NEVADA DOT

Nevada Department of Transportation

STATE HIGHWAY PRESERVATION REPORT

February 2013

State of Nevada

Department of Transportation

State Highway Preservation Report

Report to the 2013 Legislature
As Required by Nevada Revised Statute 408.203 (3)

February 2013
(Biennium 2011-2012)

Nevada Revised Statute 408.203(3)

The director of the Nevada Department of Transportation shall report to the Legislature by February 1 of odd-numbered years the progress being made in the Department's 12-year plan for the resurfacing of state highways. The report must include an accounting of revenues and expenditures in the preceding two fiscal years, a list of the projects which have been completed, including mileage and cost, and an estimate of the adequacy of projected revenues for timely completion of the plan.

State of Nevada

Department of Transportation

Mission

The Department provides a better transportation system for Nevada through unified and dedicated efforts.

Vision

The Department is the nation's leader in delivering transportation solutions, improving Nevada's quality of life.

Values

The efforts of Department employees to attain the Department goals will be governed by the following Department's Core Values:

Integrity – Doing the right thing
Honesty – Being truthful in our actions and our words
Respect – Treating others with dignity
Commitment – Putting the needs of the Department first
Accountability – Being responsible for our actions

Goals

The fulfillment of the Mission of the Department is to be attained within the guidelines of the Department's seven Strategic Plan Goals. They are:

To optimize safety
To be in touch with and responsive to our customers
To innovate
To be the employer of choice
To deliver timely and beneficial projects and programs
To effectively preserve and manage our assets
To efficiently operate the transportation system

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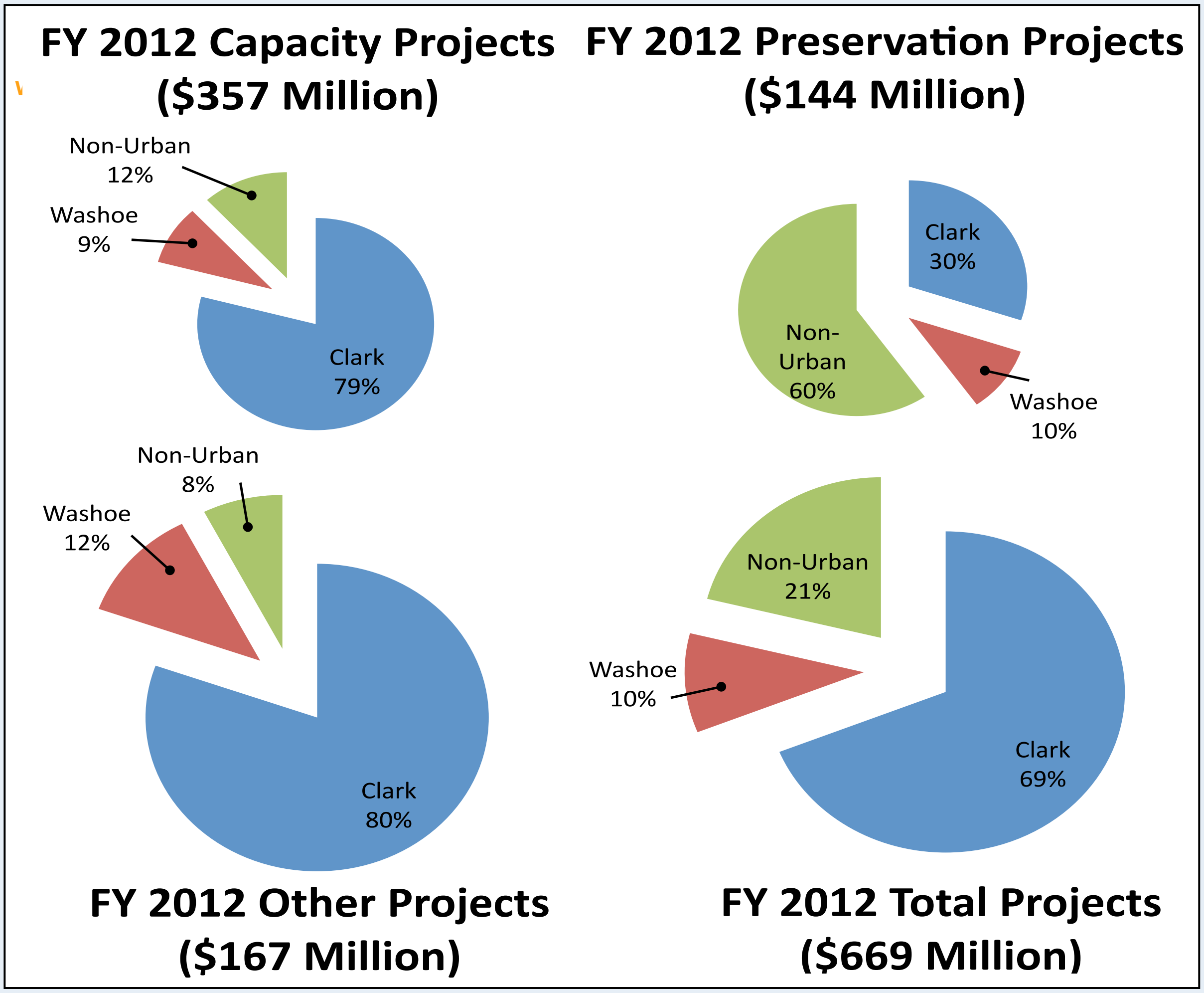
EXECUTIVE SUMMARY

The Nevada Department of Transportation (NDOT) publishes the *State Highway Preservation Report* biennially to summarize the recently performed work and anticipated workload required to preserve the state-maintained roadway network and bridge infrastructure assets. This report provides the Nevada Legislature with 2011-2012 information that can be used to determine whether future revenues are adequate to maintain and preserve the infrastructure assets at acceptable levels of service. NDOT is responsible for 5,389 miles of roadways according to the official record kept in the Highway Performance Monitoring System (HPMS). HPMS includes portions of locally-owned roadways which are maintained by other agencies, but are still part of NDOT's sphere of reporting responsibility. The pavement management database reflects 5,299 miles of state-maintained roadway network surveyed for condition (or over 98% of the roadway network) worth approximately $20 billion (replacement value) and 1,116 bridges worth approximately $2 billion (replacement value). Although the state-maintained roadway network consists of only 20% of the roads in Nevada, the network is overwhelmingly important as 54% of all automobile traffic and 80% of all heavy truck traffic travel on these roads.

Public perception of the job NDOT is doing to preserve the states roads and bridges is reflected in the 2012 Maintenance Customer Satisfaction Survey, done by the University of Nevada, Reno, where 71% of the survey respondents say that we are doing a good or excellent job in maintaining the roadway surface. While this is not a technical evaluation, it testifies to the fact that our roadways and bridges are substantially in good condition from the public's point of view while there is still plenty of room for improvement.

The shortage of highway preservation funding is not new or even unique to Nevada. Transportation infrastructure funding, including highway preservation funding, is in short supply nationwide. The only dedicated highway revenue source in Nevada is fuel tax; last increased in 1992. The Nevada Legislature has recognized the need to invest in transportation and passed legislation that generated additional highway revenue from sources such as property taxes and room taxes.



Preservation needs must compete with capacity, safety, mobility and other project types for limited funding to meet the needs of the state. The preservation needs we are unable to address with available funding are known as the backlog expressed in dollars representing the value of projects needed to achieve an acceptable level of service from our roadways and bridges. What does a backlog really mean? It means that the funding level will not allow us pay for all the rehabilitation projects necessary to bring the transportation infrastructure to a high condition level where it provides the users with an acceptable level service at a minimum annual maintenance cost. It does not mean that our roadways and bridges are falling apart. It does mean that when we address each deteriorated road or bridge, it will cost us more because we had to wait.

Historically, NDOT's 12-year plan for resurfacing of state highways included eliminating the backlog in that amount of time. The current preservation backlog is estimated to be $2.05 billion for pavement and bridges. Considering the current size of the backlog and the available funding, that may be an unrealistic goal. In order to eliminate the preservation backlog entirely in the next 12 years would require an additional $285 million annually. This report reflects the 12-year plan to eliminate the backlog which is useful for comparison to prior reports, but this methodology will be revisited when this report is updated for 2015.

MAP-21, the Moving Ahead for Progress in the 21st Century Act was signed into law on July 6, 2012. MAP-21 is the first long-term highway authorization enacted since 2005 and significantly changed funding requirements; detailed information on programmatic changes have only recently become available. The Department has not yet incorporated MAP-21 information to fully reflect the changes related to funding in this Preservation Report. The decision was made to update this report per the previous format, and implement necessary changes in the 2015 report.

Much of this document will be rewritten for the 2015 State Highway Preservation Report to reflect the impacts of MAP-21. The conditional and cost information in this report has been updated and accurately reflects known asset conditions at the time of publication.

To preserve the existing highway system, the State of Nevada will need to increase the highway preservation funding by $285 million annually for the next 12 years.

If preservation needs are not addressed:

- **The highways and bridges will deteriorate at a rate of $286 million annually.**
- **The user costs to Nevadans will increase annually in terms of vehicle maintenance and fuel costs.**

PAVEMENT MANAGEMENT

The primary objective of pavement management is to improve the condition of the entire roadway network while maximizing pavement performance and keeping costs to a minimum. NDOT accomplishes this objective with use of a pavement management system (PMS). The PMS supports the pavement management process by providing an inventory and condition of existing pavement assets as well as recommended repairs and repair costs. The known repair costs are used to forecast short and long-term funding requirements.

Nevada's pavements have ranked in the top 20 in the nation for the last several years. All states report to the Highway Performance Monitoring System (HPMS) administered by the Federal Highway Administration (FHWA) and thus provides us with the information needed to compare. Pavement roughness is measured by specialty equipment using a global standard called the International Roughness Index (IRI). Roughness is the distortion of the pavement surface that results in an uncomfortable ride. The public has expressed that smoothness of ride on the pavement is the best indicator of the roadway condition.

Of the 5,299 centerline miles of state-maintained roadway network surveyed in 2011, 979 miles or 18.5% of the pavement require preventive maintenance treatments; 2,288 miles or 43.2% of the pavement need corrective maintenance treatments; 799 miles or 15.1% of the pavement require an overlay repair strategy; and 1,233 miles or 23.2% of the pavement need a major rehabilitation repair strategy. The pavement in need of corrective maintenance will eventually deteriorate into a more expensive overlay or major rehabilitation category.

Preventive Maintenance Treatments – surface sealing with oil (asphalt), joint sealing on concrete pavements	$
Corrective Maintenance – chip seals, filling potholes, patching larger asphalt areas, saw/seal joints on concrete, minor concrete slab repairs	$$
Overlay – added 2 to 4 inches of pavement for strength purposes (asphalt only)	$$$
Major Rehabilitation – replacing the asphalt or concrete pavement and the gravel base material that supports it	$$$$

Why would roads that are new or in excellent condition need to be in the Preventive Maintenance Category? This category of roads is considered to be in excellent condition; however, routine minor treatments are recommended at this point to keep the roadway from beginning to deteriorate prematurely; much like a routine oil change on a brand new vehicle.

FIGURE 1 displays the current pavement condition of the state-maintained roadway network. The figure shows the total number of miles required to improve the roadways to acceptable levels of service for each repair category based on the functional classification inventory. An additional 9.6% of the pavement has deteriorated from preventive maintenance to overlay and major rehabilitation during this biennium. Last biennium, 28.7% of the pavement required an overlay or major rehabilitation as compared to 38.3% of the pavement that requires an overlay or major rehabilitation today.

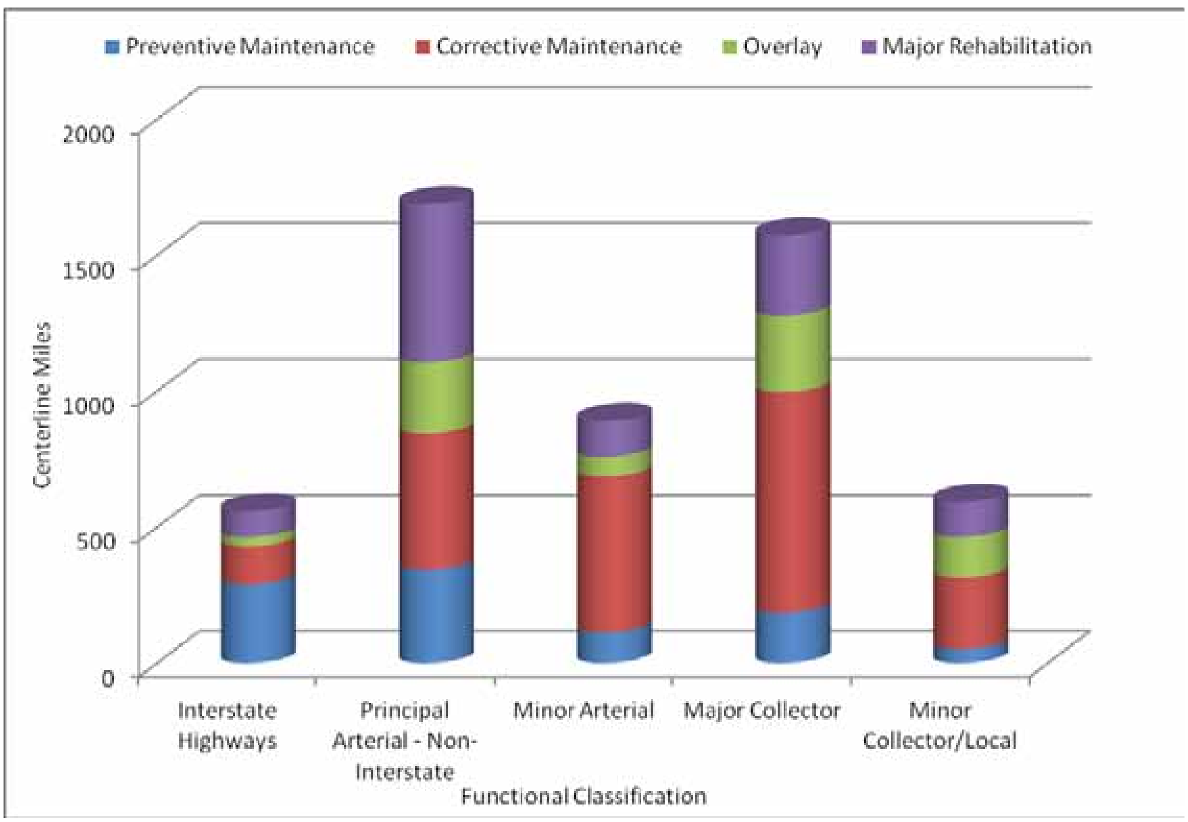


FIGURE 1: Pavement Condition on the State-maintained System by Functional Class inventory and Required Repair Strategy

BRIDGE MANAGEMENT

Bridges are managed making use of National Bridge Inventory (NBI) data, collected and maintained for every bridge in Nevada. This data provides an inventory of overall bridge condition and functionality. This bridge inventory, together with other factors such as bridge seismic and scour susceptibility, allow NDOT to identify preservation priorities and monitor the state's progress toward eliminating the backlog of bridge work.

Historically, NDOT inspected all the bridges in Nevada regardless of ownership, whether by federal, state, county, city or private entities, as long as the bridge was open to the public. NDOT no longer inspects federally-owned bridges, as each Federal agency takes care of their own. Of the 1,911 bridges evaluated in 2012, 1,428 bridges or 75% are considered to be in good condition; 358 bridges or 19% are considered to be in fair condition; and 23 bridges or 1% are considered to be in poor condition. 102 bridges or 5% of the bridges were inspected for safety but not rated. FIGURE 2 presents the current bridge condition of the state-surveyed bridge network for both state-maintained and locally-maintained bridges. Compared to the bridge condition in the last biennium, the number of 'Good' condition bridges has decreased by 98; the number of 'Fair' condition bridges has increased by 95; and the number of 'Poor' condition bridges has increased by 5.

Despite Nevada's (and the Nation's) funding challenges, the condition of our state's bridges ranks comparatively high. In a November 2012 Better Roads magazine article regarding the condition of our Nation's bridges, Nevada ranks 2nd overall, with 11% of all state and locally owned bridges classified as deficient (either Structurally Deficient or Functionally Obsolete). When considering only state-owned and interstate bridges, Nevada ranks ahead of 31 other states, with 15% of our bridges considered deficient. The statistics, based on data collected through October of 2012, indicate the overall national average for deficient bridges to be 22.5%, and the average of state and interstate bridges to be 20.1%.

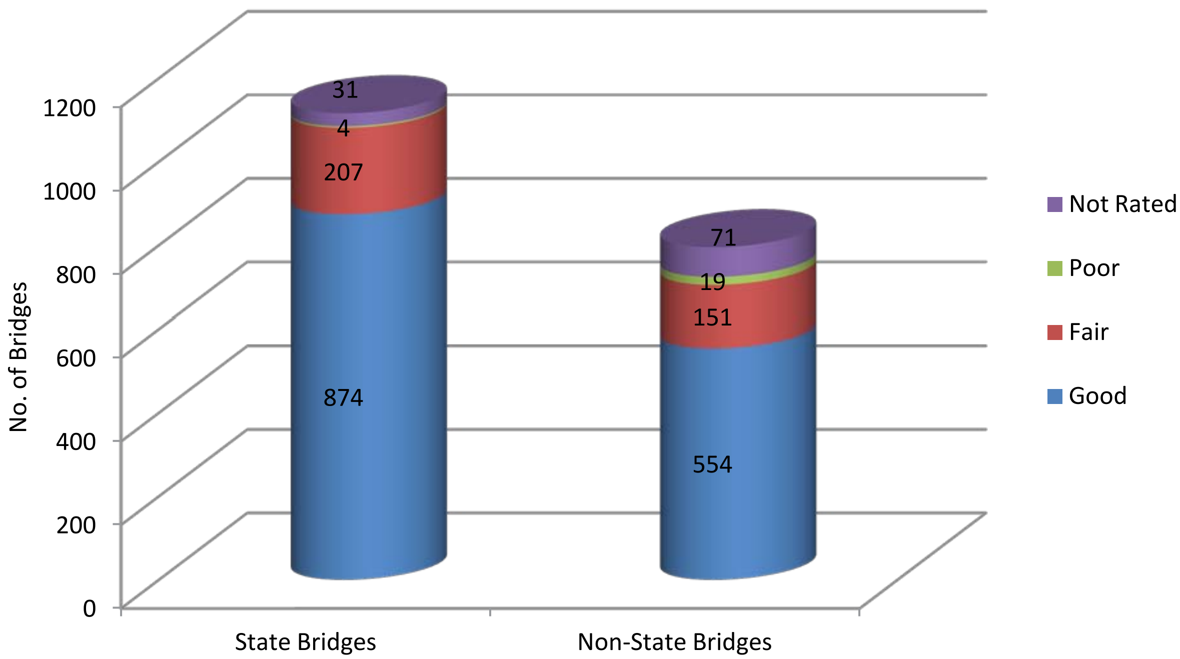


FIGURE 2: Condition of Nevada's Bridges

The majority of the state-maintained bridges were built in the 1960s through the 1980s. Since Nevada's bridges have a typical service life of 50 years, it can be estimated when the bridges will become due for major rehabilitation or replacement. FIGURE 3 illustrates that many bridges became due for major rehabilitation or replacement beginning in 2010.

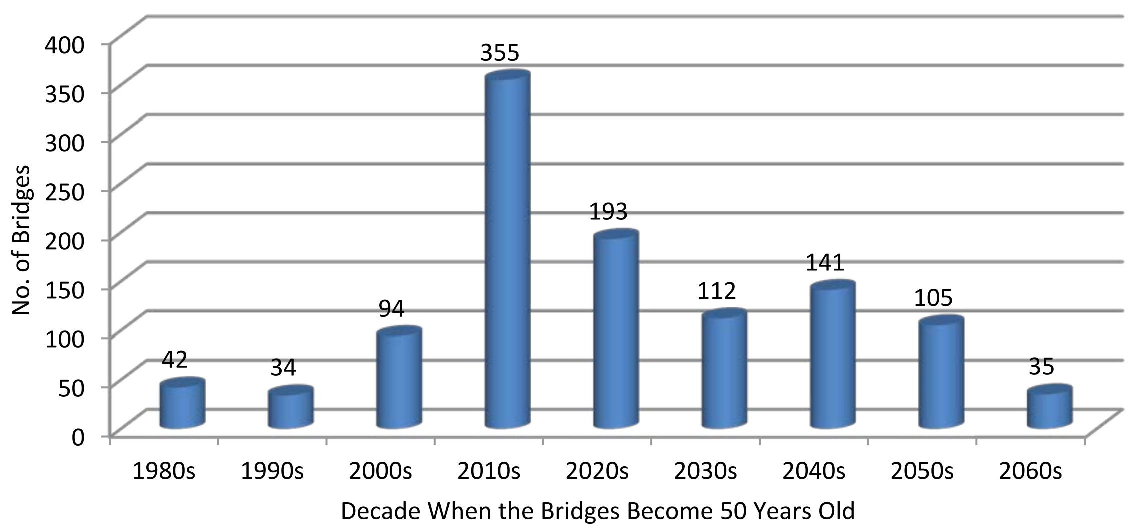


FIGURE 3: Number of 50 Year Old Bridges by Decade

PAVEMENT AND BRIDGE PRESERVATION WORK BACKLOG

TABLE 1 shows the estimated $2.05 billion backlog of pavement and bridge preservation work in fiscal year 2013. This backlog includes $1.92 billion for pavement work and $126 million for bridge work.

TABLE 1: Backlog of Pavement and Bridge Work - 2013

(State-Maintained System – Based on 2011 Condition Data)

System	Pavement	Bridges	Total
Interstate Highways	$233,888,390	$27,720,000	$261,608,390
Principal Arterial - Non-Interstate	$806,135,269	$16,300,000	$822,435,269
Minor Arterial	$221,991,640	$7,540,000	$229,531,640
Major Collector	$443,248,850	$9,220,000	$452,468,850
Minor Collector & Local	$214,391,935	$9,743,250	$224,135,185
Seismic Retrofit (System Not Identified)		$55,000,000	$55,000,000
Total	**$1,919,656,085**	**$125,523,250**	**$2,045,179,335**

During the last two years, the backlog increased by $689 million from $1.36 billion documented in the last biennium. The increasing backlog is primarily due to highway-construction inflation not being matched by revenue increases from fuel taxes and vehicle registration fees over the years. Moreover, preservation work competes with congestion relief, safety, and other enhancement projects.

If the cost of construction continues to outpace highway funding levels, the backlog is expected to increase to a total of $3.4 billion in 2025. If the funding is increased by $285 million per year (average over the next 12 years), the backlog can be eliminated by 2025. FIGURE 4 illustrates the comparison between the increase in the total backlog for pavement and bridge preservation that will occur during the next 12 years if the present funding level remains the same and the decrease in backlog if the funding level was increased.

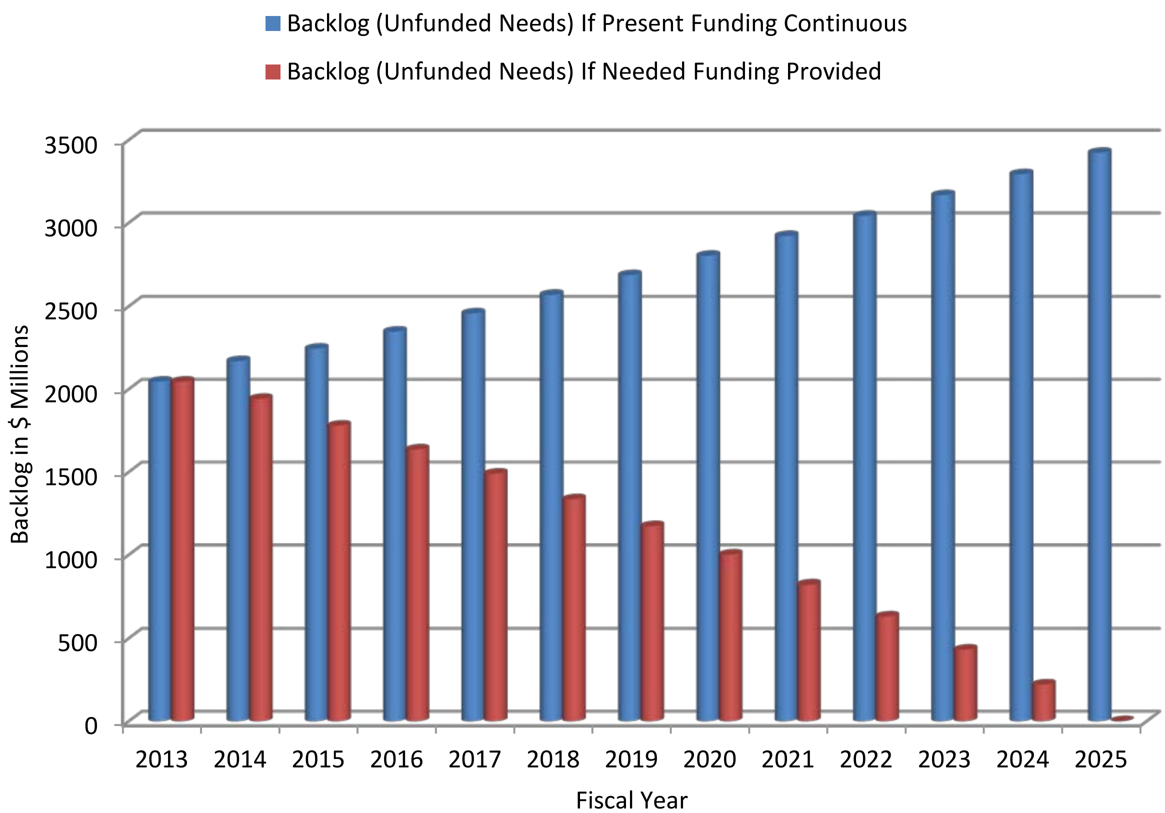


FIGURE 4: Backlog of Pavement and Bridge Preservation Work with Present Funding Level versus Needed Funding Level

TABLE 2 detailed backlog in numerical format for fiscal years 2013 through 2025.

