Notable results

- *WSDOT pavement in fair or better condition improved from 91.8% in 2012 to 93.3% in 2013*
- *Remaining Service Life of WSDOT pavement has declined 2.4% since 2012, indicating the need for more pavement preservation work*
- *WSDOT estimates a $1.5 billion pavement preservation gap in the next 10 years, current funding will meet 40% of actual needs*
- *The deferred pavement preservation backlog was $391 million in 2013, an increase from $343 million in the previous year*

Short-term pavement conditions improve slightly

Pavement conditions can be assessed in the short term by measuring the percent in good, fair and poor condition in a given year. While this provides a snapshot of pavement conditions, it does not account for long-term trends.

In 2013, 93.3 percent of WSDOT-managed pavement lane-miles were in fair or better condition, an increase from 91.8 percent in 2012. In terms of vehicle miles traveled (VMT), 92.6 percent of VMT in 2013 were on roads in fair or better condition, compared to 91.9 percent in 2012. Where pavement condition is shown by VMT, roadways with more traffic are given more weight in the calculation than less traveled roads. This improvement in statewide pavement surface condition in 2013 is due to strategic steps taken by WSDOT (see p. 11).

The condition of WSDOT-managed roadways is evaluated annually using three criteria: surface cracking (an indicator of structural deterioration), rutting (which is monitored for safety and structural reasons), and smoothness (measured by the International Roughness Index). These criteria are used to classify pavement into five categories: very good, good, fair, poor and very poor. The categories fair, good and very good indicate a pavement that is performing adequately; pavement in poor condition is deficient and needs repair, and very poor indicates failure and need for substantial restoration or reconstruction. For a more in depth look at different pavement conditions, see chart on p. 9.

Strategic asset management improves short-term pavement condition; long-term outlook is critical
2013 compared to 2012

	Pavement annual performance measures[1]		2012	2013	Goal	Goal met	Progress	Desired Trend
Short term	**Percent of pavement in fair or better condition** measured for asphalt and concrete pavement (chip seal data was not collected in 2012 or 2013 due to budget constraints). Condition is shown by lane miles as well as weighted by the vehicle miles traveled (VMT) to reflect road use.	Lane miles	91.8%	93.3%	90.0%	✓	↑	↑
		VMT	91.9%	92.6%				
Long term	**Asset sustainability ratio** measures the years of pavement service life replenished through rehabilitation, divided by the service life consumed annually.		53%	65%	90%	—	↑	↑
	Remaining service life measures the percent of a pavement segment's remaining useful life before rehabilitation or replacement is needed (also shown as average years remaining).		47.3% (7.47 yrs)	46.1% (7.29 yrs)	45% to 55%	✓	↓	↑
	Deferred preservation liability (backlog) estimates the accumulated cost in current dollars to fund the backlog of past due (deferred) pavement rehabilitation work.		$343 million	$391 million	$0	—	↑	↓

Data source: WSDOT Materials Lab.
Notes: 1 All measures, except for deferred preservation liability, are weighted by vehicle miles traveled to better capture the typical road user's experience. Calculations for all measures, excluding condition, are improved to include all pavement (asphalt, chip seal, and concrete). All measures are calculated for calendar years 2013 and 2012. For these reasons, the previous year's data is not comparable to data published in *Gray Notebook* 48, p. 10.

Long-term pavement metrics highlight critical outlook

Pavement conditions likely to decline over long-term

Long-term performance indicators provide an additional assessment of WSDOT pavement infrastructure, as they account for the impact that the projected funding gap has on pavement service life and the preservation backlog. The projected $150 million annual funding gap during the next 10 years will make it difficult for WSDOT to keep up with the necessary pavement preservation work, as the forecasted funding only covers 40 percent of the estimated need. WSDOT tracks three long-term pavement performance measures (Asset Sustainability Ratio, Remaining Service Life and Deferred Preservation Liability) that were introduced in *Gray Notebook* 48, p. 10. Two of three measures showed a downward trend in 2013.

