

Technical Memorandum

Study Title: Carson City 2024 PAVER Scenarios

Task #1

Task/Subtask Title: Pavement Management Software

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Carson City's PAVER Software Functionality and Configuration

BACKGROUND

Carson City Public Works (CCPW) has worked with APTech since 2019 in the analysis and budget forecasting of Carson City's (City) roadway pavement assets. The City requested two additional budget scenarios as a supplement to the scenarios incorporated in the *Carson City Pavement Condition Analysis Report* from August 2022. For this analysis, performance models, unit costs, and prioritization guidelines were left consistent with those used in the *Carson City Pavement Condition Analysis Report* from August 2022.

This memorandum discusses the updated budget scenario analyses with the additional scenarios requested by the City.

BUDGET SCENARIO ASSUMPTIONS

Roadway project incidentals that are typically encountered during surface treatments and rehabilitation projects are accounted for outside of PAVER. Assumed incidentals as a percentage of the total project costs are shown in table 1. Available budgets for these categories are reduced accordingly for all scenarios because unit costs in the software only account for pavement-related construction. Once a scenario is finalized, the data is exported and the numbers are adjusted accordingly to account for incidentals prior to reporting.

Table 1. CCPW Incidental Costs.

Category	Major M&R	Surface Treatments
ADA	20%	5%
Design/Project Management	12.5%	6.5%
Construction Management	8.5%	11.5%
Contingency	10%	10%
Striping	5%	15%
Total	56%	48%

An overall inflation rate of 2.46% was used. This value was calculated in 2022 based on the average of the information from the Congressional Budget Office for 2022 (6.1%) and 2023 (3.1%), and a 2.3% assumption for the remaining years of the analysis period.

The City has a dedicated budget for localized preventive maintenance and a separate budget for surface treatments and rehabilitation. The initial funding allocation split between surface treatments and rehabilitation was maintained at 30 percent for surface treatments and 70 percent for rehabilitation. Depending on the length of the analysis period, there may be years where there is a considerable funding surplus beyond the 30 percent budget allocated for surface treatments. When a considerable surface treatment funding surplus exists, funds are moved to the rehabilitation treatment budget to incorporate additional rehabilitation work. Additionally, when there is a surplus from the localized preventive maintenance budget, it is used for rehabilitation and surface treatments.

Carson City carries out stopgap maintenance on an as-needed basis throughout the network. Therefore, stopgap maintenance is excluded from all analyses to eliminate additional fund allocation to these activities.

BUDGET SCENARIO ANALYSES

Based on pavement conditions, treatment costs, performance models, and CCPW treatment strategies, the City's pavement management software was used to perform various budget and condition forecasting scenarios. The following discussion provides an overview of the analyses performed and results.

Five budget scenarios with an analysis period up to 2050 were analyzed in 2022, an additional two were requested by the City for this technical memorandum; both being constrained budgets. The five scenarios reported in 2022 were not reanalyzed and are reported again solely for comparison purposes. Details of each scenario are summarized below:

2022 Scenarios

Constrained Funding Scenarios

- **Current Funding Levels:** CCPW estimated that it spends an average of approximately \$1.4 million per year on preventive maintenance activities and \$2 million on surface treatments and rehabilitation activities received from local sources (with a 0.68% increase per year over the analysis period). There is a total of \$18.7 million from a combination of the City's 1/8 cent infrastructure sales and a one-time federal transportation grant which was distributed over the first 5 years of the analysis period toward the rehabilitation of North Carson Street and William Street. This has been incorporated into the forecast to offset costs associated with the two mentioned corridors. Additionally, Carson City reasonably expects to receive \$2.7 million in Transportation Formula Funding; this funding was distributed over the next 5-years for M&R on collector and arterial roads. This scenario predicts the future condition of the pavement network if current funding levels are maintained.
- **Current Funding Levels increased by 100 percent:** CCPW wanted to analyze the impact to their network if local funding was increased to an average of approximately \$2.8 million per year on preventive maintenance activities and \$4 million on surface treatments and rehabilitation activities (with a 0.68% increase per year over the analysis period). The additional \$18.7 million for rehabilitation activities on North Carson Street and William Street and another \$2.7 million from Federal Funding that is to be evenly distributed over the first 5 years of the analysis period were maintained since both funding streams will conclude by 2027.

Target Pavement Condition Scenarios

The additional \$18.7 million for rehabilitation activities on North Carson Street and William Street as well as the \$2.7 million in Federal Funding on regional roads that is to be evenly distributed over the first 5 years of the analysis period were maintained for these scenarios.

- **Maintain Current Condition:** This scenario predicts the annual budget requirements to maintain the current area-weighted average network PCI of approximately 62 (Fair) over the 28-year analysis period.
- **Reach Target Conditions:** This scenario predicts the annual budget requirement to reach a specified area-weighted average PCI; the following two scenarios were analyzed:
 - Approved [Pavement Management Plan](#) scenario where regional and local roadways would reach an area-weighted average PCI of at least 75 and 70, respectively, in the initial 8 years and then maintain the target conditions over the remainder of the 28-year analysis period.
 - Modified Pavement Management Plan scenario, which is more in line with the City’s current practice of roadway prioritization that focuses on roadways with higher volumes and connectivity, and addresses local roadways as funding becomes available. Regional and local roadways would reach an area-weighted average PCI of at least 70 and 50, respectively, by 2030, and then maintain target conditions over the remainder of the 28-year analysis period.

2024 Scenarios

Constrained Funding Scenarios

- **2024 Scenario 1:** CCPW wanted to analyze the impact to their network if funding for local roads was increased to \$7 million per year (for consistency, a 0.68% increase per year over the analysis period was maintained). The additional \$18.7 million for rehabilitation activities on North Carson Street and William Street and another \$2.7 million from Federal Funding that is to be evenly distributed over the first 5 years of the analysis period were maintained since both funding streams will conclude by 2027.
- **2024 Scenario 2:** CCPW wanted to analyze the impact to their network if funding for local roads was increased \$7 million per year, and an additional \$5 million was made available for Regional and Local roads (for consistency, a 0.68% increase per year over the analysis period was maintained for both of these funding increases). The additional \$18.7 million for rehabilitation activities on North Carson Street and William Street and another \$2.7 million from Federal Funding that is to be evenly distributed over the first 5 years of the analysis period were maintained since both funding streams will conclude by 2027.