NDOT will investigate whether eliminating the backlog in 12 years should be changed based on factors such as newer premium materials for pavements and bridges which give us extended service life. Over the past two decades, NDOT has used pavement age to prioritize paving and estimate budget needs. However, age only provides a rough measure of pavement condition and does not take into account the variability in pavement performance that comes with construction, climate, maintenance, loading, and other factors.

TABLE 2: Pavement and Bridge Backlog, Costs, and Funding

State-Maintained System - 2013 - 2025(in millions of dollars)

With Present Funding

		Pavement & Bridge Preservation Costs * (Normal Annual Deterioration Costs)			Pavement & Bridge Preservation Funds ** (Funds Planned for Preservation Work)				
Fiscal Year	**Backlog of Pavement & Bridge Work**	Pavement Total	Bridge Total	Pavement & Bridge Total	State Funding	Federal Funding	State Maintenance		Total
2013	**$2,045.2**	$235.3	$13.5	$248.7	$51.1	$59.8	$13.9		$124.8
2014	**$2,169.1**	$222.5	$14.2	$236.8	$61.6	$85.8	$14.3		$161.7
2015	**$2,244.1**	$241.2	$15.0	$256.2	$57.2	$81.4	$14.8		$153.4
2016	**$2,347.0**	$247.2	$15.8	$263.0	$58.8	$79.0	$15.2		$153.1
2017	**$2,457.0**	$254.6	$16.7	$271.3	$61.1	$82.2	$15.7		$159.0
2018	**$2,569.3**	$262.3	$17.6	$279.9	$63.6	$85.5	$16.1		$165.2
2019	**$2,683.9**	$270.1	$18.5	$288.7	$66.1	$88.9	$16.6		$171.7
2020	**$2,800.9**	$278.2	$19.5	$297.8	$68.8	$92.5	$17.1		$178.4
2021	**$2,920.3**	$286.6	$20.6	$307.2	$71.5	$96.2	$17.6		$185.3
2022	**$3,042.1**	$295.2	$21.7	$316.8	$74.4	$100.0	$18.2		$192.6
2023	**$3,166.4**	$304.0	$22.8	$326.8	$77.4	$104.0	$18.7		$200.1
2024	**$3,293.2**	$313.2	$24.0	$337.2	$80.5	$108.2	$19.3		$207.9
2025	**$3,422.4**								

With Needed Additional Funding

		Pavement & Bridge Preservation Costs * (Normal Annual Deterioration Costs)			Pavement & Bridge Preservation Funds ** (Funds Planned & Needed for Preservation Work)				
					Existing				
Fiscal Year	**Backlog of Pavement & Bridge Work**	Pavement Total	Bridge Total	Pavement & Bridge Total	State Funding	Federal Funding	State Maintenance	**Needed Additional Funds**	Total
2013	**$2,045.2**	$235.3	$13.5	$248.7	$51.1	$59.8	$13.9	**$227.8**	$352.6
2014	**$1,941.3**	$222.5	$14.2	$236.8	$61.6	$85.8	$14.3	**$236.9**	$398.6
2015	**$1,779.5**	$241.2	$15.0	$256.2	$57.2	$81.4	$14.8	**$246.4**	$399.7
2016	**$1,636.0**	$247.2	$15.8	$263.0	$58.8	$79.0	$15.2	**$256.2**	$409.3
2017	**$1,489.8**	$254.6	$16.7	$271.3	$61.1	$82.2	$15.7	**$266.5**	$425.5
2018	**$1,335.6**	$262.3	$17.6	$279.9	$63.6	$85.5	$16.1	**$277.1**	$442.3
2019	**$1,173.1**	$270.1	$18.5	$288.7	$66.1	$88.9	$16.6	**$288.2**	$459.9
2020	**$1,001.9**	$278.2	$19.5	$297.8	$68.8	$92.5	$17.1	**$299.7**	$478.1
2021	**$821.6**	$286.6	$20.6	$307.2	$71.5	$96.2	$17.6	**$311.7**	$497.1
2022	**$631.7**	$295.2	$21.7	$316.8	$74.4	$100.0	$18.2	**$324.2**	$516.8
2023	**$431.8**	$304.0	$22.8	$326.8	$77.4	$104.0	$18.7	**$337.2**	$537.2
2024	**$221.4**	$313.2	$24.0	$337.2	$80.5	$108.2	$19.3	**$350.6**	$558.6
2025	**$0.0**								

* Inflation assumed at 3.00% per annum.

** Revenue growth rate assumed is 4.00% per annum.

Note: Backlog of pavement and bridge work is as of beginning of fiscal year; preservation costs are those incurred during the fiscal year; and preservation funds are those that are available during the fiscal year.

SUMMARY

Highway construction costs depend on energy prices and the recent spikes in energy prices have significantly increased pavement preservation costs. The last time Nevada increased its gasoline tax was in 1992. Due to construction inflation, the State Highway Fund gasoline tax of 17.65 cents per gallon in 1992 has the highway construction purchasing power of only 7.13 cents today. The price trend for construction costs rose approximately 150% from 1992 through 2012. Additionally, Nevada’s population has more than doubled in the last two decades and congestion in urban areas has increased significantly. Therefore, the backlog continues to rise as the present investment in pavement and bridge preservation has not commensurately increased with inflation and price trends.

A safe, efficient, and reliable roadway network is a matter of importance and promotes the general welfare of all the people of the State of Nevada. Adequate preservation funding is necessary because deteriorated roads can impede the general economic and social progress of the State. Investment in infrastructure is one means to boost market economy, advance travel and trade, and provide a legacy from which future generations can prosper.

Federal Highway Administration estimates that each dollar spent on road and bridge improvement results in an average benefit of $5.20 in the form of reduced vehicle maintenance costs, reduced delays, reduced fuel consumption, improved safety, reduced road and bridge maintenance costs and reduced emissions as a result of improved traffic flow.

A Federal Highway Administration study, “Employment Impacts of Highway Infrastructure” which is updated periodically, concludes that every $1 billion invested in highway construction would support approximately 28,000 jobs, including approximately 9,500 in the construction sector, 4,300 jobs in industries supporting the construction sector and 14,000 other jobs induced in non-construction related sectors of the economy.

INTRODUCTION

This report summarizes the Nevada Department of Transportation's (NDOT) efforts to preserve the 5,299 centerline miles of state-maintained roadway network. This network consists of only 20% of the roads in Nevada. However, the network is overwhelmingly important as 54% of all traffic and 80% of all heavy trucks travel on these roads. Preserving the roadway network is one of NDOT's highest priorities. Numerous resources are employed to improve pavement condition by using cost-effective maintenance and rehabilitation strategies that maximize pavement performance.

NDOT is responsible to plan, design, construct, maintain, monitor, and protect the roadway network in Nevada. The estimated cost to replace the existing pavement network that includes asphalt/concrete surface, base and sub-base is $20 billion. The pavement assets are managed using a pavement management system (PMS). The PMS supports the pavement management process by providing an objective and systematic methodology for establishing cost-effective maintenance and rehabilitation priorities and scheduling. The PMS provides an inventory of existing pavement assets and condition as well as needed repairs and repair costs. Known repair costs are used to forecast short and long-term funding requirements.

THE PAVEMENT MANAGEMENT SYSTEM (PMS)

(How do we care for the State pavements?)

The primary objective of pavement management is to improve the condition of the entire roadway network while maximizing pavement performance and keeping costs to a minimum level. The PMS is a tool that assists the engineers with this objective. This tool provides an objective and systematic method for collecting, storing, and evaluating relevant pavement condition data. The performance of preservation strategies and the associated life-cycle costs can be easily forecasted. The PMS improves the efficiency of decision making, provides assessment on the consequences of decisions through comparative analysis, and ensures consistency of network and project level activities and decisions.

Network Inventory

(What do we maintain?)

The state-maintained roadway network contains roads that are functionally classified based on federal standards. Functional classification is a process whereby roads are grouped into classes according to the character of the traffic such as local or long distance mobility and the degree of land access. State-maintained roadways are grouped into the following functional class inventory: Interstate Highways, Principal Arterial-Non-interstate, Minor Arterial, Major Collector, and Minor Collector. FIGURE 5 presents the state-maintained roadway network inventory that is identified based on functional class.

The functional class inventory was separated into pavement groups according to the age of pavement to determine the amount of miles that are within or beyond the expected pavement service life for each type of functional class. FIGURE 6 displays the age distribution for each roadway segment based on functional class for the year 2011. FIGURE 7 presents the age distribution for the year 2010 for comparison purposes. A comparison of FIGURE 6 and FIGURE 7 reveals that the number of miles in all classes of roads that are 20 to 30 years and more than 30 years old have increased significantly.

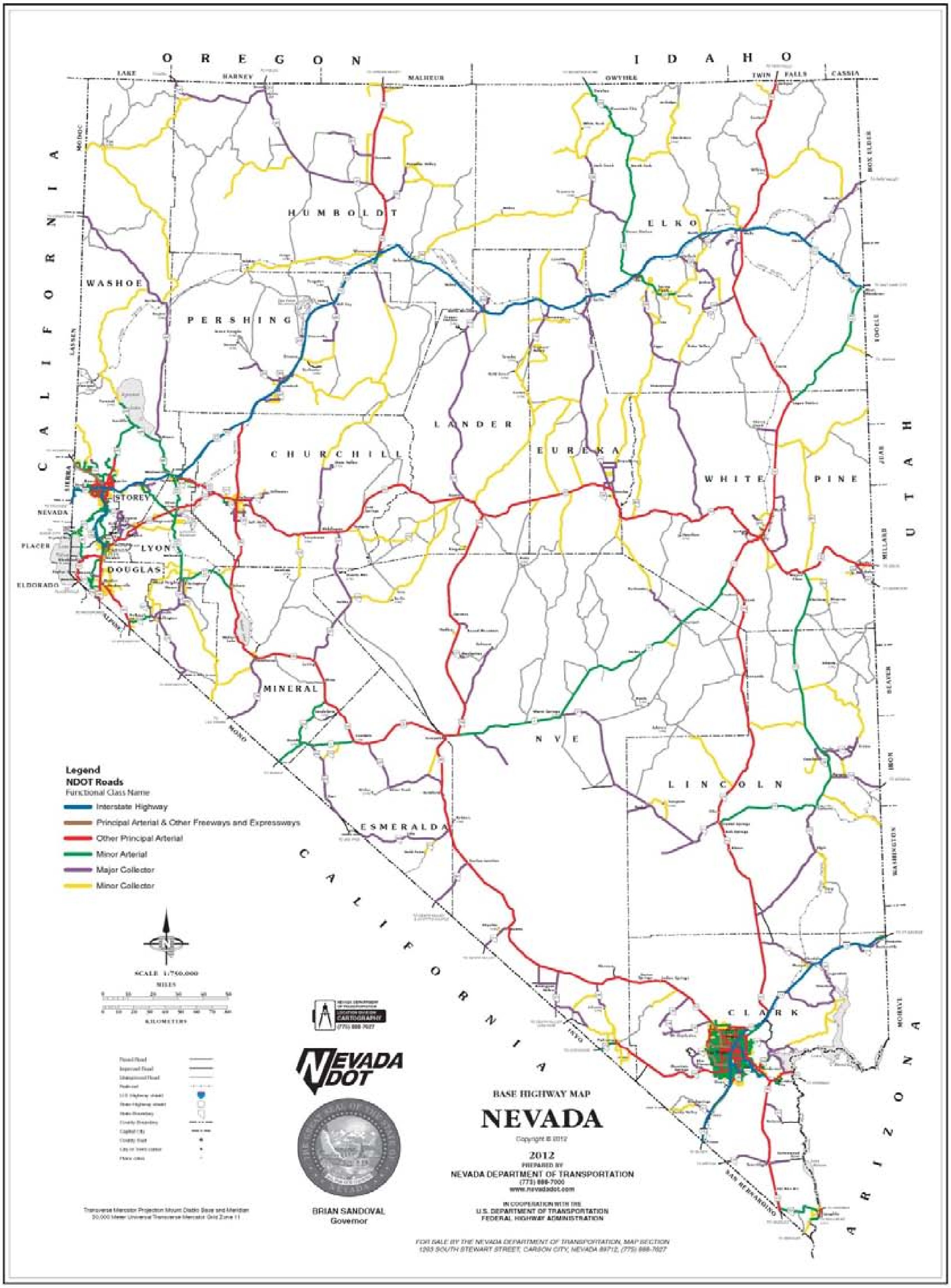


FIGURE 5: Network Inventory Identified by Functional Class

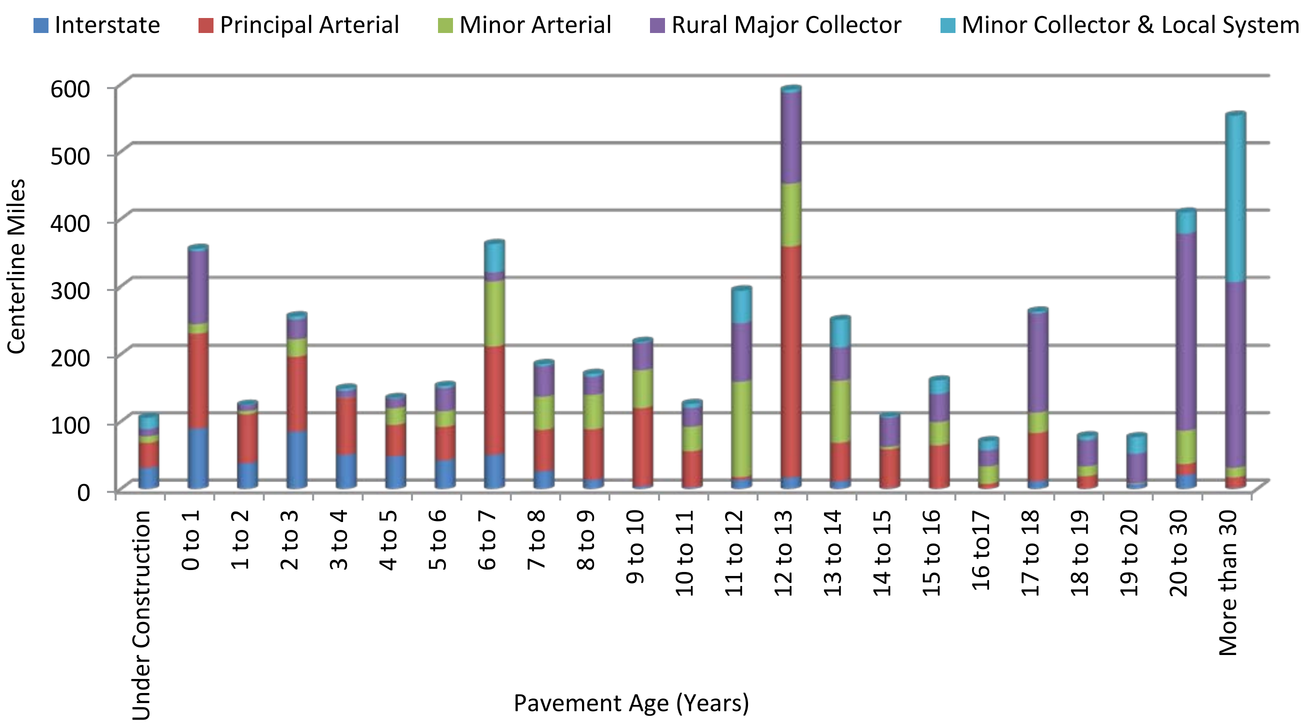


FIGURE 6: Pavement Age Distributions by Functional Class (As of November 2011)

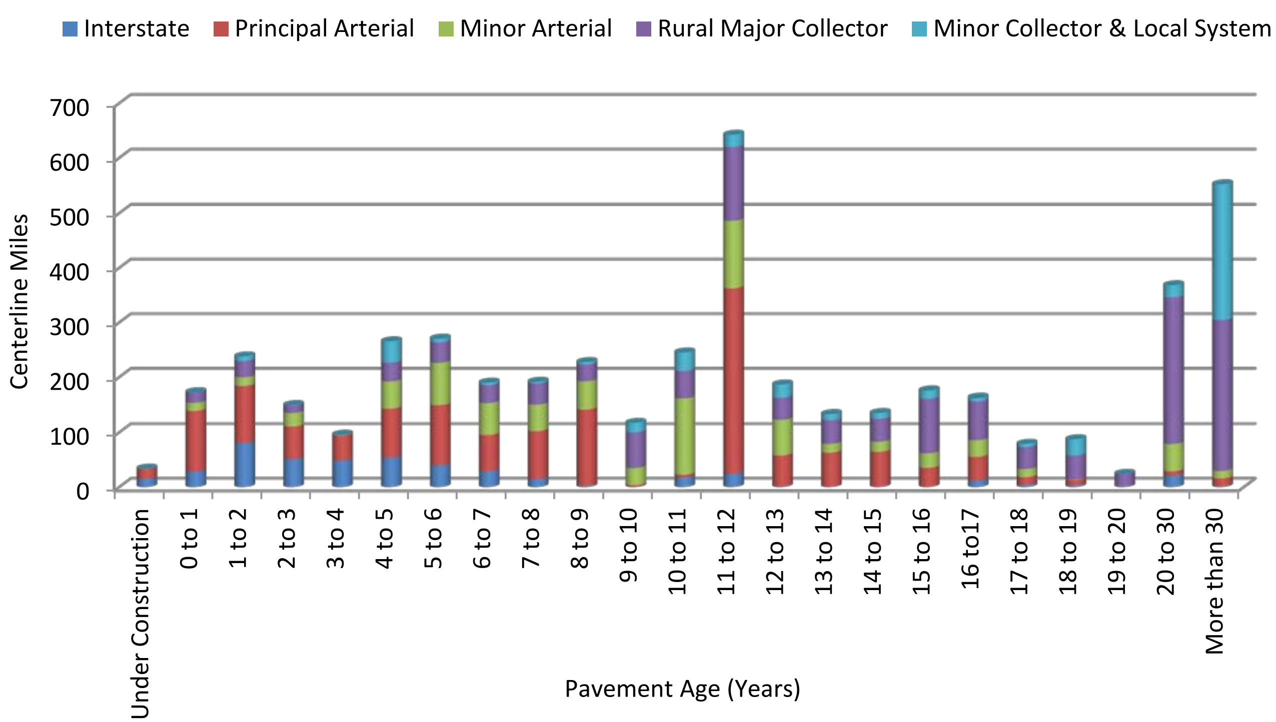


FIGURE 7: Pavement Age Distributions by Functional Class (As of June 2010)

The maintenance and rehabilitation for many of the Principal Arterial, Minor Arterial, and Rural Major Collector roads that are at least 10 to 20 years old will need to be deferred due to budget constraints. This pavement aging trend will continue until additional funding is made available for pavement preservation efforts.

Network Condition

(How do we assess the health of our pavement?)

The condition or "health" of the roadway network is determined by pavement roughness and distress data. Pavement roughness is measured by specialty equipment using a global standard called the International Roughness Index (IRI). Roughness is the distortion of the pavement surface that results in an uncomfortable ride. Distresses include various types of cracking, surface deformation such as rutting, and surface defects such as flushing or raveling. The type, extent, and severity of the distress data in combination with IRI measurements determine the current condition or "health" of the network.

New pavement exhibits excellent characteristics such as very smooth ride and no surface defects. As the pavement deteriorates and the ride becomes rough, it is necessary to spend an increasing amount of funds to maintain and rehabilitate the pavement to an acceptable level of service. The type, extent, and severity of the pavement distresses and roughness warrants what type of repair strategies are required to maintain or rehabilitate roads to acceptable levels of service. NDOT has divided its pavement preservation options into four main types of repair categories based on the pavement condition. These repair categories assist with the planning, budgeting, and scheduling of activities necessary for the preservation of the roadway network. Repair categories include:

- **Preventive Maintenance Surface Treatments:** Preventive maintenance surface treatments are applied early in the pavement service life when the ride quality is still good and there are few surface distresses. Preventive treatments are usually applied when an asphalt pavement is 3 to 4 years old and concrete pavement is less than 10 years old. Preventive treatments are applications or repairs that protect the road surface but do not improve the ride quality. Examples include fog or flush seals for asphalt pavement and the resealing of joints for concrete pavement.

- **Corrective Maintenance:** Corrective maintenance repairs are performed when preventive treatments are no longer effective and pavement surface distresses are apparent. Corrective maintenance is typically conducted when an asphalt pavement is 5 to 19 years old and a concrete pavement is 11 to 17 years old. Corrective maintenance consists of applications or repairs that protect the road surface without improving the load-bearing capacity. Examples include chip or slurry seals, filling potholes, and patching for asphalt pavement and the saw/seal of joints, spall repair, and slab jacking for concrete pavement.

- **Overlay:** Overlays are used on asphalt pavement when the pavement is in fair condition to prevent the pavement from deteriorating to a point when more expensive major rehabilitation or reconstruction strategies are required. Overlays are placed when asphalt pavement is 8 to 20 years old. Overlays are required for both functional and structural purposes. Examples include proactive overlays of 2 to 3 inches for functional purposes such as smoothness requirements and thick overlays of 4 inches or greater for structural purposes such as pavement stability.

- **Major Rehabilitation:** Major rehabilitation or reconstruction occurs when a pavement is in such condition that overlays are no longer effective and the pavement is in poor to failed condition. Examples include roadbed modification or full-depth replacement of the pavement structural section for asphalt pavement and rubblization for concrete pavement.

Pavements in the preventive and corrective maintenance repair categories have less roughness and distress and are in much better condition than pavements in the overlay and major rehabilitation repair categories. The costs for the overlay and major rehabilitation work required to upgrade roads to acceptable levels of service are far greater than the costs for preventive and corrective maintenance work.

Network Condition Based on Age

(What is the condition of our pavement?)

Pavement roughness and distress data are good indicators of the condition or “health” of the roadway network. Recommended repair categories are based on the condition of the pavement. In addition to these indicators, pavements can be assigned to a repair category based on age and functional class since pavements with similar characteristics usually deteriorate at similar rates. Therefore, the age and functional class of a pavement is also a good indicator of the type of preservation or rehabilitation work that the pavement currently requires. TABLE 3 summarizes network condition based on age and functional class. The table lists the number of miles that are required to improve the roadways to acceptable levels of service for each repair category. Approximately 43% of the pavements require corrective maintenance applications or repairs. These pavements will eventually deteriorate into conditions that require overlay repair strategies. FIGURE 8 and FIGURE 9 illustrate the same information in graphical format. The figures identify the amount of repair work required to preserve or improve the network to acceptable levels of service based on functional classes and repair categories. Low-volume road mileage is included in the table and figures. However, low volume pavement conditions are based on roughness and distress data and are not based on age.