Asset Sustainability Ratio falls below WSDOT's goal in 2013

In 2013, WSDOT's Asset Sustainability Ratio was 65 percent, up 12 percent from 2012 but still not meeting WSDOT's goal of 90 percent. This ratio measures how well WSDOT is keeping up with long-term pavement investment needs. The Asset Sustainability Ratio measures the years of pavement service life replenished through rehabilitation, divided by the service life consumed annually.

Remaining Service Life declines in 2013, meets minimum threshold

The Remaining Service Life of state-owned pavement dropped from 47.3 percent in 2012 to 46.1 percent in 2013, 1.1 percent above WSDOT's minimum threshold. Remaining Service Life is a measure of how much pavement life remains for a given section of roadway before resurfacing is required. Calculating this measure for the entire statewide road network provides an indicator of the remaining life of the state's pavement network.

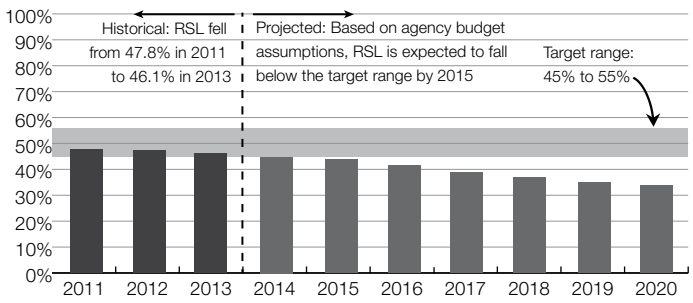
As a result of under-funding for pavement preservation, the Remaining Service Life of WSDOT pavement will reach a critically low level in 2015 when it is expected to fall below the minimum level of 45 percent. As Remaining Service Life falls below this lower limit, much more capital is required to fix the depleted roadways in order to carry traffic at an acceptable (fair or better) condition.

If rehabilitation of pavement in poor condition is deferred for too long, the pavement may deteriorate to a condition in which reconstruction is required (see p. 9). Because the cost of reconstruction is typically three to four times the cost of rehabilitation, this will increase the agency's preservation liability while Remaining Service Life falls.

Deferred Preservation Liability grows 14 percent between 2012 and 2013

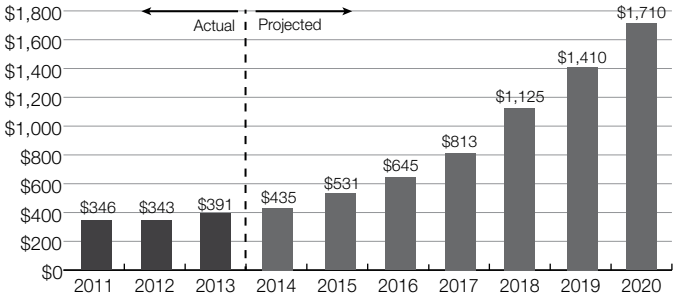
The backlog of deferred pavement preservation jumped $48 million from $343 million in 2012 to $391 million in 2013. When pavement investment is less than necessary to keep the pavement in acceptable condition, the Deferred Preservation Liability measures the funding that will eventually be needed to restore the pavement network to the expected condition. This is an estimate of the accumulated cost to fund the backlog of past due (deferred) pavement rehabilitation work. Not investing in pavement preservation due to lack of funding is like not repairing the roof on your house in order to defer costs. Eventually the roof must be repaired, in addition to any extra damage caused by not repairing the roof sooner.

Remaining Service Life of WSDOT pavements continues downward trend through 2020
Fiscal years 2011 through 2020; Remaining Service Life (RSL) shown as a percent of the original life



Data source: WSDOT Materials Lab.
Notes: For 2013, the Remaining Service Life of 46.1 percent is equivalent to 7.29 years remaining before rehabilitation is needed.

WSDOT's Deferred Preservation Liability expected to more than quadruple between 2013 and 2020
Fiscal years 2011 through 2020; Dollars in millions; Projections based on agency budget assumptions



Data source: WSDOT Materials Lab.
Notes: Deferred Preservation Liability is defined as the funding necessary to address deferred pavement rehabilitation for all pavement types. WSDOT's goal is to have $0 in Deferred Preservation Liability.

