ROADWAY PAVEMENT MAINTENANCE REPORT

NOACA will STRENGTHEN regional cohesion, PRESERVE existing infrastructure and BUILD a sustainable multimodal transportation system to SUPPORT economic development and ENHANCE the quality of life in Northeast Ohio

NORTHEAST OHIO
Lake
Geauga
Cuyahoga
Lorain
Medina
AREAWIDE COORDINATING AGENCY
NOACA: Planning For Greater Cleveland

2020

VILLAGE OF PERRY

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- Serve as the Metropolitan Planning Organization (MPO), with responsibility for comprehensive, cooperative and continuous planning for highways, public transit, and bikeways, as defined in the current transportation law.
- Perform continuous water quality, transportation-related air quality and other environmental planning functions.
- Administer the area clearinghouse function, which includes providing local government with the opportunity to review a wide variety of local or state applications for federal funds.
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- Serve as an information center for transportation and environmental and related planning.
- As directed by the Board, provide transportation and environmental planning assistance to the 172 units of local, general purpose government.

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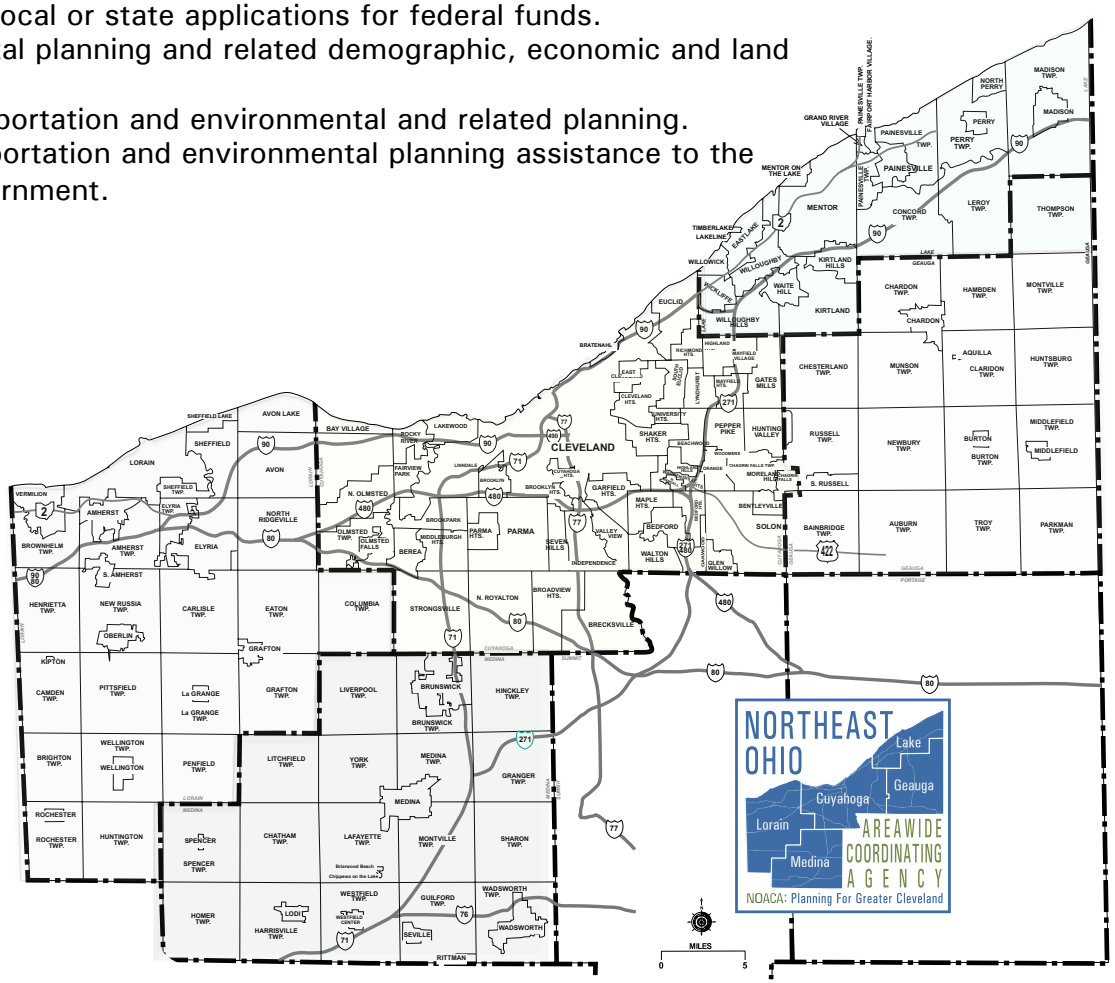

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EXECUTIVE SUMMARY

The current Ohio Department of Transportation (ODOT) pavement database has 3,659 segment records for the Northeast Ohio Areawide Coordinating Agency (NOACA) region. The NOACA region has a total of 3,344 centerline miles of roadways including freeways and federal-aid highways which is equivalent to 8,240 lane-miles. The 2020 all road types network average Pavement Condition Rating (PCR) is about 75.

In the Village of Perry there are 2.62 centerline miles of federal-aid roads, which are equivalent to 5.24 lane-miles within the village boundary. The current ODOT pavement database has five segment records for the Village of Perry roadway system. Each record comprises of several fields of various information and measures such as street name, length (miles), lane-miles length, number of lanes, function class, PCR, etc.

According to the PCR measure, about 72 percent of pavement the lane-miles are currently in the “Good” to “Very Good” condition. The rest of the lane-miles are in the “Fair” status and demand some kind of preventive maintenance treatments.

This pavement study includes four parts:

- Part I: The 2020 Pavement Network Condition
- Part II: The 2020 Backlog
- Part III: The Maintenance and Rehabilitation (M&R) Program
- Part IV: The Comparative Analysis

Considering the five-year study period of 2020 - 2024, this pavement study focuses on the required preventive maintenance treatments and some rehabilitation techniques rather than reconstruction.

Part I of this study analyzes the 2020 pavement network condition and tabulates the important information of all the five road segments in the Village of Perry.

In Part II, the Backlog is defined as the cost of pavement rehabilitation of all roads within one year (2020) and bringing the average network PCR to 80. Backlog is a “snapshot” or relative measure of outstanding rehabilitation work.

Part III introduces the optimal preventive maintenance and rehabilitation strategy for each segment and its recommended implementation year based on the NOACA maintenance decision tree.

Finally, Part IV compares the Backlog and the “M&R” program with the NOACA transportation asset management strategies. All these strategies were compared regarding their costs, the average network PCR and percent of the lane-miles below the acceptable level.