TABLE 3: Pavement Condition on the State Maintained System - 2013

By Repair Strategy Required (Based on 2011 Pavement Age and 2011 Condition Data)

Centerline Miles

Repair categories	Preventive Maintenance		Corrective Maintenance		Overlay		Major Rehabilitation		Total	
System Description	**Miles**	**%**	**Miles**	**%**	**Miles**	**%**	**Miles**	**%**	**Miles**	**%**
Interstate Highway	290	5.5%	138	2.6%	35	0.7%	95	1.7%	558	10.5%
Principal Arterial-Non Interstate	342	6.4%	503	9.5%	261	4.9%	582	11.0%	1687	31.8%
Minor Arterial	113	2.1%	572	10.8%	72	1.4%	132	2.5%	890	16.8%
Major Collector	184	3.5%	812	15.3%	282	5.3%	294	5.6%	1572	29.7%
Minor Collector and Local	50	1.0%	264	5.0%	149	2.8%	129	2.4%	593	11.1%
Total	979	18.5%	2288	43.2%	799	15.1%	1233	23.2%	5299	100.0%

Lane Miles

Repair categories	Preventive Maintenance		Corrective Maintenance		Overlay		Major Rehabilitation		Total	
System Description	**Miles**	**%**	**Miles**	**%**	**Miles**	**%**	**Miles**	**%**	**Miles**	**%**
Interstate Highway	1246	9.5%	591	4.8%	142	2.6%	394	3.0%	2372	18.1%
Principal Arterial-Non Interstate	939	7.1%	1385	12.2%	550	3.5%	1325	10.0%	4199	32.0%
Minor Arterial	277	2.1%	1370	9.6%	168	1.0%	356	2.7%	2172	16.6%
Major Collector	368	2.7%	1628	13.3%	569	2.4%	589	4.5%	3154	24.1%
Minor Collector and Local	105	0.8%	533	4.4%	300	1.5%	272	2.1%	1210	9.2%
Total	2935	22.3%	5508	44.3%	1729	11.1%	2935	22.3%	13106	100.0%

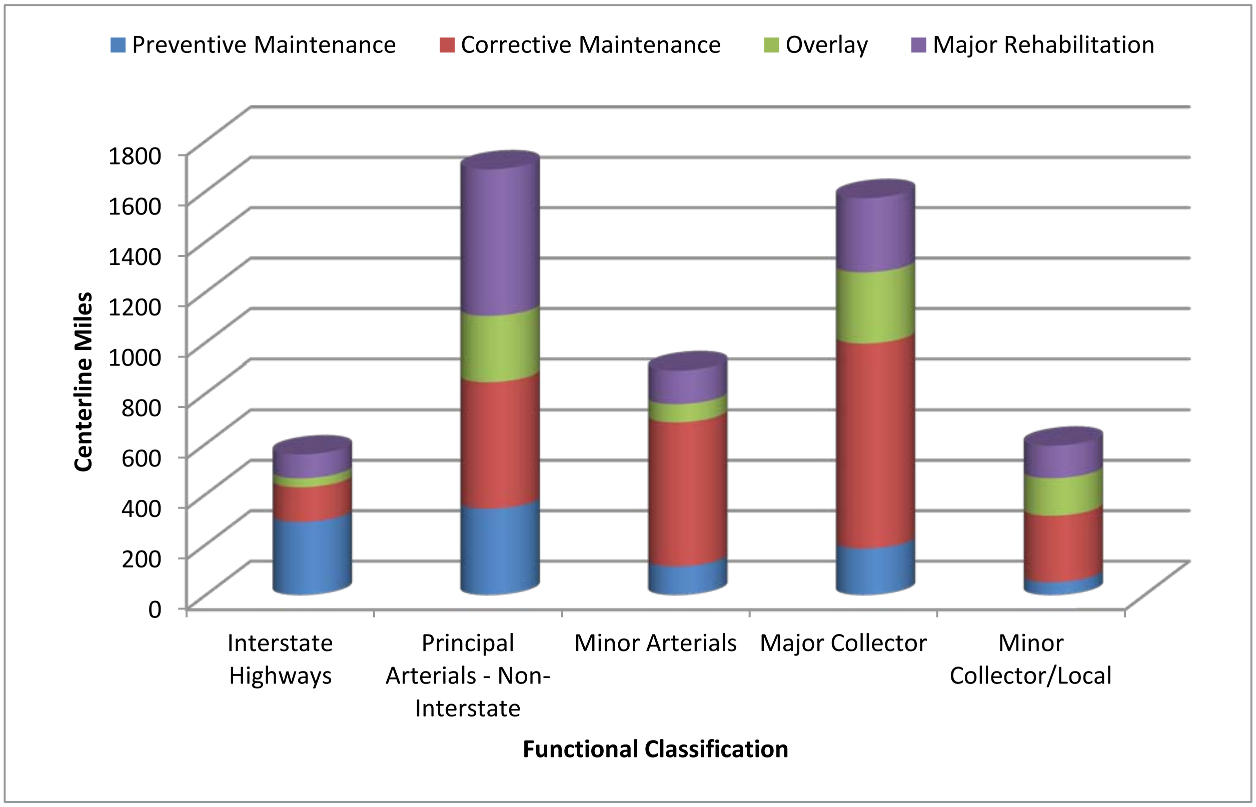


FIGURE 8: Network Condition Based on Age by Functional Classification

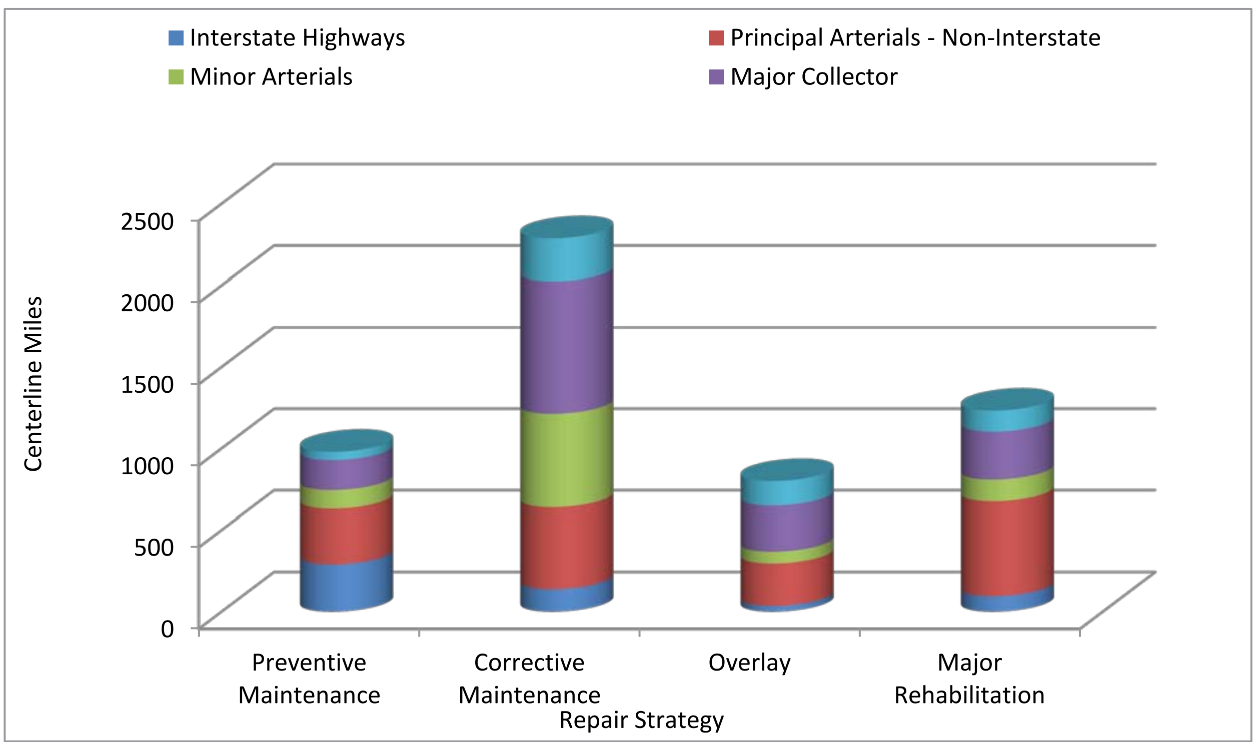


FIGURE 9: Network Condition Based on Age by Repair Category

Network Condition History

(How has our pavement condition changed?)

FIGURE 10 demonstrates the change in condition of the state-maintained roadway network based on repair categories since 1987. A significant rehabilitation program in 1999 and 2000, along with a proactive action plan that has been used since 1999, caused most pavements to remain in the preventive and corrective repair categories. However, the network is aging and will soon require overlay or major rehabilitation repair strategies. The amount of pavement that requires an overlay has been fairly consistent since 2003, but increases in 2011 and 2013 can be seen in FIGURE 10. Unfortunately, the amount of pavement that requires major rehabilitation has been increasing since 2005.

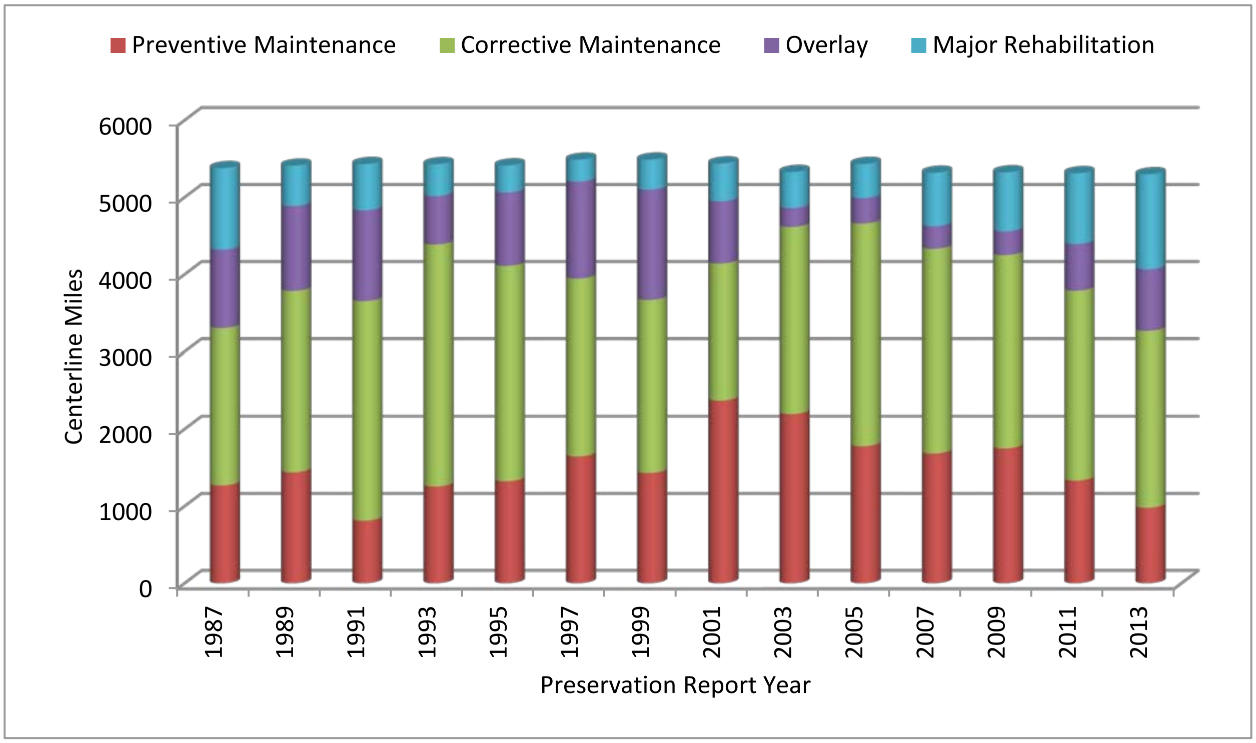


FIGURE 10: Pavement Condition over Time – 1987 to 2013

THE COST OF ROUGH ROADS

(What cost is imposed on roadway users due to poorly maintained pavements?)

Highway user costs rise when roads deteriorate and become rough. Rough roads cause increased vehicle operating costs. These additional operating costs include accelerated vehicle depreciation, additional vehicle repair, increased fuel consumption and increased tire wear.

Another consequence of rough roadways is uncomfortable ride. A recently published TRIP report indicates that Nevada motorists pay an additional $391 million annually because of rough roads. (From the report “Key Facts About Nevada’s Surface Transportation System and Federal Funding” published in April 2012.)

Furthermore, Nevada is a bridge state in freight movement. Because of this reason, Nevada’s highways get enormous amount of truck traffic. Poor road conditions will impact the economies of the trucking industry and will have an impact in the final cost of the commodity being transported. Also significant part of Nevada’s economy depends on the visitors to the state. Unfavorable road conditions will repel the visitors and divert them to other states for their recreational needs.

Federal Highway Administration estimates that each dollar spent on road and bridge improvement results in an average benefit of $5.20 in the form of reduced vehicle maintenance costs, reduced delays, reduced fuel consumption, improved safety, reduced road and bridge maintenance costs and reduced emissions as a result of improved traffic flow.

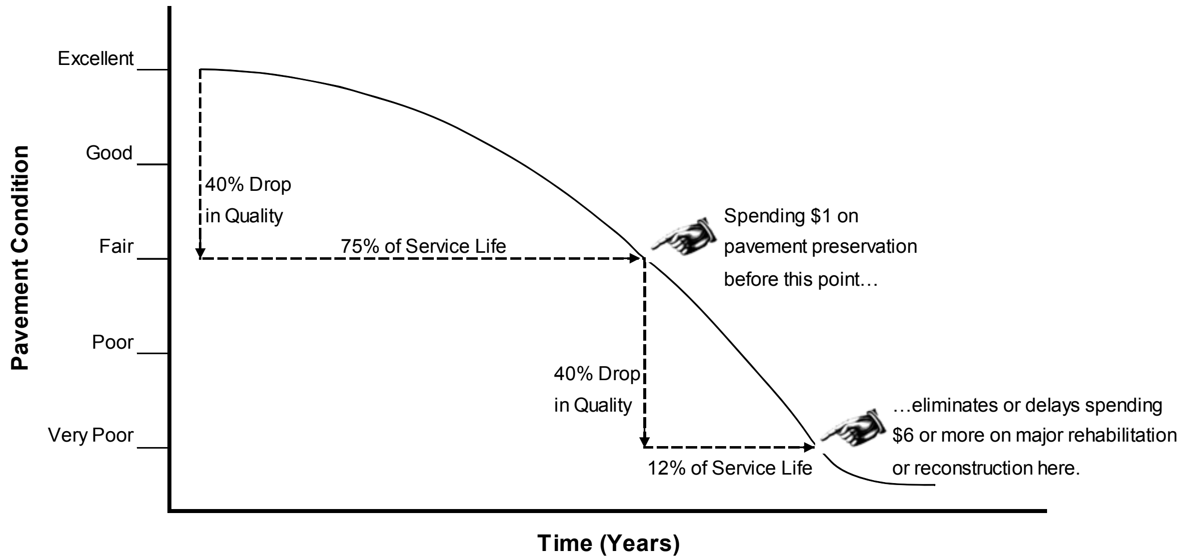
A Federal Highway Administration study concludes that every $1 billion invested in highway construction would support approximately 28,000 jobs, including approximately 9,500 in the construction sector, 4,300 jobs in industries supporting the construction sector and 14,000 other jobs induced in non-construction related sectors of the economy. (TRIP report, as above)

PRESERVATION METHODS

(What are the preservation actions? How do we select the appropriate action?)

Roads in very rough or poor condition are past the point in time when less expensive preventive and corrective maintenance or thin overlays are effective to preserve and maintain the roads in good condition. When roads are allowed to deteriorate into poor condition, more invasive and expensive major rehabilitation or reconstruction practices are required. NDOT adopted proactive pavement management practices many years ago and works hard to prevent roads from deteriorating to a point where major rehabilitation or reconstruction is required. This philosophy lowers pavement life-cycle costs and better serves the traveling public.

As shown in Figure 11, it can cost six times or more to reconstruct a road in very poor condition rather than maintaining the road in good condition by applying timely maintenance and thin overlay rehabilitation treatments.



Source: National Center for Pavement Preservation

FIGURE 11: Typical Pavement Deterioration Curve

The expected service life for asphalt pavement is a function of many parameters. The parameters having the most consequence are the road roughness and amount of truck loadings that the pavement is expected to experience. NDOT has grouped the pavement network into five major road categories. The pavement in each category share similar characteristics, deterioration patterns, truck loadings, and predicted distress rates. These network level divisions allow pavement managers to anticipate the average optimal timings for each type of preservation repair category that NDOT employs. These major road categories should not be confused with the functional classification inventory as each grouping type serves a separate and distinct purpose for pavement management purposes.

TABLE 4 presents the typical windows of opportunity for applying preventive, corrective, and proactive thin overlay repair strategies to preserve roads in fair to good condition as opposed to the timing when major rehabilitation or reconstruction is required and project costs soar. For example, an Interstate highway will need a proactive thin overlay at an average of every eight years to maintain the pavement in good condition whereas a low-volume road will need a proactive thin overlay at an average of every twenty years to maintain the pavement in good condition. Proactive thin overlays cost far less than allowing the pavement to deteriorate into a very poor condition when major rehabilitation or reconstruction is the only repair option. Cost comparisons between timely placed proactive overlays and a complete reconstruction are based on long-term life cycle costs that include initial construction and all rehabilitation and maintenance treatments required to extend the pavement service life through the analysis period.

TABLE 4: Optimal Timing for Pavement Repair Strategies on Major Road Categories

Controlled-access highways, National Highway System routes, and non-controlled-access highways

		Repair Strategy (based on pavement age in years)			
Roadway Categories	**Pavement Type**	**Preventive Maintenance**	**Corrective Maintenance**	**Overlay**	**Major Rehabilitation**
Interstates, Freeways, and All Other Controlled-Access Highways	AC	Age ≤ 4 yrs.	4 < Age < 8 yrs.	Age = 8 yrs.	Age > 8 yrs.
	PCC	Age ≤ 10	10 < Age < 18	N/A	Age > 18
Non-Controlled-Access Highways with: ADT>10,000 or ESAL>540	AC	Age ≤ 4	4 < Age < 10	Age = 10	Age > 10
Non-Controlled-Access Highways with: 1,600<ADT≤10,000 or 405<ESAL≤540 And National Highway System routes with ADT≤10,000	AC	Age ≤ 4	4 < Age < 12	Age = 12	Age > 12
Non-Controlled-Access Highways off the National Highway System with: 400<ADT≤1,600 or 270<ESAL≤405	AC	Age ≤ 4	4 < Age < 15	Age = 15	Age > 15
Non-Controlled-Access Highways off the National Highway System with: ADT≤400	AC	Age ≤ 4	4 < Age < 20	Age = 20	Age > 20

Notes: ADT = Average Daily Traffic (in vehicles per day)

ESAL = Equivalent 18,000-pound Single-Axle Loads imparted daily. It takes 2,500 cars to impart a single ESAL but just one fully-loading two-axle delivery truck.

AC - Asphalt Concrete, PCC – Portland Cement Concrete

Cost Savings for a Proactive Project-level Case Study

(Real example based on two NDOT construction Projects)

Significant savings can be realized using the proactive strategy of maintaining roads in fair to good condition and not allowing the roads to deteriorate to very poor condition when a major rehabilitation or reconstruction repair option is required. One example of proactive pavement management is a project-level case study of a 12-mile section of I-80 between the California-Nevada state line and Reno. The road had a severely deteriorated pavement condition when it was rehabilitated in 1994. Prior to the 1994 reconstruction, the road was rehabilitated in 1982. The rehabilitation strategy in 1994 was to cold mill 4-in. and place a 5-in. asphalt overlay. The cost for the work was $9.6 million. In 2002, the same length of road was prioritized based on the financial consequences of a proactive thin asphalt overlay. The cost of the 2002 construction work was $6.2 million, which is actually $7 million less than the 1994 rehabilitation price when costs are adjusted for inflation. The difference in the present-worth cost of placing the thin overlay every eight years at $400,000 per centerline mile compared to the major rehabilitation every 12 years at $1 million per centerline mile is $600,000 per centerline mile. This conclusion is based on a 20-year analysis period and a 4% discount rate.

There is a significant cost saving for the State when funding is made available to proactively manage pavement. This proactive management technique of placing thin overlays when roads are in fair condition and not allowing roads to deteriorate into poor condition is overwhelmingly responsible for the reduction in project backlog reported at $528 million in 1999 and $287 million in 2005. The reduction in project backlog occurred despite below-average project expenditures during the four fiscal years from 2001 through 2004.

PROJECT PRIORITIZATION

(How do we select individual projects that assure efficient utilization of limited financial resources?)

The pavement preservation program competes for funding with capacity improvement, operations, bridge, hydraulic, and safety projects and programs. Since available funding is never unlimited, the PMS is the perfect tool to help engineers prioritize projects in such a manner that will improve the condition of the entire roadway network while maximizing pavement performance and keeping costs to a minimum.

The rationale used to prioritize pavement preservation projects is based on financial consequences as depicted in the typical pavement deterioration curve in FIGURE 11. The curve demonstrates that there will be a large difference in cost between spending funds on preservation when roads are in fair condition versus spending funds on major rehabilitation or reconstruction when roads are in very poor condition. The greater the difference in cost to maintain a road in fair condition versus the cost of complete reconstruction, the higher the priority that particular pavement segment receives for prioritization. For example, Interstate highways have been identified as the road type with the highest priority because the financial consequences of not maintaining this portion of the network in fair condition are the greatest. Delaying a rehabilitation project on the Interstate by one or two years will typically add several million dollars to rehabilitation costs. This type of road should be evaluated on an eight year proactive schedule and will deteriorate faster than low volume roads, which are on 15 to 20 year proactive evaluation schedules.

STATE PAVEMENT PRESERVATION FUNDING

(How do we fund State pavement preservation?)

The State's roadway network is predominantly financed by highway user taxes such as fuel taxes and vehicle registration fees. During the last two fiscal years, $544 million was invested in pavement preservation work. This expenditure approximately $274.5 million investment of federal funds, $268 million investment of state funds, and $1.5 million other funds. Approximately $461 million was contracted out to private contractors and $83 million was performed by NDOT maintenance forces. Overlay and reconstruction were accomplished by general road contractors and most preventive and corrective maintenance treatments were accomplished by NDOT state force. FIGURE 12 displays the funding source and construction expenditure information.

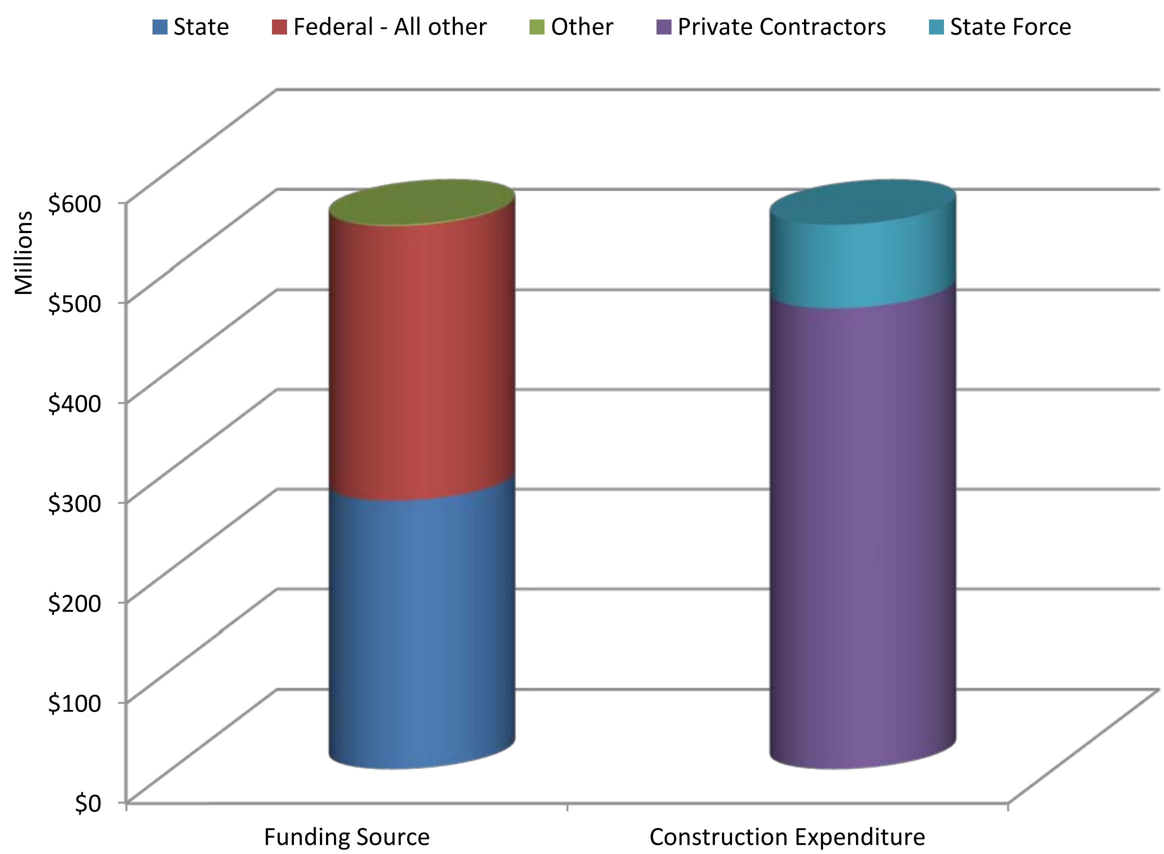


FIGURE 12: Biennial Pavement Preservation Funding and Spending – 2011 and 2012

Biennial Expenditures for Fiscal Years 2011 to 2012

(What have we expended on pavements in the last two years?)

During fiscal years 2011 and 2012, NDOT obligated $418 million for pavement overlay and reconstruction repair projects. These expenditures addressed the preservation needs for 374 miles of roads. This is an expenditure of $150 million more than the previous biennium and approximately 10 less miles of roads received overlay and reconstruction work. The additional repairs were due to competitive bids for construction work and resulting low costs.

TABLE 5 summarizes expenditures and corresponding mileage of repair strategies for fiscal years 2011 and 2012. FIGURE 13 and FIGURE 14 highlight the roadway sections that received overlay and major rehabilitation repair work during the 2011 and 2012 biennium.

TABLE 5: Pavement Expenditures and Miles of Highway that received Overlays and Major Rehabilitation

(Fiscal Years 2011 and 2012)

Fiscal Year	Repair Strategy						
	Preventive & Corrective Maintenance	Overlay		Major Rehabilitation		Total	
	Expenditures	Expenditures	Miles	Expenditures	Miles	Expenditures	Miles
2011	$11,524,217	$202,259,522	225.3	$84,887,500	10.4	$287,147,022	235.7
2012	$13,829,243.37	$128,751,494	138.5	$1,646,184	0.2	$130,397,678	138.7
Biennium Total	$25,353,460	$331,011,016	363.8	$86,533,684	10.6	$417,544,700	374.4

Costs of Construction

(How much pavement construction can be done with the current fuel taxes?)

