Nye County
Streets & Highways Plan
2019 Update

November 2019

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November 18, 2019

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1.0 EXECUTIVE SUMMARY

In 2017, the County contracted Lumos to update the 1993 Nye County Streets & Highway Plan (NCSHP) and 2004 Nye County Road Inventory & Pavement Assessment Report (NCRIPAR) by analyzing pavement condition ratings completed by the County, calculating future projections for pavement conditions and maintenance costs, providing maintenance treatment recommendations, and recommending a Capital Improvement Plan for future work on asphalt concrete pavement within Nye County. This report serves as an update to the 2017 Nye County Streets & Highway Plan.

1.1 Findings

- The pavement condition evaluation has determined the Nye County AC roadway network is currently in poor condition, with an average weighted PCI of 48.
- Several work plan scenarios were completed to estimate the effects of the maintenance and repair budget on the future conditions of the roadway network. The results are as follows:
    - In the "Do Nothing Scenario", no maintenance is performed on the County's pavement network over the next 3 years. The projected PCI would deteriorate from a 48 in 2019 to a 43 in 2022. Deferred maintenance would increase from $229 million in 2019 to $245 million in 2022.
    - At the current budget of $4.25 million, it is estimated that the roads will continue to deteriorate from a PCI of 48 in 2019 to a PCI of 45 in 2022. Deferred maintenance will steadily increase from $225 million after planned maintenance is applied, to $231 million in 2022.
    - To maintain the current PCI in the near term, Nye County should budget $10 million per year (unadjusted for inflation) on maintenance and repair needs. Over time, the County's PCI will start to gradually increase due to decreased deferred maintenance quantities.

1.2 Recommendations

Nye County should continue to update the PAVER database to reflect current pavement conditions. Recommendations for additional PAVER database improvements are as follows:

- Determine actual or estimated construction dates for all pavement sections that currently have original construction dates (OCDs) of 1900. Currently only 30% of the street sections in the Nye County database have accurate OCDs. Inaccurate OCDs negatively impact PAVER's projected PCIs, deferred maintenance, budget calculations, PCI deterioration families and the sections to which those families are assigned. The deterioration curves are built from a pavement section's age and inspected PCIs. Increasing the amount of sections with accurate OCDs will increase the likelihood that PAVER's projections will properly reflect current and future pavement conditions, budget calculations, and deferred maintenance costs.
- Develop a quality control (QC) plan for data collection and input. A typical QC plan would include:
    - Assign QC staff to oversee data collection and input activities.
    - Annual pavement distress identification training in accordance with ASTM D6433 for all inspectors and QC staff.
    - Develop an inspection "calibration" process which would include:
        - Inspections by all inspectors and QC staff performed on a pre-determined selection of streets.

        - Compare distress types and quantities collected to assist in correcting inconsistencies in the collected data and to identify any additional training needs.
    - Set limits for variations that would initiate additional analysis by QC staff, such as:
        - New roadway sections with low PCI's
        - Old roadway sections with high PCI's
        - Sections with high standard deviations (±10 PCI points) between sample units. Inspection audits that differ by greater than 5 PCI.
    - Utilize PAVER's data validation reporting tools to analyze data input activities.
- Properly link inspection inventory to the GIS files within PAVER. By properly mapping inspection results, future projections and maintenance work plans with shape files (.shp) can be provided by PAVER saving the County time and effort in future pavement management projects.
- As pavement management projects are completed, the County should continue to enter these projects and costs into PAVER.
- Use PAVER to produce an inspection schedule. Lumos recommends querying the database for sections that have not been inspected for a period of at least three years.

2.0 INTRODUCTION

2.1 Nye County Background

Nye County is the largest County by area in the state of Nevada at 18,199 square miles, and the third largest County by area in the United States. As of the most recent US Census Data (2010), the total population of Nye County is 43,946. The County is comprised of several unincorporated towns, which includes Beatty, Gabbs, the County seat of Tonopah, and the largest unincorporated town of Pahrump. Other communities within Nye County include Amargosa Valley, Belmont, Carvers, Crystal, Manhattan, and Round Mountain. A majority of the land (approximately 93%) within Nye County is federally owned, with a large block of land dedicated to the Tonopah Test Range, Nellis Air Force Range, and the Nevada Test Site. This area of federally owned land in south central Nye County restricts the development of north/south public transportation routes through the County.

The Town of Pahrump is located in the southeast corner of Nye County, adjacent to the California-Nevada border and approximately 60 miles west of Las Vegas. At a population of 36,441, Pahrump comprises almost 83% of the total population within Nye County. From the year 1990 to 2010, Pahrump had grown 520%; however, based on recent US Census estimates, growth in Pahrump has been stagnant since 2010. Because of the large total population percentage in Pahrump compared to the remainder of the County, a majority of the pavement management work is focused in Pahrump.

2.2 Pavement Management History

In 1993, the County commissioned Lumos to prepare the Nye County Street and Highway Plan (NCSHP). The purpose of the 1993 NCSHP was to produce a plan that served as a comprehensive management tool, enabling the County to make objective and informed decisions relative to the maintenance and growth of the County's roadway network, while providing the necessary information to allocate maintenance funds in an economical and equitable manner. The 1993 NCSHP inventoried and analyzed roadway structures, drainage structures and traffic control devices to forecast maintenance needs and developed a Roadway Management System to properly plan for future maintenance.

As an update to the 1993 NCSHP, Lumos prepared the Nye County Road Inventory and Pavement Assessment (NCRIPA) in 2004. The 2004 Report updated and modernized portions of the 1993 NCSHP by utilizing the PAVER computer database to update, manage and view pavement information and conditions. The work associated with the report generated GIS base roadway mapping, and a photo log of road condition assessments for pavement throughout Nye County. In 2017, Lumos prepared the Nye County Streets & Highways Update which provided the County with an updated Capital Improvement Plan (CIP) and updated projected and evaluated PCIs.

2.3 Project Purpose

Nye County has a vast network of roadways and a relatively small population, presenting a challenging funding environment for the County to maintain and repair the roads within their district. To help the County get a better understanding of the cost associated with roadway maintenance and repair (M&R), Lumos has been tasked with developing this update to the 2017 Nye County's Streets & Highway Plan. This document serves to allow County staff to better understand the conditions of their roadway system while providing an M&R strategy to get the most useful life out of their roads within their current roadway maintenance budget.

2.4 Project Description

As a general rule of thumb, asphalt concrete (AC) roadways have a design life of 25 years. If the roadway network is properly maintained, an entity can extend the life of their roads well beyond the original design life. Conversely, if regular maintenance is ignored, the roads will fail prior to the 25-year design life and costs to repair these roads will increase significantly. The goal of a pavement management plan is to continually maintain the roads and delay the increased cost of complete road reconstruction once a road has failed.

The 2019 Nye County Streets and Highways Plan Update has been developed based on Lumos' knowledge of pavement strategies and treatment techniques, information obtained from the existing Nye County PAVER™ database, Capital Improvement Projects completed since September 2017, an estimated CIP Budget for the next three years, planned or ongoing CIP projects, and recent bid results for County road M&R projects. Actual current road conditions were not verified in person by Lumos staff during the creation of this update. This update should be used as a planning tool to better understand the current conditions of Nye County roads, determine the type of treatment needed for the different distresses on AC roads, estimate the M&R budget needed to maintain or improve the general conditions of the roadway network, and plan future M&R projects.

