THE VILLAGE OF WOODMERE ROADWAY PAVEMENT MAINTENANCE REPORT

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Executive Summary

The 2016 Ohio Department of Transportation (ODOT) pavement database has 3,626 segment records for the Northeast Ohio Areawide Coordinating Agency (NOACA) region. The NOACA region has a total of 3,330 centerline miles of roadways including freeways and federal-aid highways which is equivalent to 8,561 lane-miles. The regional segment average Pavement Condition Ratings (PCR) is about 77.

In the Village of Woodmere there are 8.7 centerline miles of federal-aid roads, which are equivalent to 1.6 lane-miles within the Village boundary that include State Route 87 (SR 87). The 2016 ODOT pavement database has five segment records for the Village of Woodmere 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 Ratings (PCR), etc.

According to the PCR measure, about 93 percent of the pavement lane-miles are currently in the “Very Good” condition. The rest of the lane-miles are in the “Fair” status and demands some kind of preventive maintenance.

This pavement study includes four parts:

- Part I: The 2016 pavement network condition,
- Part II: The 2018 backlog,
- Part III: The Maintenance and Rehabilitation (M&R) program,
- Part IV: The Comparative analysis.

Considering the five-year study period of 2018 – 2022, this pavement study focuses on the required preventive maintenance treatments and some rehabilitation techniques rather than reconstruction.

Part I of this study analyzes the 2016 pavement network condition and tabulates the important information of all the five road segments in the Village of Woodmere.

In Part II, the backlog is defined as the cost of pavement rehabilitation of all roads within one year (2018) 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.
The Village of Woodmere is located in Cuyahoga County. Woodmere is one of the five municipalities, along with Hunting Valley, Moreland Hills, Orange Village and Pepper Pike, that originally formed Orange Township, the birthplace of President James A. Garfield. While the other four municipalities were established in the 1920s, Woodmere was incorporated as a village in 1944. Today, centered along Chagrin Boulevard, Woodmere serves as the primary commercial district for all parts of the original Orange Township.

As of the Northeast Ohio Areawide Coordinating Agency (NOACA) 2015 estimates, the Village had a population of 875 and employment of 2,796. The Village of Woodmere highway includes State Route 87 (SR 87). Cleveland-Hopkins International Airport is the nearest airport.

Map 1 illustrates the Village of Woodmere location in the NOACA region.
Map 1: Village of Woodmere Location in the NOACA Region
For the purpose of this study:

**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.

**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.

**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. Projects that address deficiencies in the pavement structure or increase the structural capacity of the facility are not considered preventive maintenance.

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 reconstruction of pavement that has deteriorated to a poor condition.

This pavement study analyzes the current status of the Woodmere pavement network condition and considers the five-year study period of 2018-2022. It mainly focuses on the required roadway pavement preventive maintenance treatments and some rehabilitation techniques rather than reconstruction. The 2016 Ohio Department of Transportation (ODOT) pavement database was used as the input data and RoadMatrix software was utilized as the NOACA Pavement Management platform.

Seven roadway pavement preventive maintenance and rehabilitation treatments were considered in the Woodmere pavement network analysis for the study period and Table 1 illustrates the selected treatment and their associated planning level costs.
## Table 1: Selected Pavement Treatments and Their Planning Level Costs

<table>
<thead>
<tr>
<th>Maintenance Treatment Type</th>
<th>Cost per SQ FT (2016$)</th>
<th>Estimated Cost per 12-FT lane-Mile (2016$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crack Fill</td>
<td>0.08</td>
<td>5,100</td>
</tr>
<tr>
<td>Joint Repair</td>
<td>0.24</td>
<td>15,200</td>
</tr>
<tr>
<td>Crack Fill and Slurry</td>
<td>0.4</td>
<td>25,300</td>
</tr>
<tr>
<td>Preventive Maintenance Minor</td>
<td>0.5</td>
<td>31,700</td>
</tr>
<tr>
<td>Micro – Pave Type</td>
<td></td>
<td>Surface Treatment</td>
</tr>
<tr>
<td>Selective Patch, Mill and 1.5” O/L</td>
<td>1.5</td>
<td>95,000</td>
</tr>
<tr>
<td>2.0 inch Hot Mix Mill and Overlay</td>
<td>1.9</td>
<td>120,400</td>
</tr>
</tbody>
</table>

**Pavement Maintenance Treatment Definitions**

**Crack Fill:** it is the placement of asphalt emulsion into non-working cracks to reduce water infiltration and to reinforce the adjacent pavement.