BACKGROUND

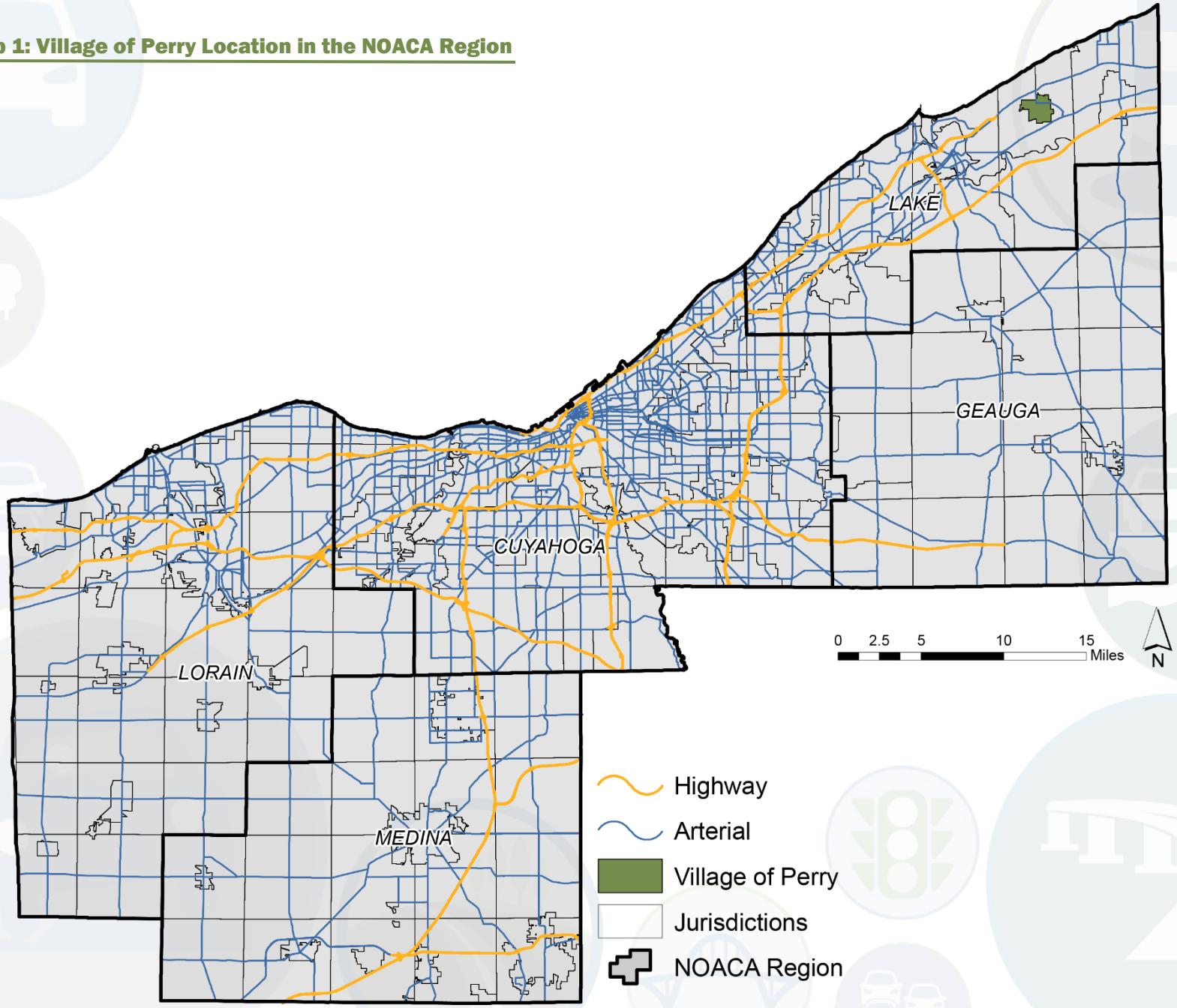
Perry is a village in Lake County. It is named in honor of Commodore Oliver Hazard Perry to commemorate his victory over the British fleet at the Battle of Lake Erie in September 1813. The battle was a turning point in the western theater during the War of 1812.

According to 2020 Northeast Ohio Areawide Coordinating Agency (NOACA) estimates, the population of village is 1,602 and there are 572 households. The 2020 estimated employment number is 591.

Cleveland-Hopkins International Airport is the nearest airport.

Map 1 illustrates the Village of Perry location in the NOACA region.

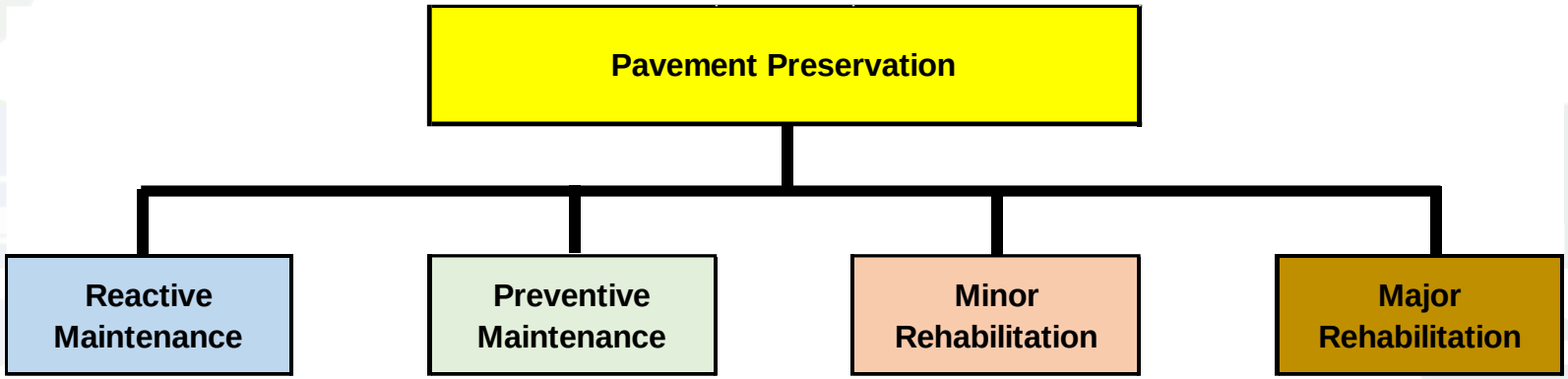
Map 1: Village of Perry Location in the NOACA Region



DEFINITIONS FOR PAVEMENT MAINTENANCE TERMINOLOGY

Pavement Preservation is "a program employing a network level, long-term strategy that enhances pavement performance by using an integrated, cost-effective set of practices that extend pavement life, improve safety and meet motorist expectations. A pavement preservation program consists primarily of four components: Reactive Maintenance, Preventive Maintenance, Minor Rehabilitation, and Major Rehabilitation/ Reconstruction as shown in Figure 1.

Figure 1: Components of Pavement Preservation



Reactive Maintenance is also known as routine or corrective maintenance consists of work that is performed to respond to specific conditions and deficiencies on pavements that are distressed and possibly unsafe. These activities are not planned in advance and seldom improve the pavement system performance in a long term.

Preventive Maintenance is considered as cost effective treatments to an existing roadway system and its appurtenances that preserves the system, delays future deterioration, and maintains or improves the functionality condition of the system without increasing structural capacity.