Due to the large size of Nye County, the roadway management responsibilities have been broken up into the following geographic regions:

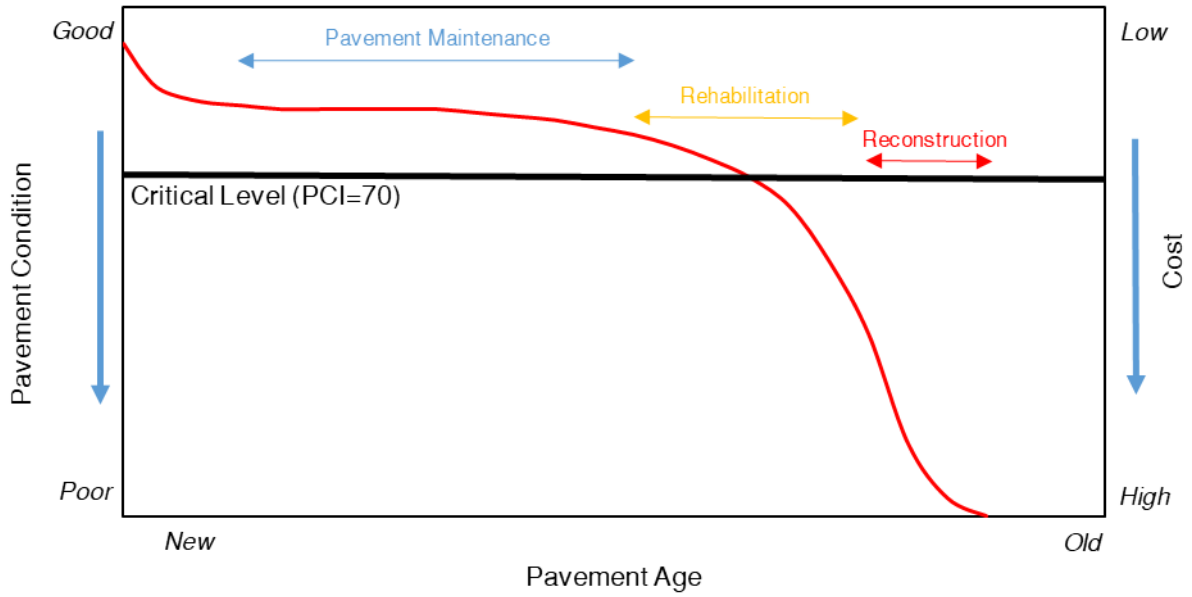
- North Region (Tonopah, Gabbs, Round Mountain, Carver, Belmont, Manhattan, etc.)
- Beatty Region
- Amargosa Region
- Pahrump Region

3.0 PAVEMENT MANAGEMENT PLAN

The objective of this Pavement Management Plan is to develop a consistent approach to maximize available funds to maintain and repair the paved roadway system within Nye County. Maintaining the roads will not only provide residents of the County with a safe and smooth roadway network, but will also save the County money by preserving and maintaining the pavement instead of the increased costs associated with unnecessary rehabilitation efforts that may impact a pavement earlier in its design life without prior treatments. This Pavement Management Plan and corresponding Capital Improvement Plan (CIP) will help the County track pavement inventory and conditions, estimate future roadway conditions, determine future M&R costs and prioritize future M&R projects.

Figure 1 below illustrates a typical asphalt performance curve (red) and when the typical phases of M&R should be applied. The figure illustrates that as pavement ages and/or deteriorates, the cost to reconstruct an AC road increases greatly. It is estimated that reconstructing a road costs four times more than roadway maintenance and rehabilitation strategies.

Figure 1: Asphalt Performance Curve and M&R Costs



3.1 Pavement Management Software – PAVER

The County currently uses PAVER™ to inventory and monitor the conditions of the roads located throughout the County. PAVER™ was developed by the United States Army Corps of Engineers Construction Engineering Research Laboratory (USACERL) to manage pavement networks using inspection data, OCDs, past M&R treatments, and ASTM D 6433 to evaluate road conditions to calculate a pavement condition index (PCI) rating from 0 to 100. Table 1 shows the ASTM D 6433 rating scale of PCI values with corresponding colors.

Table 1: PCI Value Range

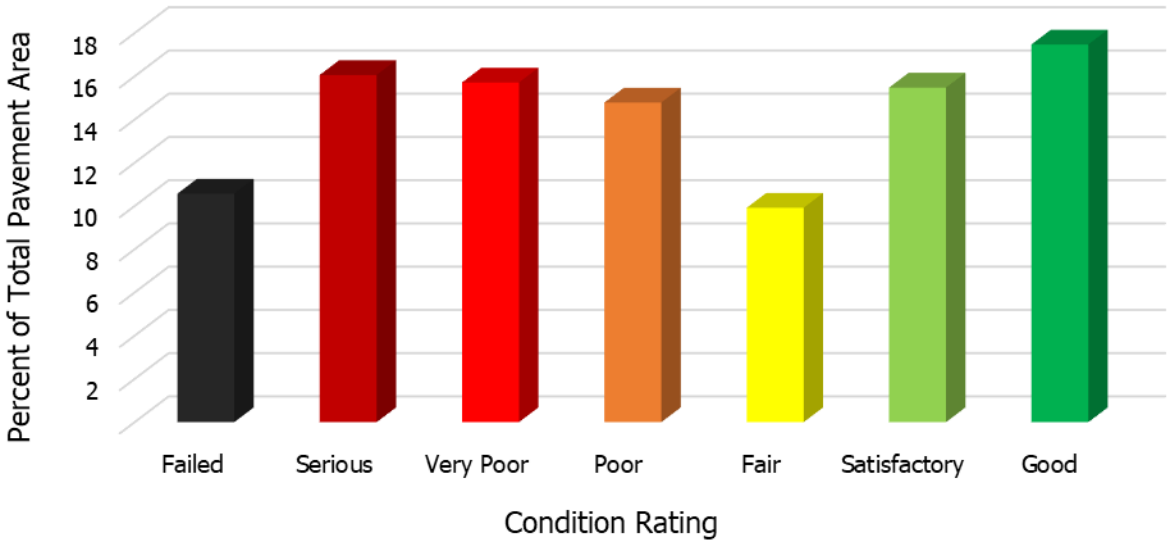
Road Rating Category	PCI Low Value	PCI High Value
Good	86	100
Satisfactory	71	85
Fair	56	70
Poor	41	55
Very Poor	26	40
Serious	11	25
Failed	0	10

PAVER™ also has the capability of developing maintenance and repair work plans by performing multiple levels of analysis to show where to best allocate funding. A user inputs cost estimates for repair work and budgetary constraints and PAVER™ runs an iterative process to determine the most cost-effective plan for maintaining and repairing the roadway network. Section 3.8 of this report discusses work plans developed for Nye County based on optimizing work against a specified budget, determining the budget needed to maintain a specified condition level, and determining the budget needed to improve the road condition.

3.2 Existing Nye County Road Conditions

The County has performed regular County-wide PCI inspections since 2004. Over the years, data has been input into PAVER™ with the software generating PCI ratings on each section of road based on the quantity and types of distresses. Figure 2 shows the percentage of roadway that currently fall within each road condition category described in Table 1.

Figure 2: Nye County Current AC Road Conditions



3.2.1 PCI Projections

Nye County staff have performed road inspections to quantify each type of distress and input these results into PAVER™ along with the date the road was constructed, if available. With the inspection data and construction date, PAVER™ uses an average deterioration curve to estimate the future conditions of roads within a set of data. Although inspections for all AC roads owned and maintained by Nye County have been performed, the actual date of construction and/or the most recent road rehabilitation date is uncertain for many of the roads within Nye County. If a road construction date is uncertain, Nye County was directed by PAVER™ support staff to insert a year of 1900 for the construction date.

Figure 3 shows the graph of the calculated PCI versus the age of pavement during the time of the most recent inspection for all AC roads in Nye County. The dark green trend line shows the average pavement deterioration curve. Figure 3 illustrates that by inserting the construction date of 1900, the pavement deterioration curve is extended out well past any realistic expectations of pavement life, i.e. a 75 year old road would have a much lower PCI than a 78 as the curve suggests.