Pavement preservation funding expected to decline

The forecasted Deferred Preservation Liability, shown on p. 6, indicates the liability will grow to $1.7 billion by 2020. Once preservation of the pavement system becomes unsustainable, pavement repair and rehabilitation needs grow exponentially while the life left remaining in the system is at critically low levels.

Federal Highway Administration releases draft pavement rules for comment (MAP-21)

The Federal Highway Administration (FHWA) draft rules for the Moving Ahead for Progress in the 21st Century (MAP-21) legislation are requiring all states to report on the following pavement performance measures:

- Percentage of pavements on the interstate system in good condition;
- Percentage of pavements on the interstate system in poor condition;
- Percentage of pavements on the National Highway System (excluding the interstate system) in good condition; and
- Percentage of pavements on the National Highway System (excluding the interstate system) in poor condition.

WSDOT is evaluating and providing comments to the FHWA on the proposed rules and is well positioned to be in compliance with these reporting standards. For additional information on this rule release, see p. v.

Pavement preservation funding expected to continue to decline

The pavement preservation budget has experienced continuous funding reductions since 2000. The current planned budget over the next five biennia averages $100 million per year, resulting in a drop of 57 percent since 2000. Despite this downward trend in pavement preservation funding, WSDOT has adopted various innovative strategies to maintain pavement conditions (see p. 11).

With projected funds estimated at $100 million per year, WSDOT determined the optimal distribution of funds for each pavement type was approximately 60 percent for asphalt pavements, 30 percent for concrete and 10 percent for chip seal. This distribution also reflects the amount of statewide traffic traveling on each pavement type.

Proposed pavement preservation projects are prioritized and evaluated by the following four principles:

- Avoid excessive costs of reconstruction;
- Extend pavement life through cost-effective maintenance;
- Result in lower annual cost; and,
- Mitigate risks on roadways with high freight and commute traffic volumes.

WSDOT estimates a $1.5 billion funding gap during next 10 years

Based on the current pavement system conditions and by leveraging cost-effective, life extending strategies (see p. 11), WSDOT estimates a need of $250 million per year. With planned pavement preservation funding of $100 million per year for the next 10 years, only 40 percent of the actual need is met. This amounts to a total funding gap of $1.5 billion during the next decade. This is similar to expecting the average life of pavements to more than double (see graph below).

What 40% funding means for state roads

On average, chip seal **needs** to be replaced every **seven** years. Funding at 40% **replaces** it every **27** years.

On average, asphalt **needs** to be resurfaced every **15** years. Funding at 40% **resurfaces** it every **42** years.

Data source: WSDOT Materials Lab.

Pavement preservation funding needs vary from year to year, depending on pavement conditions and the rate of deterioration at various locations around the state. However, WSDOT has been tracking pavement performance for more than 40 years and the historical life of a rehabilitation cycle is well known. Using this information, the average renewal life for different types of pavement can be estimated, to help determine the funding necessary for pavement preservation.

WSDOT strives to reduce pavement preservation costs

WSDOT has two main goals to lower its annual pavement preservation needs: reduce pavement preservation project cost and extend pavement life. When a large funding gap exists, the system deteriorates and a reduction in Level of Service is inevitable.

First Goal: Reduce pavement preservation project costs

Project costs related to construction materials, labor, equipment, and traffic control are not expected to decrease in the future. Highway construction costs have been rising faster than the rate of inflation, and are expected to continue to do so (see Construction Cost Trends Annual Report, p. 29). The scope of projects can be reduced in an effort to lower costs, which includes WSDOT's strategic implementation of practical design (see p. 11). Cost reductions resulting from practical design could lead to average savings of 5 to 10 percent of project costs.

Second Goal: Extend pavement life

Annual funding needs are reduced by adding more years to the pavement life. This can be accomplished through better construction methods, improved use of materials, extensive preventive maintenance and/or optimal timing of preservation treatments. WSDOT is continually developing and implementing improved procedures in an effort to accomplish extended pavement life. Extending the average time between asphalt resurfacings by one year, from 15 to 16 years, saves $12 million each year. Extending pavement life for chip seals by an additional year, from seven to eight, yields a savings of $5 million per year.