Pavement Rehabilitation is defined as resurfacing, restoration, and rehabilitation (3R) work consisting of structural enhancements that extend the service life of an existing pavement and/or improve its structural capacity. Rehabilitation techniques include restoration treatments and/or structural overlays. This may include partial recycling of the existing pavement, placement of additional surface materials, and/or other work necessary to return an existing pavement to a condition of structural or functional adequacy.

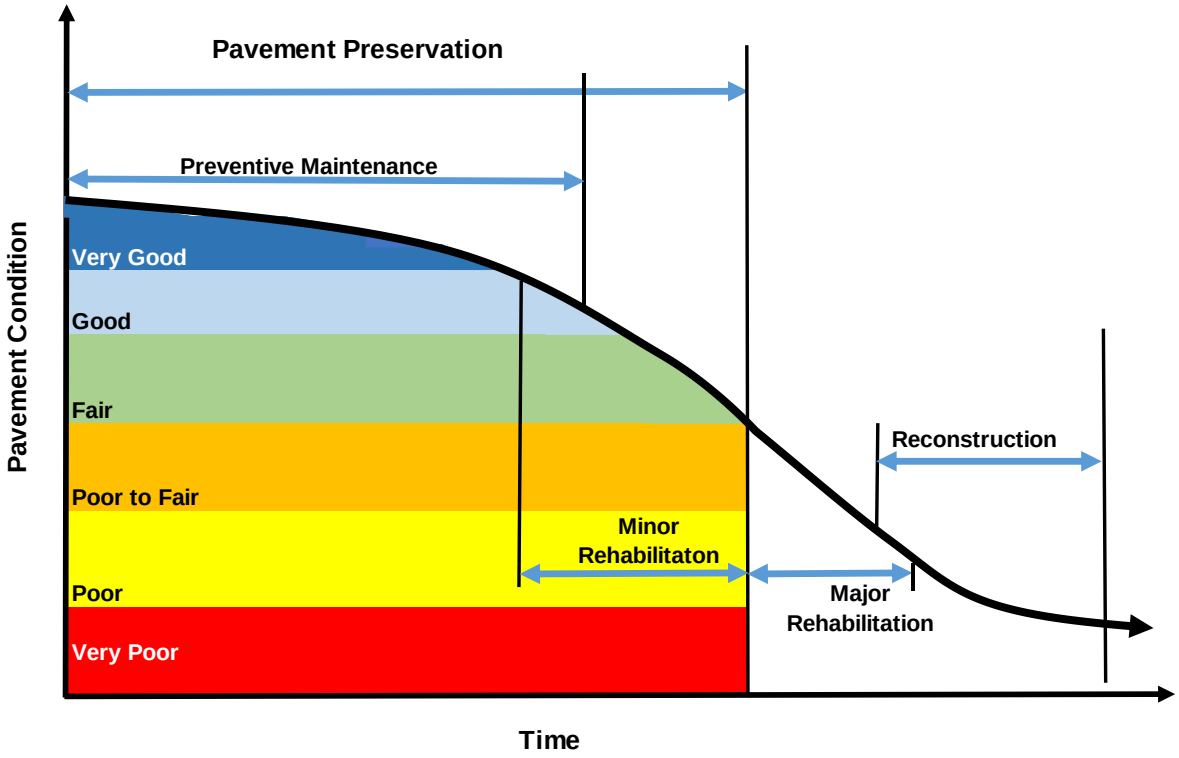
Minor Rehabilitation consists of non-structural enhancements made to the existing pavement sections to eliminate age-related, top-down surface cracking that develop in flexible pavements due to environmental exposure. Because of the non-structural nature of minor rehabilitation techniques, these types of rehabilitation techniques are placed in the category of pavement preservation.

Major Rehabilitation consists of structural enhancements that both extend the service life of an existing pavement and/or improve its load-carrying capability.

Pavement Reconstruction is defined as the replacement or reestablishment of the original pavement structural capacity by the placement of the equivalent or increased pavement structure. Reconstruction may utilize either new or recycle materials for the reconstruction of the complete pavement structure.

Figure 2 illustrates a general schematic for the timing of the pavement preservation Components.

Figure 2: A General Schematic for Timing of Pavement Preservation Components



Selected Pavement Treatments

Chip Seals is a two-step process which includes first an application of asphalt emulsion and then a layer of crushed rock to an existing asphalt pavement surface. A chip seal gets its name from the “chips” or small crushed rock placed on the surface.

Microsurfacing is similar to slurry seal. It consists of the application of a mixture of water, asphalt emulsion, aggregate (very small crushed rock), and chemical additives to an existing asphalt concrete pavement surface. Polymer is commonly added to the asphalt emulsion to provide better mixture properties. The major difference between slurry seal and microsurfacing is in how they “break” or harden. Slurry relies on evaporation of the water in the asphalt emulsion. The asphalt emulsion used in microsurfacing contains chemical additives which allow it to break without relying on the sun or heat for evaporation to occur. Thus, microsurfacing is an application that hardens quicker than slurry seals and can be used when conditions would not allow slurry seal to be successfully placed. Streets that have a lot of shade and streets that have a lot of traffic are good candidates for microsurfacing.

Thin Overlays (1″ – 1½” of asphalt) and ultra thin overlays (less than 1″) offer an economical resurfacing, preservation and renewal paving solution for roads requiring safety and smoothness improvements. Thin asphalt overlays not only provide a new pavement surface for a fraction of the cost of rebuilding a roadway, but they are the only preventive maintenance technique that adds structural value while helping to extend a pavement’s service life.

Patching is the process of filling potholes or excavated areas in the asphalt pavement. Quick repair of potholes or other pavement disintegration helps control further deterioration and expensive repair of the pavement.

Pavement Milling consists of removing the existing surface layer with a milling machine and then transporting the material to a storage facility. New asphalt plant mix, often containing some recycled asphalt pavement (RAP), is installed to replace the milled out material. Milling can also remove distresses from the surface, providing a better driving experience and/or longer roadway life.

Full-Depth Reclamation is an in-place recycling method for reconstruction of existing flexible pavements using the existing pavement section material as the base for the new roadway-wearing surface. This process can include adding chemicals to the base layer in order to increase its strength capacity. The treatment of the base layer and recycled asphalt provides a stronger foundation for present and future traffic. This process effectively produces a cost-effective solution that maximizes limited budgets.

Joint Sealing is to minimize infiltration of surface water and in compressible material into the joint system. Sealants can also reduce dowel bar corrosion potential by reducing entrance of de-icing chemicals.

Load Transfer Retrofit involves the installation of dowel bars into existing concrete pavement to provide load transfer across transverse cracks or joints. Dowel bars are short steel bars that provide a mechanical connection between slabs without restricting horizontal joint movement. They increase load transfer efficiency by allowing the leave slab to assume some of the load before the load is actually over it. This reduces joint deflection and stress in the approach and leave slabs.