Figure 3: Deterioration Curve - All Data

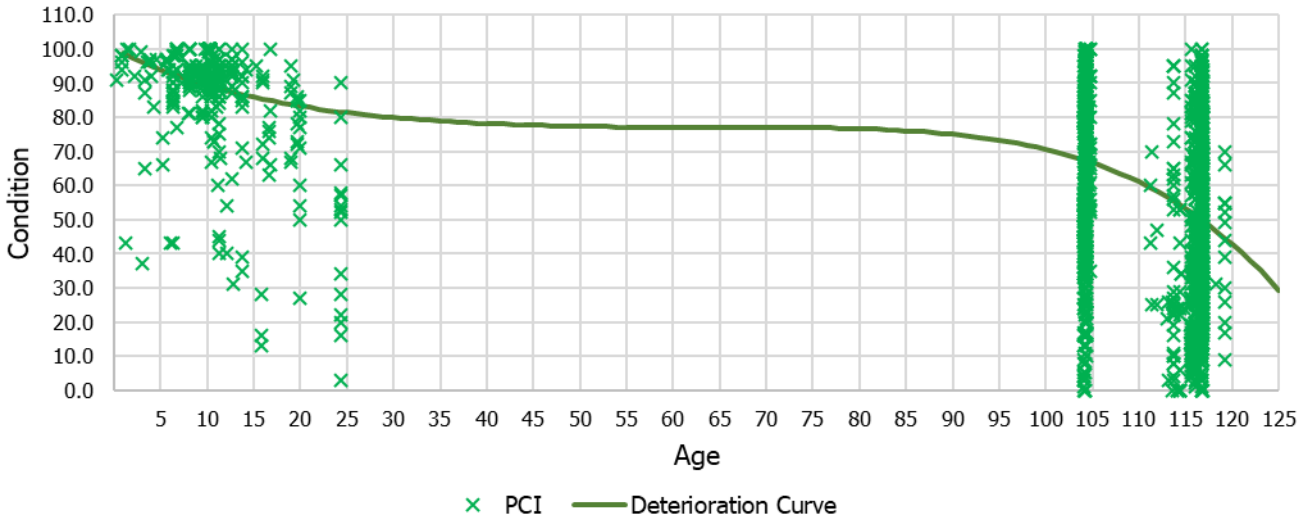
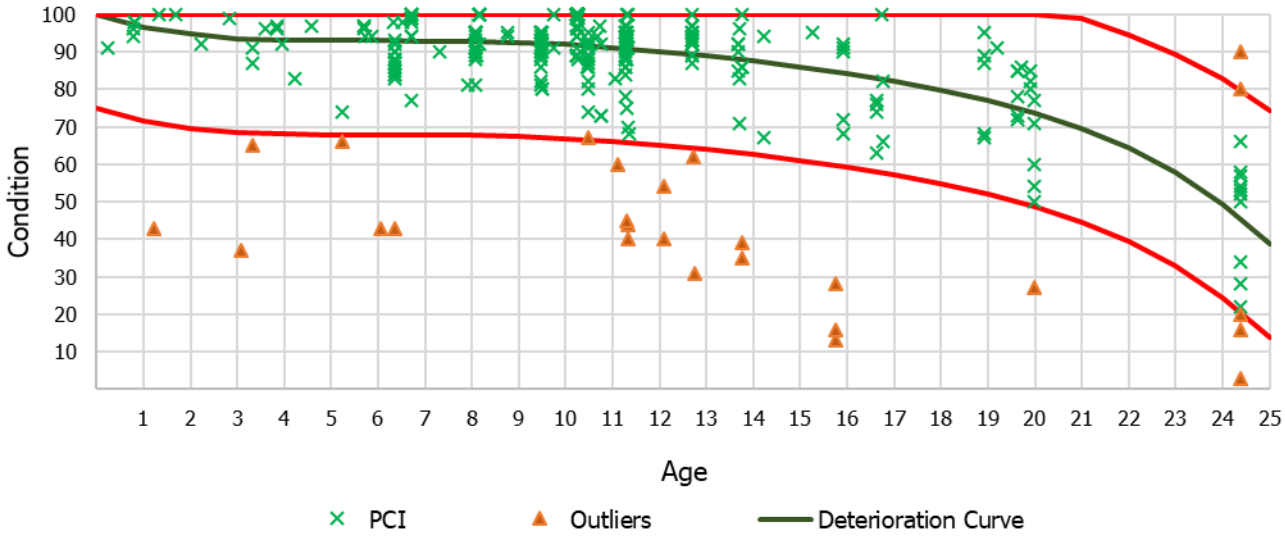


Figure 4 shows the deterioration data with the roads of an unknown construction date and data outside the 99th percentile being disregarded, the 99th percentile is shown by the red lines and the orange triangles are the outliers. These outliers should be reviewed by County staff to ensure proper evaluation techniques and careful data entry were performed, i.e. a 1 year old street should have a much higher PCI than a 43.0; in this case, the age and inspection data should be reviewed for proper data input. A total of 309 sections out of 1036, or approximately 30%, have realistic OCDs entered in PAVER, with 25 outlying data points. The shape of this curve is closer to a typical pavement deterioration curve; however, the curve has a steep drop off from pavement age 14 years to 24 years due to the limited data set.

Figure 4: Deterioration Curve - Select Data



When using Figure 4 for the 3-year maintenance strategies discussed in Section 3.8, the PAVER™ models overestimate the deterioration over the requested 3-year projection period. Using Figure 3 (although it shows an inaccurate pavement life) results in consistent pavement deterioration over the 3-year period. The only caveat to the Figure 3 data is if a PCI is a 70, it will be projected to stay at 70 throughout the 3-year work plan. These projections more closely correspond those provided in the 2017 NCSHP.

In order to provide more accurate projections, Lumos recommends the County work to determine the actual construction date for a larger percentage of roads, especially roads that are more than 24 years old. Providing more data on pavement age will increase the accuracy of PCI deterioration curves. Ideally each zone should have its own PCI deterioration curve, i.e. Pahrump will have a different PCI deterioration curve than Round Mountain. These zones are in different climatic regions resulting in different asphalt concrete deterioration.

3.2.2 Current PCI Rating

When considering the inspections from 2004 to 2017 on all AC roads within the County, including parking lots and the Tonopah airport, the weighted average PCI rating at the time of each inspection was 56. Roads have continued to deteriorate since these inspections and using the deterioration curve from Figure 4, PAVER™ estimates the current Area Weighted Average PCI rating to be 48, which is considered poor road conditions. Table 2 lists the number of road sections, total roadway area, and current estimated average weighted PCI for each geographic region in Nye County.

Table 2: Nye County Regional Statistics

Region	Number of Sections	Total Roadway Area (Ft^2)	Weighted Average PCI
North	354	20,630,907	38
Beatty	49	2,486,713	44
Amargosa	57	6,159,626	48
Pahrump	576	37,322,476	55
Total	1036	66,599,722	48

3.3 Importance of Pavement Management

Without a pavement management plan, preventive and/or minor maintenance needs are often preempted by major repairs and roadway reconstruction. Roads that need preventive maintenance are typically at minimal acceptable levels which is why they are often considered lower priority than new construction or reconstruction of failed streets. Using a Pavement Management Software (PMS) benefits an agency by organizing inventory and simultaneously calculating PCIs without the need of doing time consuming hand calculations for projected PCIs and budgets. With an objective, consistent method of evaluating pavement condition, M&R needs and priorities can be determined on a systematic, documentable engineering basis. Also, a PMS can be used to ensure selection of the most cost-effective M&R strategy by performing a life-cycle cost analysis on all feasible M&R strategies.

Maintenance strategies are important tools for extending the service life of roadways in a cost-effective manner. Maintenance costs remain relatively low until a road's condition has deteriorated to below "good" condition. Once this level has been reached the cost of repairs rises sharply and will only escalate as the pavement nears the end of its life; therefore, preventive maintenance is applied to roads in good and fair condition when appropriate, with the goal of maintaining their condition, making it the most cost-effective means of protecting infrastructure.

3.4 Maintenance and Repair Planning

Applying the appropriate maintenance treatment at the correct time slows deterioration and extends the life of the pavement. Typically, a PCI of 70 (good condition) is used as a critical level when determining timing of more aggressive treatment techniques. If a typical roadway falls below a PCI of 70, preventive maintenance is applied, and the roadway condition is raised to good or excellent levels.

Because the County's road conditions are estimated to currently have an average PCI of 48 (poor conditions), setting the critical level of preventive maintenance at 70 would ignore a majority of the roads under Nye County's jurisdiction. After analyzing PCI data and developing various work plan scenarios, it has been determined that the critical level for Nye County's preventive maintenance planning is recommended to be set at a PCI of 55; i.e. repairing roads near the 55 rating should be a higher priority than the more expensive work of reconstructing failed roads.

For general planning purposes, the following road rating categories are used to develop general M&R recommendations below. It should be noted that these recommendations are for planning purposes only and not definitive requirements for roadway repair.

PAVER recognizes M&R that has not been completed, is not scheduled to be completed, or is not feasible to complete and calculates work that is unfunded, which will be referred to as "Deferred Maintenance". Section 3.8 shows the County's current deferred maintenance condition and gives deferred maintenance projections for each strategy. The County's objective should be to continually reduce deferred maintenance which will eventually start to increase the County's overall PCI.

3.4.1 Road Condition – Excellent – PCI 100-86

Roads under this condition category are typically newly constructed or resurfaced. General maintenance on "excellent" conditioned roads include fog seals and asphalt rejuvenation to prevent early pavement oxidation or weathering.

3.4.2 Road Condition – Satisfactory – PCI 85-71

Typical pavement age of roads within the satisfactory category are generally 5-10 years old. These roads are beginning to see minor signs of distress and will need more attention from road maintenance staff. Preventive maintenance is recommended for roads in this category, including crack sealing, surface sealing and localized shallow depth patching.

3.4.3 Road Condition – Fair – PCI 70-56

Roads within the fair category are seeing more moderate severity in distresses. At this point in the roadway life cycle, it is imperative to make the repairs to the roads because the rate of deterioration is greatly increased once the PCI drops below 70. Crack sealing, surface sealing and shallow patching will typically not be effective to the more severe distresses. Repairs to roads within this category generally include full-depth patching, slurry/micro seal and chip seal.