Tables 2 and 3 show the annual report card used by CCPW that summarizes the average area-weighted PCI for all facility types over the analysis period for the 2024 budget scenarios. These tables show the percentage change between the first and twenty-eighth year of the analysis period.

Table 2: 2024 Scenario 1 Report Card.

Pavement Condition Index (PCI) - Annual Report Card												
Facility Type		Estimated PCI										Percent Change 2022 to 2050
		2022	2025	2028	2030	2034	2037	2040	2043	2046	2050	
City-wide	Regional Roads	74	72	69	67	63	61	59	57	54	50	-32%
	Local Roads	56	53	52	52	51	52	51	51	50	50	-11%
	All Roads	62	60	58	57	55	55	54	53	51	50	-20%
Performance District 1	Regional Roads	69	69	67	68	67	69	66	62	59	53	-23%
	Local Roads	57	55	53	52	54	54	55	57	57	57	0%
	All Roads	61	59	58	57	58	59	59	58	58	56	-9%
Performance District 2	Regional Roads	80	77	77	73	72	70	70	69	67	64	-20%
	Local Roads	53	50	49	49	49	50	49	48	47	45	-14%
	All Roads	63	59	59	57	57	57	56	55	54	52	-18%
Performance District 3	Regional Roads	77	73	67	62	58	53	54	49	50	47	-39%
	Local Roads	58	57	54	54	51	52	52	51	50	50	-14%
	All Roads	64	62	58	57	53	52	52	51	50	49	-24%
Performance District 4	Regional Roads	79	78	75	72	66	64	59	58	53	47	-41%
	Local Roads	51	48	49	50	49	49	48	47	45	43	-15%
	All Roads	61	59	58	58	55	54	52	51	48	44	-27%
Performance District 5	Regional Roads	65	62	60	58	52	50	47	45	41	40	-38%
	Local Roads	60	58	55	55	53	54	51	52	52	53	-12%
	All Roads	62	59	57	56	53	53	49	49	48	49	-22%

Table 3: 2024 Scenario 2 Report Card.

Pavement Condition Index (PCI) - Annual Report Card												
Facility Type		Estimated PCI										Percent Change 2022 to 2050
		2022	2025	2028	2030	2034	2037	2040	2043	2046	2050	
City-wide	Regional Roads	74	79	83	84	87	89	85	84	82	78	5%
	Local Roads	56	54	53	53	52	52	53	53	53	52	-8%
	All Roads	62	63	63	63	64	64	64	64	62	61	-2%
Performance District 1	Regional Roads	69	80	82	86	89	87	87	82	85	76	10%
	Local Roads	57	56	54	53	54	55	58	58	59	58	2%
	All Roads	61	64	63	64	66	65	67	66	67	64	5%
Performance District 2	Regional Roads	80	82	86	87	87	88	85	84	82	80	0%
	Local Roads	53	50	48	49	49	49	49	49	48	46	-12%
	All Roads	63	61	62	62	62	63	62	62	60	58	-8%
Performance District 3	Regional Roads	77	81	79	83	86	89	88	85	84	78	2%
	Local Roads	58	58	55	55	52	52	55	55	53	52	-10%
	All Roads	64	65	62	64	63	64	65	64	62	60	-6%
Performance District 4	Regional Roads	79	84	87	86	87	89	83	84	78	78	-1%
	Local Roads	51	48	50	51	50	50	50	49	47	45	-11%
	All Roads	61	61	63	64	63	64	61	62	58	57	-7%
Performance District 5	Regional Roads	65	69	79	79	86	90	82	85	80	77	19%
	Local Roads	60	58	55	56	54	55	54	56	56	56	-6%
	All Roads	62	62	63	64	66	67	64	66	64	63	2%

As illustrated in Figure 1 and Tables 2 and 3, increasing the funding level by \$7 million annually for local roads shows a decline in network condition over the analysis period, starting at a PCI of 62 and declining to a PCI of 50 in 28. This is an overall network PCI increase of 17 points at the end of the analysis period when compared to the current funding. However, when the funding level is increased by \$12 million annually, the network will only decline one point by the end of the analysis period