Highway construction costs depend on energy prices and recent spikes in energy prices have significantly increased preservation costs. The State Highway Fund gasoline tax of 17.65 cents per gallon in 1992 has the highway construction purchasing power of 7.13 cents in 2012 because of inflation in construction costs. The average 2012 western states construction costs were approximately 250% that of 1992. The construction cost index measures the price development of labor, materials, transport, and other input factors in the production of highway projects. A steep rise in the construction cost index for the western states was observed between 2003 and 2008 when energy prices skyrocketed nationally. The construction cost index is strongly influenced by the price of fuel. Gasoline prices rose above $4 per gallon in 2008 and have fluctuated in that neighborhood since; currently averaging around $3.40 per gallon for regular gasoline. The average Nevada price for gasoline was around $1.28 per gallon in 1992 and around $1.23 per gallon in 1996.

FIGURE 13: Overlay and Major Rehabilitation Projects Advertised in Fiscal Year 2011

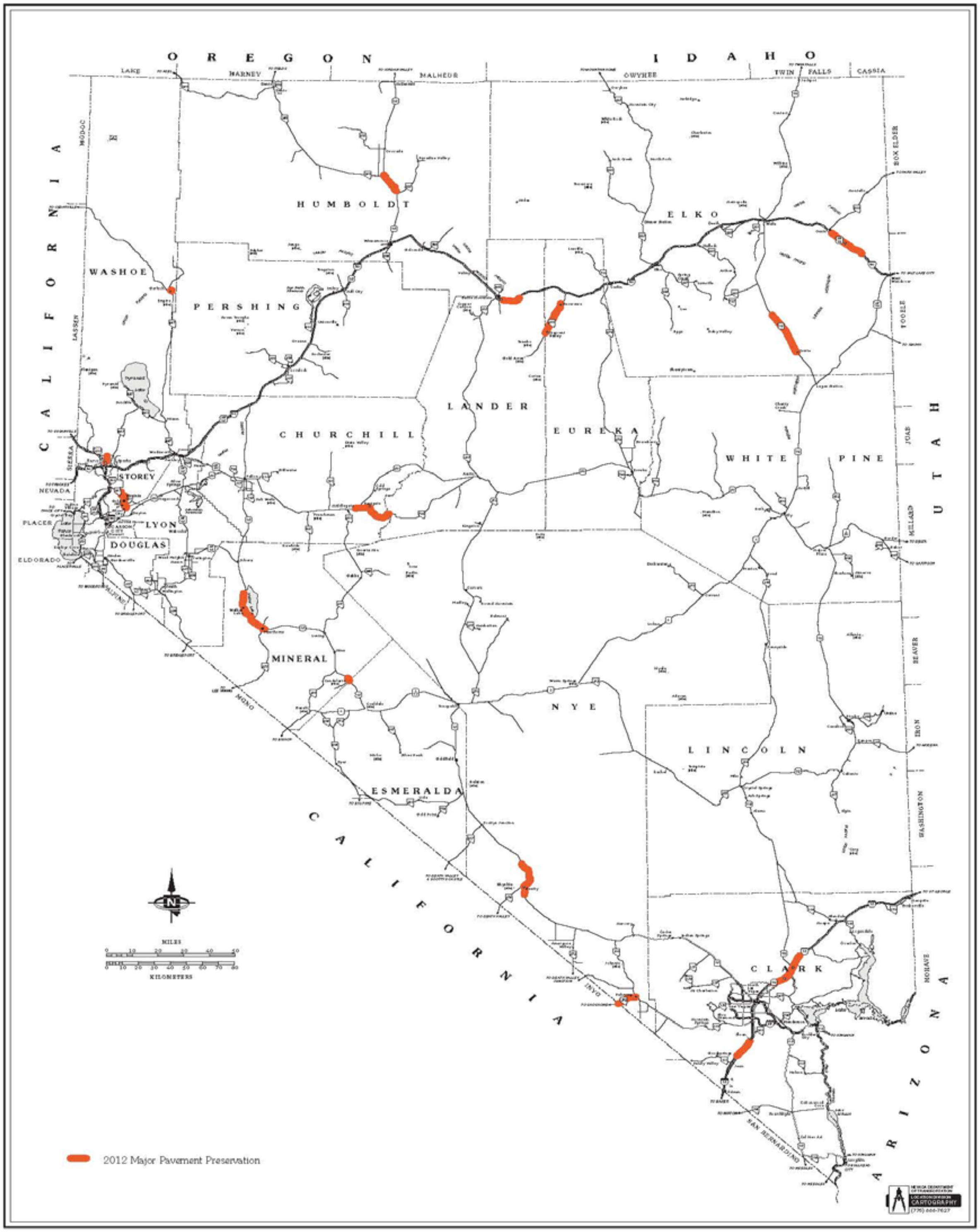


FIGURE 14: Overlay and Major Rehabilitation Projects Advertised in Fiscal Year 2012

FIGURE 15 shows the average of construction cost indices for the Western States since 1990. The average construction cost index increased 86% from 2003 through 2012.

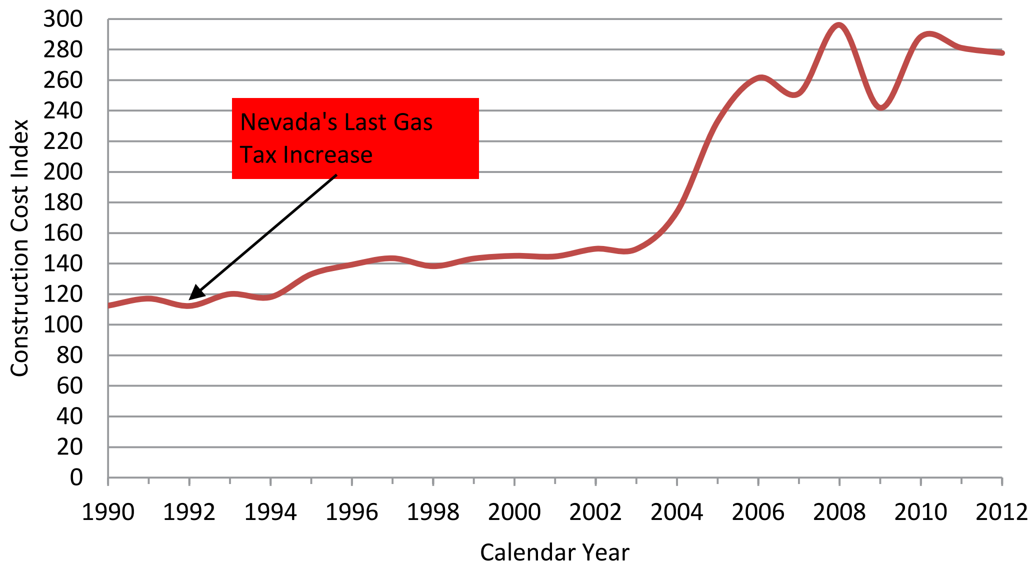


FIGURE 15: Average of the Construction Cost Indices of California, Colorado, Oregon, Utah, and Washington.

FIGURE 16 shows the pavement overlay cost trend over the years for the state-maintained network.

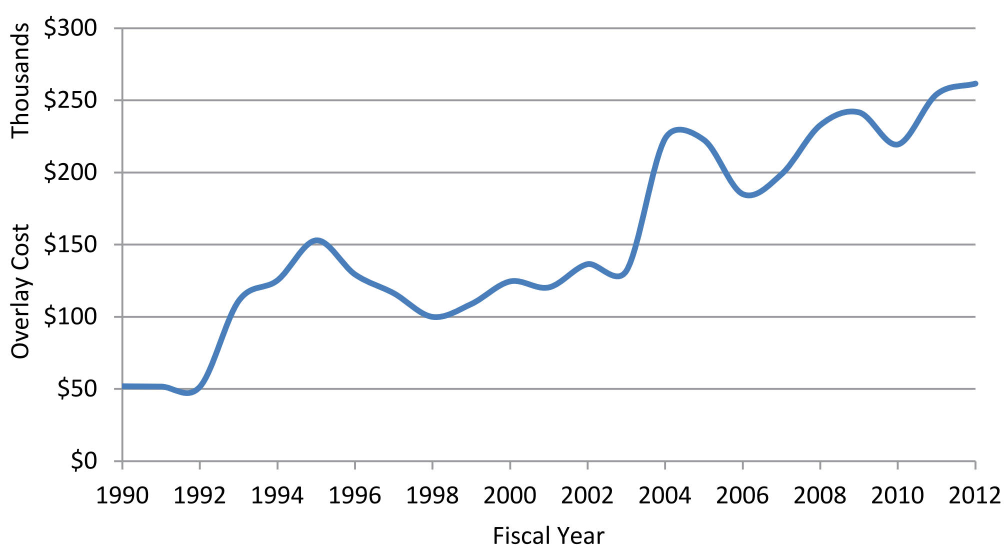


FIGURE 16: Pavement Overlay Costs over Time

Construction prices were slightly depressed in 2006, but increased with overall inflation until 2009. Pavement overlay costs declined in 2010, but rebounded 33% since then to a new high in 2012. An excessively large increase in the construction cost index and corresponding pavement overlay costs without a proportionate increase in pavement preservation revenue has made the proactive management of the state-maintained roadway network difficult to sustain. NDOT's long-term proactive pavement management plan will only be effective if adequate funding is made available to apply proactive thin overlays on a timely basis before roads deteriorate to a condition where expensive major rehabilitation and reconstruction repair methods are required.

BACKLOG OF PAVEMENT PRESERVATION WORK

(What will it cost to bring the pavement to excellent condition?)

NDOT's long-term proactive pavement management plan is to maintain the entire pavement in fair to good condition in order to reduce the need for more expensive major rehabilitation and reconstruction repair methods. Since this optimized plan is not possible due to current funding constraints, the amount of overlay and major rehabilitation project backlog is assessed. Pavement in the preventive and corrective repair categories is not included in the backlog because this pavement is maintained with existing routine-maintenance funds. TABLE 6 identifies the amount of work required to preserve all pavement in good condition. The cost to eliminate the backlog of overlay and reconstruction repair work is approximately $1.9billion.

TABLE 6: Backlog of Overlay and Major Rehabilitation Work

State-Maintained System - 2013

	Overlay		Major Rehabilitation		Total	
System	**Lane Miles**	**Cost**	**Lane Miles**	**Cost**	**Lane Miles**	**Cost**
Interstate Highways	142	$37,071,390	394	$196,817,000	535	$233,888,390
Principal Arterial - Non-Interstate	550	$143,873,769	1325	$662,261,500	1874	$806,135,269
Minor Arterial	168	$44,050,140	356	$177,941,500	524	$221,991,640
Major Collector	569	$148,848,350	589	$294,400,500	1158	$443,248,850
Minor Collector & Local	300	$78,523,435	272	$135,868,500	572	$214,391,935
Total	1729	**$452,367,085**	2935	**$1,467,289,000**	**4,664**	**$1,919,656,085**

**The cost includes pavement, ancillary repairs, and engineering on projects. Ancillary repairs typically include repairing signs and signals, replacing traffic delineators, repairing ditches and culverts, and grading shoulders.*

** $500,000 per lane mile reconstruction cost was used based on historic data*

Available Funding Versus Needed Funding

(How much financial resources we have and what will it take to bring the entire pavement to excellent Condition?)

The current $1.9 billion of pavement preservation backlog will increase to $2.3 billion in 2017, and climb to $3.3 billion in 2025 with the present funding level. The funding required to eliminate the pavement preservation backlog will be $272 million per year over the next 12 years. FIGURE 17 illustrates comparison between the backlog if needs remain unfunded verses the backlog if additional funding becomes available. TABLE 7 summarizes the backlog increase if present funding levels continue and the additional revenue required to eliminate the backlog by 2025.

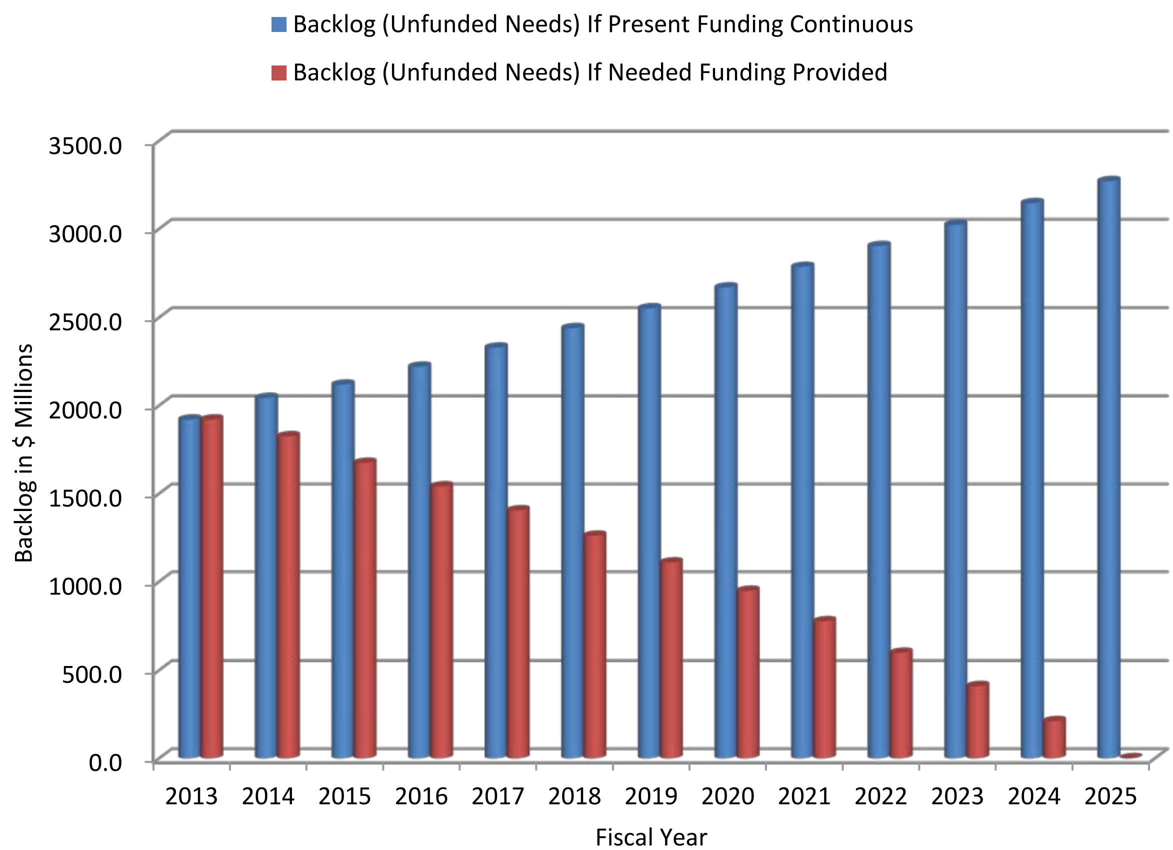


FIGURE 17: Backlog of Pavement Needing Overlay or Major Rehabilitation with Present Funding vs. Needed Funding

NDOT will be reviewing the 12-year horizon for eliminating the backlog to see if that is still a reasonable and practical approach and timeline.

TABLE 7: Pavement Backlog, Costs, and Funding

State-Maintained System - 2013 – 2025 (in millions of dollars)

With Present Funding

		Pavement Preservation Costs * (Normal Annual Deterioration Costs)			Pavement Preservation Funds ** (Funds Planned for Preservation Work)				
Fiscal Year	Backlog of Pavement Work	Overlay & Major Rehabilitation	Preventive & Corrective Maintenance	Total	State Overlay & Major Rehabilitation	Federal Overlay & Major Rehabilitation	State Pavement Maintenance		Total
2013	$1,919.7	$222.6	$12.7	$235.3	$46.0	$53.8	$12.7		$112.5
2014	$2,042.4	$209.5	$13.1	$222.5	$56.0	$78.0	$13.1		$147.1
2015	$2,117.9	$227.8	$13.5	$241.2	$52.0	$74.0	$13.5		$139.5
2016	$2,219.6	$233.3	$13.9	$247.2	$53.4	$71.4	$13.9		$138.6
2017	$2,328.2	$240.3	$14.3	$254.6	$55.5	$74.2	$14.3		$144.0
2018	$2,438.9	$247.6	$14.7	$262.3	$57.7	$77.2	$14.7		$149.6
2019	$2,551.5	$255.0	$15.2	$270.1	$60.0	$80.3	$15.2		$155.5
2020	$2,666.2	$262.6	$15.6	$278.2	$62.5	$83.5	$15.6		$161.5
2021	$2,782.9	$270.5	$16.1	$286.6	$64.9	$86.8	$16.1		$167.8
2022	$2,901.6	$278.6	$16.6	$295.2	$67.5	$90.3	$16.6		$174.4
2023	$3,022.4	$287.0	$17.1	$304.0	$70.2	$93.9	$17.1		$181.2
2024	$3,145.3	$295.6	$17.6	$313.2	$73.1	$97.6	$17.6		$188.3
2025	$3,270.1								

With Needed Additional Funding

		Pavement Preservation Costs * (Normal Annual Deterioration Costs)			Pavement Preservation Funds ** (Funds Planned & Needed for Preservation Work)				
					Existing				
Fiscal Year	Backlog of Pavement Work	Overlay & Major Rehabilitation	Preventive & Corrective Maintenance	Total	State Overlay & Major Rehabilitation	Federal Overlay & Major Rehabilitation	State Pavement Maintenance	Needed Additional Overlay & Major Rehabilitation	Total
2013	$1,919.7	$222.6	$12.7	$235.3	$46.0	$53.8	$12.7	$217.6	$330.1
2014	$1,824.8	$209.5	$13.1	$222.5	$56.0	$78.0	$13.1	$226.3	$373.4
2015	$1,673.9	$227.8	$13.5	$241.2	$52.0	$74.0	$13.5	$235.4	$374.9
2016	$1,540.3	$233.3	$13.9	$247.2	$53.4	$71.4	$13.9	$244.8	$383.4
2017	$1,404.1	$240.3	$14.3	$254.6	$55.5	$74.2	$14.3	$254.6	$398.6
2018	$1,260.1	$247.6	$14.7	$262.3	$57.7	$77.2	$14.7	$264.8	$414.4
2019	$1,107.9	$255.0	$15.2	$270.1	$60.0	$80.3	$15.2	$275.4	$430.9
2020	$947.2	$262.6	$15.6	$278.2	$62.5	$83.5	$15.6	$286.4	$447.9
2021	$777.5	$270.5	$16.1	$286.6	$64.9	$86.8	$16.1	$297.8	$465.7
2022	$598.4	$278.6	$16.6	$295.2	$67.5	$90.3	$16.6	$309.8	$484.2
2023	$409.5	$287.0	$17.1	$304.0	$70.2	$93.9	$17.1	$322.2	$503.4
2024	$210.1	$295.6	$17.6	$313.2	$73.1	$97.6	$17.6	$335.0	$523.3
2025	$0.0								

*Inflation assumed at 3.00% per annum **Revenue growth rate assumed is 4.00% per annum.

Note: Backlog of pavement work is as of beginning of fiscal year; preservation costs are those incurred during the fiscal year; and preservation funds are those that are available during the fiscal year.

Financial Needs History

(What was the pavement preservation backlog in the past and how did they change over the years?)

FIGURE 18 demonstrates how the financial needs for pavement preservation have changed since 1987. Generally, the total needs increased with inflation until 1999 and decreased the following biennium because of an aggressive maintenance program in the late 1990s. In the last few years, abnormally high inflation in roadway construction costs has caused a dramatic increase in financial needs. Inflation coupled with less investment for pavement preservation is an assurance that financial needs will not decrease in the foreseeable future. FIGURE 19 identifies the financial needs for pavement repairs that are inflation-adjusted to 2012 dollars.

PAVEMENT PRESERVATION ACTION PLAN

(How will we improve our pavements? How do we prioritize available resources? What are the financial resources needed?)

Available funding for pavement preservation needs is uncertain for the immediate and distant future. Therefore, NDOT developed both short- and long-term action plans to ensure that funds will be invested in the most cost-effective manner possible. Greater demand on the existing roadway network, constrained resources, and heightened expectations from the traveling public are cause for very challenging times. There has never been a more critical time to plan and deliver services in an efficient manner.

Short-term Action Plan

(What will we do if there is no additional preservation funding?)

Although the following short-term action plan is not entirely proactive pavement management, the plan protects the most costly pavement assets such as the Interstate highways and Non-interstate Principal Arterial roads. Less traveled roads will be allowed to deteriorate into the major rehabilitation repair category because lack of funding does not allow implementing more proactive pavement management. If there is no additional preservation funding through fiscal year 2025, the pavement backlog will rise from the current level of $1.9 billion to $3.3 billion in 2025.

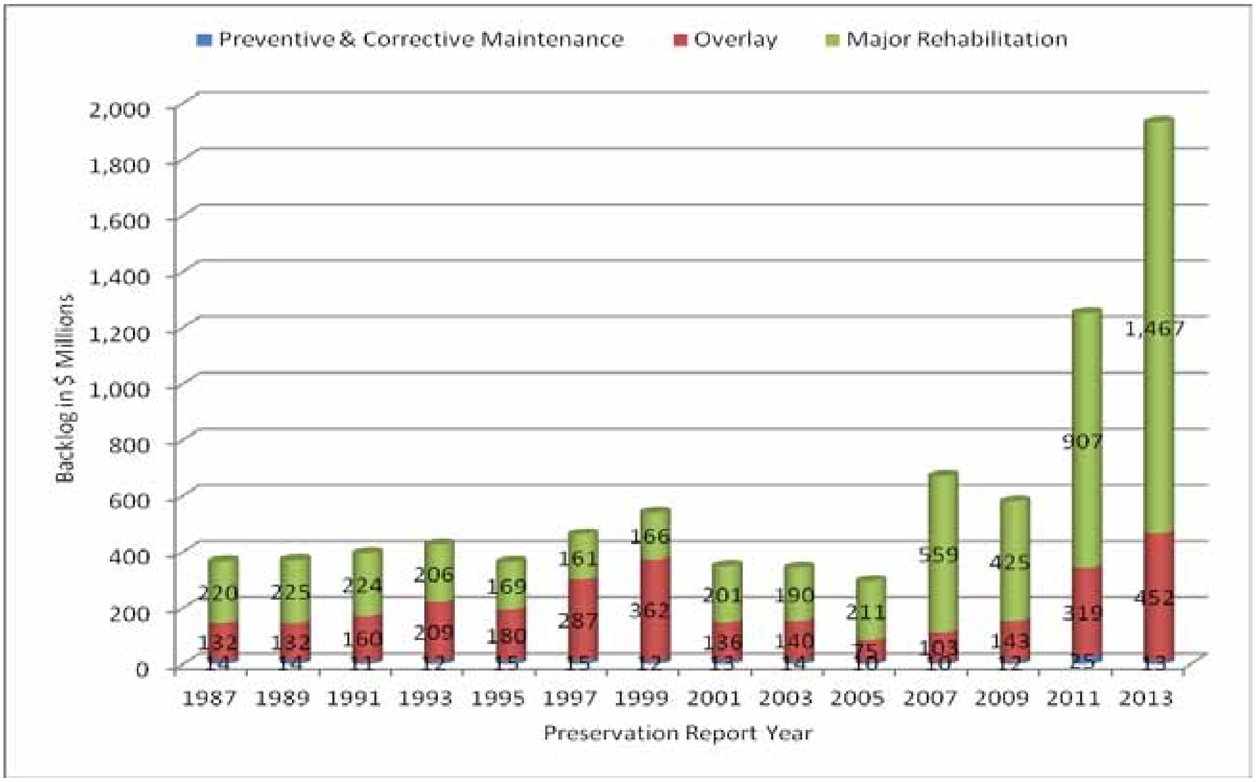


FIGURE 18: Status of Network by Cost of Repair Strategy Required – 1987 to 2013

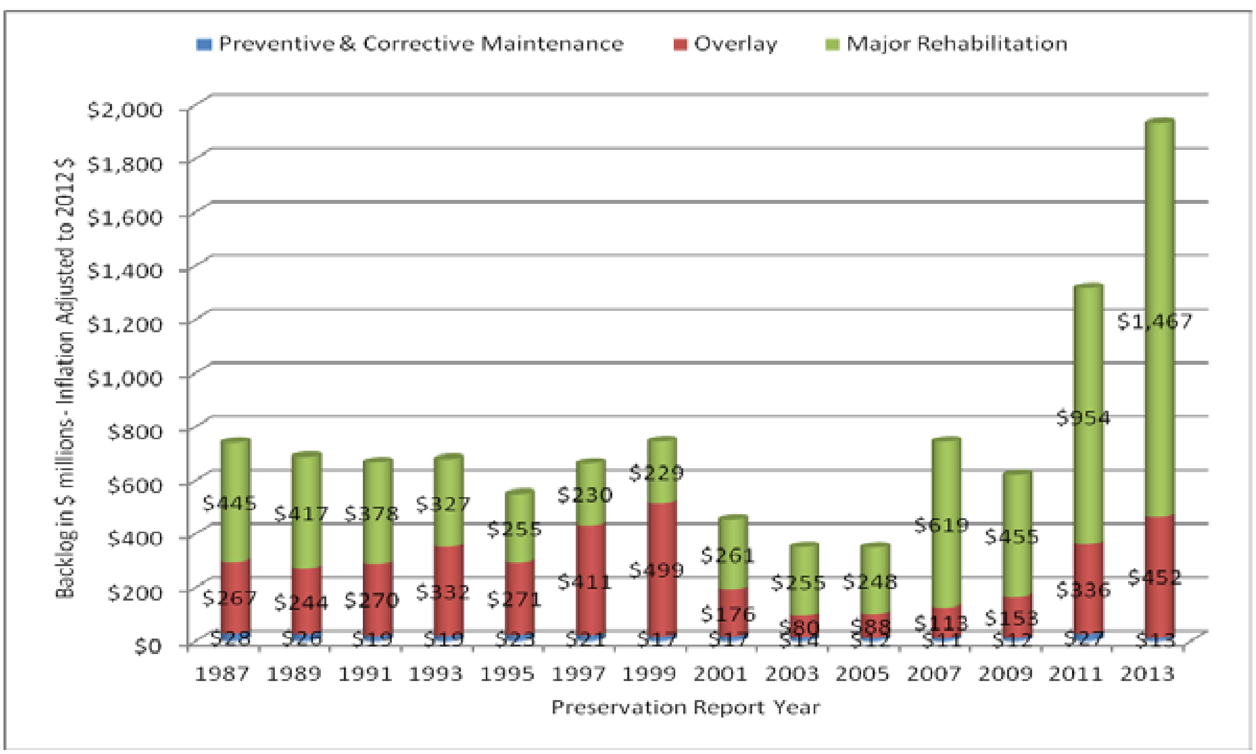


FIGURE 19: Status of Network by Composite Consumer Price Index – 1987 to 2013

Furthermore, NDOT plans on incorporating a Condition based prioritization process to its pavement management practices. NDOT uses the Present Serviceability Index (PSI) to quantify the condition of its roadways. The PSI is calculated from the measured roughness (International Roughness Index, or IRI) along a roadway segment, as well as the type and extent of pavement distress present.