3.4.4 Road Condition – Poor – PCI 55-41

Roads within the poor category are more expensive to repair compared to M&R techniques addressed in the better road condition categories; however, if funding is available, emphasis should be made to rehabilitate existing roads in this category instead of the increased cost of road reconstruction in the lower condition categories. Rehabilitation techniques within this category include full depth patching, resurfacing, or mill and overlay of pavement.

3.4.5 Road Condition – Very Poor/Serious/Failed – PCI 40-0

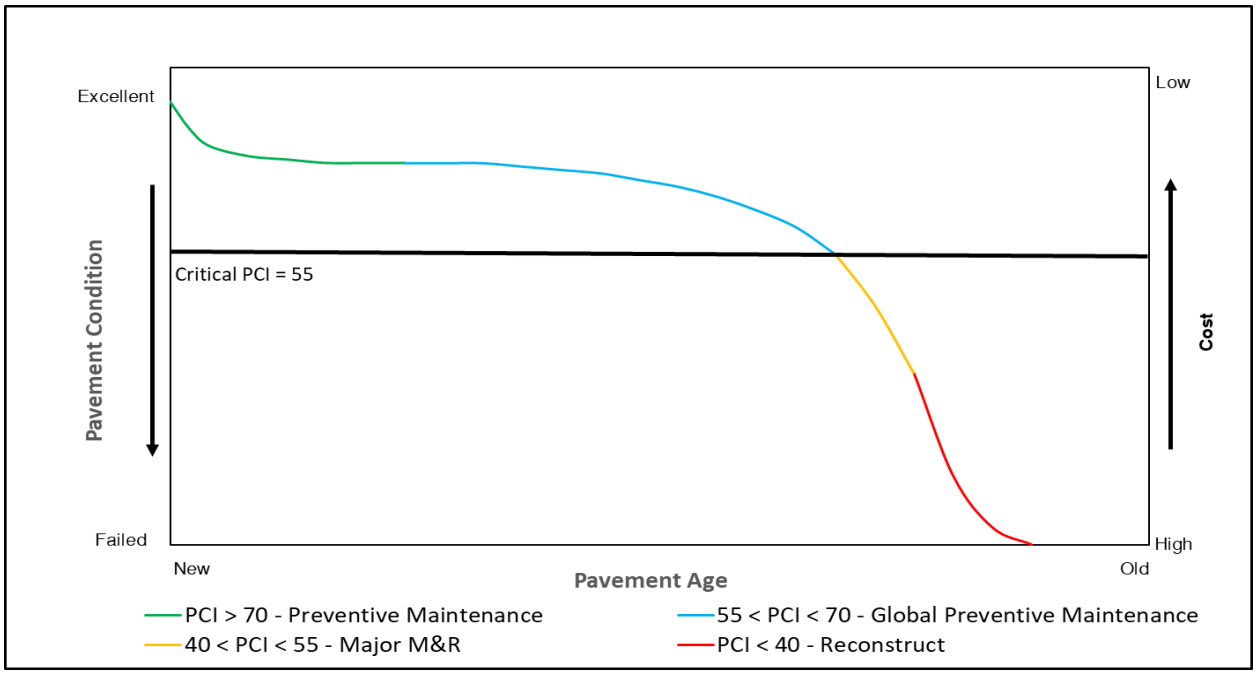
Roads with a PCI of less than 40 typically have deteriorated beyond the point where they can receive maintenance repairs and need full resurfacing or complete section reconstruction. Roads in this category have high severity in cracking, high severity load related distresses and possible issues with the pavement structure and substructure. Typical repair techniques include pulverizing existing asphalt in large sections of roadway, repairing the substructure and paving a new section of asphalt. Depending on the severity of deterioration, the road repair may need to include removal of the full section of base and asphalt and complete reconstruction of the roadway section. Roads deemed to be failed will typically need a full section repair and are the most expensive to replace.

3.4.6 Work Planning by Condition

Nye County has identified the critical PCI thresholds pertaining to work planning. For roads with a PCI greater than 70, preventive maintenance such as crack seals and localized patching will be performed. For roads with a PCI between 55 and 70, global preventive maintenance such as fog seals, slurry seals, chip seals, etc. will be performed. For roads with a PCI between 40 and 55, Major

M&R such as Mill and Overlay, Full Depth Patching, etc. will be performed. For roads with a PCI below 40, a full road reconstruct will be performed. Figure 5 shows the PCI thresholds for work planning set by Nye County.

Figure 5: Nye County Work Planning by Condition



3.5 Maintenance and Repair Techniques

Selecting the correct type of treatment and rehabilitation technique is imperative to an effective Pavement Management Plan. The factors considered when determining these techniques includes types of pavement distress, age, condition, traffic levels, expected future plans and available funding.

3.5.1 Crack Seal

Crack seal is a flexible, polymer-modified, rubberized asphalt blend that adheres to the edges of existing cracks and fills in the voids. When dried, crack seal provides a barrier that prevents water from intruding and impacting the base and sub-base section of the road. Crack seal is a long-term, cost effective way to maintain and extend the life of the pavement. Sealing minor cracking may extend the useful pavement life for several years when an overlay project is not scheduled.

3.5.2 Surface Seal

Surface seal is a generic term for fog seal or rejuvenating seal, which includes the application of an asphalt emulsion sprayed on an existing pavement to protect the surface of the roadway. In general, surface seal coat the aggregate particles of the roadway to improve chip retention, prevent raveling, fill small cracks and surface voids and provide a waterproof layer that protects the base course and subgrade. Surface seals can provide improvements to distresses of minor cracking and alligator cracking. Meanwhile, instances of minor raveling may adequately be sealed with a surface seal thereby preventing further deterioration. Furthermore, with the advancement of polymer pavement, new roadways shall receive a surface seal one to two years after construction.

3.5.3 Slurry and Micro Sealing

A slurry seal is a mixture of fine aggregate, asphalt emulsion, water, and mineral filler. The mineral filler most often used is Portland cement and reduces break time of the slurry or micro seal. A slurry seal acts as a wearing surface and seals the existing asphalt surface. Slurry seals are used to seal the existing asphalt pavement surface, slow surface raveling, seal small cracks, and improve surface friction. Slurry seals can be placed in areas where chip seals would not be a good choice due to high traffic volume, e.g. intersections, signaled and stop areas, and business areas. These seals can be placed in areas where pavement and ambient temperatures are as low as 50 degrees Fahrenheit. Slurry seals should not be placed at night, and by design are intended to be a single stone thick application. If application during the night or colder temperatures is required, the use of a standard slurry seal may not be permissible. Micro sealing uses a chemical break and may be placed in cooler conditions, as low as 40 degrees Fahrenheit or during nighttime. Micro seals can give more structural support than slurry seals, may be used on pavements with more sever distresses and can be applied in multiple layers when needed.

3.5.4 Chip Seal

Generally, alligator cracking or more general cracking can be repaired most cost effectively by chip seals. In cases where raveling progresses to the point where ride quality is affected, a thin overlay, or pre-leveling followed by a chip seal may be applied. A chip seal is a single spray application, usually of liquid or emulsified asphalt, and immediately after a single layer of aggregate. This type of seal reduces the infiltration of air and water into the pavement and may be used to improve skid resistance of slippery pavements.

3.5.5 Shallow Pavement Patching

Shallow pavement patching restores structural integrity and improves ride quality when done correctly. Repairs of partially deteriorated sections of pavement will improve the overall quality without the expense of a full depth patch. Shallow pavement patching is typically used where cracking deterioration is in the top one-third of the pavement section and the existing substructure and bottom pavement section has not been compromised. Shallow pavement patching is the recommended repair for raveling, bleeding and minor alligator cracking.

3.5.6 Full Depth Pavement Patch

When a pavement surface has failed from sub-soil issues or severe distresses, the entire pavement section will typically need to be replaced. Full depth replacement consists of pulverizing the entire depth of pavement and possibly replacing the substructure if compromised. If the damage is due to underlying soils, the unsuitable soils are removed from the site and structural material is installed prior to the base and new asphalt pavement. Full depth pavement patch is recommended for more severe alligator cracking, rutting, swelling and depressions.

3.5.7 Mill and Overlay

Overlay patches are generally applied when an area is too large to be economically repaired by hand with a small crew. Roads are typically milled down to at least one-third the pavement thickness and then a pavement overlay is applied. The overlay, which uses hot plant-mix asphalt, also has the advantage of setting quickly. Typically, pavement overlays are applied in areas of pavement failure or wear problems rather than areas with a base or subgrade problems. Pitting, minor cracking, weathering and oxidation are typical failures where overlay can be effective by quickly and permanently restoring the surface.