Pavement Level of Service can decline due to long-term funding shortfalls

Reducing the Level of Service refers to letting the pavement conditions worsen before rehabilitation is planned. This is one way of extending pavement life, where the road user (traveling public and commercial vehicles) will be driving on roads in poor condition longer.

As pavement conditions deteriorate past the optimum time for rehabilitation, risks related to safety and vehicle operations increase. Large scale reductions in the Level of Service, which often result from continued under-funding, can potentially increase the following risks:

- **Safety:** Pavement deterioration, if allowed to continue, can lead to unsafe driving conditions in the form of excessive ruts, potholes, or extremely rough roads that can affect vehicle operation. When the condition deteriorates enough that safety and vehicle operation may potentially be at risk, it may be necessary to reduce speed limits to better reflect road conditions. All roads in Washington are designed, constructed and maintained with one primary goal: safety of the traveling public.
- **Excessive vehicle operating costs:** Poor road conditions can lead to excessive vehicle operating costs, especially on high volume roadways (see p. 12).
- **Disruption to traffic:** When pavement conditions become poor, there is an increased risk of sudden pavement failures that cause unexpected traffic disruption.
- **Excessive reconstruction costs:** Delaying pavement rehabilitation when it is in a poor condition often leads to reconstruction costs, which are several times higher than rehabilitation at the optimal time. Risk increases when reconstruction is required more and more frequently across the state as pavement conditions deteriorate.

Several sections of State Route 100 near Ilwaco were damaged in 2014 by heavy truck traffic. As a result, WSDOT reduced the speed limit from 35 mph to 25 mph to help reduce further deterioration of the roadway.

Under-funding preservation increases long-term costs

Under-funding pavement preservation may save money in the short-term, but it substantially increases long-term costs. This is because under-funding results in increased pavement damage and more expensive future pavement restoration. If WSDOT only invests 40 percent of the preservation dollars needed (due to the $900 million funding gap during the next 10 years), an additional cost of $700 million will be needed to address the increased pavement damage. This approach is equivalent to putting the deferred needs on a credit card at 28 percent interest. It would be far less expensive to pay for the preservation needs as they occur.

The pavement infrastructure managed by WSDOT (excluding bridges, land value, lighting and guardrails) has a replacement (reconstruction) value of $16 billion.

Preserving roads is a priority for most Washingtonians

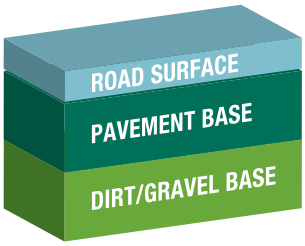
For example, if this value were divided among the 5.4 million adult citizens of Washington, who have a shared interest in these infrastructure assets, it amounts to about $3,000 per person. Preserving this investment at Lowest Life Cycle Cost ($250 million per year) is $46 dollars a year (or 89 cents per week) for each adult Washingtonian, and much less expensive than reconstruction.

In 2013, the Washington State Transportation Commission released the results of a statewide survey reporting that 60 percent of residents are willing to pay more

WSDOT's good condition pavement declines while that in fair and poor condition increases

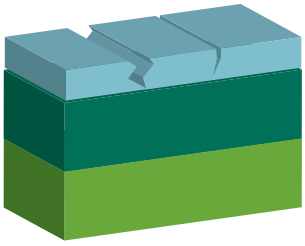
Actual numbers for 2008 and 2013; Projected 2019; Percent of lane miles and vehicle miles traveled[1] (VMT) by condition category; Characteristics of pavement at each condition