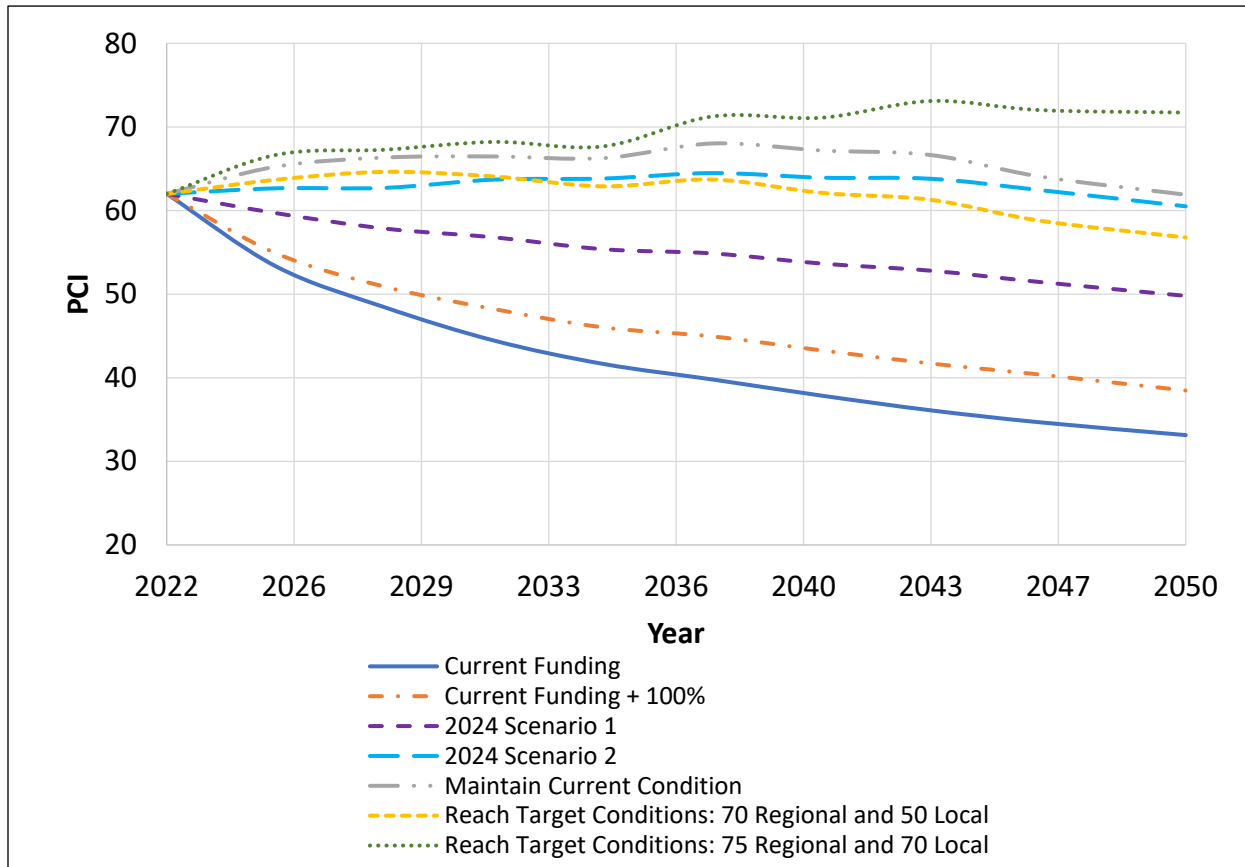


Figure 1. Chart of PCI over time for analyzed budget scenarios.

Figure 2 shows the average annual budgets for every scenario. The average annual difference between the current funding and the two proposed increases (\$7 million annually and \$12 million annually) are \$7.68 million and \$13.17 million, respectively.

The difference between the proposed funding increases (\$7 million annually and \$12 million annually) and the annual budget required to meet the City’s approved Pavement Management Plan pavement condition targets (75 for regional roads and 70 for local roads) are \$17.75 million and \$12.26 million, respectively.

The difference between the proposed funding increases (\$7 million annually and \$12 million annually) and the annual budget required to meet the proposed modified pavement condition targets (70 for regional roads and 50 for local roads) are \$10.22 million and \$4.73 million, respectively.

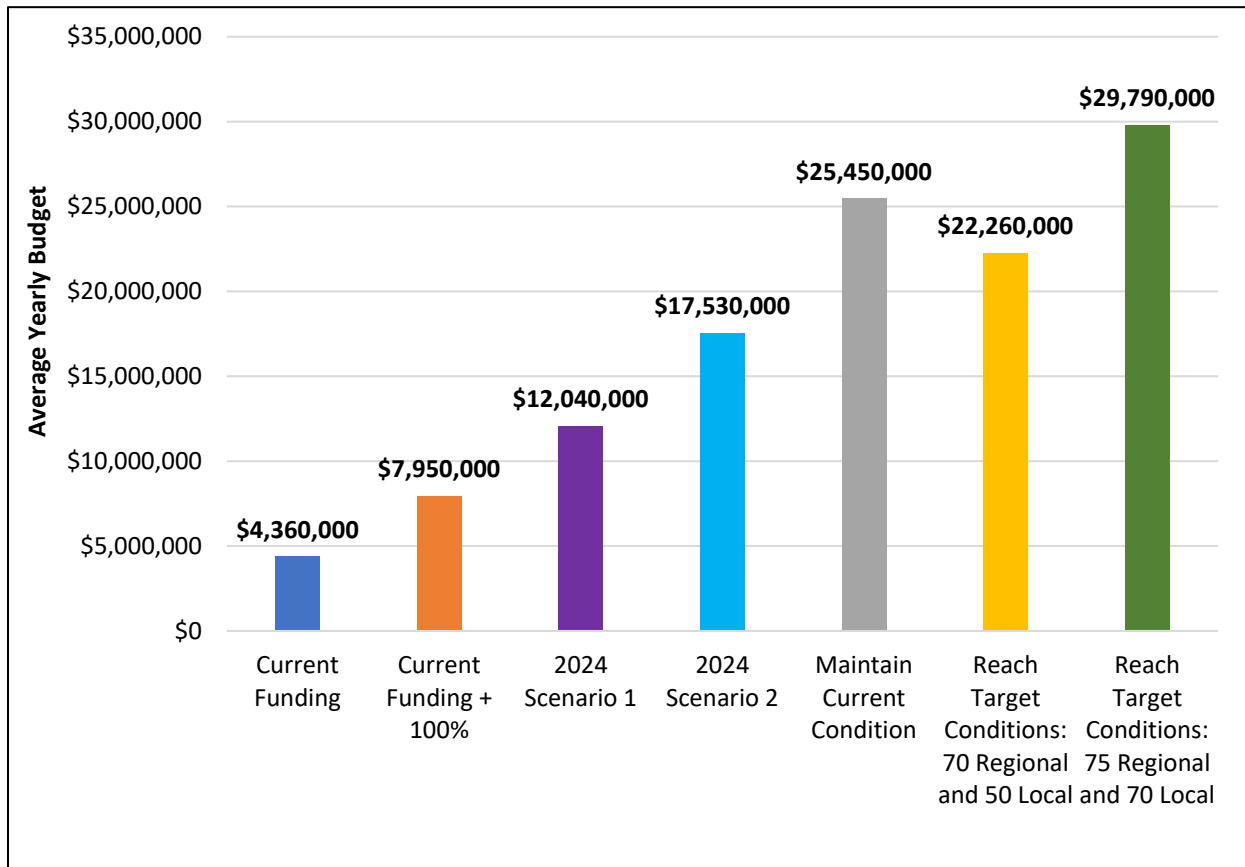


Figure 2. Average annual budget per scenario.

Figures 3 through 14 show the forecasted condition categories for the 2024 scenarios by percentage of network area for the overall network, regional roads, and local roads for 2030 and 2050 respectively. If the budget were increased by \$7 million annually for local roads, approximately 40 percent of the network would be in Fair or better condition (PCI > 55) by the end of the analysis period, with approximately 35 percent of Regional roads and 42 percent of local roads in Fair or better condition. Were the budget to be increased \$12 million annually (with \$7 million exclusively dedicated to local roads), approximately 58 percent of the network would be in Fair or better condition, with approximately 84 percent of Regional roads and 46 percent of local roads in Fair or better condition.