3.5.8 Pavement Reconstruction

Pavement reconstruction is the replacement of the entire existing pavement structure by the placement of the equivalent or increased pavement structure. Reconstruction generally requires the complete removal and subsequent replacement of the existing pavement structure. This process may utilize either new or recycled material incorporated into the build materials, which are then used for the reconstruction of the complete pavement section. Pavement reconstruction is required when a pavement has either failed or has become functionally obsolete.

3.6 Pavement Treatment Matrix

A Pavement Treatment Matrix Spreadsheet is included in Appendix C of the 2017 NCSHP report. The matrix lists each AC pavement distress found during Nye County's PCI inspections and recommends a treatment for each distress. The matrix is intended as a planning tool to help Nye County's pavement maintenance staff. Prior to performing a maintenance project, Lumos recommends Nye County staff to evaluate the pavement distresses for severity, traffic conditions, and overall project area impact before determining the best treatment techniques for that maintenance project.

3.7 Nye County Pavement Maintenance Budget

The Nye County Regional Transportation Commission (RTC) funds the road maintenance program for all regional roads within Nye County. The funding is accrued from a ¼-cent sales tax and a recently passed 4-cent motor vehicle fuel tax. Regarding RTC funds available for pavement maintenance, repair, and reconstruction for Fiscal Year (FY) 20/21, Nye County's total budget for road repair is $4.25 million. A total $316,498 of the road repair budget is dedicated to crack sealing, pothole repairs and localized patching. A total of $1,753,852 of the road repair budget is dedicated to Preventative Maintenance Projects, leaving $2,179,650 for Major M&R.

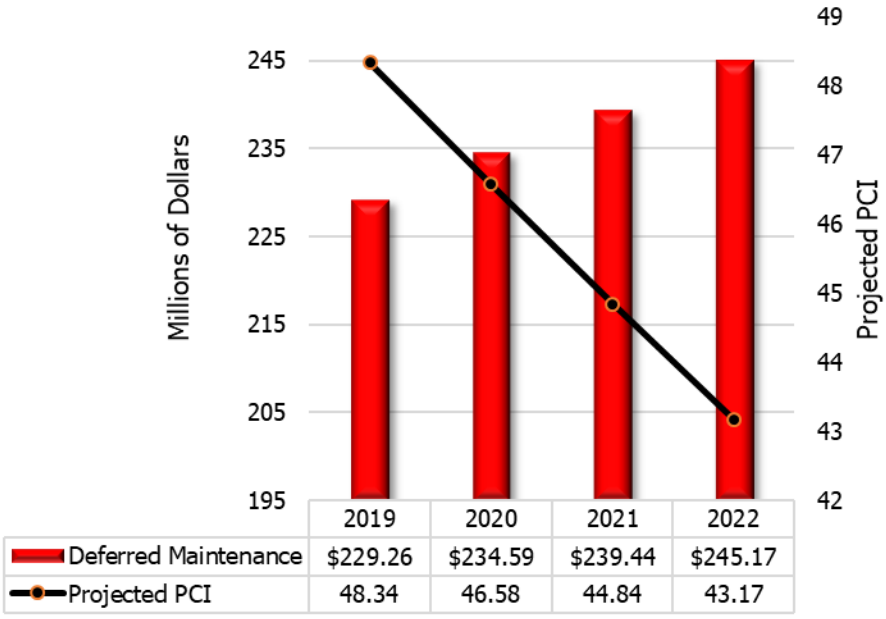
3.8 Nye County Pavement Funding Strategy

Below are three proposed 3-year term strategies to help Nye County staff understand the cost associated with maintaining their pavement network. A graph of projected PCIs and projected deferred maintenance is included in each of the following subsections, along with two figures in Section 3.8.4 that compare each of the strategies' PCIs and deferred maintenance quantities. Strategy 1 shows the expected deterioration of the pavement if no maintenance is performed over the next 3 years. Strategy 2 is the current method employed by the County and is the most common method for public agencies to plan for pavement maintenance activities. Strategy 3 projects the financial needs to maintain the roadway conditions throughout Nye County.

3.8.1 Strategy 1 – Do Nothing Scenario

For comparison, Strategy 1 shows the effects of ignoring pavement M&R for the next 3 years. PAVER™ estimates the current (2019) weighted average PCI rating for Nye County to be 48. If no M&R work is performed on Nye County Roads over the next 3 years, PAVER™ projects the weighted average PCI to deteriorate to 43 by 2022. Deferred maintenance will steadily increase from $229 million to $245 million.

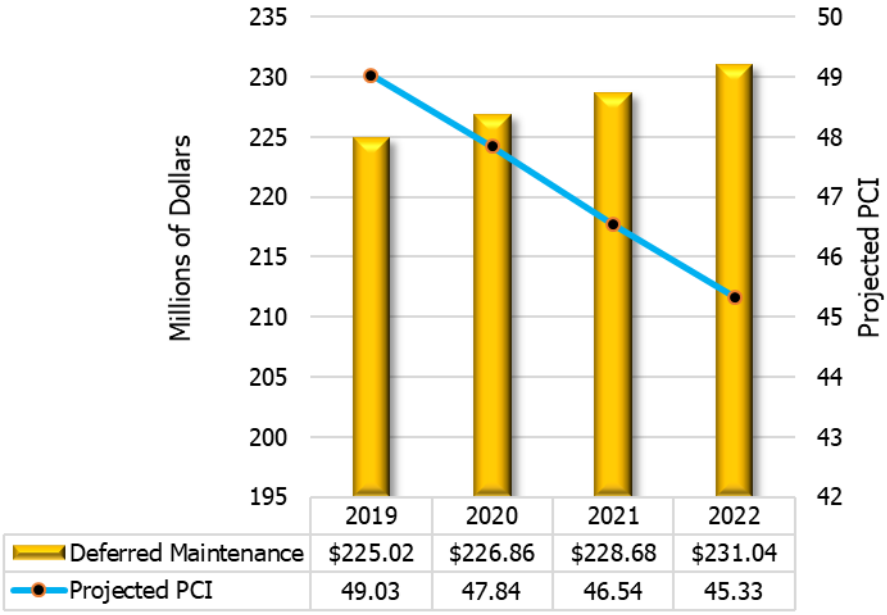
Figure 6: Do Nothing Scenario Projected PCI and Deferred Maintenance



3.8.2 Strategy 2 - Current Pavement Budget

The County has a proposed annual budget (FY 20/21) for pavement maintenance of $4.25 million. A total $316,498 of the road repair budget was dedicated to crack sealing, pothole repairs and localized patching. A total of $1,753,852 of the road repair budget was applied to Preventative Maintenance Projects, leaving $2,179,650 for Major M&R. Applying the FY 20/21 budget for the next 3 fiscal years, and ignoring any impacts from inflation, PAVER™ projects the weighted average PCI to be 45 by FY 22/23. Figure 7 illustrates that the proposed budget and ability to implement maintenance projects will result in pavement conditions that continue to deteriorate over a 3-year period with deferred maintenance increasing from $225 million in 2019 to $231 million in 2022. The County's projected PCI will drop from a 49 after planned maintenance is applied in 2019, to a 45 in 2022. When considering effects from inflation, we expect the actual PCI will be lower and deferred maintenance to be higher at the end of the 3-year analysis period.