Partial-Depth Repairs are defined as the removal and replacement of small areas of deteriorated (or spalled) concrete, typically in joints or cracks. The depth of deterioration can vary from a few millimeters to the full depth of the pavement.

Full-Depth Repair is a concrete pavement restoration (CPR) technique that can be used to restore the structural integrity and ride ability to concrete pavements having certain types of distresses. It involves making lane-width, full-depth saw cuts to remove the deteriorated concrete down to the base, repairing the disturbed base, installing load-transfer devices, and refilling the excavated area with new concrete. It is an effective, permanent treatment to repair pavement distresses particularly those that occur at or near joints and cracks. By removing and replacing isolated areas of deterioration, full-depth repairs may delay or stop further deterioration and restore the pavement close to its original condition. The distresses that can be addressed using full-depth repairs include transverse cracking, corner breaks, longitudinal cracking, deteriorated joints, D-Cracking, blowups, and punch outs.

Table 1 illustrates the typical planning level costs of the above selected treatments.

Table 1: Selected Pavement Treatments and their Planning Level Costs

Treatments for Asphalt Pavements	Typical Cost per SQ FT (2020$)	Estimated Cost per 12- FT Lane-Mile (2020$)	Preservation Component
Crack Sealing, Rejuvenators, Chip Sealing	0.09	5,700	Preventive Maintenance
Microsurfacing, Slurry Seal	0.26	16,500	
Partial Depth Patching, Chip & Seal / Micro-Surface with Partial Depth Patch, Full Depth Patching	0.43	27,200	
Thin Hot Mix Asphalt Overlays without Milling	0.54	34,200	
Pavement Milling	0.78	49,400	Minor Rehabilitation
Full-Depth Reclamation	1.77	112,100	Major Rehabilitation

Table 1: Selected Pavement Treatments and their Planning Level Costs (Continued)

Treatments for Concrete Pavements	Typical Cost per SQ FT (2020$)	Estimated Cost per 12- FT Lane-Mile (2020$)	Preservation Component
Cleaning and Sealing of Joint and Cracks	0.11	7,000	Preventive Maintenance
Load Transfer Retrofit	0.40	25,300	
Partial Depth Repair	1.50	95,000	Minor Rehabilitation
Full-Depth Repair	2.07	131,100	Major Rehabilitation

Maintaining the roadways in a state of good repair is essential and experience has shown that, over time it is less expensive to invest in preventive maintenance and/or rehabilitation in an ongoing basis rather than in a high cost reconstruction of pavement that has deteriorated to a poor condition.

This pavement preservation study analyzes the current status of the Perry pavement network condition and considers the five-year study period of 2020-2024. It mainly focuses on the required roadway pavement preventive maintenance treatments and some rehabilitation techniques rather than reconstruction. The current Ohio Department of Transportation (ODOT) pavement database was used as the input data and RoadMatrix software was utilized as the NOACA Pavement Management platform.

This report includes the following four parts:

I. The 2020 status of the Perry pavement network condition,
II. The 2020 “Backlog” treatment list,
III. The optimal preventive maintenance and rehabilitation strategies, and
IV. The comparative analysis.

PART I: 2020 PAVEMENT CONDITION

In order to provide an accurate assessment of the current status and further pavement analyses, the pavement network is required to be divided into homogeneous discrete sections in terms of surface distress, traffic volumes, pavement structure, etc. The current ODOT pavement database has five segment records for the Village of Perry roadway system. Each record comprises of several fields of various information and measures such as street name, length (miles), lane-miles length, number of lanes, function class, Pavement Condition Rating (PCR), etc.

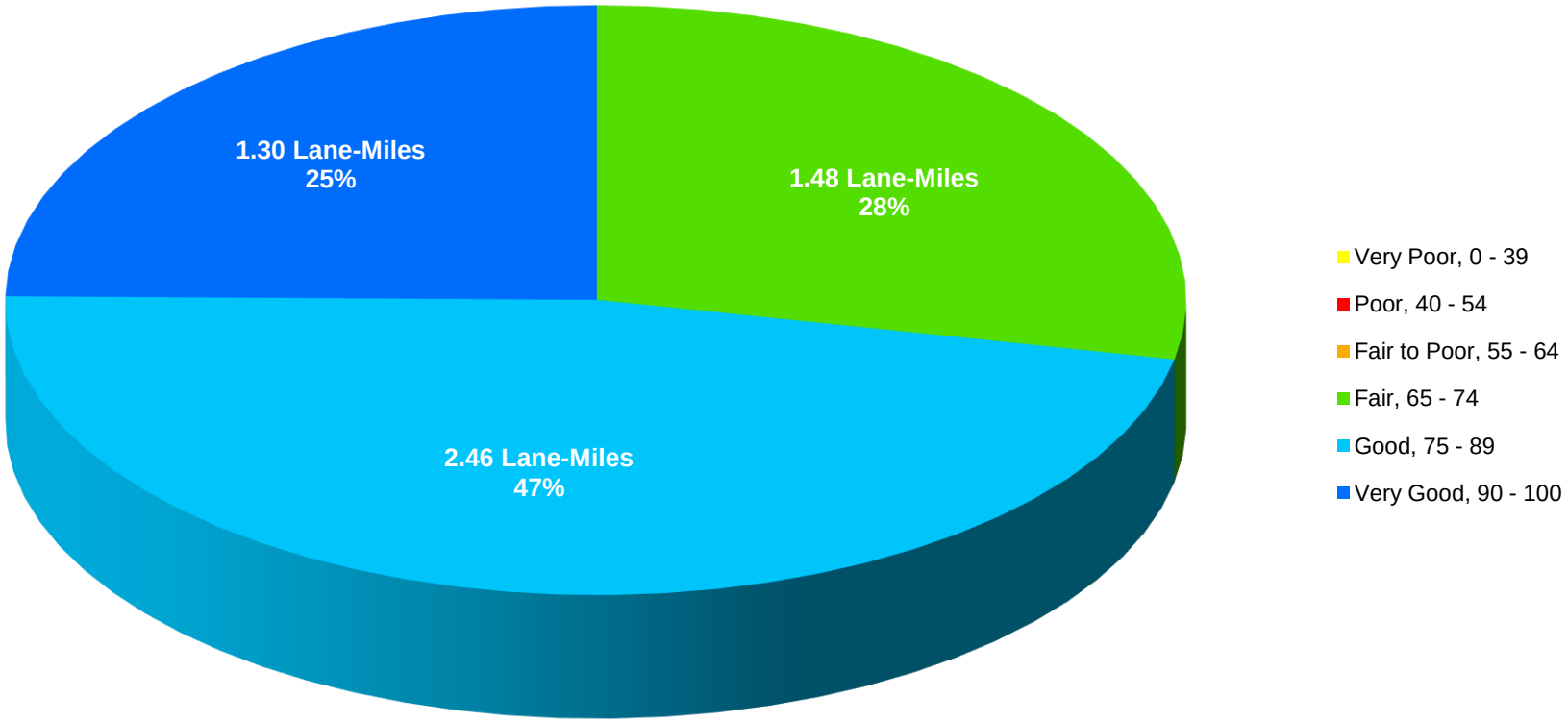
Based on the utilized ODOT database, there are 2.62 centerline miles of federal-aid eligible roads which are equivalent to 5.24 lane-miles in the Village of Perry. The total area of roadway is 311,521 Sq. Ft.