WHAT DRIVERS SEE	WHAT IS HAPPENING		2008	2013	Projected 2019	Trend	Desired trend
GOOD/VERY GOOD	GOOD/VERY GOOD	By lane miles	82.7%	76.6%	47%	↓	↑
		By VMT[1]	79.2%	73.5%	55%		
FAIR	FAIR	By lane miles	11.8%	16.7%	31%	↑	↔
		By VMT[1]	15.1%	19.1%	25%		
POOR	POOR	By lane miles	3.9%	5.0%	14%	↑	↓
		By VMT[1]	4.4%	5.9%	14%		
VERY POOR	VERY POOR	By lane miles	1.6%	1.7%	9%	↑	↓
		By VMT[1]	1.2%	1.5%	7%		



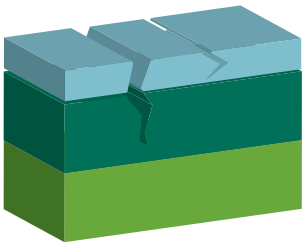
This pavement is in good condition with very minimal deterioration

Motorists experience a smooth road with minimal cracks, ruts or potholes



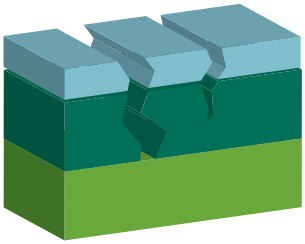
The most cost effective time to resurface or repair a road is when the surface shows wear, yet before the underlying structure is damaged, this means the agency is managing by lowest life cycle cost (LLCC)

Preventive preservation repairs is a good strategy to maximize the road's service life



Waiting until a road is in poor condition costs more, because damage to the underlying structure requires more expensive pavement restoration (1.5 to 2 times the LLCC)

Poor and very poor roads cause more wear on vehicles and higher fuel use



Delaying rehabilitation further can lead to deep pavement failure which requires more expensive reconstruction (3 to 4 times the LLCC)

This road requires reactive repairs to hold it together until reconstruction, not a good long-term cost saving strategy

Data source: WSDOT Materials Lab.

Notes: Percents may not add to 100 due to rounding. These condition figures do not include chip seal pavement, also known as Bituminous Surface Treatments (BST), which was not measured in 2012 or 2013 due to budget reductions. Chip seal pavement accounts for 30 percent of lane miles on the state's highway network, yet because chip seal roads have less traffic than asphalt or concrete, they account for 5.5 percent of the vehicle miles traveled on WSDOT's roadway network. 1 Where pavement condition is shown by VMT, roadways with more traffic are weighted more heavily than less traveled roads. Weighting pavement condition by VMT better accounts for the higher costs to maintain and preserve roads with more traffic.

Pavement condition measurements vary in 2013

in transportation taxes and fees to ensure that future transportation needs are met. Use of the increased funds to preserve infrastructure was considered important for 78 percent of residents, with 84 percent rating maintenance and repair of existing roads, highways, and bridges as important. The report on the survey findings can be accessed online at http://1.usa.gov/1Cbmtwl.

Progress to date on pavement reporting requirements

Results Washington

Results Washington, Gov. Jay Inslee's performance management system for the state, includes a measure for pavement conditions for state and local roads on the National Highway System (NHS). This measure strives to have no more than 10 percent of state and local NHS pavements (as a percentage of annual vehicles miles traveled) in poor condition by 2017. In 2013, 6 percent of NHS pavements were in poor condition, the same as in 2012.

This measure of pavement condition is based on the International Roughness Index (IRI), which has varying condition thresholds depending on roadway speed. For example, a road with a higher speed limit has a lower poor condition IRI threshold, because pavement roughness is more noticeable when driving at higher speeds.

The NHS is a network of strategic highways within the United States, and includes both state and local highways and roads serving major airports, ports, rail and/or truck terminals, pipeline terminals and other transport facilities. About 61 percent of WSDOT-managed pavement are on the NHS. Washington's NHS network includes 14,718 lane miles of pavement. More than three quarters of this roadway is managed by WSDOT, and the remaining 23 percent is managed by local governments.

Governmental Accounting Standards Board

The state is also required to follow Generally Accepted Accounting Principles, which include pronouncements from the Governmental Accounting Standards Board (GASB). This board governs the financial reporting of infrastructure assets, and requires WSDOT to maintain an up-to-date inventory of assets and to document condition assessments.