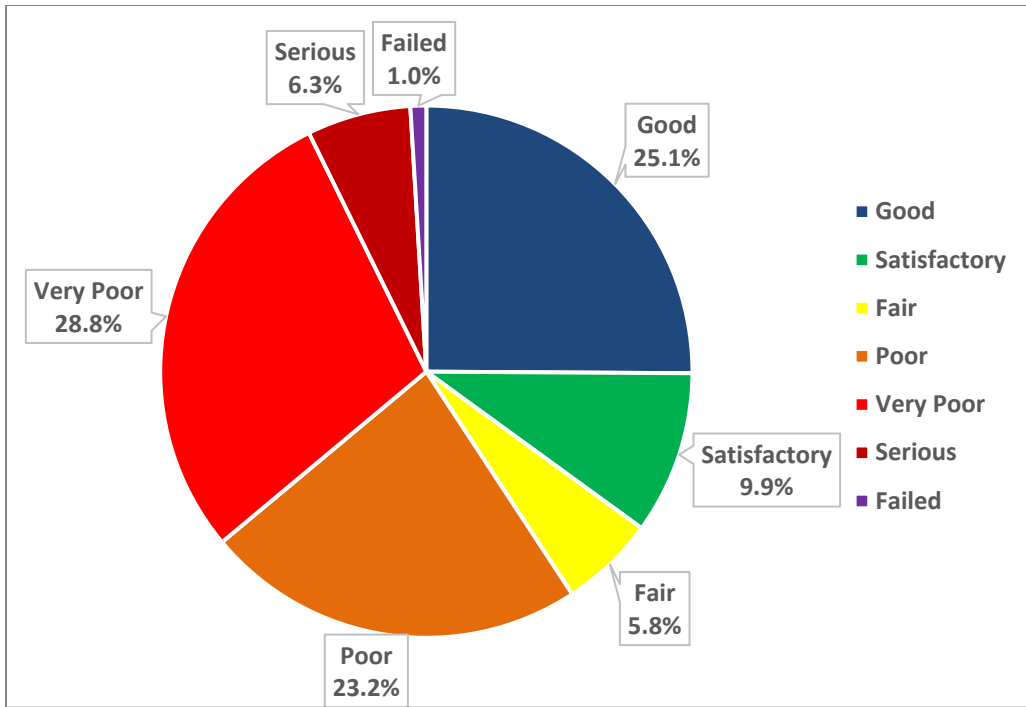


Figure 3. 2024 Scenario 1 – Forecasted Network pavement area by condition category in 2030.

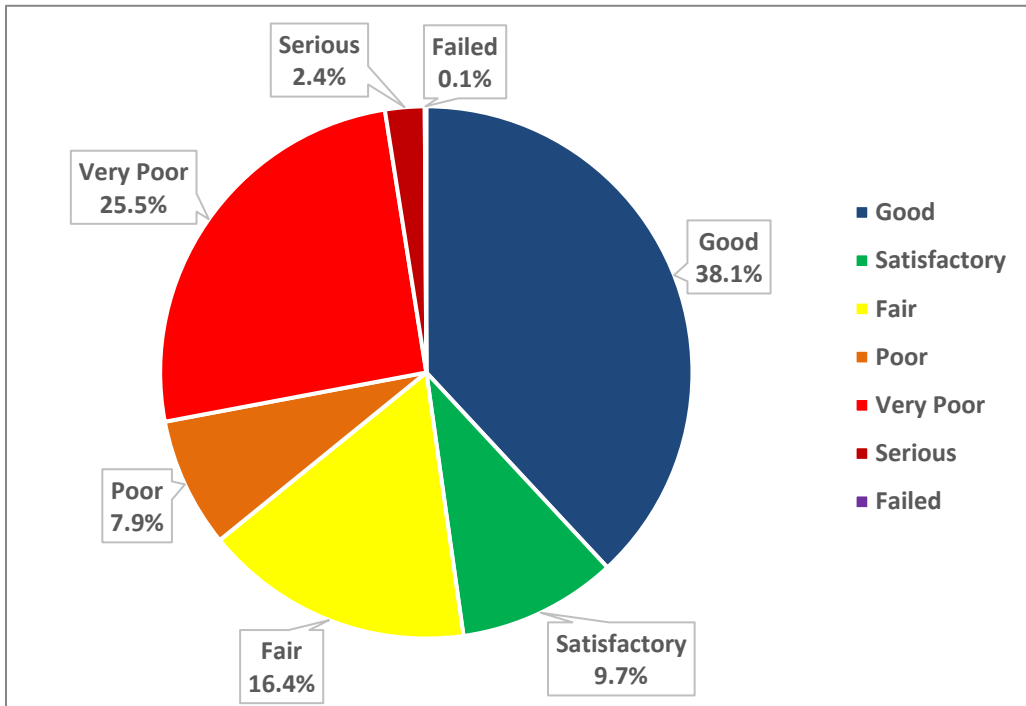


Figure 4. 2024 Scenario 1 – Forecasted Regional Roads pavement area by condition category in 2030.