The PCR measure is a qualitative description of the structural state of the pavement. The PCR values span a spectrum of descriptive narrative ranging from “Very Good” to “Very Poor”. Each roadway segment is scored from 0 to 100 with 0 representing completely distressed pavement and 100 indicating perfect pavement condition. The lane-miles weighted average of the Village of Perry segments PCRs is about 81. Table 2 and Figure 3 summarize the 2020 Perry pavement network condition by percentages of roadway lane-miles length.

Table 2: 2020 Perry Pavement Network Condition

Pavement Condition	PCR Range	Lane-Miles	Percent of Lane-Miles
Very Poor	0 - 39	0.00	0%
Poor	40 - 54	0.00	0%
Fair to Poor	55 - 64	0.00	0%
Fair	65 - 74	1.48	28%
Good	75 - 89	2.46	47%
Very Good	90 - 100	1.30	25%

Figure 3: 2020 Perry Pavement Network Condition Chart by Lane-Miles



As indicated, about 72 percent of the pavement lane-miles are currently in the “Good” to “Very Good” condition and the lane-miles weighted average PCR also represents a “Good” condition. The rest of the lane-miles are in the “Fair” status and demand some kind of preventive maintenance treatments.

Map 2 illustrates the 2020 Perry roadway pavement condition for each segment record and Table 3 tabulates the 2020 Perry pavement condition listing.

Map 2: 2020 Village of Perry Pavement Condition

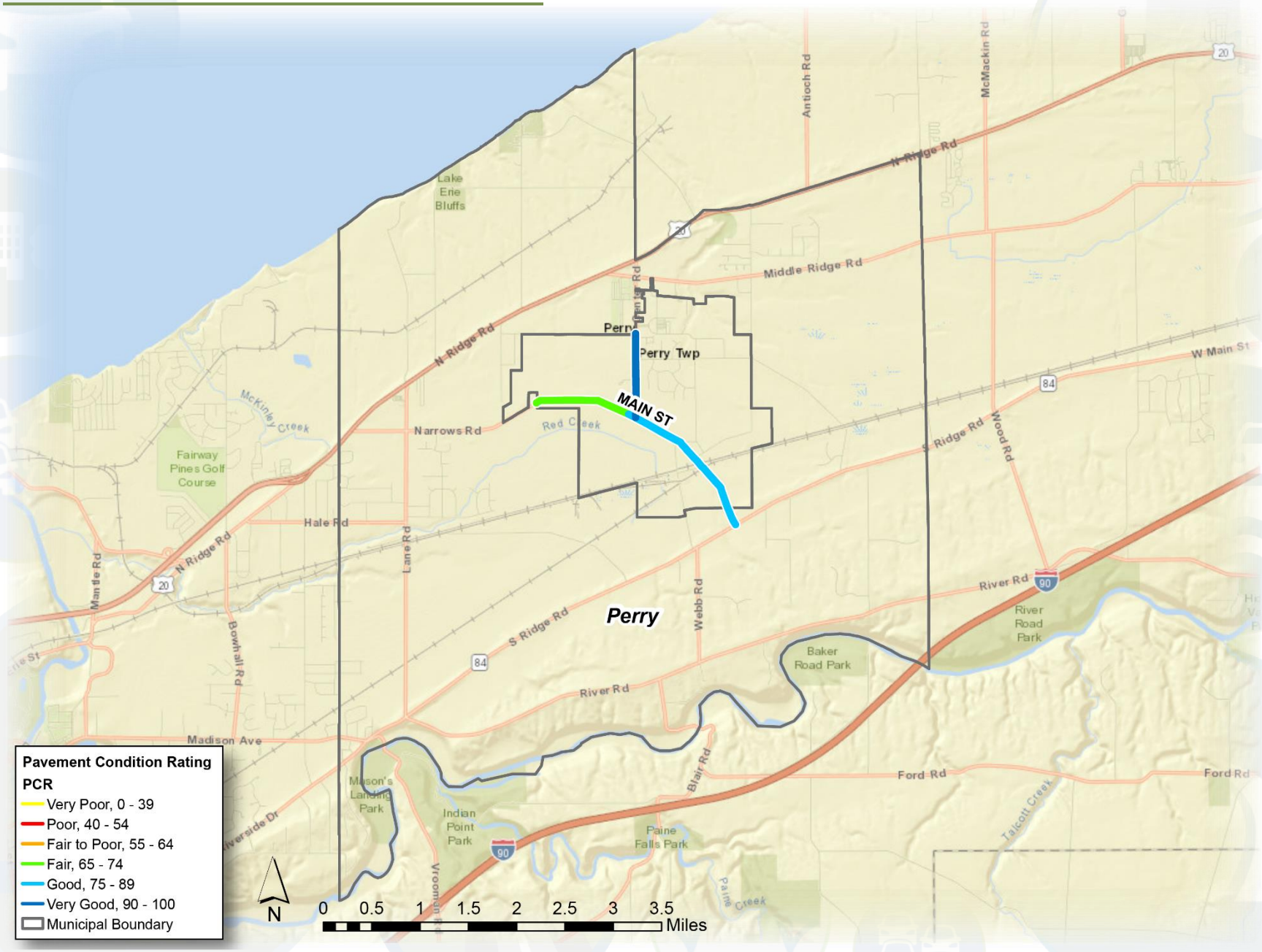


Table 3: 2020 Village of Perry Pavement Condition Listing

ROAD NAME	FROM	TO	FUNC CLASS	LANE-MILES	PCR
CENTER RD	MAIN ST	PERRY VILLAGE NCL	MAJOR COLLECTOR	1.30	96
MAIN ST	PERRY WCL	W OF CENTER RD	MAJOR COLLECTOR	1.48	73
MAIN ST	S OF HARPER ST	S RIDGE RD (SR-84)	MAJOR COLLECTOR	1.16	75
MAIN ST	S OF THOMPSON ST	S OF HARPER ST	MAJOR COLLECTOR	0.24	78
MAIN ST	W OF CENTER RD	S OF THOMPSON ST	MAJOR COLLECTOR	1.06	80

PART II: 2020 CURRENT BACKLOG

The Backlog is defined as the cost of pavement rehabilitation of all roads within the current year (2020) and bringing the average network PCR to 80. Backlog is a "snapshot" or relative measure of outstanding rehabilitation work. The Backlog not only represents how far behind the pavement network is in terms of its present physical condition, but also its cost value serves as a benchmark to measure the impact of various funding strategies. Additionally, the current Backlog offers a basis for comparison to future and/or past year's Backlogs.