For the purpose of GASB reporting, WSDOT has a pavement condition goal of 85 percent of state-owned lane miles in fair or better condition, which WSDOT met in the most recent assessment cycle ending in 2013. Pavement conditions for GASB are assessed based on IRI, cracking and rutting.

Strategic Plan Goal 1:
STRATEGIC INVESTMENTS
Strategy 1.1 (Strategic Investments) - Create a process to identify strategic preservation and maintenance investments and strategic operational and multimodal capacity improvement investments in corridors to achieve performance levels.

In support of this strategy, WSDOT developed a policy for planning, programming and managing asphalt and chip seal pavements in order to improve the agency's effective management of these assets in a declining revenue climate. For more detailed information related to these efforts, see the section on WSDOT's strategy of using maintenance to extend pavement life on p. 11.

Results Washington Leading Indicator

Based on current funding levels, control the percent of state and local pavements in poor condition from increasing over 10% by 2017.

Status: On plan (green)

Strategies:

1. **Convert asphalt surfaces to chip seal** - The life-cycle annual cost for a chip seal surfaced pavement is approximately one-third the cost of an asphalt surface. By 2016, it is expected that the cumulative six-year cost reduction due to chip seal conversion will be $100 million.
2. **Implement practical design** - WSDOT uses the practical design approach to make project decisions that focus on the specific problem that the project is intended to address. This is a performance-based approach that looks for lower cost solutions in order to meet specific performance criteria.
3. **Strategic pavement maintenance** - Performing maintenance treatments at the appropriate time (before rehabilitation is needed) extends pavement life and results in lower annual cost. In August 2014, WSDOT implemented a policy that no pavement rehabilitation should take place without first using strategic maintenance to extend pavement life.
4. **Prioritize cost effective projects** - WSDOT prioritizes projects that avoid reconstruction, have a lower annual cost and are on higher volume roads.

Percent of National Highway System (NHS) pavement in poor condition

WSDOT	5%
Local	15%
Total	6%

Immediate mitigation for at risk or off plan status:

WSDOT is seeking asset preservation funding as part of a transportation revenue package.

Innovative strategies improve pavement conditions

WSDOT strategically sustains pavement performance

WSDOT has developed aggressive strategies during the last several years to increase efficiency and counteract the effects of the pavement preservation economic shortfall. Some of the components of this strategy have resulted in long-term benefits, but most have short-term effects that only temporarily bridge the funding gap. Each strategy described here is designed to either accomplish transportation goals at a lower cost, or extend the pavement life for a given set of conditions.

Strategy: Converting asphalt surfaces to chip seal is often cost effective

WSDOT estimates that by 2016 it will have converted 2,270 lane-miles of roadway to chip seal, resulting in a cumulative six-year cost reduction of $100 million.

The average annual cost for a chip seal surfaced pavement during its life cycle is approximately one-third the cost of an asphalt surface. The average service life of chip seal pavement is about 45 percent the lifespan of asphalt (6.7 years for chip seal compared to 15 years for asphalt). Chip seal resurfacing is best performed when placed on asphalt in fair condition (two to four years earlier than asphalt pavement would normally become due for resurfacing). The typical traffic threshold is for roadways with less than 10,000 average daily vehicles, although some routes with higher traffic volumes have been successfully converted to chip seals.

While chip seal conversion is a high priority, it will be difficult for WSDOT to sustain an aggressive chip seal conversion policy with the projected future budget decline.

Resurfacing asphalt roadways with chip seal pavement saves WSDOT approximately $12,000 per year for every lane mile converted.

Practical Design strategies were used on State Route 20 in eastern Washington to focus repairs on the specific sections of pavement that required rehabilitation, rather than resurfacing the entire roadway.

Strategy: Implementing practical design addresses key problems

WSDOT's Transportation Secretary, Lynn Peterson gave direction in August 2014 to implement a practical design program. This is a cost-saving approach to make project decisions that focus on the specific problem the project is intended to address. This performance-based approach looks for lower cost solutions that produce the best return on investment in order to meet specific performance criteria. For pavement preservation, practical design focuses on treatments that address the deterioration in the pavement structure. In the 2013-2015 biennium, practical design (also known as minimal pavement design) accounted for project savings of $19.4 million.