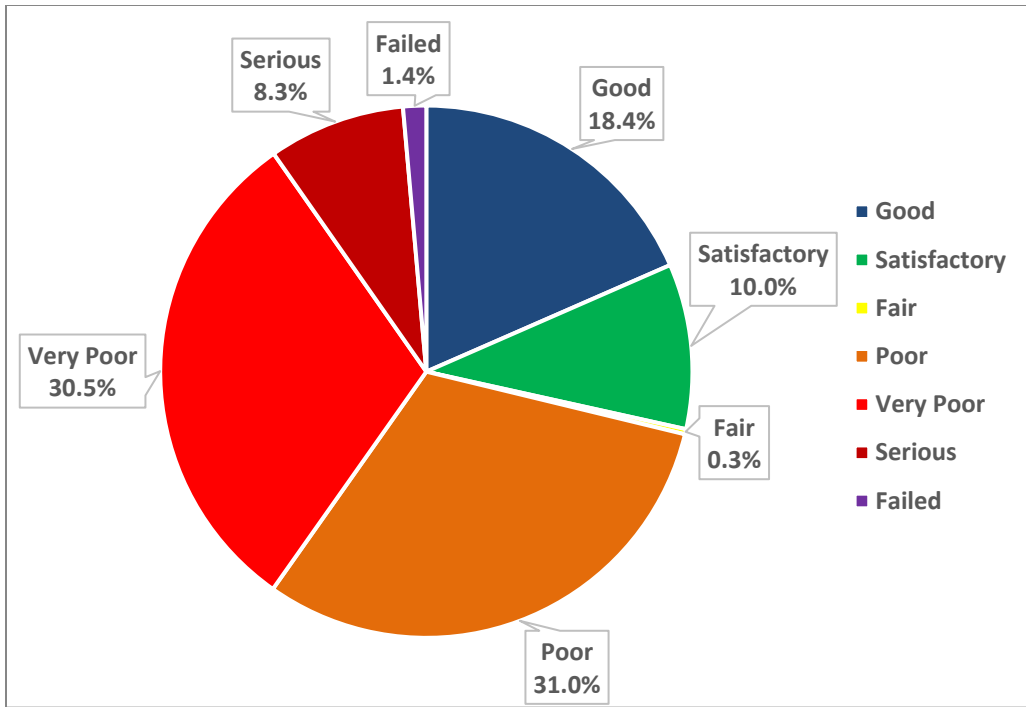


Figure 5. 2024 Scenario 1 – Forecasted Local Roads pavement area by condition category in 2030.

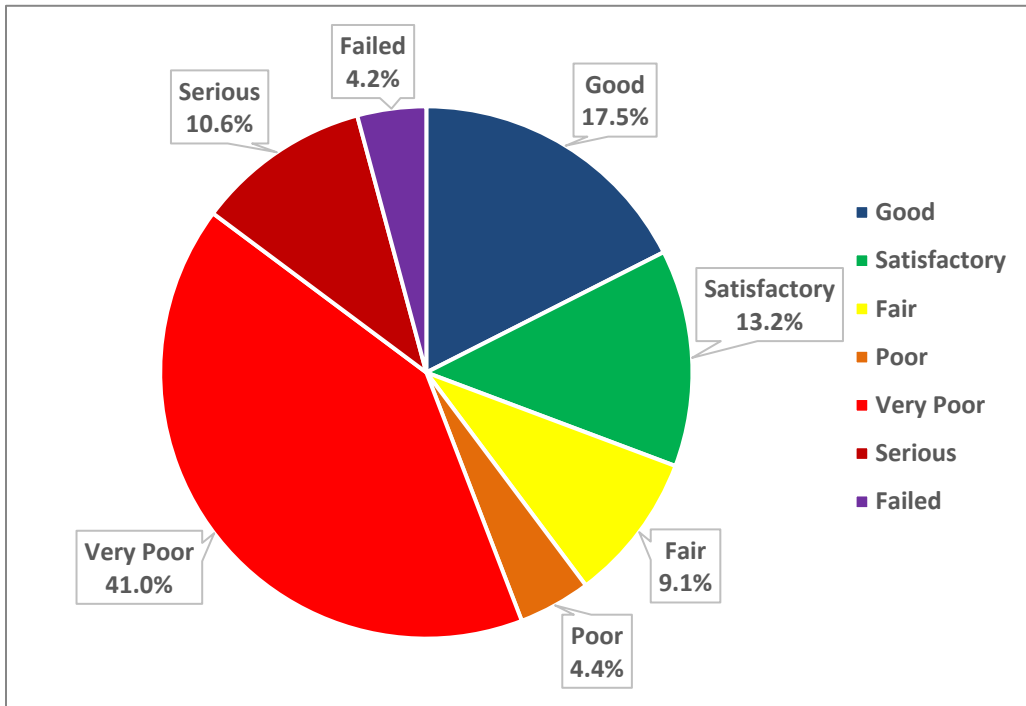


Figure 6. 2024 Scenario 1 – Forecasted Network pavement area by condition category in 2050.

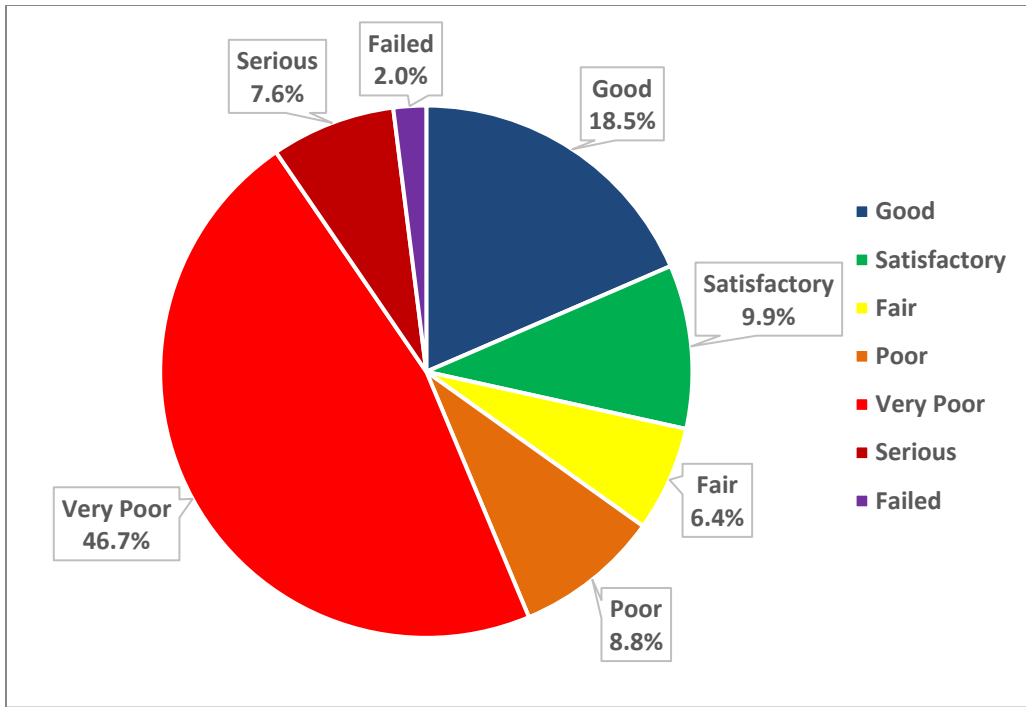


Figure 7. 2024 Scenario 1 – Forecasted Regional Roads pavement area by condition category in 2050.

