that are asphalt versus concrete were calculated based on the following table:

- FHWA Highway Statistics. (2011). "Functional System Length - 2011 Miles by Type of Surfaces." Table HM-51. http://www.fhwa.dot.gov/policyinformation/statistics/2011/hm51.

The percentages of public centerline miles in poor condition for each state were calculated based on the following tables:

- FHWA Highway Statistics. (2011). "Functional System Length - 2011 Miles By Measured Pavement Roughness." Table HM-64. http://www.fhwa.dot.gov/policyinformation/statistics/2011/hm64.cfm.
- FHWA Highway Statistics. (2011). "Functional System Length - 2011 Miles By Measured Pavement Roughness/Present Serviceability Rating." Table HM-63. http://www.fhwa.dot.gov/policyinformation/statistics/2011/hm63.cfm.

Lane-miles of state-owned road were found in the following table:

- FHWA Highway Statistics. (2011). "State highway Agency-Owned Public Roads - 2011 1/Rural and Urban Miles; Estimated Lane-Miles and Daily Travel." Table HM-81. http://www.fhwa.dot.gov/policyinformation/statistics/2011/hm81.cfm.

Endnotes

1 Smart Growth America and Taxpayers for Common Sense. (2011). *Repair Priorities: Transportation spending strategies to save taxpayer dollars and improve roads*. Available at http://www.smartgrowthamerica.org/repair-priorities.

2 Calculated based on the Federal Highway Administration's Highway Statistical Series, for years 2004–2008. This data refers to the network of the nation's roads owned by state highway agencies. A "lane-mile" is a unit of measurement used to determine the size of a road network and accounts for road capacity as well as road length (for example, one mile of a six-lane highway would be measured as six lane-miles).

3 Smart Growth America and Taxpayers for Common Sense. (2011). *Repair Priorities: Transportation spending strategies to save taxpayer dollars and improve roads.* Available at http://www.smartgrowthamerica.org/repair-priorities. Calculated based on the Federal Highway Administration's Highway Statistical Series, for years 2004-2008.

4 Federal Highway Administration. (2011). Highway Statistics Series. Available at http://www.fhwa.dot.gov/policyinformation/statistics/2011.

5 Calculated based on the Federal Highway Administration's Highway Statistical Series, for years 2009–2011. See Appendix A on page 14 for full methodology.

6 Calculated based on the Federal Highway Administration's Highway Statistical Series for 2008. See Appendix A on page 14 for full methodology.

7 Calculated based on the Federal Highway Administration's Highway Statistical Series, for years 2009–2011. See Appendix A on page 14 for full methodology.

8 Estimated based on the Federal Highway Administration's (FHWA) Highway Statistics Series for years 2008 and 2011. FHWA reports pavement conditions for "public roads," a category that includes and does not distinguish between roads owned by states, federal agencies, counties and towns and municipalities. This means that there is not enough information to determine how the pavement condition of roads owned exclusively by states have changed over time, and these figures represent estimates based on available data for all public roads. More information about how state road conditions were estimated is available in Appendix A on page 14.

9 Calculated based on the Federal Highway Administration's Highway Statistical Series, for years 2009–2011 and 2004–2008. See Appendix A on page 14 for full methodology.

10 Calculated based on the Federal Highway Administration's Highway Statistical Series, for years 2009–2011 and 2004–2008. See Appendix A on page 14 for full methodology.

11 American Association of State Highway and Transportation Officials (AASHTO) and the Road Information Project. (2009). "Rough Roads Ahead: Fix Them Now or Pay for It Later." Available at http://www.ttap.mtu.edu/library/RoughRoadsAhead.pdf.

12 Calculated based on the Federal Highway Administration's Highway Statistical Series, for years 2004–2008.

13 Calculated based on the Federal Highway Administration's Highway Statistical Series, for years 2009–2011. This figure is in 2010 dollars. See Appendix B on page 29 for full methodology.

14 Calculated based on the Federal Highway Administration's Highway Statistical Series, for years 2009–2011, based on the assumption that the 1.9 million lane-miles of state-owned roads have the same portion in poor condition as public roads—17 percent as of 2008. The road repair treatment costs used in this calculation are in 2010 dollars. See Appendix C on page 37 for full methodology.

15 Calculated based on the Federal Highway Administration's Highway Statistical Series, for years 2009–2011. See Appendix C on page 37 for full methodology.

16 Calculated based on the Federal Highway Administration's Highway Statistical Series, for years 2009–2011. See Appendix A on page 14 for full methodology.

17 Texas Transportation Institute. (2012). *2012 Urban Mobility Report*. Available at http://d2dtl5nnlpfr0r.cloudfront.net/tti.tamu.edu/documents/mobility-report-2012.pdf.

18 American Society of Civil Engineers. (2013). *2013 Report Card for America's Infrastructure*. Available at http://www.infrastructurereportcard.org/a/#p/roads/conditions-and-capacity.

19 Wyoming Department of Transportation. (2013, September 3). "19 Projects Planned for Additional Fuel Tax Revenue in FY 2014." Retrieved January 13, 2014, from http://www.dot.state.wy.us/news/19-projects-planned-for-additional-fuel-tax-revenue-in-fy-2014.

20 Michigan Department of Transportation. https://www.michigan.gov/mdot/0,4616,7-151-9621_15757---,00.html.

21 TRIP. (2013, October). Bumpy Roads Ahead: America's roughest rides and strategies to make our roads smoother. Available at http://www.tripnet.org/docs/Urban_Roads_Report_Oct_2013.pdf.

22 Estimated state-owned lane-miles in poor condition as of 2011 is the product of state-owned lane-miles and percent of public centerline miles in poor condition (see Table A2 for full centerline mile calculations).

23 See note 22.

24 See note 22.

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Smart Growth America is the only national organization dedicated to researching, advocating for and leading coalitions to bring better development to more communities nationwide. From providing more sidewalks to ensuring more homes are built near public transportation or that productive farms remain a part of our communities, smart growth helps make sure people across the nation can live in great neighborhoods. For more information visit www.smartgrowthamerica.org.

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