The PSI is a number between 5 and 0. A PSI of 5 represents a pavement that is smooth and completely free of distress or irregularities. A pavement with a PSI of 0 has failed completely and is no longer navigable at the posted speed. Figure 20A, B, & C describe the PSI Rating Scale and the corresponding condition descriptions. Figure 20D describes the Present Serviceability Index (PSI) Pavement Condition by Prioritization Category.

Typically, new pavements have an initial PSI around 4.5 and have reached the end of their service life at 2.5 or 2.0, depending on functional classification of roadway. The PSI is calculated from the following equation:

PSI = (5 x e (-0.0041 x Average IRI)) – (1.38 x RD2) – (0.03 x Distress Ext0.5)

IRI = International Roughness Index (inch/mile), average of right and left wheel paths

RD = Rut depth (inch)

Distress Ext = The sum of non-wheel path, transverse, and fatigue cracking extents as well as patching.

As illustrated previously in Figure 11, pavement managers seek to optimize the type and timing of maintenance work so that roadways are maintained in serviceable condition at the lowest life-cycle cost. Over the past two decades, NDOT has used pavement age to prioritize paving and estimate budget needs. However, age only provides a rough measure of pavement condition and does not take into account the variability in pavement performance that comes with construction, climate, maintenance, loading, and other factors.

Through a sustained pavement management effort, NDOT now has several years of performance history on the different pavement types in its inventory. NDOT is beginning to transition towards using condition based deterioration models to estimate current and future paving needs as well as using pavement condition data to prioritize pavement rehabilitation projects. This will provide management and elected officials a clearer picture of roadway conditions across the state, as well as more precise estimates of the funding necessary to reach a target condition level.

A prototype condition report table and map are shown in FIGURES 20A, 20B, 20C, 20D and FIGURE 21.

Condition Term	PSI Range	Example Photo	Description
Very Good	≥ 4.00		Pavements in "Very Good" condition are smooth and generally free of distress. As new condition.
Good	3.50 to 3.99		Pavements in "Good" condition are beginning to show minor distress that is typically environmental rather than load related. On asphalt pavements, the form of distress is typically light non-wheelpath longitudinal and transverse cracking and minor surface raveling. Concrete pavements may have occasional spalls related to incompressible material collecting in the joints. The ride is still very good. Asphalt pavements in this category can especially benefit from preventive maintenance like crack sealing and seal coating (chip, slurry, scrub, etc), which protects the pavement structure from water infiltration and weathering. Concrete pavements can benefit from having joints re-sealed and spalls patched. These are some of the most cost effective types of pavement maintenance, but they must be applied proactively to pavements in good condition.

Figure 20A: Present Serviceability Index (PSI) Rating Scale and Condition Descriptions

Condition Term	PSI Range	Example Photo	Description
Fair	3.00 to 3.49		Pavements in “Fair” condition have more developed environmental distress and may show early signs of fatigue. On asphalt pavements, the non-wheelpath longitudinal and transverse cracks are more frequent and reaching moderate severity along with light surface oxidation and weathering (if a seal has not yet been applied). If structural distress is present, it will usually just be starting in the form of light severity ruts and fatigue cracks in the wheel paths. Concrete pavements may have a few cracked slabs, but the cracks are generally tight and non-working. The ride is good. Asphalt pavements in this category are usually candidates for a thin overlay or, on lower volume roads, a thicker seal coat treatment (microsurfacing, double chip seal, cape seal, etc). Applying an overlay at this condition level can preempt the formation of more severe structural distress. Concrete pavements can again benefit from having joints and cracks sealed, and from slab replacement (whole or partial) where cracks are working.
Mediocre	2.50 to 2.99		Pavements in “Mediocre” condition will typically have accumulated significant quantities of environmental and structural pavement distress. On asphalt pavements, non-wheelpath longitudinal and transverse cracks will have reached medium severity and may be so closely spaced as to constitute block cracks. Ruts and lightly networked fatigue cracks are typically present in the wheel paths. Concrete pavements will have slabs with both working and non-working cracks, as well as light faulting between panels. The ride is acceptable. Asphalt pavements in this category may still be candidates for an overlay or thicker seal coat treatment, but will usually require some deep patching before the new surface is laid. Compared to pavements in “Fair” condition, the asphalt overlay depth may need to be increased to address the structural deterioration. Concrete pavements may be candidates for a life extending, global resurfacing treatment consisting of slab replacements, dowel bar retrofits, and profile grinding.

Figure 20B: Present Serviceability Index (PSI) Rating Scale and Condition Descriptions (continued)

Condition Term	PSI Range	Example Photo	Description
Poor	2.00 to 2.49		Pavements in “Poor” condition have accumulated significant quantities of environmental and load related distress. On asphalt pavements, the non-wheelpath longitudinal and transverse cracks are of moderate to high severity, the surface is weathered, and rutting and fatigue cracking are widespread. Concrete pavements have faults and broken slabs with working cracks. The ride is poor and falls below the Interstate and NHS acceptability threshold. Lower volume asphalt roadways in may still be candidates for an thick overlay or partial depth rehabilitation like cold in-place recycling (CIR.) Higher volume asphalt roadways will usually require reconstruction or an equivalent treatment such as roadbed modification. Concrete pavements may still be candidates for reprofiling, but will more commonly require full depth reconstruction.
Very Poor / Failed	< 2.00		Pavements in “Very Poor” condition have accumulated large quantities of environmental and structural distress. On asphalt pavements, the surface is pitted and there are wide non-wheelpath longitudinal and transverse cracks, networked and spalled fatigue cracks, and deep ruts. Concrete pavements will have shattered and faulted slabs. In both cases, the deterioration is advanced to the point where portions of the pavement may come lose, resulting in a pothole. The ride is very poor and the road may no longer be navigable at the posted speed. The ride falls significantly below the Interstate and NHS acceptability threshold. Pavements that have reached this condition level will typically require frequent maintenance attention and generate citizen complaints and claims. They will usually require full depth reconstruction.

Figure 20C: Present Serviceability Index (PSI) Rating Scale and Condition Descriptions (continued)

Condition Term	PSI Range	2011 Condition by Prioritization Category (% and miles)					
		CAT 1	CAT 2	CAT 3	CAT 4	CAT 5	*TOTAL*
Very Good	≥ 4.00	**10.4%** (135 mi)	**28.4%** (531 mi)	**10.5%** (254 mi)	**3.9%** (66 mi)	**0.4%** (13 mi)	***9.3%*** *(999 mi)*
Good	3.50 to 3.99	**47.3%** (614 mi)	**46.9%** (876 mi)	**51.3%** (1,236 mi)	**23.3%** (400 mi)	**7.3%** (252 mi)	***31.5%*** *(3,378 mi)*
Fair	3.00 to 3.49	**30.8%** (400 mi)	**18.3%** (341 mi)	**30.0%** (724 mi)	**41.7%** (717 mi)	**24.4%** (840 mi)	***28.2%*** *(3,022 mi)*
Mediocre	2.50 to 2.99	**8.1%** (106 mi)	**4.8%** (90 mi)	**6.3%** (152 mi)	**23.5%** (405 mi)	**32.3%** (1,109 mi)	***17.2%*** *(1,862 mi)*
Poor	2.00 to 2.49	**3.1%** (40 mi)	**1.3%** (23 mi)	**1.5%** (36 mi)	**5.8%** (100 mi)	**23.1%** (794 mi)	***9.1%*** *(993 mi)*
Very Poor / Failed	< 2.00	**0.3%** (3 mi)	**0.3%** (6 mi)	**0.4%** (11 mi)	**1.8%** (31 mi)	**12.5%** (429 mi)	***4.3%*** *(480 mi)*

FIGURE 20D: Present Serviceability Index (PSI) Pavement Condition by Prioritization Category – 2011

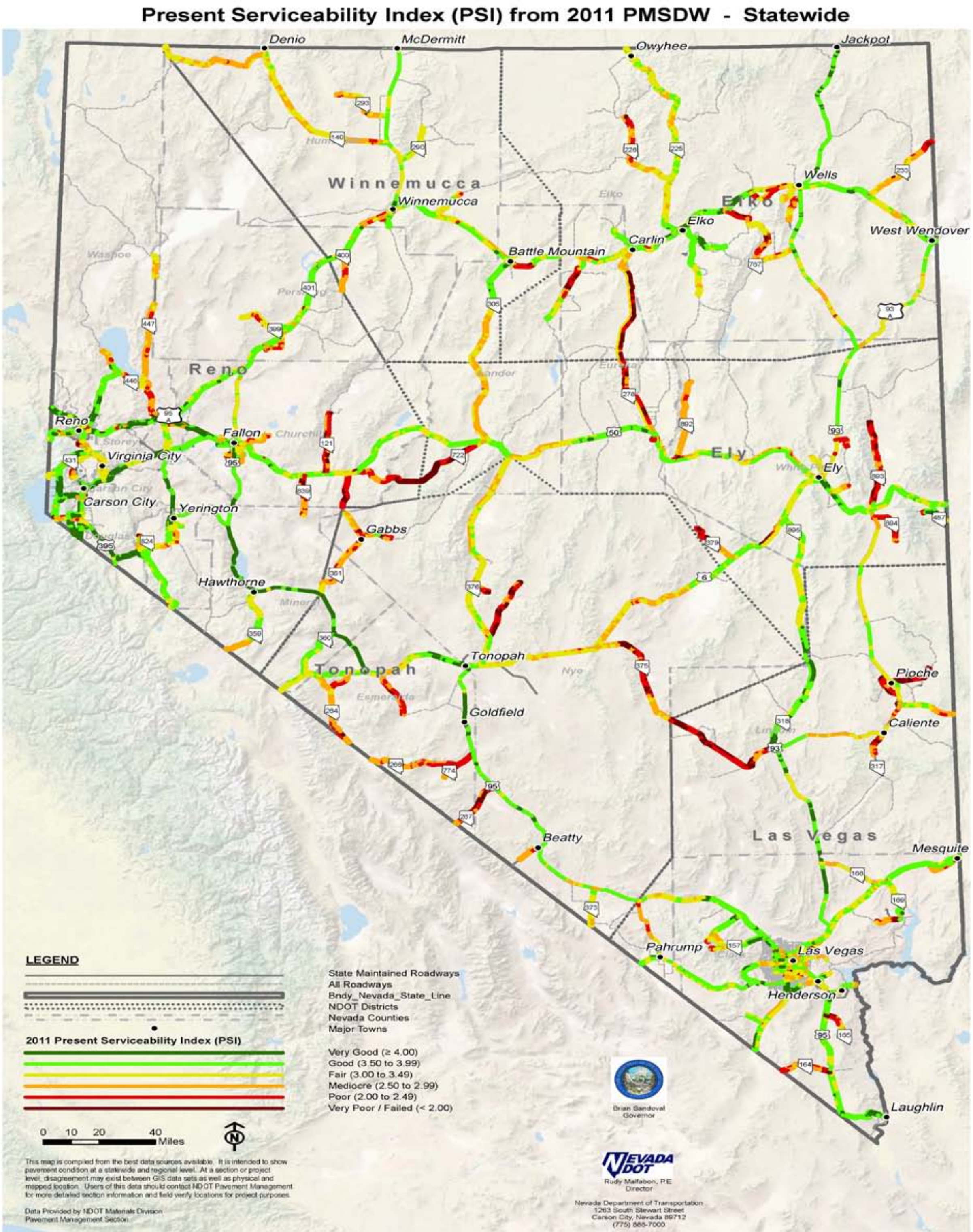


FIGURE 21: Statewide Present Serviceability Index (PSI) Pavement Condition - 2011

The following pavement management practices will be implemented for the short-term action plan:

- Maintain the Interstate highways and Non-interstate Principal Arterial roads at a high level of service by the construction of proactive thin asphalt overlays as funding allows and major rehabilitation of inferior pavement segments as necessary.
- Apply preventive and corrective maintenance treatments and repairs to other routes as funding allows.
- Create condition based deterioration models to estimate current and future paving needs and rehabilitation.
- Incorporate a Condition based prioritization process using the PSI rating system into the PMS in order to better determine and report the optimal timing of pavement needs and rehabilitation in order to provide management and elected officials a clearer picture of roadway conditions across the state, as well as more precise estimates of the finding necessary to reach a target condition level.

Long-term Action Plan

(What will we do if legislators acted to increase preservation funding?)

NDOT's long-term action plan includes the proactive philosophy of applying thin asphalt overlays at appropriate intervals based on the rate of pavement deterioration. Thin asphalt overlays prevent the network from deteriorating into the need for more costly repairs. The long-term action plan relies on the Legislature to adequately fund preservation needs. The following pavement management practices will be implemented for the long-term action plan (if adequate funding is provided):

- Maintain the Interstate highways and Non-interstate Principal Arterial roads at a high level of service by the construction of proactive thin asphalt overlays as funding allows and major rehabilitation of inferior pavement segments as necessary.
- Preserve the Minor Arterial, Major Collector, and Minor Collector roads at an adequate to good level of service by the construction of proactive thin asphalt overlays as funding allows and major rehabilitation of inferior pavement segments as necessary.

- Manage the low-volume roads at a minimal and acceptable level of service by application of preventive and corrective maintenance treatments and repairs.

FIGURE 22 and FIGURE 23 highlight the overlay and major rehabilitation projects anticipated to be constructed with fiscal year 2014 and 2015 funds, respectively. FIGURE 24 shows projects contingent upon additional funding for fiscal years 2014 & 2015.

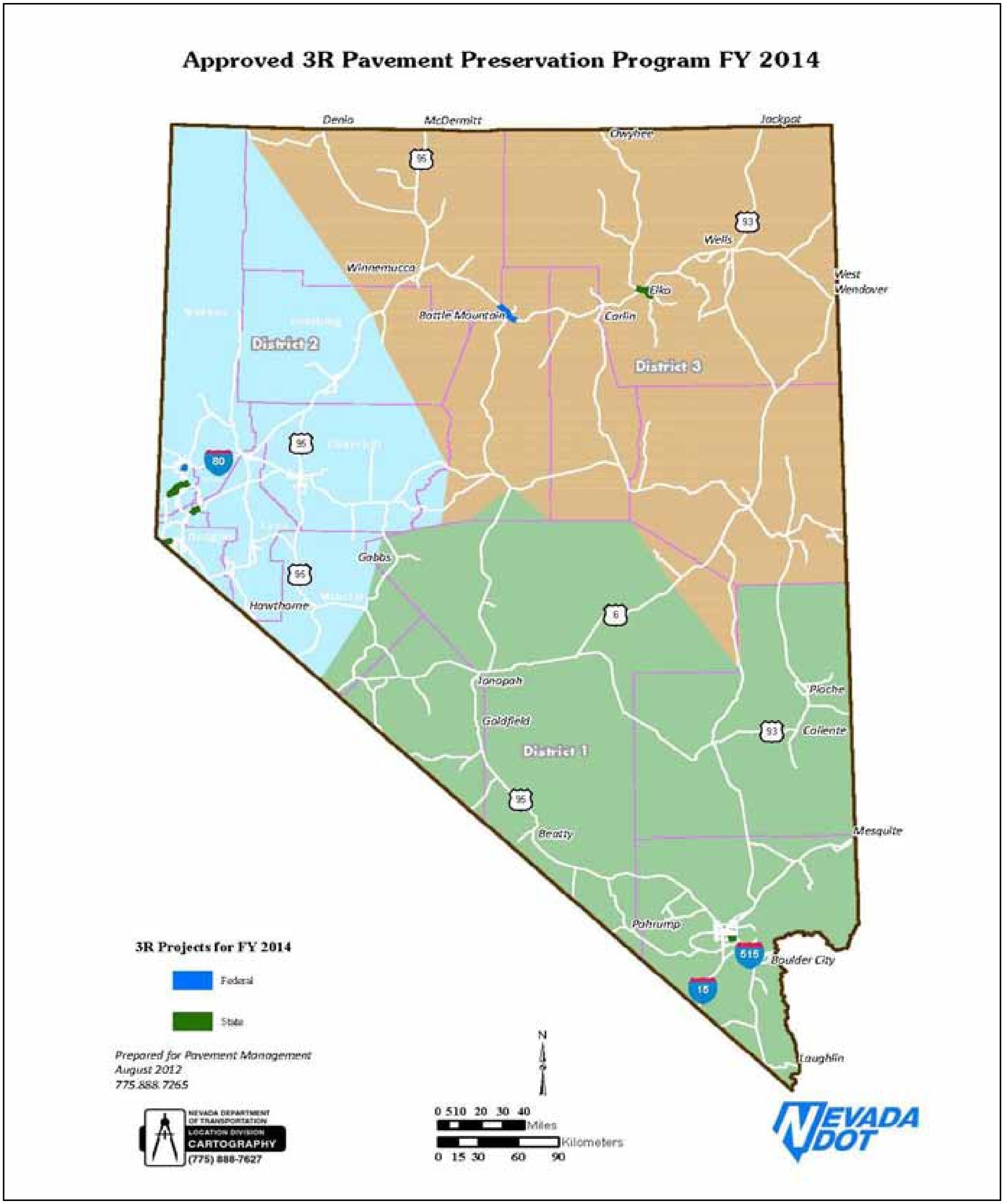


FIGURE 22: Overlay and Major Rehabilitation Projects Planned for Fiscal Year 2014

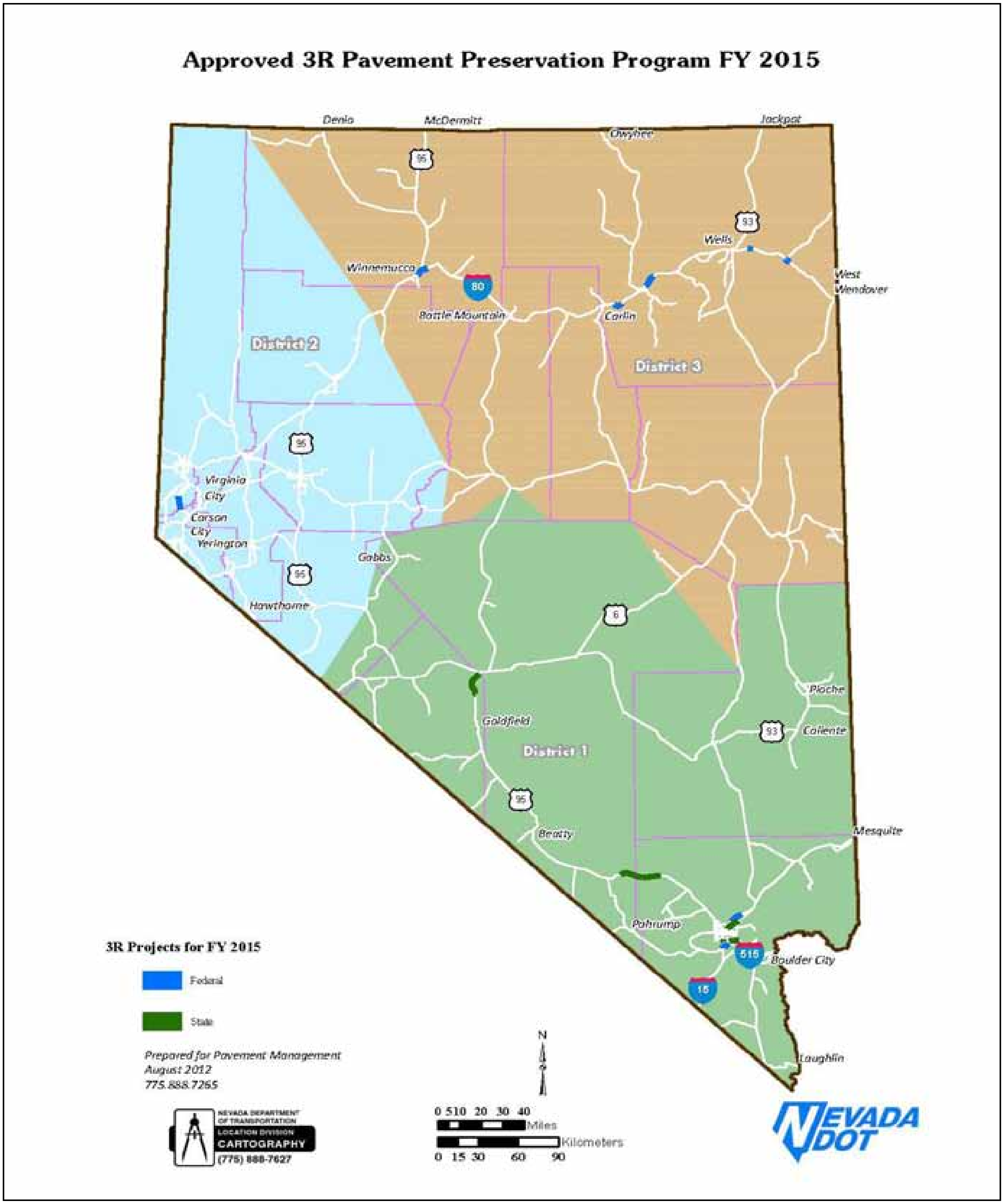


FIGURE 23: Overlay and Major Rehabilitation Projects Planned for Fiscal Year 2015

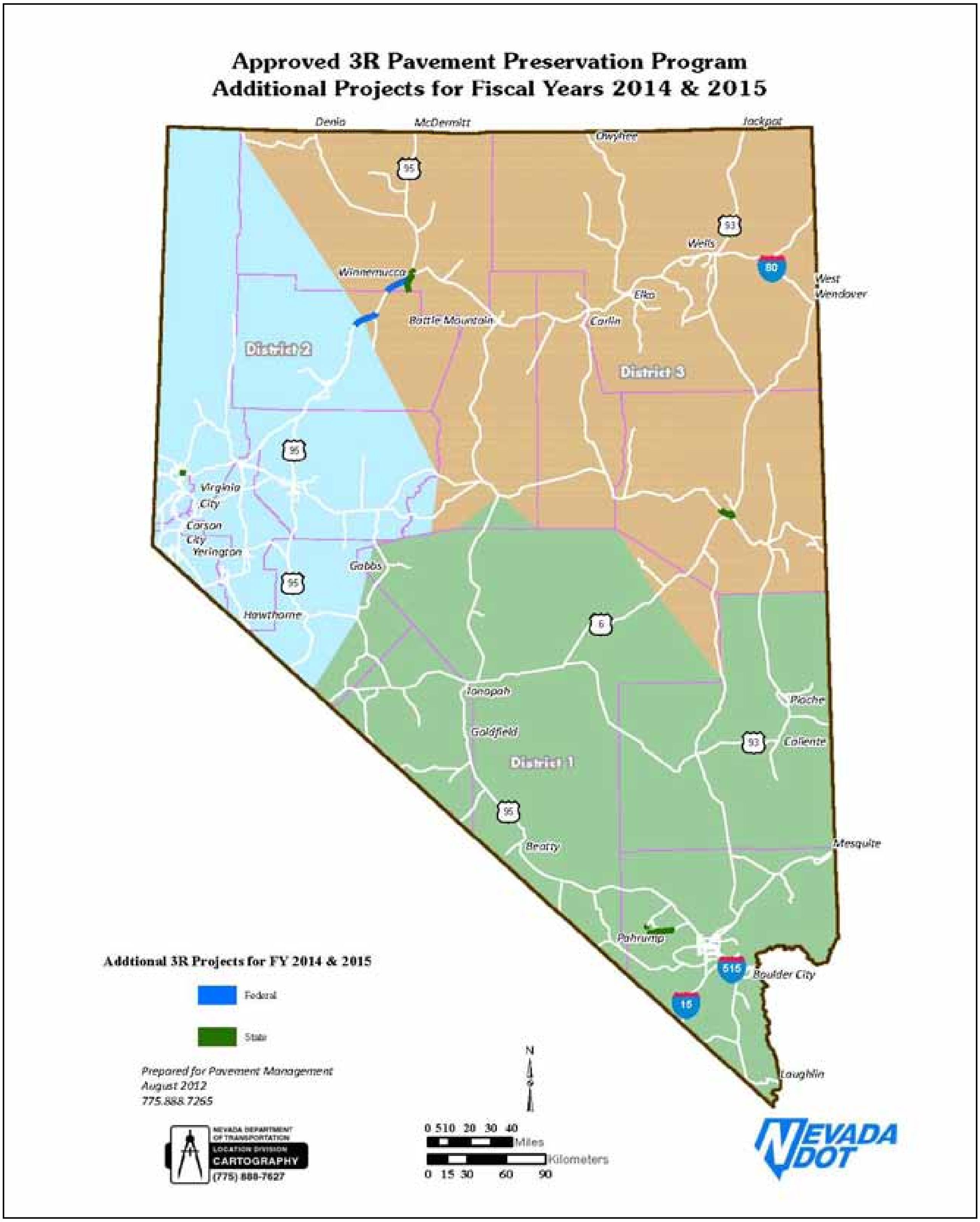


FIGURE 24: Additional Projects Planned for Fiscal Year 2014 & 2015

The long-term action plan also includes an emphasis on the coordination and integration of routine pavement maintenance activities with planned overlay and major rehabilitation repair work. Routine pavement maintenance activities help to maintain the pavement functional condition, slow down the deterioration rate, and prevent premature structural failure. Neglecting routine maintenance will accelerate the effects of aging and deterioration as well as increase pavement life-cycle costs. Numerous benefits result when the performance of routine pavement maintenance activities are properly timed and integrated in the pavement management process.