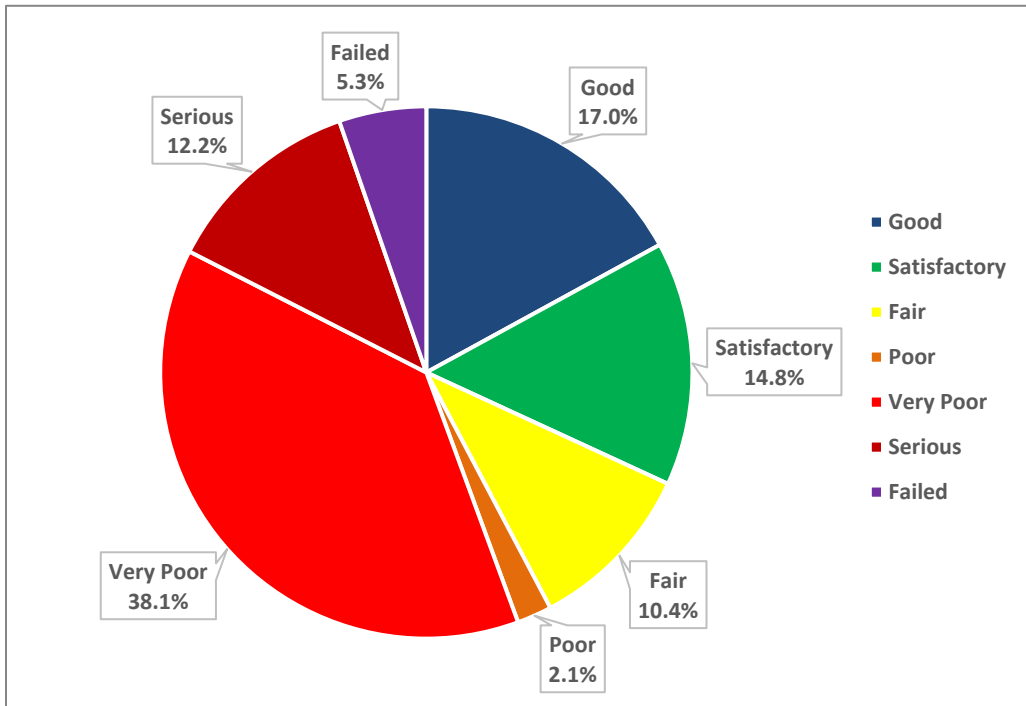


Figure 8. 2024 Scenario 1 – Forecasted Local Roads pavement area by condition category in 2050.

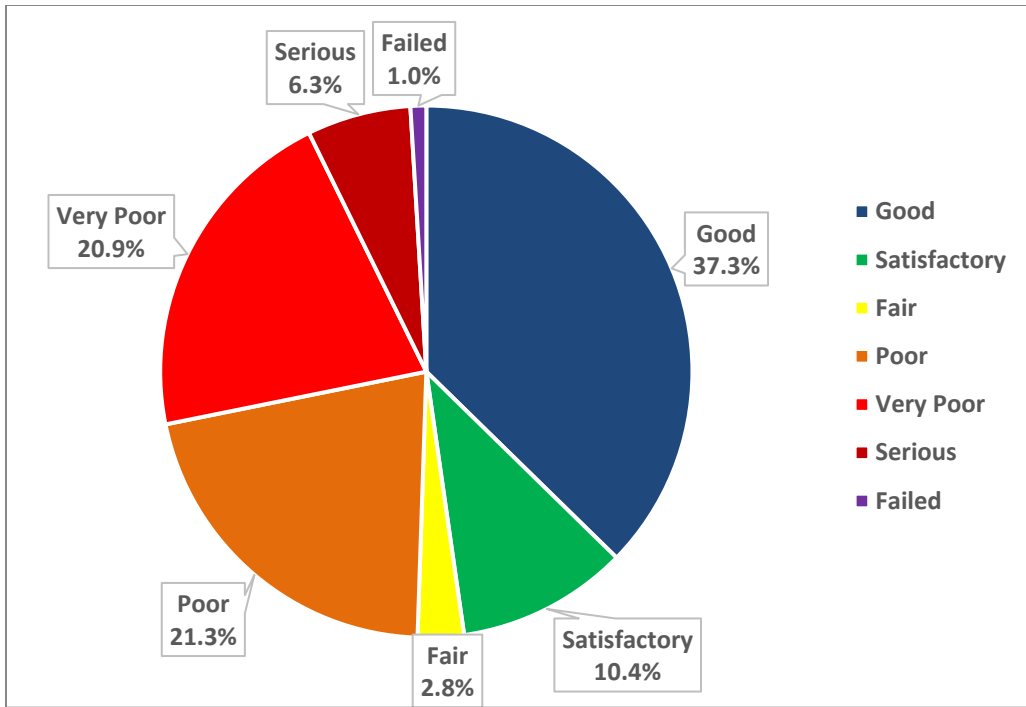


Figure 9. 2024 Scenario 2 – Forecasted Network pavement area by condition category in 2030.