The Backlog strategy does not utilize any reconstruction treatment, but instead considers pavement preventive maintenance and rehabilitation treatments. This strategy achieves the average network PCR 80, and also maintains all the pavement conditions above the minimum acceptable level. In this study, the minimum acceptable PCR for the arterial roadway function class is 55 and for the major and minor collector is 50.

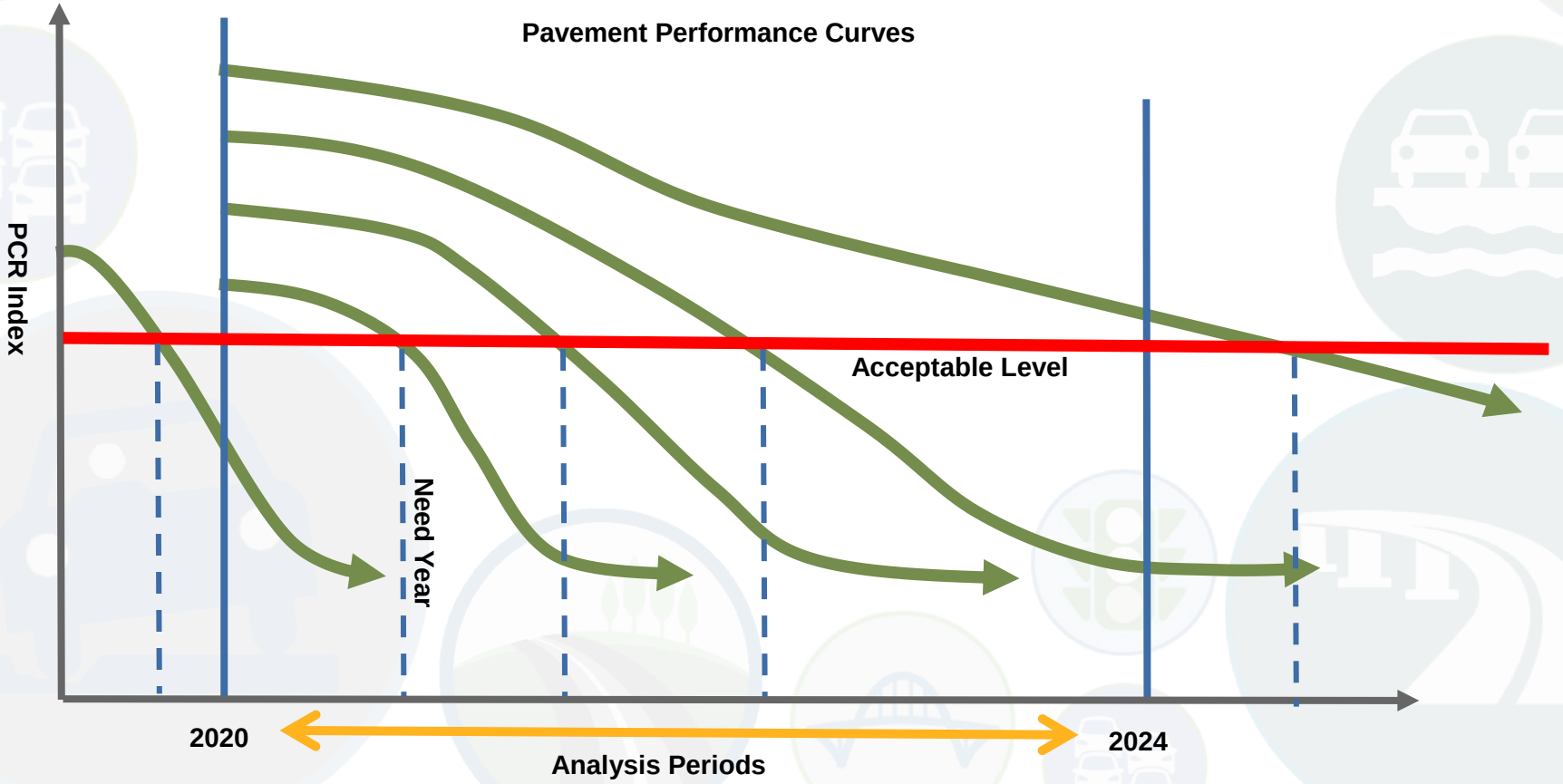
The Appendix includes all the Backlog pavement treatments. As illustrated, the 2020 Backlog treatment list includes segments which their 2020 PCRs are below the minimum acceptable level and are recommended with various rehabilitation treatments. There are two segments in the 2020 Backlog list with the total of 2.64 lane-miles. The 2020 Backlog cost of the recommended treatments is over 50 thousand dollars.

PART III: MAINTENANCE & REHABILITATION (M&R) PROGRAM

In order to estimate the preventive maintenance and rehabilitation requirements of a pavement network over a period of time, the first step is to determine the "Need Year" or when a pavement segment requires rehabilitation. The "Need Year" of a pavement is defined as the year in which the pavement condition falls below a critical level. Pavement condition of a road segment deteriorates under traffic, climate, etc. and consequently its PCR value is reduced. Without any treatments and depending on the deteriorating factors, pavements perform differently and Figure 4 depicts the typical acceptable level and "Need Year" relation for several road segments. As shown, the definition of the acceptable level is a critical factor in determining the "Need Year" for any road segment.