PAVEMENT RESEARCH

(What research are we doing to improve our pavement?)

NDOT continuously strives to improve pavement standards and the quality of materials used on the roadway network. Therefore, research is conducted both in-house and in partnership with different entities to deliver the best products and materials in the most cost-effective manner. Current NDOT research includes the following projects:

- Evaluation of the Mechanistic-Empirical Pavement Design Guide (MEPDG). MEPDG is a modern pavement design methodology based on engineering mechanics and empirical knowledge. This evaluation requires local calibration efforts in terms of materials used and in-service conditions (environment and traffic) which lead to pavement performance predictions. Significant progress has been made in the required material characterization over the last five to six years. Further efforts have been extended into quantifying the traffic analysis and environmental inputs. There have also been some preliminary design comparisons between the MEPDG and the current state-of-practice design method. The end result of these efforts will be a pavement design tool that can more accurately characterize the specific roadway conditions in Nevada and allow engineers to more appropriately address those conditions for longer lasting roadways.
- Use of recycled asphalt materials (RAP) in highway construction. Uses include the addition of RAP into base layer aggregates, recycling the RAP as a dust control measure,

and dirt road surface treatments. NDOT has allowed using RAP in the plant-mix pavement up to 15% by weight for the last two years. There is continued effort to evaluate RAP regarding characterization of materials as well as the impact on the long term performance of pavements. NDOT has cautiously approached the use of RAP in the plant-mix pavement layer due to concerns over possible detrimental effects RAP may have on the mixture and its resulting long-term performance.

- Development of crack resistant asphalt mixtures. This research will determine whether modifications can be made to asphalt mixtures that will increase the resistance to reflection cracking. Research has recently been completed to evaluate the effectiveness of current NDOT maintenance and rehabilitation procedures. Based on this research, guidelines have been developed to recommend the most appropriate maintenance and rehabilitation applications for differing pavement conditions throughout the state. Further research is currently underway to develop more crack resistant mixtures to be used in several of the recommended guideline applications.

- Use of warm mix asphalt (WMA) in highway construction. Warm mix asphalt used additives or foaming technologies to produce asphalt mixtures at temperatures that are 30 – 500 F lower than the conventional hot mix asphalt which leads to lower energy consumption, lower emissions, and lower dust generation. The first NDOT project to use WMA in the plant-mix pavement was completed on SR443 in Reno and samples were evaluated at the University of Nevada, Reno. NDOT has cautiously approached the use of WMA in the plant-mix pavement layer and started the development of a permissive specification for WMA technologies.

- Use of recycled ground tire rubber. Rubberized asphalt in hot-applied chip seal surface treatments has been used on several projects. In addition, terminal blend rubberized asphalt has been used for preservation overlays on several contracts and use of the terminal blend rubberized asphalt as an option in future more projects is planned. Several crumb rubber overlay projects have been completed on Interstate highway concrete pavement in the Las Vegas area.

SUMMARY

The cost of delaying needed preservation repairs is very high as evidenced in the project-level case study of proactive pavement management. In practical terms, there is common agreement that every $1 invested proactively saves $6 or more reactively in future major rehabilitation and reconstruction costs. There is not approved pavement preservation funding that allows for the long-term proactive pavement management action plan. Without additional funding, more reconstruction repair methods will be required in the future. The effect of deferred funding will become more obvious to the motoring public as traveling on roads get rougher and distresses become more visible. The planned preservation expenditures for fiscal years 2013 through 2015 were not adequate to accommodate NDOT's long-term action plan. There will be a need for additional funding to rehabilitate the roads that have deteriorated into the major rehabilitation repair category.

BRIDGE PRESERVATION

INTRODUCTION

This report summarizes the Nevada Department of Transportation's (NDOT) efforts to preserve the state's estimated $2 billion worth of bridge infrastructure. Preserving the bridge infrastructure is one of NDOT's highest priorities. Numerous resources are employed to maintain bridges in structurally sound, functional, and safe condition.

Although the focus in the following discussion is on state-maintained bridges, information on bridges maintained by other agencies is also included because these bridges are eligible for federal funds that are administered by NDOT. Moreover, NDOT is responsible for inspecting and reporting the condition of all public bridges in Nevada.

MAP-21, the Moving Ahead for Progress in the 21st Century Act was signed into law on July 6, 2012. MAP-21 is the first long-term highway authorization enacted since 2005 and significantly changed bridge funding requirements; detailed information on programmatic changes was not available until October, 2012. Major changes include the reclassification of the Highway Bridge Program (HBP) funding, elimination of the "Functionally Obsolete" classification, and significant changes to the funding criteria for bridge replacement and rehabilitation.

Unfortunately, the late release of MAP-21 information has not allowed the Department to fully reflect the changes related to bridge funding in this Preservation Report. The decision was made to update this report per the previous format, and implement necessary changes per MAP-21 within the 2015 report.

Much of this document will be rewritten for the 2015 State Highway Preservation Report to reflect the impacts of MAP-21. The conditional and cost information in this report has been updated and accurately reflects known structural conditions at the time of publication.

THE BRIDGE MANAGEMENT SYSTEM

(How do we care for our bridges?)

Bridges are managed using the National Bridge Inventory (NBI) data. This data provides an inventory of bridge condition, location, needed repairs, load limits, susceptibility to flooding, and ownership information. A separate inventory allows NDOT to ascertain earthquake susceptibility and risks. These inventories, together with other factors, allow NDOT to identify preservation priorities and monitor the state's progress toward eliminating the backlog of bridge work.

Bridge Inventory

(What do we maintain?)

All public bridges in Nevada are included in the NDOT bridge inventory. There are currently 1,972 public bridges in Nevada. A bridge is a structure spanning 20 feet or more that carries traffic over a depression or obstruction, and includes multiple box culverts and pipes. The maintenance of the bridge inventory is shared by many different organizations: NDOT maintains 1,116 bridges; county and city governments maintain 715 bridges; federal agencies maintain 61 bridges; private entities maintain 44 bridges; and other local agencies maintain 36 bridges.

Bridge Condition Survey

(How do we assess our bridges' health?)

Bridge serviceability is characterized by use of a numerical assessment called the Sufficiency Rating. Sufficiency Ratings vary from 0 to 100. A 100 Sufficiency Rating represents a bridge with no deficiencies. Prior to MAP-21 implementation, the sufficiency rating was primarily used to determine eligibility for federal funding; it is also used to assess the overall condition of a bridge and assists in the prioritization of bridge preservation efforts.

The condition assessment is based upon a physical inspection of the structure. The deleterious effects of age, environment, fatigue, hydrologic scour, settling, and traffic collisions are assessed in the evaluation. Every bridge in Nevada is inspected at least once every two years.

Bridges in poor condition are inspected more often. Inspection findings are factored into the determination of the bridge load, condition and sufficiency ratings.

The load rating denotes the strength of the bridge compared to design-truck loading. Structures with low condition or load rating may be classified as “structurally deficient.” Structurally deficient bridges are not necessarily unsafe or dangerous. Rather, these bridges become a priority for corrective measures, and may be posted to restrict the weight of vehicles using them. If a deficiency is determined to be severe, or the load carrying capacity is extremely low, the bridge would be closed to protect the travelling public.

NDOT adheres to policies and procedures in accordance with the FHWA’s requirements. The FHWA included the verbiage discussing structurally deficient bridges in a report to Congress entitled “2008 Status of the Nation’s Highways, Bridges, and Transit: Conditions and Performance.” The verbiage was as follows: “*Structurally deficient bridges are not inherently unsafe. Bridges are considered structurally deficient if significant load-carrying elements are found to be in poor or worse condition due to deterioration and/or damage, or the adequacy of the waterway opening provided by the bridge is determined to be extremely insufficient to the point of causing intolerable traffic interruptions. That a bridge is deficient does not imply that it is likely to collapse or that it is unsafe. By conducting properly scheduled inspections, unsafe conditions may be identified; if the bridge is determined to be unsafe, the structure must be closed. A deficient bridge, when left open to traffic, typically requires significant maintenance and repair to remain in service and eventual rehabilitation or replacement to address deficiencies. To remain in service, structurally deficient bridges often have weight limits that restrict the gross weight of vehicles using the bridges to less than the maximum weight typically allowed by statute*.”

Bridge assessments also include appraisal ratings, which measure how well the bridge serves the public, or its functionality. Included in the appraisal ratings are reviews of the deck geometry, under-bridge clearances, waterway adequacy, and approach geometry. Within this appraisal evaluation, a substandard structure is termed “functionally obsolete.” Like structurally deficient bridges, functionally obsolete bridges are able to serve the traveling public. However, functionally obsolete bridges may be more susceptible to congestion, collisions, or flooding because of the restrictive clearances and geometrics. The 2008 FHWA Report included the following verbiage regarding functionally obsolete bridges: "*Functional obsolescence is a function of the geometrics of the bridge in relation to the geometrics required by current design standards. While structural deficiencies are generally the result of deterioration of the conditions of the bridge components, functional obsolescence generally results from changing traffic demands on the structure. Facilities, including bridges, are designed to conform to the design standards in place at the time they are designed. Over time, improvements are made to the design requirements. As an example, a bridge designed in the 1930s would have shoulder widths in conformance with the design standards of the 1930s, but current design standards are based on different criteria and require wider bridge shoulders to meet current safety standards. The difference between the required, current-day shoulder width and the 1930s' designed shoulder width represents a deficiency. The magnitude of these types of deficiencies determines whether a bridge is classified as functionally obsolete*." Although functionally obsolete bridges are generally not as great a concern as structurally deficient bridges, these bridges can also become a priority for corrective measures and may be posted for vehicle size restrictions.

In addition to the Sufficiency Rating, a bridge's susceptibility to seismic activity is considered when assessing its condition or "health." Nevada is the third most seismically active state in the US. Only California and Alaska are more seismically active. The central and western parts of Nevada are the most active, but southern Nevada does have the potential for damaging earthquakes. NDOT has replaced or retrofitted 107 bridge structures at a cost of over $36 million since it began including seismic activity as a component in the project prioritization process. Additionally, NDOT has placed a high priority on 125 more state-owned bridges in need of seismic retrofitting. The cost to upgrade bridges in need of seismic retrofitting is estimated at $55 million.

Generally, bridges with sufficiency ratings more than 80 are considered "good", ratings of between 50 and 80 can be considered "fair", and ratings less than 50 are considered "poor". FIGURE 25 illustrates the condition of bridges in Nevada. Only 1 % of the bridges in Nevada are considered to be in poor condition. NDOT goes above and beyond the requirement in inspecting the bridges. The railroad crossings and the pedestrian structures are not required to be inspected by the Federal Highway Administration. For the sake of public safety, NDOT inspect these bridges, but does not provide any ratings.

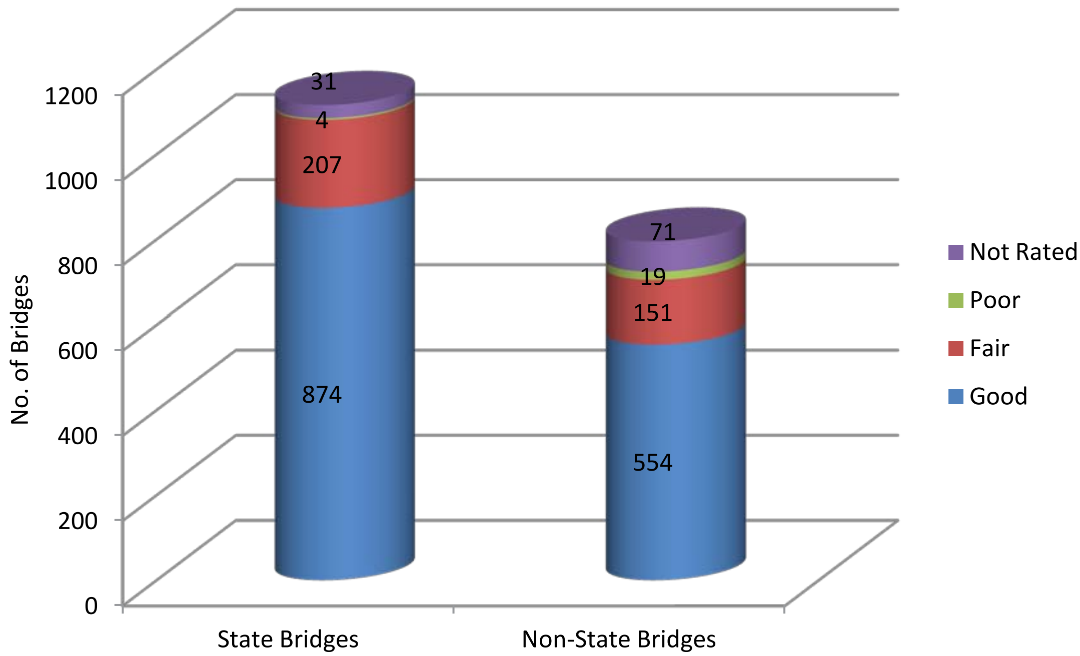


FIGURE 25: Condition of Bridges in Nevada

There are 1,116 bridges on the state-maintained system that were surveyed in 2011. Based on the survey, 142 or 12.7% of the bridges are Functionally Obsolete. Of the bridges surveyed, only 28 bridges are eligible for federal Highway Bridge Program (HBP) funding. The other 114 bridges are not eligible for federal funding. Another 19 or 1.7% of the bridges are Structurally Deficient and are eligible for federal funding.

There are 795 bridges on the locally-maintained system that were surveyed in 2011. Based on the survey, 26 or 3.3% of the bridges are Functionally Obsolete. Of the bridges surveyed, only 17 bridges are eligible for federal Highway Bridge Program (HBP) funding. The other 9 bridges are not eligible for federal funding. Another 18 or 2.3% of the bridges are Structurally Deficient and eligible for federal funding. FIGURE 26 summarizes the substandard bridge conditions on the state- and locally-maintained bridge network and eligibility for federal funding.

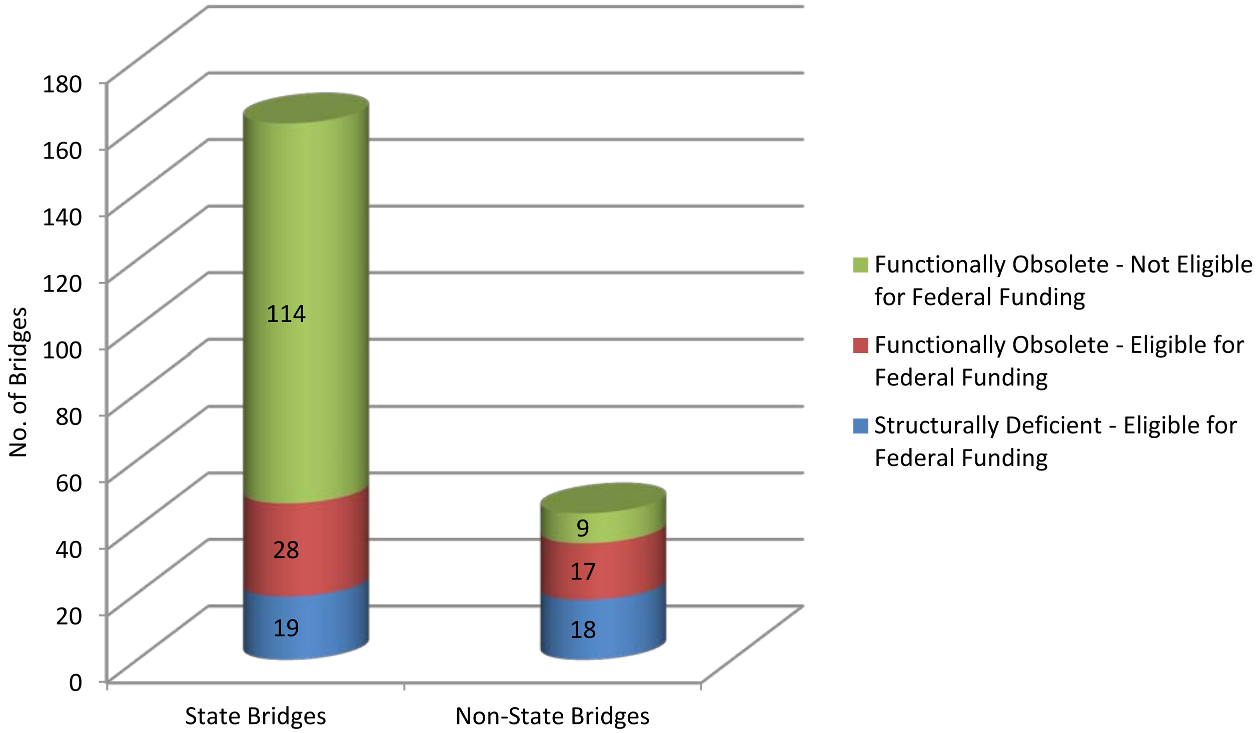


FIGURE 26: Substandard Bridges and Funding Eligibility

Nevada bridge conditions compare very favorably to the bridge conditions in many other states. Nevada's advantageous environment along with the relatively "young" age of the bridges contributes to the encouraging results. Most bridges have a service life of at least 50 years. Recently built bridges are expected to have a design life of 75 years. This prolonged design life was achieved by improvements in material, design, and construction methods. FIGURE 27 shows the age distribution of the State's bridges grouped by decade in which the bridge was originally constructed.

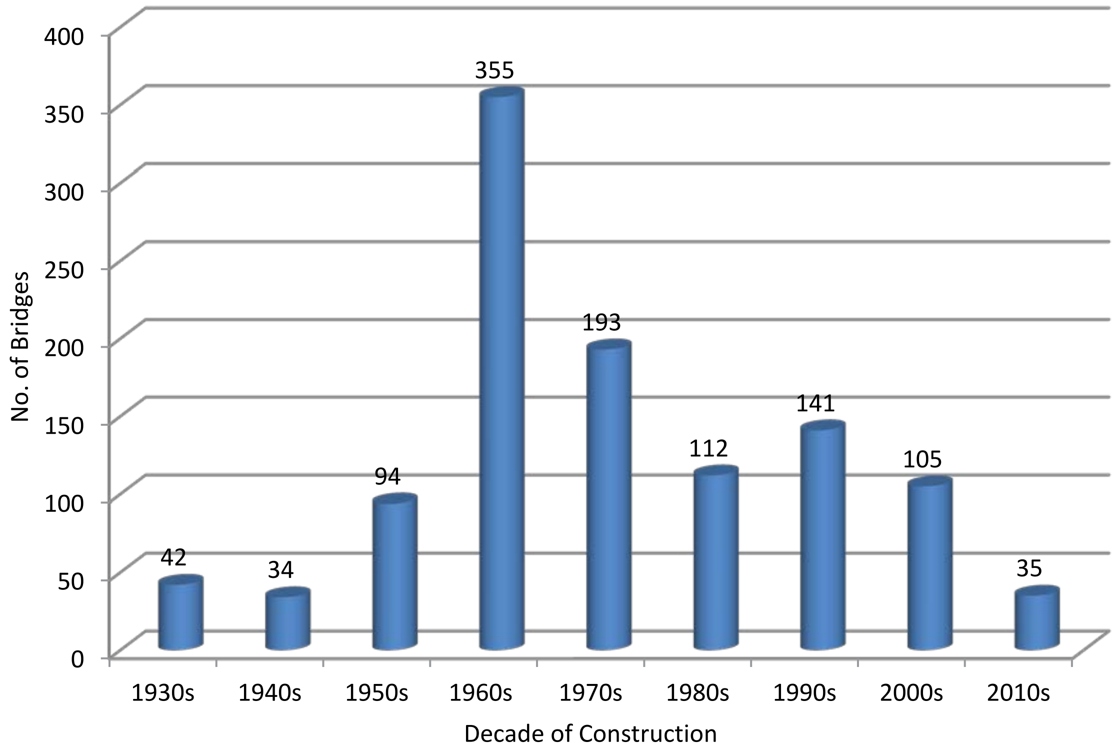


FIGURE 27: State Bridges, Decade of Construction

FHWA categorizes deficient bridges as either Structurally Deficient or Functionally Obsolete.

Bridges are considered **Structurally Deficient** if:

- Significant load-carrying elements are found to be in poor condition.
- Has insufficient load carrying capacity & may have weight limits to remain in service. (See picture on the right.)
- More susceptible to flooding with significant traffic impacts.

Example of Structurally Deficient Bridge

Bridges are considered **Functionally Obsolete** if:

- Original design geometrics such as shoulder width, lane width, lateral clearance and vertical clearance do not meet current standards. (See pictures below.)

- They may be more susceptible to congestion, collisions, or flooding because of the restrictive clearances and geometrics.

Examples of Functionally Obsolete Bridges

Due to the fact that these terms cause undue concern, FHWA is considering changing the terminology. These terms do not imply that the bridge is unsafe. Safety and maintenance concern are identified during regularly scheduled inspections.

FIGURES 28A, 28B, 28C, 28D, and 28E locate the Functionally Obsolete and Structurally Deficient bridges in the State's bridge inventory.

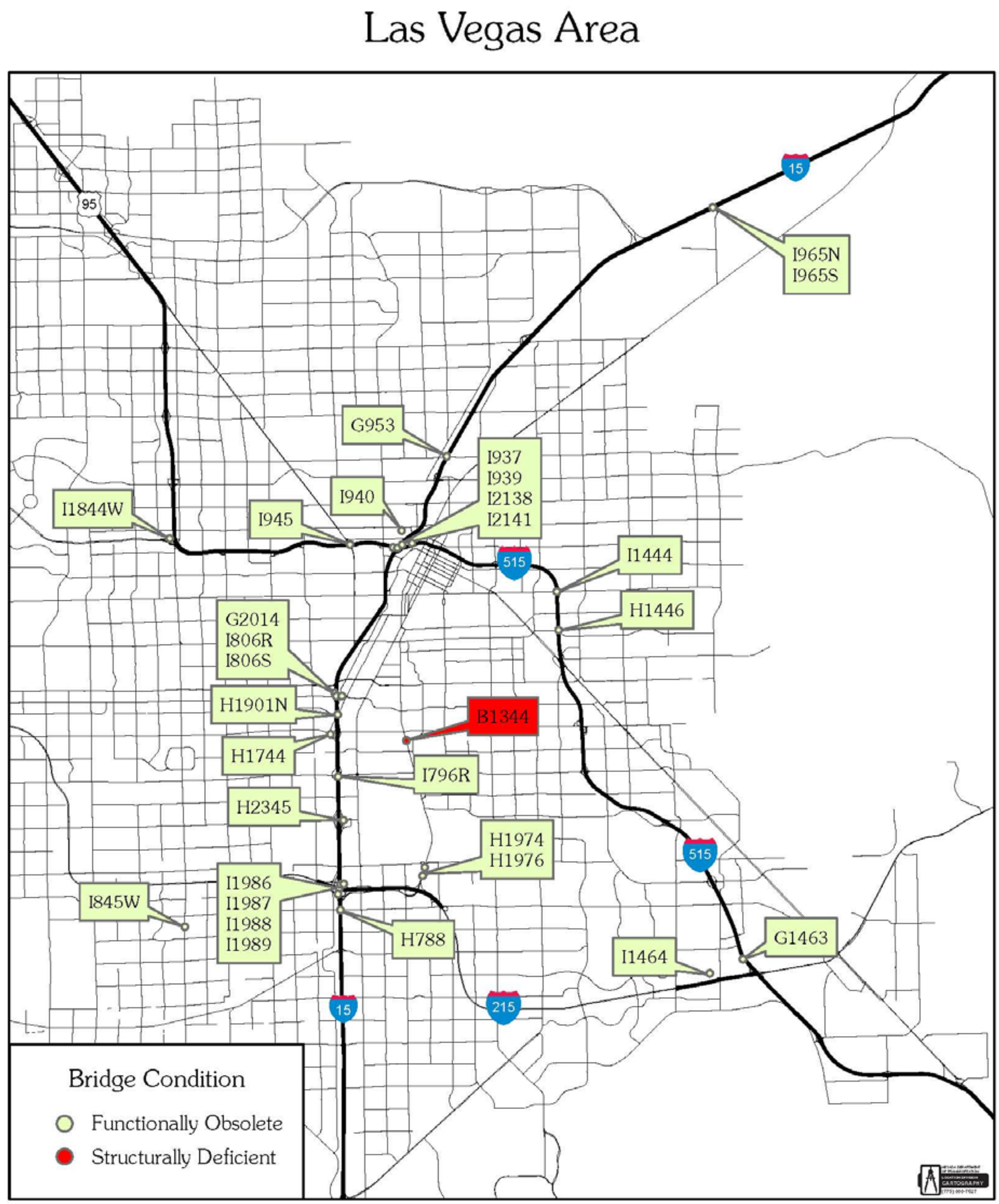


FIGURE 28A: Locations of Structurally Deficient and Functionally Obsolete Bridges

(Bridges categorized as structurally deficient or functionally obsolete may have less than desirable load carrying capacity or geometrics, but are not considered unsafe. Please refer to discussion in the Bridge Condition Survey, P.57-58.)