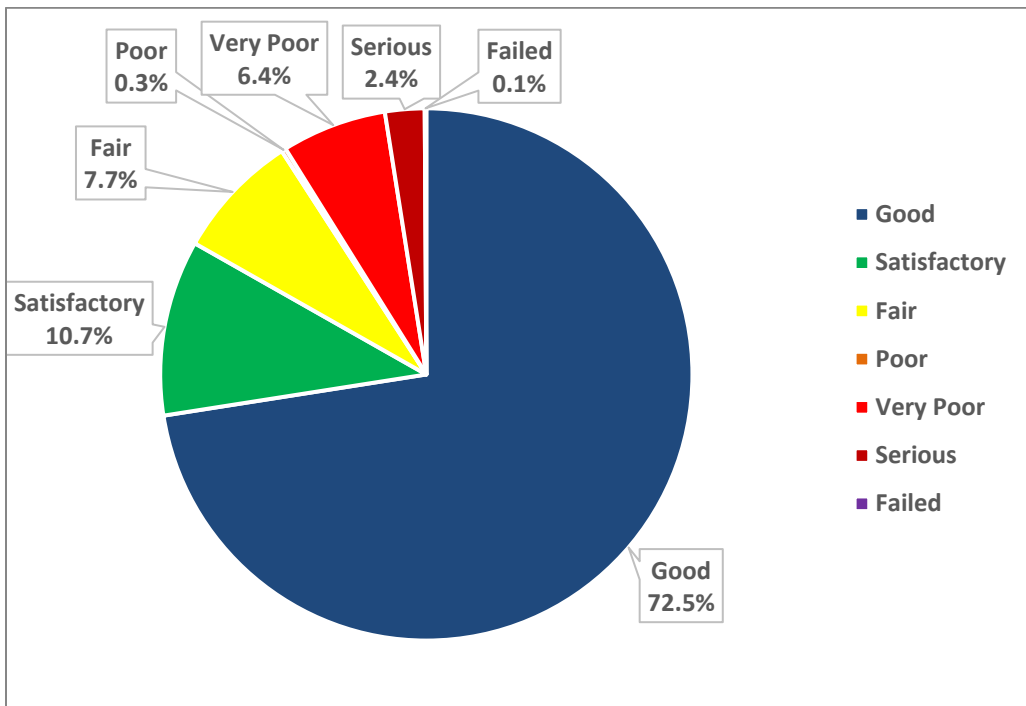


Figure 10. 2024 Scenario 2 – Forecasted Regional Roads pavement area by condition category in 2030.

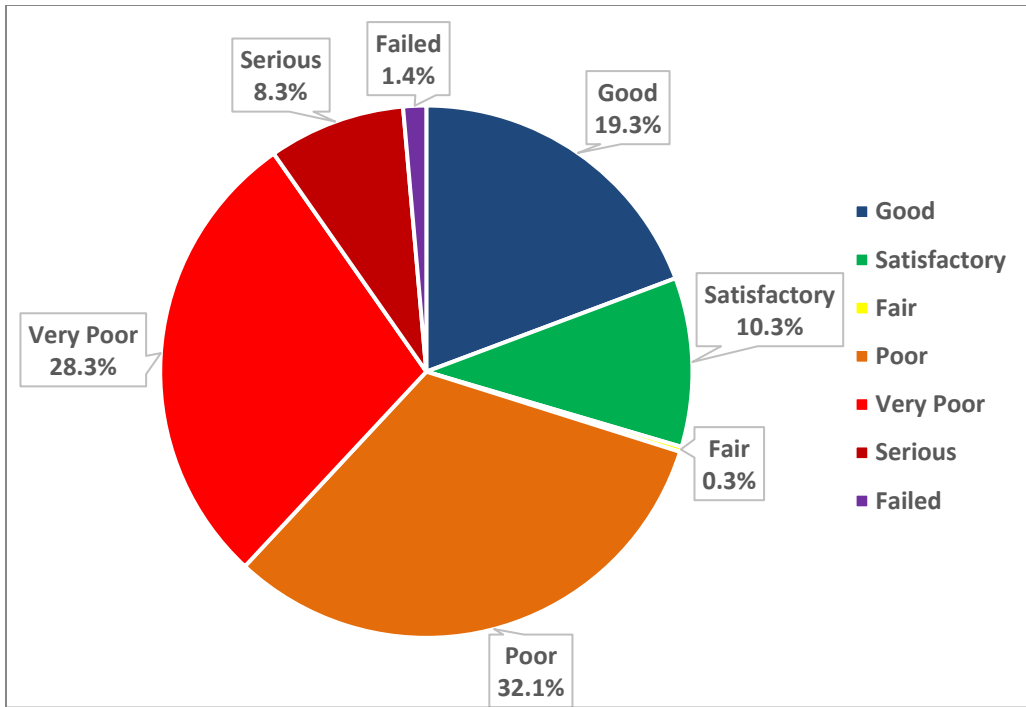


Figure 11. 2024 Scenario 2 – Forecasted Local Roads pavement area by condition category in 2030.

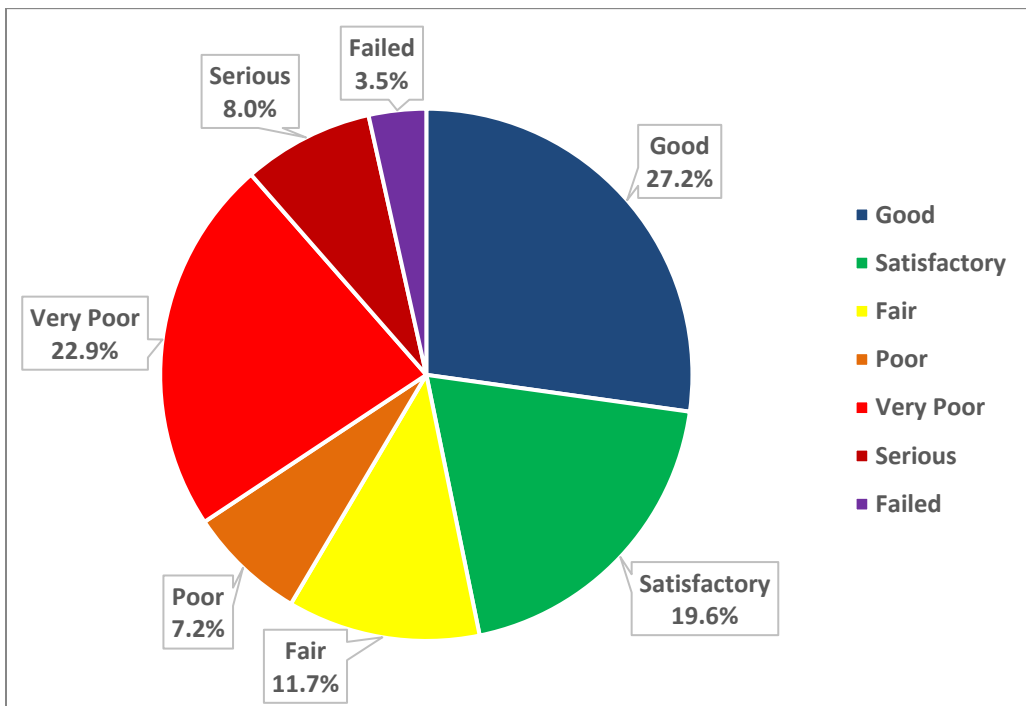


Figure 9. 2024 Scenario 2 – Forecasted Network pavement area by condition category in 2050.