Figure 7: Current Budget ($4.25M/Yr.) Projected PCIs and Deferred Maintenance

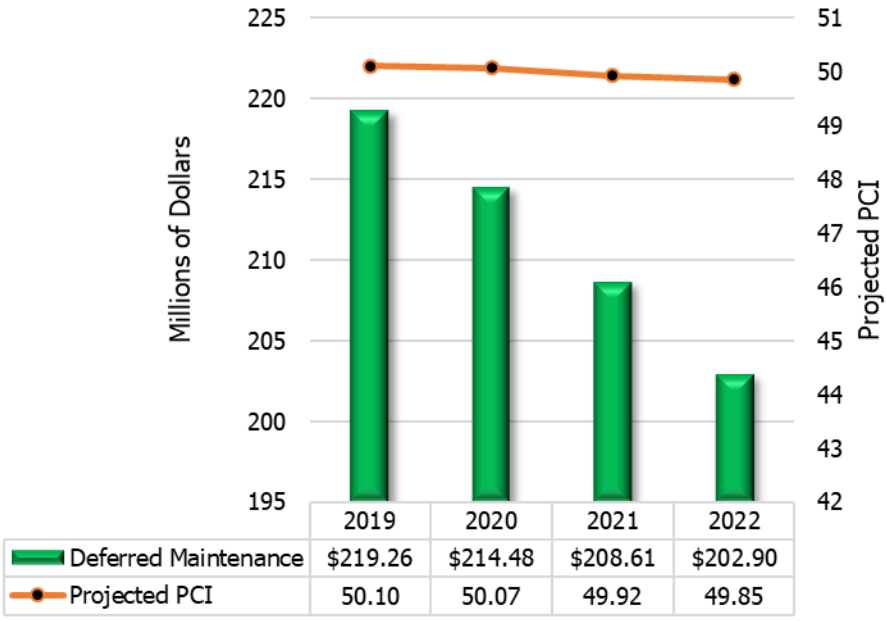


	2019	2020	2021	2022
Deferred Maintenance	$225.02	$226.86	$228.68	$231.04
Projected PCI	49.03	47.84	46.54	45.33

3.8.3 Strategy 3 - Maintain Existing Conditions Scenario

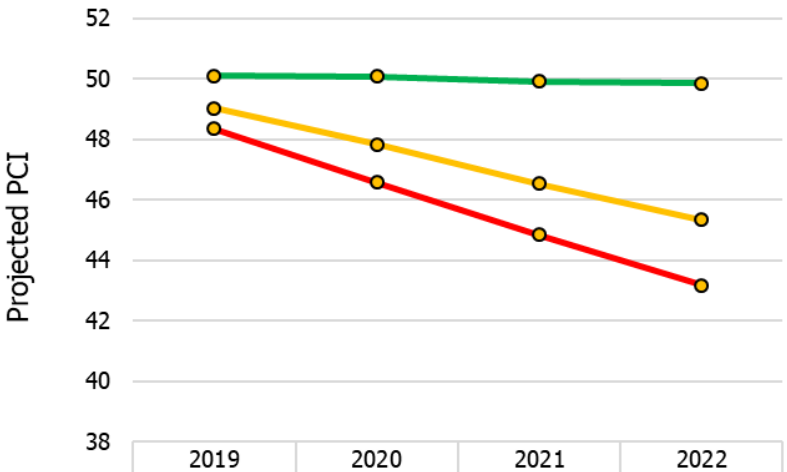
With the current weighted average PCI rating of 48, Strategy 3 analyzes the fiscal impacts of maintaining the current road conditions over a 3-year period. Several PAVER™ work plan scenarios were analyzed to develop an estimated cost of $10 million per year to maintain the current road conditions. Figure 8 shows a $10 million per year budget will initially raise the County's PCI from a 48 to a 50 in the year 2019, then maintain the PCI of 50 for the next 3 years while significantly decreasing deferred maintenance from $219 million in 2019 to $203 million in 2022. In 2022 the PCI slightly decreases, but when this scenario is extended for a 10-year period the PCI starts to increase around year 7 when deferred maintenance lowers to around $156 million, then continues to gradually increase as deferred maintenance decreases. When considering effects from inflation, it is likely the total cost to maintain road conditions will be significantly higher. This strategy demonstrates that a significant increase in annual pavement maintenance budget is needed to maintain the existing road conditions and decrease deferred maintenance throughout Nye County.

Figure 8: Maintain Existing Conditions ($10M/Yr.) Projected PCIs and Deferred Maintenance



3.8.4 Summary of Strategies

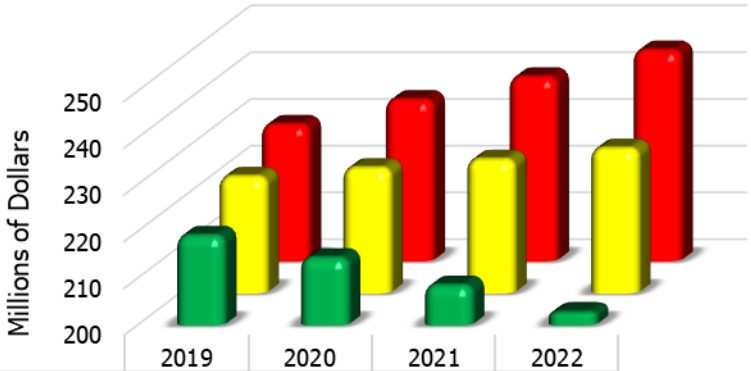
Figure 9: PCI Summary



	2019	2020	2021	2022
Maintain Existing Conditions	50.10	50.07	49.92	49.85
Current Budget	49.03	47.84	46.54	45.33
Do Nothing	48.34	46.58	44.84	43.17

Figure 9 shows each strategy's projected PCIs throughout the next 3 years. Strategies 1 and 2 are very similar with the Current Budget ending in just 2 PCI points higher than the Do Nothing Scenario while the Maintain Existing Conditions stays in the 50 PCI range.

Figure 10: Deferred Maintenance Summary



	2019	2020	2021	2022
Maintain Existing Conditions	$219.26	$214.48	$208.61	$202.90
Current Budget	$225.02	$226.86	$228.68	$231.04
Do Nothing	$229.26	$234.59	$239.44	$245.17

Figure 10 shows each strategy's deferred maintenance throughout the next 3 years. The Maintain Existing Conditions Scenario's deferred maintenance decreases steadily while the Do Nothing Scenario and Current Budget Strategy's deferred maintenances steadily increase.

4.0 CAPITAL IMPROVEMENT PLAN

4.1 Cost Estimating

Cost estimates presented in the CIP have been prepared for planning purposes to provide guidance in project planning and timing of implementation. Final project costs will vary depending on project scope/complexity, schedule, and labor/material costs at the time of bid; furthermore, project costs may vary greatly depending on where the project is located, as projects within Pahrump are typically a less expensive than projects within some of the more rural areas of Nye County.

4.2 Maintenance and Repair Costs

Table 3 shows the cost estimates for each M&R technique. Unit costs were developed from bid tabulations and experience with similar project designs. These costs were input into PAVER™ and used to determine the most cost-efficient CIP possible, based on PCI data input into PAVER™.

Table 3: Costs for AC Pavement M&R

Item	Unit Cost		Unit
Crackseal	$	1.10	LF
Surface Seal	$	0.14	SF
Slurry Seal	$	0.20	SF
Micro Seal	$	0.28	SF
3/8" Chip Seal	$	0.50	SF
Shoulder Leveling	$	1.35	LF
Shallow Pavement Patch	$	4.15	SF
Full Depth Pavement Patch	$	9.00	SF
Mill and Overlay	$	5.00	SF
Full Reconstruction	$	8.25	SF

4.3 Capital Improvement Plan

The 3-year recommended CIP is included in the sections below. The CIP is intended as a planning tool to ensure Nye County is saving/reserving adequate funds for necessary improvement projects and should be updated regularly. Roads selected for the CIP are based on PAVER™ generated work plans and projections, prioritizing roads with higher traffic volumes, and the dispersal of funds across the County while still considering the high percentage of residents in the Town of Pahrump.

Projects selected for the CIP follow the recommendations discussed in Section 3.3 by focusing on maintenance repairs to roads that have deteriorated to the critical PCI level of 55. Projects with an asterisk have already been approved by the RTC Board and have been chosen by Nye County Public Works focusing on minor arterial and local roadways, planned communities, areas with large population growth, and current low PCIs. If the program only focuses on roads that have deteriorated to the critical level, many of the failed road segments will be completely ignored. Therefore, each year the CIP includes road reconstruction projects to help reduce the number of failed roads within the County's jurisdiction. For the next three years, the CIP recommends allocating a majority of the

road maintenance budget to reconstruct failed roads within Nye County, and the remaining portion of the budget to perform maintenance techniques, such as overlays and surface seals. Proposed Micro-seal Projects for years 2019 and 2021 have been included with this report in Appendix A. For the years without Proposed Micro-seal projects, the CIP devotes a majority of the budget to reconstruction of failed roads. This will increase failed road's PCIs to 100 which will make more of a difference to the County's average area weighted PCI than applying other M&R techniques. If, over time, Nye County can improve the overall quality of their roads, Lumos recommends increasing the critical level to a PCI of 70 for future CIP projects.