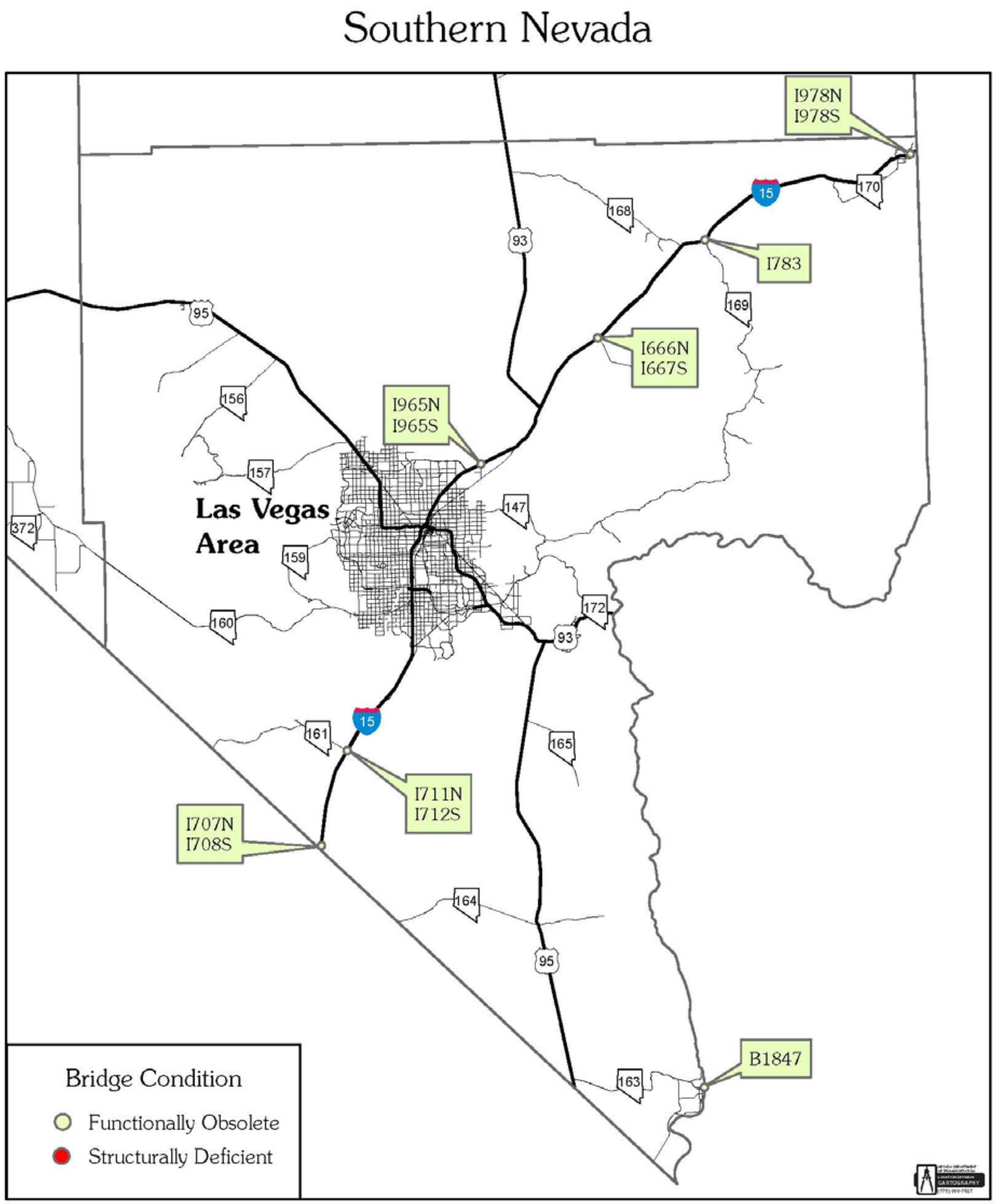


FIGURE 28B: Locations of Structurally Deficient and Functionally Obsolete Bridges

(Bridges categorized as structurally deficient or functionally obsolete may have less than desirable load carrying capacity or geometrics, but are not considered unsafe. Please refer to discussion in the Bridge Condition Survey, P.57-58.)

Reno Area

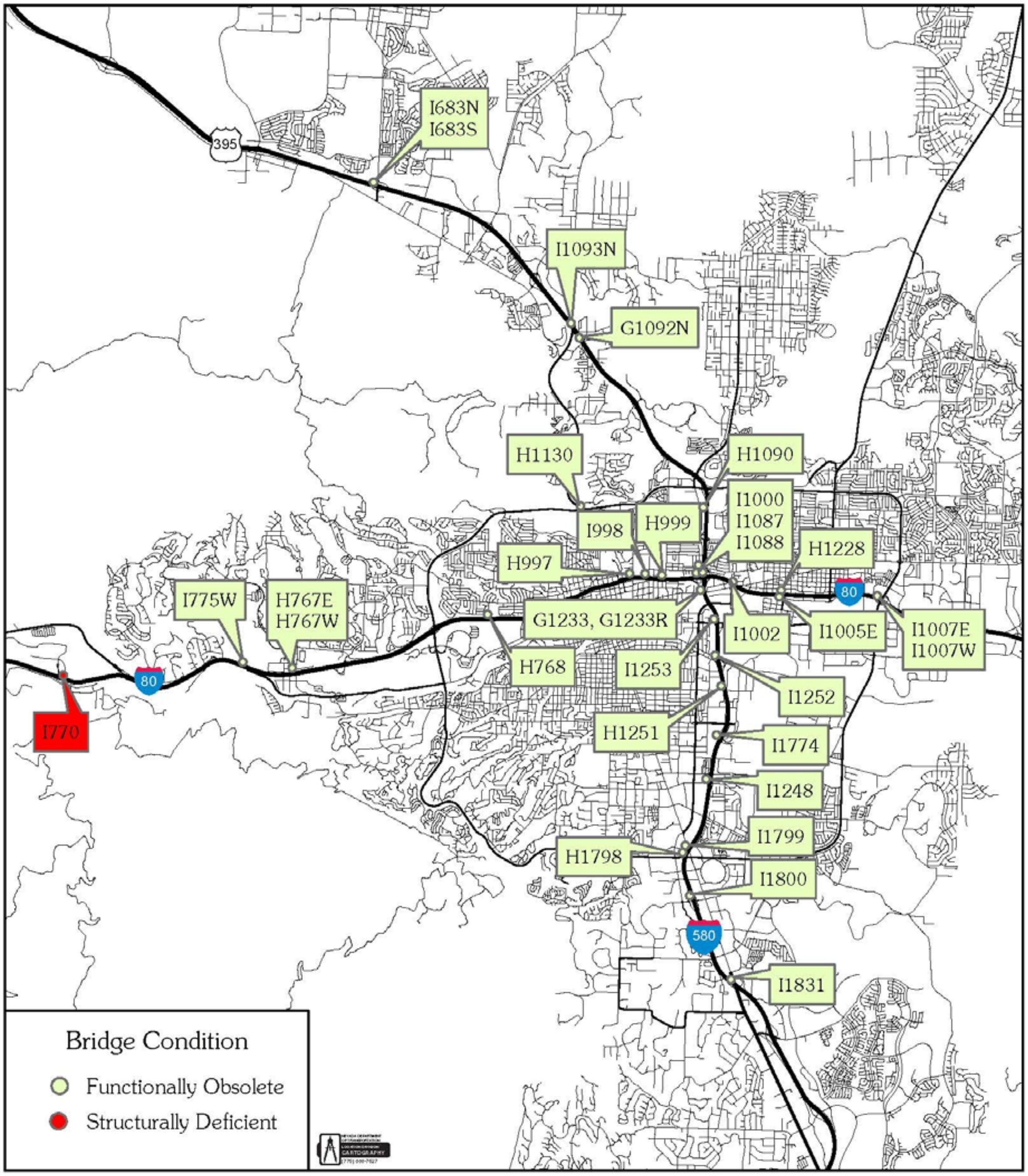


FIGURE 28C: Locations of Structurally Deficient and Functionally Obsolete Bridges

(Bridges categorized as structurally deficient or functionally obsolete may have less than desirable load carrying capacity or geometrics, but are not considered unsafe. Please refer to discussion in the Bridge Condition Survey, P.57-58.)

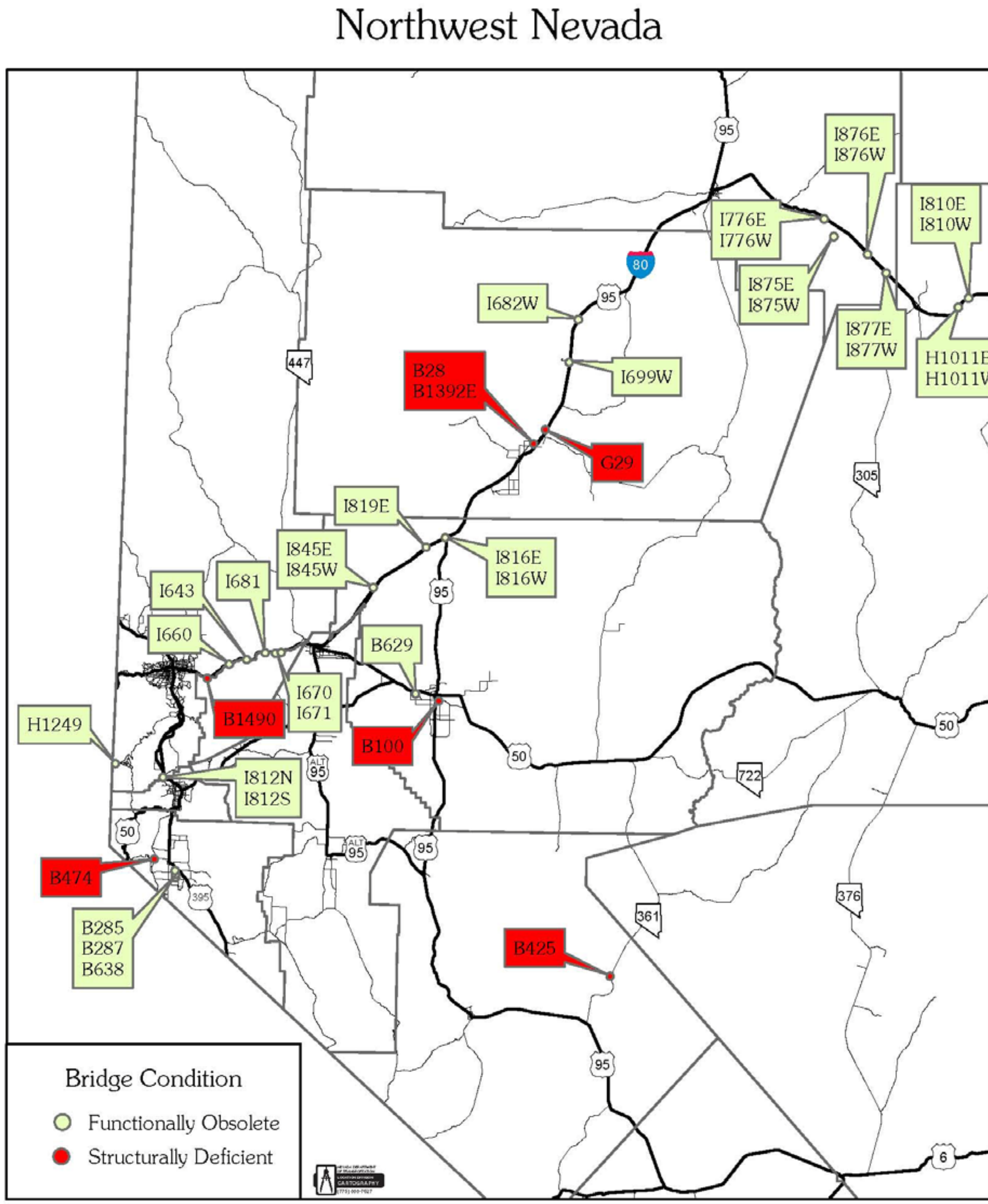


FIGURE 28D: Locations of Structurally Deficient and Functionally Obsolete Bridges

(Bridges categorized as structurally deficient or functionally obsolete may have less than desirable load carrying capacity or geometrics, but are not considered unsafe. Please refer to discussion in the Bridge Condition Survey, P.57-58.)

Northeast Nevada

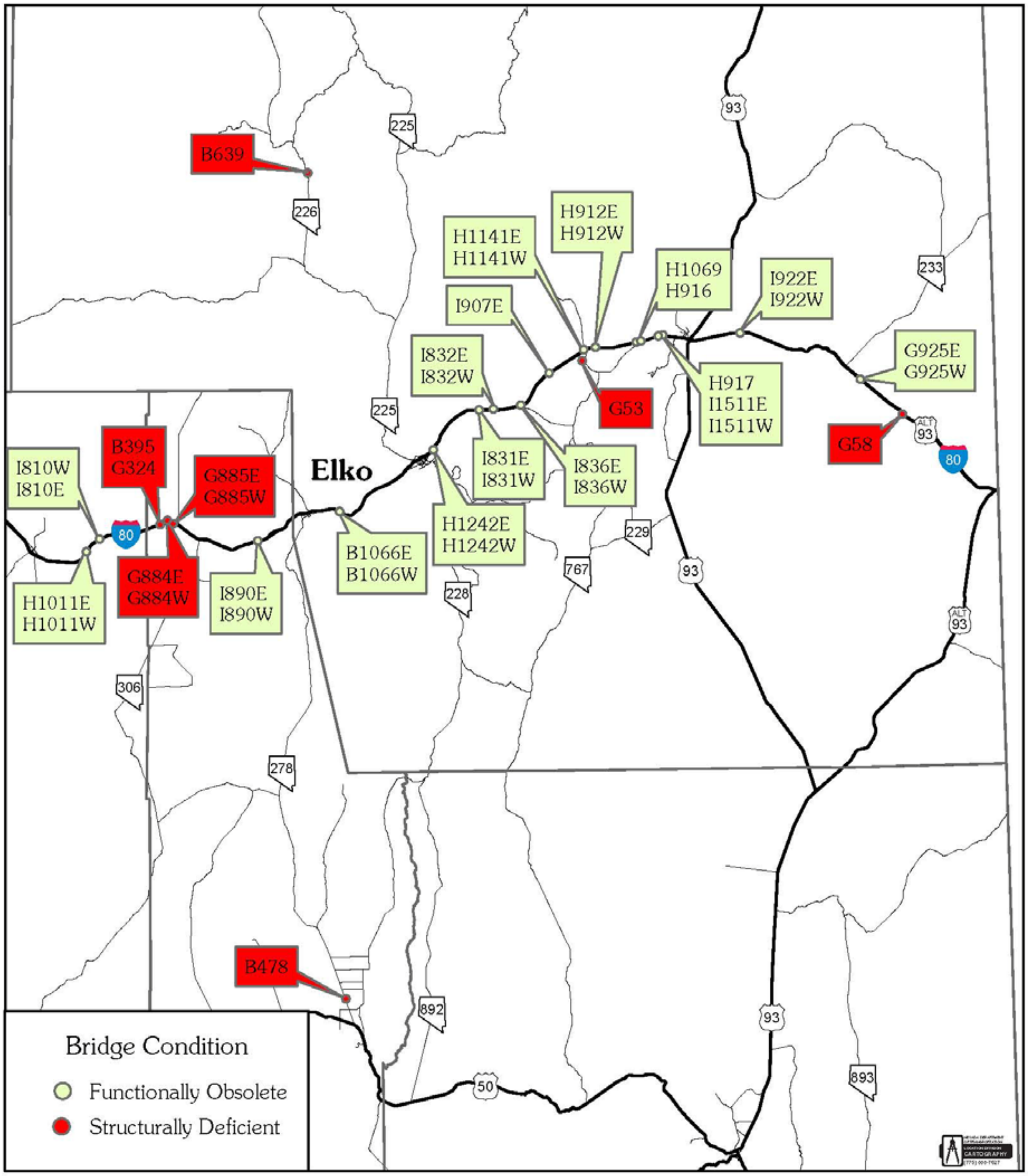


FIGURE 28E: Locations of Structurally Deficient and Functionally Obsolete Bridges

(Bridges categorized as structurally deficient or functionally obsolete may have less than desirable load carrying capacity or geometrics, but are not considered unsafe. Please refer to discussion in the Bridge Condition Survey, P.57-58.)

Bridge Condition over Time

(How has our bridge condition changed?)

FIGURE 29: Conditions of State Bridges illustrates bridge conditions grouped by good, fair, and poor categories. The number of bridges in each category has remained fairly stable since 1996. FIGURE 30 shows that the numbers of Functionally Obsolete and Structurally Deficient bridges eligible for federal funding have decreased significantly from 1996 through 2012.

FIGURE 31: Conditions of Local Bridges demonstrates that the condition of locally-maintained bridges has retained a similar proportion of good, fair, and poor bridge conditions in comparison to the total number of bridges surveyed from 1996 through 2012. These conditions slightly improved over the years despite the fact that there were over two times as many bridges surveyed in 2012 as compared to 1996. FIGURE 32 depicts the number of Functionally Obsolete and Structurally Deficient locally-maintained bridges that are eligible for federal funding.

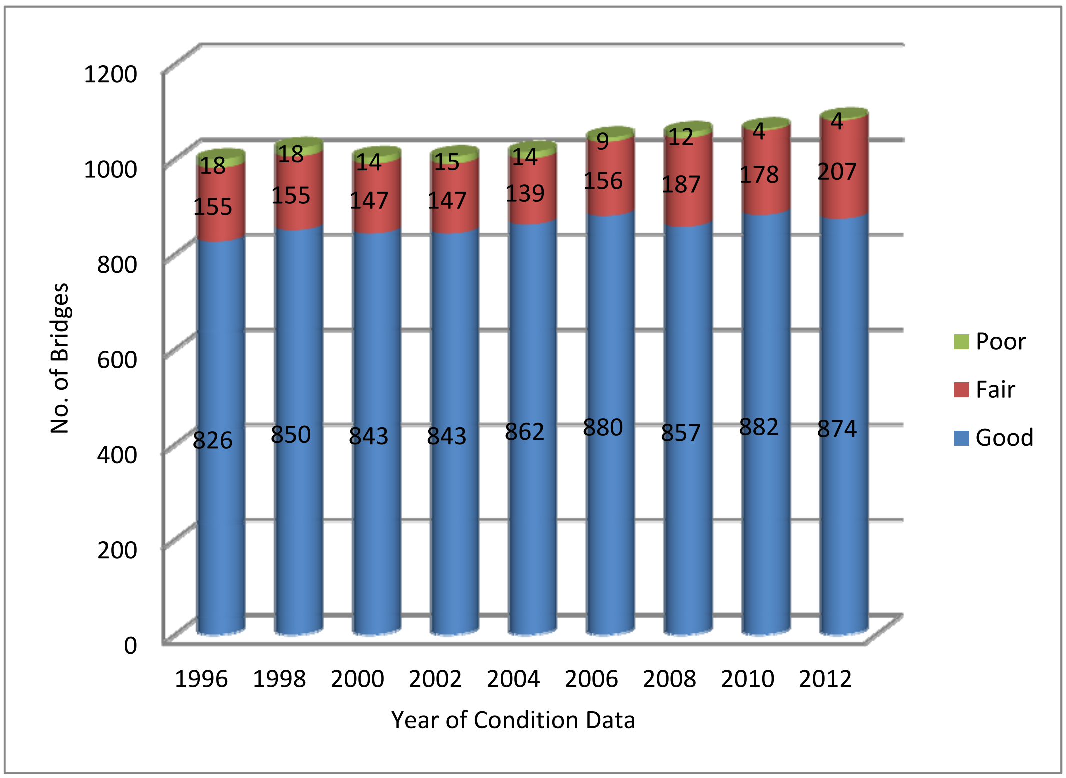


FIGURE 29: Conditions of State Bridges

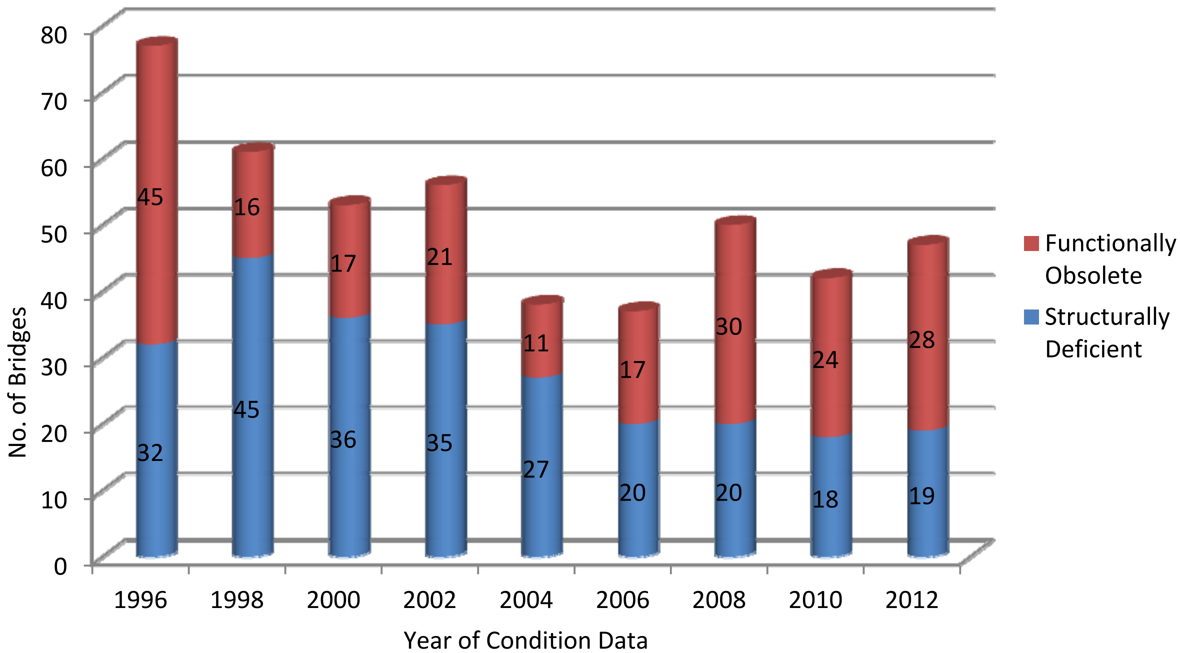


FIGURE 30: Substandard State Bridges Eligible for Federal Funding

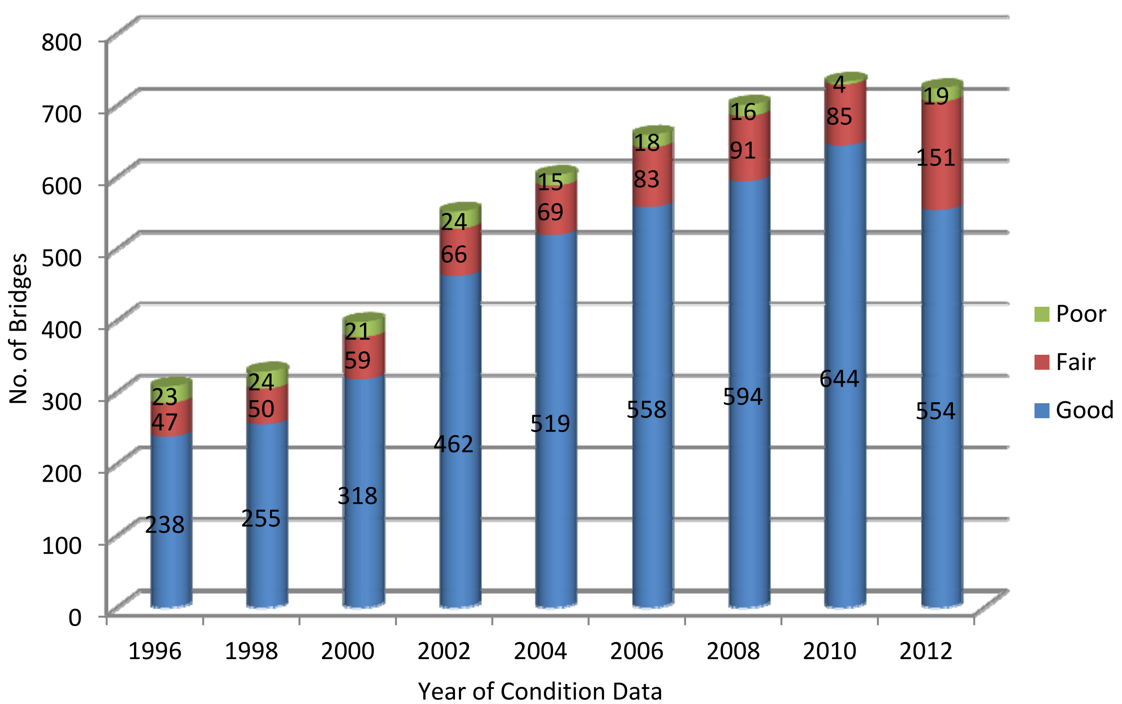


FIGURE 31: Conditions of Local Bridges

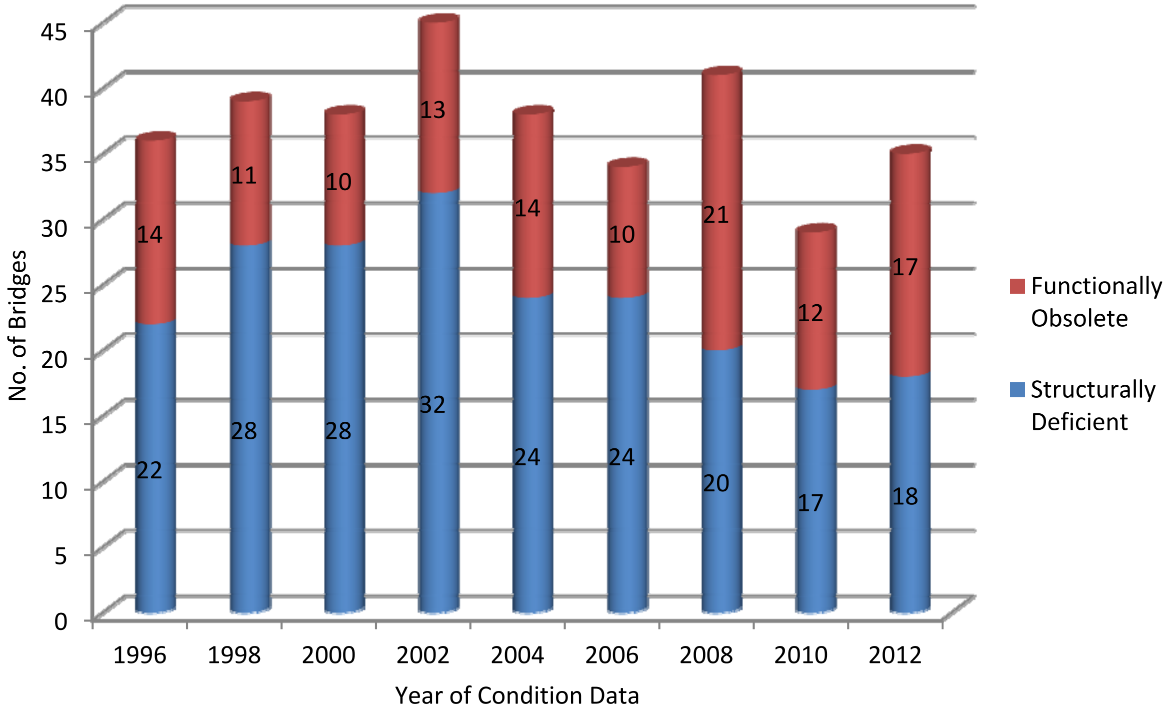


FIGURE 32: Substandard Local Bridges Eligible for Federal Funding

THE COST OF BRIDGE CLOSURE FOR OWNERS

(What will a bridge closure cost?)