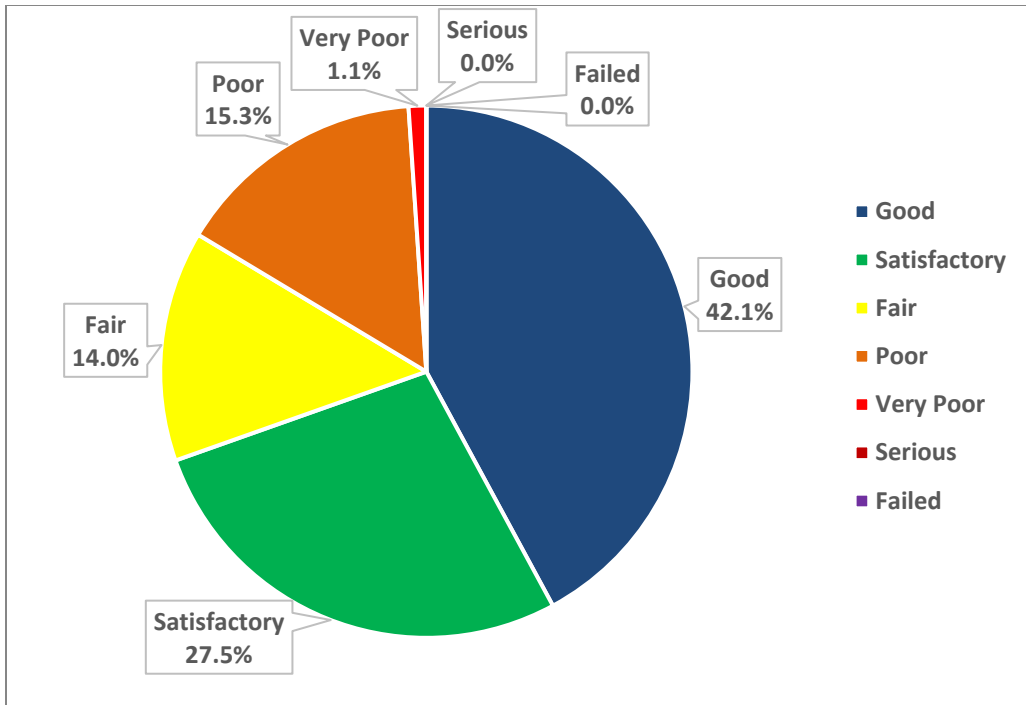


Figure 12. 2024 Scenario 2 – Forecasted Regional Roads pavement area by condition category in 2050.

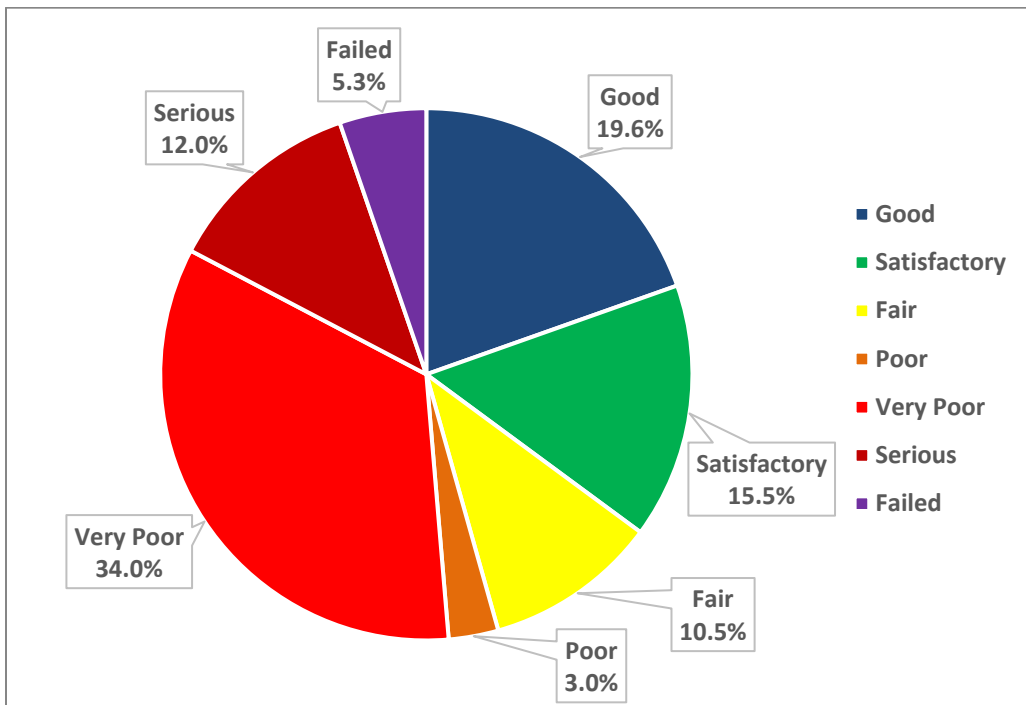


Figure 13. 2024 Scenario 2 – Forecasted Local Roads pavement area by condition category in 2050.

SUMMARY

Carson City Public Works requested two additional maintenance and rehabilitation scenarios. To provide comparable results, all assumptions and software configurations were maintained consistent with the analyses in the *Carson City Pavement Condition Analysis Report* from August 2022. The following summarizes the findings from analyzing the M&R planning scenarios:

- At the current funding of approximately \$4.36 Million per year, the overall area-weighted average of the network would be a 46 by 2030 and 33 by 2050.
- Increasing the current funding by \$7 million annually for local roads shows a slower decline in network condition over the analysis period. At this budget level the PCI for the network would reach a 57 by 2030 and a 50 by 2050.
- Increasing the current funding by \$12 million annually (\$7 million annually dedicated exclusively to local roads) shows the overall network condition will remain between 65 and 61 throughout the analysis period.
- The condition of the City roadway network has reached the point that the rate of decline is greater than current funding levels can sustain. If the City desires to overcome the declining trend, it is recommended that the results of this analysis be used to demonstrate to decision makers the condition of the roadway network, and the impact on overall network pavement conditions when available funding does not meet the need for pavement M&R.
- It is also recommended that while planning for M&R work the City maintains their use of preservation treatments such as crack sealing, patching, and surface treatments, to preserve the roads currently in good condition. Pavement preservation actions will help to prevent a further decline in overall network condition and reduce funding needs for costly M&R work.