Fiscal Years (FY)	Recommended Street Maintenance Project	Total Cost
2019-20	**Pahrump Region**	
	Reconstruction	
	Leslie – Basin to Irene*	$1,100,000
	Mill & Overlay	
	Blagg Rd. – Simkins to Harris Farm*	$680,000
	Silver Sage Dr. – Majestic View to Barney St.	$200,000
	Beatty Region	
	Reconstruction	
	Duncan Dr. – C. Ave to End	$55,000
	Doing Ave. – D Ave to C Ave	$105,000
	Mill & Overlay	
	W. Cottonwood – US-95 to C Ave.*	$420,000
	2019 PM Project	
	See Appendix A	$1,613,000
	Surface Seal	
	Resurfaced roads from FY 18/19 and recently paved roads	$300,000
	North Region	
	Mill & Overlay Round Mountain Roads	$100,000
	Contingency	$115,000
2020-21	**Pahrump Region**	
	Reconstruction	
	Leslie – Irene St. to Mesquite Ave.*	$1,010,000
	Mill & Overlay	
	Blagg Rd. – Calvada Blvd. to Florida St.*	$400,000
	Blagg Rd. – Florida St. to SR-372*	$450,000
	Amargosa Region	
	Mill & Overlay	
	Farm Rd. – School Ln. to Powerline Road*	$635,000
	Powerline Rd. – Mecca Rd. to MM-2	$1,320,000
	Surface Seal	
	Resurfaced roads from FY 19/20 and good/excellent roads	$310,000
	Contingency	$130,000

*These Projects were approved by the Nye County RTC Board on 3/13/19

Fiscal Years (FY)	Recommended Street Maintenance Project	Total Cost
2021-22	Tonopah Region	
	Mill & Overlay	
	Tonopah Ave. – US 95 to Arizona St.*	$240,000
	Oddie Ave. – US 95 to McQuillan St.*	$230,000
	Central St. – Cross Ave. to Butler Ave.*	$230,000
	Ray Tenant Lane – US 95 to EOP*	$120,000
	Micro Seal	
	See Appendix A	$650,000
	Pahrump Region	
	Reconstruction	
	Basin Ave. – Dahlia St. to Blagg Rd.*	$1,130,000
	Mill & Overlay	
	Gamebird Rd. – Winchester Ave. to Simmons	$1,105,000
	Surface Seal	
	Resurfaced roads from FY 20/21 and good/excellent roads	$415,000
	Contingency	$130,000
2022-23	Pahrump Region	
	Reconstruction	
	Charleston Park Ave. – Leslie St. to SR-372*	$1,730,000
	David St. – Charleston Park Ave. to Basin Ave.	$1,100,000
	Mill & Overlay	
	Kellog Rd. – Jane Ave. to Fox Ave.*	$690,000
	Kellog Rd. – Fox Ave. to Hafen Ranch Rd.*	$730,000

*These Projects were approved by the Nye County RTC Board on 3/13/19

5.0 CONCLUSION

This report serves as an update to the 1993 Nye County Street & Highway Plan, 2004 Road Inventory & Pavement Assessment Report, and 2017 Nye County Street & Highway Plan by calculating future projections for pavement conditions and maintenance costs, providing maintenance treatment recommendations, and recommending a CIP for future work on AC pavement within Nye County. Data from the 2004 Report, and subsequent pavement distress inspection results performed by Nye County staff, have been input into the PAVER™ database to calculate the most cost effective work plans for M&R of Nye County roads. Lumos ran several work plan scenarios and developed a CIP based on the current Nye County road maintenance budget, prioritization of roads with higher traffic volumes, and the dispersal of funds across the County while still considering the higher density of residents in the Town of Pahrump.

5.1 Summary of Findings

- The pavement condition evaluation has determined the Nye County AC roadway network is currently in poor condition, with an average weighted PCI of 48.
- Several work plan scenarios were completed to estimate the effects of the maintenance and repair budget on the future conditions of the roadway network. The results are as follows:
    - In the "Do Nothing Scenario" no maintenance is performed on the County's pavement network over the next 3 years. The projected PCI would deteriorate from a 48 in 2019 to a 43 in 2022.
    - At the current budget of $4.25 million, it is estimated that the roads will continue to deteriorate from a PCI of 48 in 2019 to a PCI of 45 in 2022.
    - To maintain the PCI in the near term, Nye County should budget $10 million per year (unadjusted for inflation) on maintenance and repair needs.

5.2 Summary of Recommendations

Nye County should continue to update the PAVER database to reflect current pavement conditions. Recommendations for additional PAVER database improvements are as follows:

- Determine actual or estimated construction dates for all pavement sections that currently have original construction dates (OCDs) of 1900.
- Develop a quality control (QC) plan for data collection and input.
- Properly link inspection inventory to the GIS files within PAVER.
- As pavement management projects are completed, the County should continue to enter these projects and costs into PAVER.
- Use PAVER to produce an inspection schedule.

6.0 REFERENCES

[1] United States Census Bureau, American Fact Finder Community Facts: Nye County, Nevada, 15 May 2017. <https://factfinder.census.gov/faces/nav/jsf/pages/community_facts.xhtml>

[2] "Pavement Maintenance Management for Roads and Streets Using the PAVER System", US Army Corps of Engineers Construction Engineering Research Laboratory, August 1990.

[3] PAVER™ Pavement Management Software – Colorado State University, 21 May 2017. <http://www.paver.colostate.edu/>

APPENDIX A

Micro-seal Project 2019							
Year	NetworkID	BranchID	SectionID	Area (Ft^2)	PCI Before	PCI After	Cost
2019	Pahrump	Barney	50	148,792	60.54	63.66	$41,661.76
2019	Pahrump	Barney	60	155,372	65.22	68.34	$43,504.16
2019	Pahrump	Barney	70	149,856	71.64	74.76	$41,959.68
2019	Pahrump	Buol	10	63,072	74.31	77.43	$17,660.16
2019	Pahrump	Calvada	40	141,552	68.83	71.95	$39,634.56
2019	Pahrump	Calvada	50	133,752	73.94	77.06	$37,450.56
2019	Pahrump	Center	13	40,464	72.66	75.78	$11,329.92
2019	Pahrump	Elderberry	80	129,048	70.34	73.46	$36,133.44
2019	Pahrump	Longhorn	10	64,320	74.07	77.19	$18,009.60
2019	Pahrump	Malibou	30	40,100	74.31	77.43	$11,228.00
2019	Pahrump	MaryLou	20	61,704	73.35	76.47	$17,277.12
2019	Pahrump	Turner	20	145,796	76.83	79.95	$40,822.88
2019	Pahrump	Zolin	10	66,000	72.67	75.79	$18,480.00
2019	Pahrump	212	90	126,720	77.13	80.25	$35,481.60
2019	Pahrump	Ambush	10	13,512	79.43	82.55	$3,783.36
2019	Pahrump	Barney	80	150,444	78.02	81.14	$42,124.32
2019	Pahrump	Batdorf	10	29,675	77.69	80.81	$8,309.00
2019	Pahrump	Bellville	10	41,088	62.74	65.86	$11,504.64
2019	Pahrump	Blagg	10	148,848	71.64	74.76	$41,677.44
2019	Pahrump	Blagg	100	61,680	66.89	70.01	$17,270.40
2019	Pahrump	Bridger	50	32,825	77.9	81.02	$9,191.00
2019	Pahrump	Cabo	10	24,675	75.96	79.08	$6,909.00
2019	Pahrump	Calvada	18	31,848	66.89	70.01	$8,917.44
2019	Pahrump	Cedarwood	10	17,904	77.69	80.81	$5,013.12
2019	Pahrump	Cimmaron	15	5,520	78.54	81.66	$1,545.60
2019	Pahrump	Corbin	80	94,920	69.62	72.74	$26,577.60
2019	Pahrump	Cortina	10	85,876	71.87	74.99	$24,045.28
2019	Pahrump	CountryPl	10	101,448	79.4	82.52	$28,405.44
2019	Pahrump	Court	10	11,976	67.16	70.28	$3,353.28
2019	Pahrump	Dahlia	10	50,414	78.56	81.68	$14,115.92
2019	Pahrump	Dylan	10	5,520	75.13	78.25	$1,545.60
2019	Pahrump	Emery	10	56,952	64.17	67.29	$15,946.56
2019	Pahrump	Equus	10	7,920	71.86	74.98	$2,217.60
2019	Pahrump	Fairwood	10	6,048	75.96	79.08	$1,693.44
2019	Pahrump	Gamebird	60	153,612	72.37	75.49	$43,011.49
2019	Pahrump	Gamebird	80	137,253	79.66	82.78	$38,430.97
2019	Pahrump	Gato	10	7,440	62.74	65.86	$2,083.20
2019	Pahrump	GoldPoint	10	18,864	75.96	79.08	$5,281.92
2019	Pahrump	HafenRch	40	36,120	77.98	81.10	$10,113.60
2019	Pahrump	Happy	10	15,792	67.16	70.28	$4,421.76
2019	Pahrump	Honeysuckl	10	112,896	71.24	74.36	$31,610.88
2019	Pahrump	Humboldt	10	23,592	70.33	73.45	$6,605.76
2019	Pahrump	Irene	60	127,944	66.9	70.02	$35,824.32
2019	Pahrump	Jake	10	18,100	64.14	67.26	$5,068.00
2019	Pahrump	Jarvis	10	34,138	61.29	64.41	$9,558.64
2019	Pahrump	Julia	10	22,848	72.47	75.59	$6,397.44
2019	Pahrump	Karis	10	20,600	72.45	75.57	$5,768.00
2019	Pahrump	Kearny	10	25,004	79.37	82.49	$7,001.10
2019	Pahrump	Keenan	20	47,736	78.21	81.33	$13,366.08
2019	Pahrump	Kellogg	20	131,976	71.62	74.74	$36,953.28