FIGURES 28A through 28E show the Structurally Deficient and Functionally Obsolete bridge locations. The deficient and obsolete bridges are primarily located on I-15 in Las Vegas and I-80 and US-395 in Reno. These routes connect Nevada with the rest of the country and carry hundreds of thousands of automobiles and trucks on a daily basis. If closure of a bridge in rural Nevada was required, the detour might add a few` hundred additional miles to the travelers' journeys. A bridge closure and subsequent detours in urban areas will create extensive traffic jams and cause additional vehicle crashes. In both rural and urban bridge closures, the user costs due to travel delay or crashes will be quite significant until the bridge is reconstructed or repaired. Often, user costs due to delay or crashes can be in the hundreds of thousands of dollars per day. The importance of bridge maintenance and rehabilitation cannot be overemphasized.

The Nevada Interstates carry more than 100,000 vehicles daily in the Northern Nevada urban area and approximately 250,000 in the Southern Nevada urban area. The economic impacts of a bridge closure and subsequent activities are widespread. For example, the nationally reported bridge collapse in Minneapolis, Minnesota in 2007 had an economic impact on the state totaling $17 million in 2007 and $43 million in 2008 due to additional user costs. The additional user costs were estimated at $247,000 per day due to added travel time. The Minneapolis Bridge carried 140,000 vehicles daily before the collapse. This account does not include the compensations to the deceased and injured and the law suit expenses.

PROJECT PRIORITIZATION

(How do we select individual projects that assure efficient utilization of limited financial resources?)

The bridge preservation program competes for funding with capacity improvement, operations, pavement, hydraulic, and safety projects and programs. Since available funding is never unlimited, Engineers prioritize projects in such a manner that will improve the condition of the entire bridge infrastructure network while maximizing bridge performance and keeping costs to a minimum.

Bridge projects are developed and prioritized based upon bridge condition (sufficiency ratings and Structurally Deficient and Functionally Obsolete status), essentiality for public needs (NHS status, ADT, and ADTT etc...), and association of other ongoing project work at the same location (pavement rehabilitation work etc…). Seismic retrofit work is prioritized based on a bridge’s earthquake vulnerability and importance. The seismic vulnerability of all state-owned bridges has been investigated. Certain bridge types, such as large culverts, do not need seismic retrofit.

STATE BRIDGE PRESERVATION FUNDING

(How do we fund State bridge preservation?)

Similar to pavement rehabilitation, bridge work is paid for with fuel taxes and vehicle registration fees. Historically, available funding has only been sufficient to offset annual preventive/corrective maintenance costs.

Federal funds are available for bridge replacement, rehabilitation, or seismic retrofits. To qualify for replacement, the bridge must be either Functionally Obsolete or Structurally

Deficient and have a sufficiency rating less than 50. To qualify for rehabilitation, the bridge must be either Functionally Obsolete or Structurally Deficient and have a sufficiency rating less than 80. Typically, about 82% of federal funds are spent on bridge replacement and rehabilitation and about 18% of federal funds are spent on seismic retrofit work.

Under federal funding guidelines, off-system bridges must receive a minimum of 15% of the available federal funds. Bridges are described as off-system when the bridges are not located on the federal aid highway system. Off-system roads include Rural Minor Collector and Rural and Urban Local roads. Bridges are described as on-system when the bridges are located on the federal aid highway system. The Interstate, Urban Collector, and Rural Minor Arterial roads are included in the federal aid highway system. Of the 1,116 state-maintained bridges, 1,039 bridges are on-system and 77 bridges are off-system. Of the 795 county, city, private, and other local bridges, 429 bridges are on-system and 366 bridges are off-system.

Biennial Expenditures for Fiscal Years 2011 to 2012

(What have we expended on bridges in the last two years?)

TABLE 8 lists approximately $22 million worth of bridge preservation work that NDOT obligated in fiscal years 2011 and 2012.

TABLE 8: Bridge Expenditures in Fiscal Years 2011 and 2012

	Repair Strategy					
Fiscal Year	**Preventive Maintenance**	**Corrective Maintenance**	**Rehabilitation**	**Replacement**	**Seismic Retrofit**	**Total**
2011	$1,135,767	$4,206,940	$0	$1,108,000	$3,901,444	$10,352,151
2012	$1,308,338	$5,743,660	$4,312,582	$570,000	$0	$11,934,580
Biennium Total	$2,444,105	$9,950,599	$4,312,582	$1,678,000	$3,901,444	$22,286,731

TABLE 9 lists the numbers of bridges that NDOT rehabilitated, replaced, or seismically retrofitted during the last biennium for fiscal years 2011 and 2012.

TABLE 9: Numbers of Bridges Rehabilitated, Replaced, or Seismically Retrofitted in Fiscal Years 2011 and 2012

Fiscal Year	Entity	On Federal-Aid System?	Repair Strategy: Rehabilitation	Replacement	Seismic Retrofit	Total
2011	State	On-System		2	3	
	Local/Other	On-System				
		Off-System				
2012	State	On-System	5			
	Local/Other	Off-System		1		
		Total	**5**	**3**	**3**	**11**

Backlog of Bridge Preservation Work

(What will it cost to bring the bridges to excellent condition?)

Ideally, bridges maintained in fair or good condition for as long as possible will extend bridge service life and reduce the need for bridge replacement. Currently, a $126 million project backlog for bridge preservation work exists. Bridge preservation includes repair strategies such as corrective maintenance, rehabilitation, and replacement work.

TABLE 10 lists the backlog of currently needed bridge repair work. Preventive maintenance needs are not included in the bridge project backlog because this work is performed using routine-maintenance funds.

TABLE 10: Backlog of Bridge Work, State Bridges 2013

(Based on 2011 Condition Data)

System	Repair Strategy Required: Corrective Maintenance	Rehabilitation	Replacement	Seismic Retrofit	Total
Principal Arterial - Interstate	$18,720,000	$9,000,000		--	$27,720,000
Principal Arterial - Non-Interstate	$7,000,000	$9,300,000		--	$16,300,000
Minor Arterial	$3,040,000	$4,500,000		--	$7,540,000
Major Collector	$4,120,000	$5,100,000		--	$9,220,000
Minor Collector & Local	$2,080,000	$3,000,000	$4,663,250	--	$9,743,250
System Not Identified				$55,000,000	$55,000,000
Total	**$34,960,000**	**$30,900,000**	**$4,663,250**	**$55,000,000**	**$125,523,250**

Present Funding Versus Needed Funding

(How much financial resource do we have? What will it take to bring the bridges to excellent Condition?)

The majority of the state-maintained bridges were built in the 1960s through the 1980s. Since bridges normally have a useful service life of 50 years, it can be estimated when the bridges will become due for major rehabilitation or replacement (Recently built bridges have a service life of 75 years). FIGURE 33 illustrates that many bridges become due for major rehabilitation or replacement beginning in 2013.

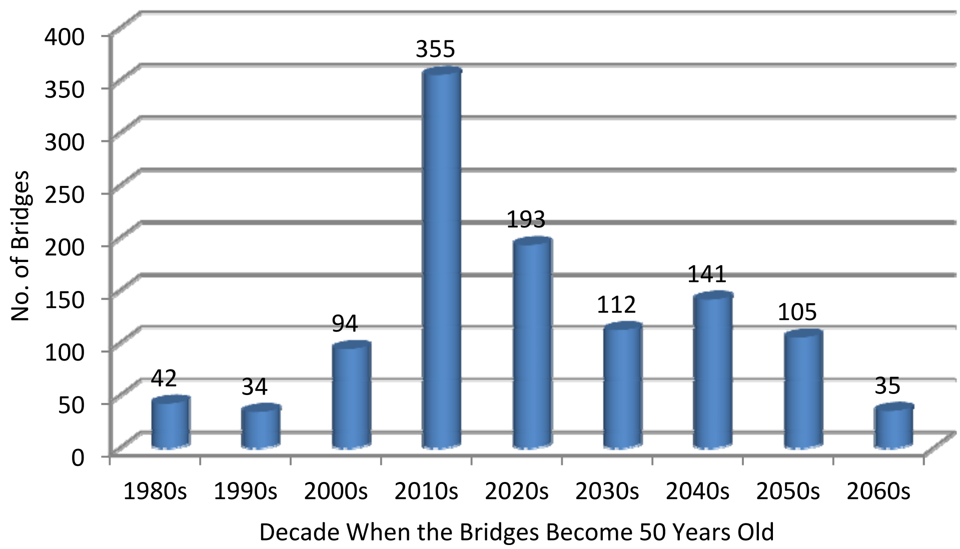


FIGURE 33: 50 Year Old Bridges

Under the present user-fee structure, the current $126 million project backlog of bridge work will increase gradually to $152 million in 2025. The needed funding scenario, which requires moderate revenue increases in future years, will eliminate the backlog in 2025 if funding is provided. FIGURE 34 highlights a comparison between the backlog if needs remain unfunded versus the backlog if funding becomes available. TABLE 11 lists the backlog and costs for both present funding levels and needed funding levels for bridge repair work. The table shows the incremental increase or decrease in funding needs depending upon whether funding is provided or not. If funding is not provided, the backlog will continually exist. If additional funding is provided, the backlog can be eliminated in 2025.

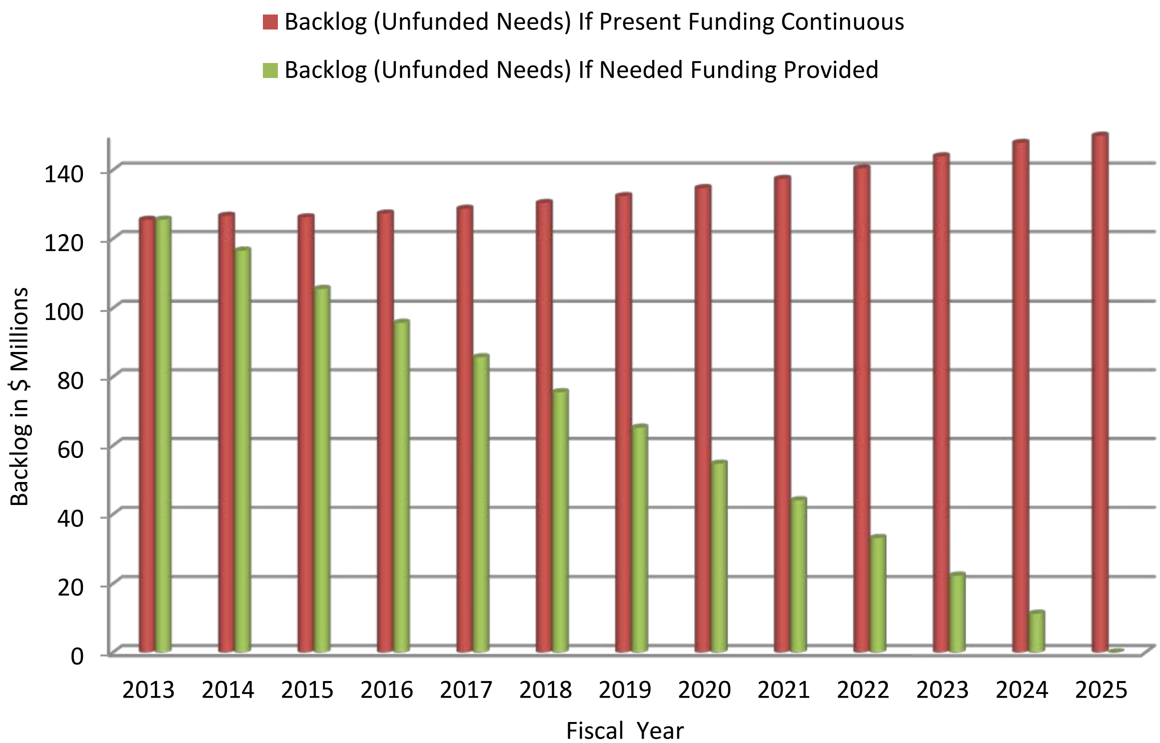


FIGURE 34: Backlog of Bridge Preservation Work with Present Funding vs. Needed Funding

BRIDGE PRESERVATION ACTION PLAN

(How will we improve our bridges? How do we prioritize available resources? What are the financial resources needed?)

NDOT's bridge preservation action plan is similar to plans detailed in previous State Highway Preservation Reports. The action plan is to preserve Nevada's public bridges in good condition by implementing the following bridge management practices:

- Replace or rehabilitate Structurally Deficient bridges before the bridges become hazardous or overly burdensome to users.
- Replace or rehabilitate Functionally Obsolete bridges before the bridges become hazardous or overly burdensome to users.
- Seismically retrofit bridges that do not meet current seismic standards.
- Apply timely repair strategies to existing structures.
- Apply consistent preventive maintenance strategies to existing structures.

TABLE 11: Bridge Backlog, Costs, and Funding

State-Maintained System - 2013 - 2025 (in millions of dollars)

With Present Funding

Fiscal Year	Backlog of Bridge Work	Bridge Preservation Costs * (Normal Annual Deterioration Costs)			Bridge Preservation Funds ** (Funds Planned for Preservation Work)				
		Corrective Maintenance, Rehabilitation, Replacement	Preventive Maintenance	Total	State Corrective Maintenance, Rehabilitation, Replacement	Federal Corrective Maintenance, Rehabilitation, Replacement	State Preventive Maintenance		Total
2013	$125.5	$12.3	$1.2	$13.5	$5.1	$6.0	$1.2		$12.3
2014	$126.7	$13.0	$1.3	$14.2	$5.6	$7.8	$1.3		$14.7
2015	$126.2	$13.7	$1.3	$15.0	$5.2	$7.4	$1.3		$13.9
2016	$127.3	$14.5	$1.3	$15.8	$5.4	$7.7	$1.3		$14.4
2017	$128.7	$15.3	$1.4	$16.7	$5.6	$8.0	$1.4		$15.0
2018	$130.4	$16.2	$1.4	$17.6	$5.8	$8.3	$1.4		$15.6
2019	$132.4	$17.1	$1.5	$18.5	$6.1	$8.7	$1.5		$16.2
2020	$134.7	$18.0	$1.5	$19.5	$6.3	$9.0	$1.5		$16.8
2021	$137.4	$19.0	$1.5	$20.6	$6.6	$9.4	$1.5		$17.5
2022	$140.5	$20.1	$1.6	$21.7	$6.8	$9.7	$1.6		$18.2
2023	$144.0	$21.2	$1.6	$22.8	$7.1	$10.1	$1.6		$18.9
2024	$147.9	$22.3	$1.7	$24.0	$7.4	$10.5	$1.7		$19.6
2025	$152.3								

With Needed Additional Funding

Fiscal Year	Backlog of Bridge Work	Bridge Preservation Costs * (Normal Annual Deterioration Costs)			Bridge Preservation Funds ** (Funds Planned & Needed for Preservation Work)				
		Corrective Maintenance, Rehabilitation, Replacement	Preventive Maintenance	Total	State Corrective Maintenance, Rehabilitation, Replacement	Federal Corrective Maintenance, Rehabilitation, Replacement	State Preventive Maintenance	Needed Additional Funds	Total
2013	$125.5	$12.3	$1.2	$13.5	$5.1	$6.0	$1.2	$10.1	$22.5
2014	$116.5	$13.0	$1.3	$14.2	$5.6	$7.8	$1.3	$10.5	$25.2
2015	$105.6	$13.7	$1.3	$15.0	$5.2	$7.4	$1.3	$11.0	$24.9
2016	$95.7	$14.5	$1.3	$15.8	$5.4	$7.7	$1.3	$11.4	$25.8
2017	$85.7	$15.3	$1.4	$16.7	$5.6	$8.0	$1.4	$11.9	$26.9
2018	$75.5	$16.2	$1.4	$17.6	$5.8	$8.3	$1.4	$12.3	$27.9
2019	$65.2	$17.1	$1.5	$18.5	$6.1	$8.7	$1.5	$12.8	$29.0
2020	$54.7	$18.0	$1.5	$19.5	$6.3	$9.0	$1.5	$13.3	$30.2
2021	$44.1	$19.0	$1.5	$20.6	$6.6	$9.4	$1.5	$13.9	$31.4
2022	$33.3	$20.1	$1.6	$21.7	$6.8	$9.7	$1.6	$14.4	$32.6
2023	$22.3	$21.2	$1.6	$22.8	$7.1	$10.1	$1.6	$15.0	$33.9
2024	$11.2	$22.3	$1.7	$24.0	$7.4	$10.5	$1.7	$15.6	$35.2
2025	$0.0								

* Inflation assumed at 3.00% per annum.
** Revenue growth rate assumed is 4.00% per annum.

Note: Backlog of Bridge work is as of beginning of fiscal year; preservation costs are those incurred during the fiscal year; and preservation funds are those that are available during the fiscal year.

BRIDGE RESEARCH

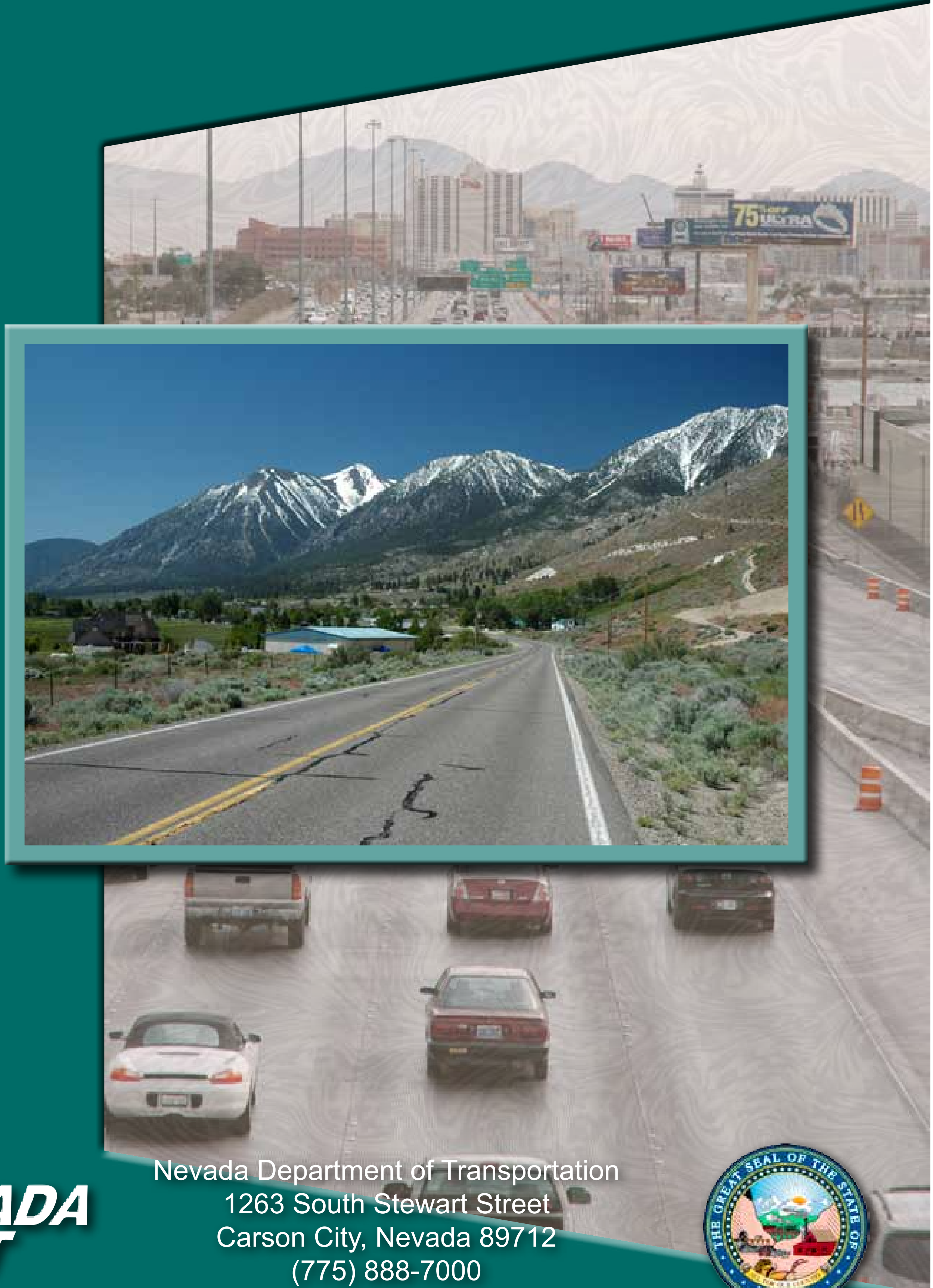
(What research are we doing towards safe and long lasting bridges?)

Since bridges represent a major capital investment, we must do what we can to make them perform as well and as long as possible. A research study involving physical testing of scale models of bridge columns at the University of Nevada – Reno was recently completed to evaluate enhancements to column construction details in order to minimize earthquake damage and resultant bridge closures. New research projects have been initiated to study the use of engineered cement-like composite materials for bridge deck overlays and to study the incidence of cracking in the webs of post-tensioned concrete bridges. Field trial installations are continuing for new products/materials that demonstrate significant potential for improving bridge performance and providing bridge protection. Applications currently under study include bridge deck protective overlay and membrane systems and bridge expansion joint systems.

SUMMARY

The State has enjoyed the benefit of favorable bridge conditions as compared to the bridge conditions in many other states for quite a while. Nevada's favorable environment, along with the relatively "young" age of the bridges, has contributed to the encouraging results. However, bridge assets are aging. 355 bridges will become at least 50 years old in the years from 2010 through 2019. Another 193 bridges will become 50 years old in the years from 2020 through 2029. After the useful service life of 50 years, costs for major rehabilitation or replacement rise as bridges require more than corrective maintenance strategies. The aging bridges will add an additional strain on present funding allocations. Backlog will continue to exist unless moderate revenue increases are committed to bridge preservation efforts.

STATE HIGHWAY PRESERVATION REPORT



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