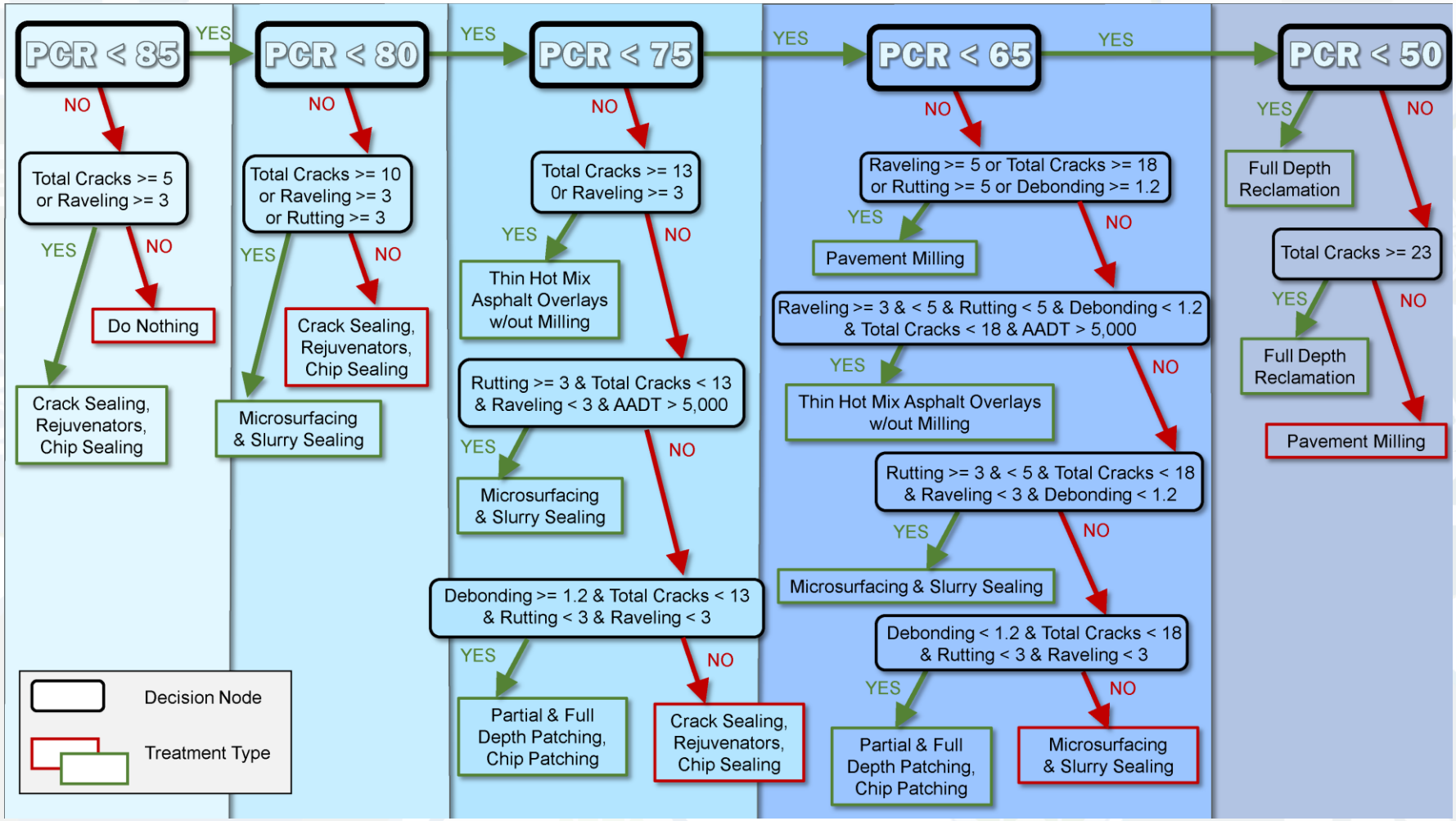
In this study, the critical level is set by the minimum acceptable PCR. As mentioned earlier, In the NOACA region, the minimum acceptable PCR for the arterial roadway function class is 55 and for the major and minor collector is 50.

Figure 4: The PCR Acceptable Level and "Need Year" Relation



The second step is to determine any feasible preventive maintenance and/or rehabilitation strategies based on a decision tree approach. The “M&R” program determines the optimal preventive maintenance and rehabilitation strategy for each segment and its recommended implementation year based on the considered decision tree. The Appendix includes all the “M&R” treatments for the identified segments with the implementation year in the period of 2020 to 2024 and the “M&R” program cost includes all the deferred maintenance cost. Figure 5 shows a snapshot of a typical decision tree applied for maintenance of flexible pavements along major collectors.

Figure 5: A Typical Decision Tree Applied for Pavement Maintenance



PART IV: COMPARATIVE ANALYSIS

The current NOACA transportation asset management policy includes two strategies

- Maintain 15% Deficiency: this strategy attempts to maintain the total lane-miles with PCR below the acceptable level no more than 15 percent.
- Maintain an Average Network PCR of 80: applies a set of maintenance treatments in order to keep the roadway network average PCR more than, or equal to 80 over the study period.

This section compares the discussed Backlog and the "M&R" program treatments with the NOACA transportation asset management strategies.

In addition to the above strategies, this comparative analysis considers another scenario as the minimum benchmark. The "Maintain Lowest Standard PCR" treatment strategy is based on the minimum PCR thresholds of 55 for arterials and 50 for collectors and a set of annual budget constraints. The annual budget constraints are calculated in three steps: First, the segments with the "M&R" recommended implementation in each specific analysis year are selected. Second, a subset of the selected segments which their "Need Years" are in the analysis period are identified. It should be noted that the selected segments with the "Need Year" beyond the analysis period are excluded from the budget constraint calculation. Third, the "M&R" treatment costs for the identified segments in the second step, are added together to provide an annual budget constraint for this scenario.

As discussed, all the above scenarios apply a decision tree approach to determine technically feasible maintenance and rehabilitation strategies for each segment requiring rehabilitation during the five-year period.

Table 4 summarizes the comparison results of all the above scenarios over the five-year period for the Village of Perry. In this table, the "5-Year Total Required Dollars" column shows the accumulation of the annual costs over five years calculated based on inflation-adjusted dollars for each strategy. Also, the network average PCR is the lane-miles weighted average.

Table 4: Performance Comparison of the Constraint Scenarios

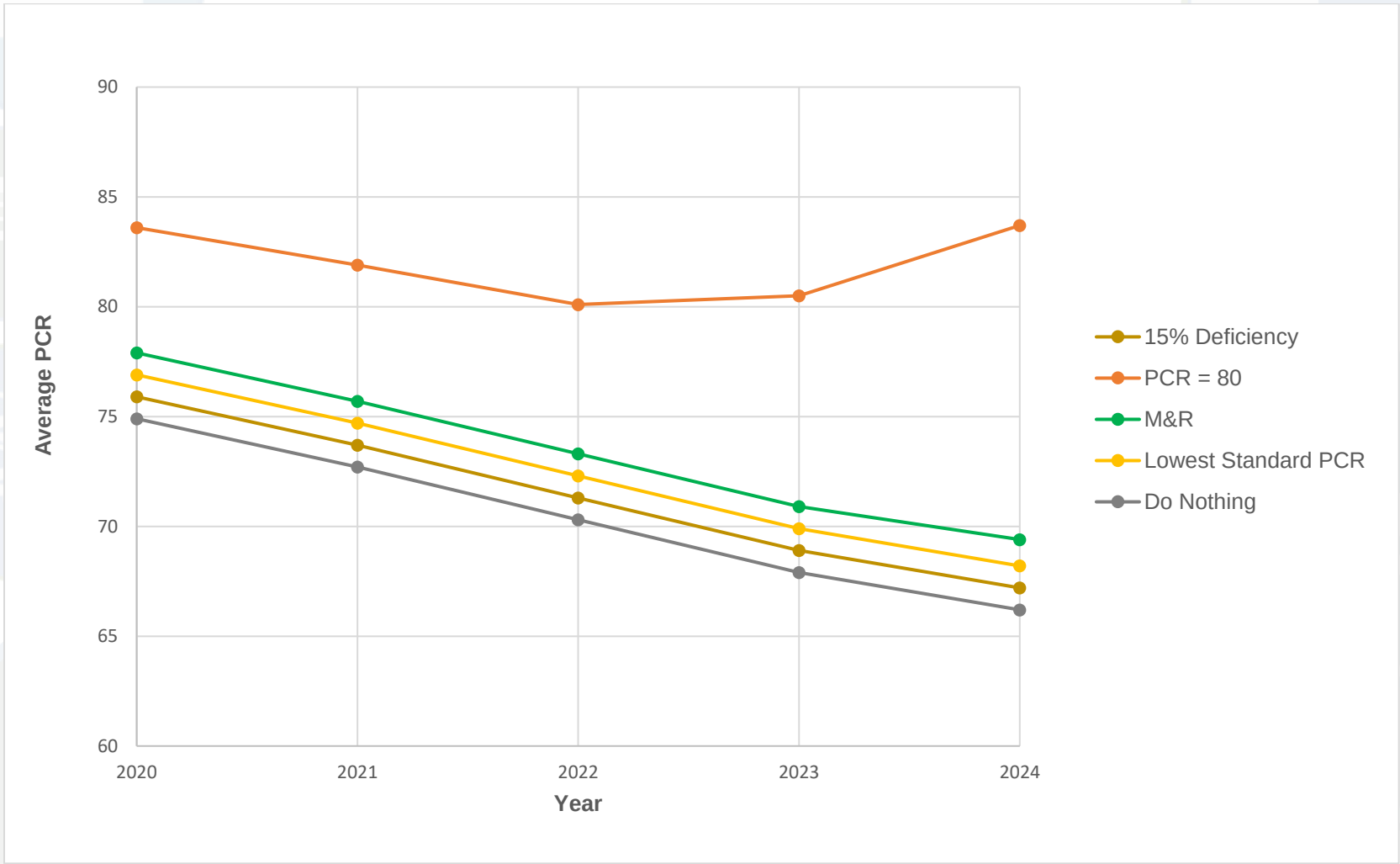
Maintenance Strategy	Strategy Group	5-Year Total Required Dollars	Network Average PCR	Network PCR at the End of the 5-Year Period	Percent of Pavement below the Minimum PCR
2020 Current Backlog	2020 Backlog	52,711	83.6	-	0%
Maintain 15% Deficiency	NOACA Transportation Asset Management Targets	0	73.2	68.2	0%
Maintain an Average Network PCR of 80		131,569	82.0	83.7	0%
M&R Program	Scenarios	20,892	73.4	69.4	0%
Maintain Lowest Standard PCR		0	73.2	68.2	0%