Year	NetworkID	BranchID	SectionID	Area (Ft^2)	PCI Before	PCI After	Cost
2019	Pahrump	LazyLizard	15	5,496	79.42	82.54	$1,538.88
2019	Pahrump	Marigold	10	13,704	75.98	79.10	$3,837.12
2019	Pahrump	Meier	Original	160,632	78.23	81.35	$44,976.96
2019	Pahrump	Monterey	10	18,408	78.22	81.34	$5,154.24
2019	Pahrump	Mourning D	10	5,472	74.82	77.94	$1,532.16
2019	Pahrump	MtCharlstn	30	107,406	78.02	81.14	$30,073.68
2019	Pahrump	Murphy	Orig.2	126,432	72.5	75.62	$35,400.96
2019	Pahrump	Pablo	10	11,064	67.15	70.27	$3,097.92
2019	Pahrump	Paiute	10	125,208	71.09	74.21	$35,058.24
2019	Pahrump	Palm	10	57,675	77.67	80.79	$16,149.00
2019	Pahrump	Papigo	10	18,552	71.87	74.99	$5,194.56
2019	Pahrump	Pechstein	17	37,848	69.62	72.74	$10,597.44
2019	Pahrump	Pittman	10	64,032	79.37	82.49	$17,928.96
2019	Pahrump	Pluto	10	126,504	79.36	82.48	$35,421.12
2019	Pahrump	Princeton	10	31,296	78.56	81.68	$8,762.88
2019	Pahrump	QuarterHrs	10	149,464	66.89	70.01	$41,849.92
2019	Pahrump	RockinDoc	10	59,256	75.98	79.10	$16,591.68
2019	Pahrump	Saddletree	10	61,920	71.26	74.38	$17,337.60
2019	Pahrump	Sandy	33	64,512	70.45	73.57	$18,063.36
2019	Pahrump	Simkins	25	63,336	75.96	79.08	$17,734.08
2019	Pahrump	Sumpter	10	30,625	77.69	80.81	$8,575.00
2019	Pahrump	Sundowner	10	5,520	71.09	74.21	$1,545.60
2019	Pahrump	Thousand	40	127,800	62.05	65.17	$35,784.00
2019	Pahrump	Ticondroga	17	5,400	79.43	82.55	$1,512.00
2019	Pahrump	Turner	10	143,276	78.56	81.68	$40,117.28
2019	Pahrump	Ulrich	10	5,736	72.67	75.79	$1,606.08
2019	Pahrump	Wells	10	11,208	75.93	79.05	$3,138.24
2019	Pahrump	Wildflower	10	7,968	64.14	67.26	$2,231.04
2019	Pahrump	Winchester	10	141,064	76.36	79.48	$39,497.92
2019	Pahrump	Winery	20	15,216	62.74	65.86	$4,260.48
2019	Pahrump	Woodchips	30	13,752	78.54	81.66	$3,850.56
2019	Beatty	250	10	126,720	79.44	82.56	$35,481.60
2019	Beatty	250	20	60,312	79.44	82.56	$16,887.36
2019	Beatty	A Ave	10	42,624	68.83	71.95	$11,934.72
2019	Beatty	Crowell	10	90,624	67.17	70.29	$25,374.72
2019	Beatty	D Ave	10	48,456	71.1	74.22	$13,567.68
2019	Beatty	D Ave	20	31,920	71.1	74.22	$8,937.60
2019	Beatty	E Ave	10	49,350	63.19	66.31	$13,818.00
2019	Beatty	Elliot	10	32,375	64.93	68.05	$9,065.00
2019	Beatty	Knight	10	58,500	68.8	71.92	$16,380.00
2019	Beatty	Revert	10	22,992	77.67	80.79	$6,437.76
			Total Area (Ft^2)	**5,759,212**	**Total Estimated Cost**		**$1,612,579.33**

Micro-seal Project 2021							
Year	NetworkID	BranchID	SectionID	Area (Ft^2)	PCI Before	PCI After	Cost
2021	Tonopah	Bryan	10	57,048	75.98	79.10	$15,973.44
2021	Tonopah	Caragana	10	5,440	69.62	72.74	$1,523.20
2021	Tonopah	Cemetery	10	20,928	75.15	78.27	$5,859.84
2021	Tonopah	Central	10	31,458	65.65	68.77	$8,808.24
2021	Tonopah	Charles	10	10,720	71.88	75.00	$3,001.62
2021	Tonopah	Eureka	10	10,656	70.35	73.47	$2,983.68
2021	Tonopah	Florence	10	54,408	68.88	72.00	$15,234.24
2021	Tonopah	IdahoCr	10	21,076	68.88	72.00	$5,901.28
2021	Tonopah	Jackson	10	2,544	72.7	75.82	$712.32
2021	Tonopah	South	21	40,675	71.91	75.03	$11,389.00
2021	Tonopah	Summit	22	18,400	72.71	75.83	$5,152.00
2021	Artesia	Applewood	10	4,189	79.89	83.01	$1,172.84
2021	Artesia	Deerfield	10	19,383	71.47	74.59	$5,427.14
2021	Artesia	Fieldstone	10	31,709	75.43	78.55	$8,878.46
2021	Artesia	Grain Mill	10	38,287	79.88	83.00	$10,720.42
2021	Artesia	Graystone	10	25,901	78.36	81.48	$7,252.36
2021	Artesia	Graystone	20	28,814	79.89	83.01	$8,068.03
2021	Artesia	Jonquil	10	3,478	63.25	66.37	$973.73
2021	Artesia	ongmeadow	20	25,963	76.15	79.27	$7,269.56
2021	Artesia	Peppertree	10	42,675	77.62	80.74	$11,948.97
2021	Artesia	Sandalwood	10	29,737	79.13	82.25	$8,326.48
2021	Crystal	221	10	46,875	71.96	75.08	$13,125.00
2021	Gabbs	B	10	9,312	68.89	72.01	$2,607.36
2021	Gabbs	H	10	12,024	69.07	72.19	$3,366.72
2021	Hadley	Cove	10	85,404	70.36	73.48	$23,913.12
2021	Hadley	Dixie	10	50,589	68.89	72.01	$14,164.92
2021	Hadley	Gypsum	10	8,844	76.06	79.18	$2,476.32
2021	Hadley	Hadley	10	175,306	73.54	76.66	$49,085.68
2021	Hadley	Horseshoe	10	30,723	77.78	80.90	$8,602.44
2021	Hadley	Jewell	10	9,900	70.36	73.48	$2,772.00
2021	Hadley	Prospect	10	111,771	73.54	76.66	$31,295.88
2021	Hadley	Toquima	10	13,596	78.65	81.77	$3,806.88
2021	Outside	745	20	126,720	78.57	81.69	$35,481.60
2021	Outside	745	80	126,720	70.34	73.46	$35,481.60
2021	Outside	745	100	126,720	77.7	80.82	$35,481.60
2021	Outside	815	60	124,632	70.34	73.46	$34,896.96
2021	Outside	847	10	47,448	70.86	73.98	$13,285.44
2021	Outside	950	50	19,200	72.23	75.35	$5,376.00
2021	RndMtn	Mariposa	10	57,024	69.6	72.72	$15,966.72
2021	RndMtn	Shoshone	10	19,944	69.07	72.19	$5,584.32
2021	RndMtn	Stebbins	10	48,408	71.6	74.72	$13,554.24
2021	RndMtn	Sunnyside	40	6,096	70.62	73.74	$1,706.88
2021	Senita	Senita	10	86,520	74.8	77.92	$24,225.60
2021	Shoshone	Kelsey	10	19,344	61.45	64.57	$5,416.32
2021	TphAirSub	TruckRte	10	134,948	69.22	72.34	$37,785.44
			Total Area (Ft^2)	**2,021,557**			**$566,035.89**