Practical design concepts for asphalt pavements include such strategies as milling and overlaying roadways for only those lanes requiring rehabilitation, eliminating "curb to curb" fixes within city limits, providing "surgical" repairs to only a portion of a given section of pavement that requires rehabilitation, and considering lower cost solutions for ramps. Practical design solutions for chip seal roadways include resurfacing the travel lanes (deferring shoulders to future rehabilitation cycles), chip sealing through towns instead of placing asphalt where practical, providing repairs and focusing chip seal where it is most needed.

Practical design strategies for concrete roadways includes the use of "triage" practices for older concrete pavement that needs limited renewal to improve smoothness and replace selected cracked panels. Driving smoothness is restored by diamond grinding the pavement surface to smooth out any roughness. Triage has the advantage of delaying the eventual need for reconstruction. Many sections of WSDOT roadway, such as the Interstate 5

corridor through Seattle, have been restored this way since 2007. For more detailed information on concrete preservation strategies, see *Gray Notebook* 52, p. 11.

Strategy: Maintenance extends pavement life

Performing maintenance at the appropriate time is one strategy that WSDOT is aggressively implementing to be more cost-effective and extend pavement service life. In August 2014, WSDOT implemented a policy that no pavement rehabilitation should take place without first using maintenance efforts to extend pavement life. Performing maintenance extends pavement life, resulting in lower annual cost, and helps protect the integrity of the pavement structure.

Asphalt roadways in Washington average 15 years of service life per resurfacing cycle, with chip seal roadways averaging about 6.7 years. For every year WSDOT extends the pavement service life, the cost savings for asphalt and chip seal roads averages about 8 percent and 15 percent, respectively, of the resurfacing cost.

In 2009, WSDOT began a process in which funds from the pavement preservation budget were used for maintenance treatments. Based on the success of this effort, funds have increased for this purpose every biennium since, with $12 million planned for maintenance in the 2015-2017 biennium, almost twice the amount that was funded in the 2013-2015 biennium.

Strategy: Prioritizing projects allocates funds strategically

There is not enough funding to complete all the project needs for the pavement preservation program. Prioritization that is based on cost-effectiveness is used to determine which potential projects will be selected for completion. This prioritization process considers the following factors:

- **Risk of reconstruction:** Projects are evaluated according to the current condition of the pavement structure, and whether or not the section of road is at risk of requiring reconstruction. Pavement reconstruction is several times more than the cost of rehabilitation (work performed to extend the service life of an existing pavement).
- **Pavement management annual cost:** With all other factors being equal, projects with a lower cost per lane-mile per year will receive higher priority. Cost per lane-mile per year is the key performance measure for cost-effectiveness for WSDOT pavement management.
- **Traffic volume:** If a higher volume roadway experiences a pavement failure, more traffic is affected and the cost of emergency repair is typically more than it would be on a lower volume roadway. With all other factors being equal, projects with higher traffic volume are a higher priority.

Considering user costs helps WSDOT prioritize projects

The National Cooperative Highway Research Program Report 720 indicates that very rough roads will lead to average vehicle operating costs of 2 cents more per mile. Although this amount seems small, if multiplied by 200,000 vehicles per day (the typical traffic on the 15-mile stretch of Interstate 5 between SeaTac and downtown Seattle), this cost amounts to $21.9 million annually. The full report can be accessed at http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_rpt_720.pdf.

Road user costs are typically divided into two categories: vehicle operating costs and user delay costs. Vehicle operating costs include the additional cost (additional fuel consumption and “wear and tear” on the vehicle) to vehicle owners for driving on roads in poor condition. User delay cost refers to additional costs to the road user that are due to construction delays.

WSDOT’s investment strategies for pavement preservation are determined by considering the total costs and benefits of road use and managing the roadway efficiently and effectively for the agency and the users.