Note: The Backlog required budget is for the year of 2020 only.

The Appendix lists all the treatments with their implementation years in the period of 2020 to 2024 for the above maintenance strategies.

Figure 6 illustrates the annual network average PCR for the discussed maintenance and rehabilitation strategies. It should be noted that the Backlog scenario has only one value of 83.6 for 2020.

Figure 6: Average PCR Comparison by the Constraint Scenarios and by Year



One segment along Main Street dominates the performance of the pavement network in the village. Therefore, the "M&R" program recommends only one treatment to maintain the pavements in fair condition, and its network average PCR will be 69 at the end of the five-year analysis period.

The "Maintain an Average Network PCR of 80" scenario costs over 130 thousand dollars, and the network average PCR is 14 points higher than that of the "M&R" program at the end of the five-year period.

Most pavements are currently in good condition. Therefore the "Maintain Lowest Standard PCR" and the "Maintain 15% Deficiency" scenarios do not recommend any treatments. Without applying any treatments, the network average PCR values for both scenarios will be almost similar to that of the "M&R" program at the end of the analysis period.

It should be noted that the Backlog cost as the benchmark is about 2.5 times more than the "M&R" program budget, and its network average PCR is 14 points higher than that of the "M&R" program at the end of the five-year period.

APPENDIX

The 2020 Current Backlog

Pavement Treatment List

ROAD NAME	FROM	TO	TREATMENT RECOMMENDATION	LANE-MILES	COST
MAIN ST	PERRY WCL	W OF CENTER RD	PARTIAL & FULL DEPTH PATCHING, CHIP PATCHING	1.48	33,602
MAIN ST	S OF HARPER ST	S RIDGE RD (SR-84)	MICROSURFACING & SLURRY SEALING	1.16	19,109
REQUIRED BACKLOG BUDGET (2020$)					**$52,711**

The Maintain 15% Deficiency

As indicated in Table 4, the cost of the “Maintain 15% Deficiency” scenario is zero. Therefore, this strategy does not recommend any pavement maintenance treatments.

The Maintain an Average Network PCR of 80

Pavement Treatment List

ROAD NAME	FROM	TO	RECOMMENDED TREATMENT	LANE-MILES	IMPLEMENTATION	
					COST (2020$)	YEAR
MAIN ST	PERRY WCL	W OF CENTER RD	PARTIAL & FULL DEPTH PATCHING, CHIP PATCHING	1.48	33,602	2020
MAIN ST	S OF HARPER ST	S RIDGE RD (SR-84)	MICROSURFACING & SLURRY SEALING	1.16	19,109	2020
THE 2020 REQUIRED BUDGET FOR THE "MAINTAIN AN AVERAGE NETWORK PCR OF 80" STRATEGY					**$52,711**	

ROAD NAME	FROM	TO	RECOMMENDED TREATMENT	LANE-MILES	IMPLEMENTATION	
					COST (2023$)	YEAR
MAIN ST	S OF HARPER ST	S RIDGE RD (SR-84)	MICROSURFACING & SLURRY SEALING	1.16	20,700	2023
MAIN ST	S OF THOMPSON ST	S OF HARPER ST	PARTIAL & FULL DEPTH PATCHING, CHIP PATCHING	0.24	11,215	2023
THE 2023 REQUIRED BUDGET FOR THE "MAINTAIN AN AVERAGE NETWORK PCR OF 80" STRATEGY					**$31,915**	

ROAD NAME	FROM	TO	RECOMMENDED TREATMENT	LANE-MILES	IMPLEMENTATION	
					COST (2024$)	YEAR
MAIN ST	PERRY WCL	W OF CENTER RD	THIN HOT MIX ASPHALT OVERLAYS WITHOUT MILLING	1.48	46,943	2024
THE 2024 REQUIRED BUDGET FOR THE "MAINTAIN AN AVERAGE NETWORK PCR OF 80" STRATEGY					**$46,943**	

Note: The "Maintain an Average Network PCR of 80" strategy does not have any pavement maintenance treatments with the recommended implementation years of 2021 and 2022.

The M&R Program

Pavement Treatment List

ROAD NAME	FROM	TO	RECOMMENDED TREATMENT	LANE-MILES	IMPLEMENTATION	
					COST (2024$)	YEAR
MAIN ST	S OF THOMPSON ST	S OF HARPER ST	PAVEMENT MILLING	0.24	20,892	2024
THE 2024 REQUIRED BUDGET FOR THE "M&R" PROGRAM					**$20,892**	

Note: The "M&R" program does not have any pavement maintenance treatments with the recommended implementation years of 2020, 2021, 2022 and 2023.

The Maintain Lowest Standard PCR

As indicated in Table 4, the cost of the “Maintain Lowest Standard PCR” scenario is zero. Therefore, this strategy does not recommend any pavement maintenance treatments.

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