WSDOT utilizes sustainable practices for managing pavement

A sustainable transportation system is one that preserves the environment, is durable and takes into account the materials used and how it is built. The statement “Reduce, Reuse and Recycle” embodies the concepts of sustainable highways at WSDOT.

The first focus area, reducing, involves working to eliminate the need to replace what is already built. Building higher-quality, longer lasting roadways reduces the need to regularly replace those roadways. A long-standing philosophy at WSDOT is to design and build pavement structures strong enough that rehabilitation will be targeted at the surface layer, and that deeper repairs

Sustainability is key to WSDOT pavement management

Hot-in-place asphalt paving (shown above on State Route 542 near Deming) requires a long train of equipment to heat, loosen, remove, reconstitute and repave the asphalt in one pass.

will not be necessary. About 90 percent of WSDOT pavement preservation projects entail removing only a thin surface of distressed pavement and then replacing the worn out asphalt with new asphalt surfacing.

WSDOT also implements sustainable pavement practices by reusing and recycling materials. WSDOT uses four main methods to reuse and recycle asphalt:

- Recycling up to 40 percent of asphalt pavement results in a cost savings of $14 million to $18 million annually.
- Cold-in-place asphalt recycling reconditions roadway pavements by turning the existing asphalt layers into a stabilized base, which is then overlaid with a new asphalt surface.
- Asphalt shingle recycling allows the asphalt binder contained in the shingles (which make up about 30 percent asphalt) to be incorporated into a new asphalt mix. WSDOT's Standard Specifications were changed in 2014 to allow asphalt shingle recycling.

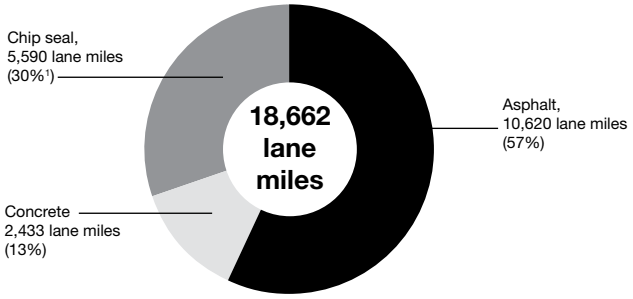
Like asphalt, concrete pavements offer many reuse applications. Crushed concrete from worn out concrete pavements is currently used for many concrete aggregate applications (such as pavement base material), and changes are being considered to allow crushed concrete aggregate in new concrete.

Contributors include Dave Luhr, Pat Morin, Matt Neeley, Tim Rydholm, Jeff Uhlmeyer and Alison Wallingford

WSDOT manages 18,662 lane miles of state-owned pavement

In 2013, WSDOT managed 18,662 lane miles of pavement, which is more than three roundtrips driving between Seattle and New York City. More than half (57 percent) of WSDOT-managed pavement is asphalt, 30 percent is chip seal and 13 percent is concrete. In terms of annual vehicle miles travelled (VMT), 67 percent of travel occurs on asphalt roads and 28 percent of annual VMT is on concrete roads. Even though chip seal roads comprise nearly one-third of Washington's state-owned roads, they only account for 5 percent of annual VMT.

More than half of WSDOT pavement is asphalt
Calendar year 2013; Lane miles of WSDOT pavements by type



Data source: WSDOT 2013 State Highway Log.
Notes: 1 If WSDOT converts all of the 1,410 lane miles programmed or identified for chip seal conversion in 2013 through 2016, chip seal will account for about 37 percent (6,900 lane miles) of WSDOT's pavement by the end of calendar year 2016.

WSDOT's *Pavement Notebook:* Detailed performance information

WSDOT's *Pavement Notebook* presents detailed performance reports of pavement, such as conditions by county and legislative district, average pavement life, international roughness statistics, and lane miles paved by year. Two new papers that will be presented at the International Conference on Managing Pavement Assets in May are also available: Visualizing Pavement Management Data at the Project Level and Economic Evaluation of Pavement Management Decisions. The *Pavement Notebook* can be accessed at: http://www.wsdot.wa.gov/Business/MaterialsLab/Pavements/PavementNotebook.htm.