**Slurry Seal:** a mixture of fine aggregate, asphalt emulsion, water, and mineral filler, used when the primary problem is excessive oxidation and hardening of the existing surface. Slurry seals are used to retard surface raveling, and improve surface friction.

**Joint Repair:** used to remove deteriorated concrete pavement long joint/crack repairs. It minimizes infiltration of surface water and incompressible material into the joint system.
Preventive Maintenance (Minor): typically applied to pavements in good condition having significant remaining service life. Examples of minor preventive treatments include asphalt crack sealing, chip sealing, slurry or micro-surfacing, thin and ultra-thin hot-mix asphalt overlay, and concrete joint sealing.

Micro – Pave (Type II Surface Treatment): consist of the application of a mixture of water, asphalt emulsion, aggregate (very small crushed rock), and chemical additives. It is used to treat surfacing and rut filling on roads that get moderate to heavy levels of traffic.

2.0in Hot Mix Mill & Overlay: applied as a maintenance treatment. Thin overlays should only be placed on structurally sound pavements. That is because they offer little structural improvement, but they can renew the surface in terms of functional performance (i.e., ride quality).

Selective Patching, Mill & 1.5 O/L: it is primarily done to extend the life of a roadway. Patch mill and overlay projects are designed to remove damaged portions of the roadway and replace it with new smooth pavement.

This report includes the following four parts:

**I.** The 2016 status of the Woodmere pavement network condition,

**II.** The 2018 “backlog” treatment list,

**III.** The optimal preventive maintenance and rehabilitation strategies, and

**IV.** The comparative analysis.
**PART I: 2016 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 2016 ODOT pavement database has five segment records for the Village of Woodmere 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 Ratings (PCR), etc.

Based on the utilized ODOT database, there are 8.7 centerline miles of federal-aid eligible roads which are equivalent to 1.6 lane-miles in the Village of Woodmere. The total area of roadway is 1,271,900 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-mile weighted average of the Village of Woodmere segment PCRs is about 94. Table 2 and Figure 1 summarize the 2016 Woodmere pavement network conditions by percentages of roadway lane-miles length.

**Table 2: 2016 Woodmere Pavement Network Condition**

<table>
<thead>
<tr>
<th>Pavement Condition</th>
<th>PCR Range</th>
<th>Lane-Miles</th>
<th>Percent of Lane-Miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Poor</td>
<td>0 - 39</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Poor</td>
<td>40 - 54</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Fair to Poor</td>
<td>55 - 64</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fair</td>
<td>65 - 74</td>
<td>0.12</td>
<td>7.5%</td>
</tr>
<tr>
<td>Good</td>
<td>75 - 89</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Very Good</td>
<td>90 - 100</td>
<td>1.48</td>
<td>92.5%</td>
</tr>
</tbody>
</table>
As indicated, about 93 percent of the pavement lane-miles are currently in the “Very Good” condition and the lane-mile weighted average PCR also represents a “Very Good” condition. The rest of the lane-miles are in the “Fair” status and demands some kind of preventive maintenance.

Map 2 illustrates the 2016 Woodmere roadway pavement condition for each segment record and Table 3 tabulates the 2016 Woodmere pavement condition listing.
### Table 3: 2016 Village of Woodmere Pavement Condition Listing

<table>
<thead>
<tr>
<th>ROAD NAME</th>
<th>FROM</th>
<th>TO</th>
<th>FUNCTION CLASS</th>
<th>LANE-MILES</th>
<th>PCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRAINARD RD</td>
<td>0.06 MILES N OF SR 87</td>
<td>EATON LN</td>
<td>MINOR ARTERIAL</td>
<td>0.14</td>
<td>92</td>
</tr>
<tr>
<td>BRAINARD RD</td>
<td>SR 87</td>
<td>0.06 MILES N OF SR 87</td>
<td>MINOR ARTERIAL</td>
<td>0.12</td>
<td>71</td>
</tr>
<tr>
<td>BRAINARD RD</td>
<td>0.13 MILES S OF SR-87</td>
<td>SR 87</td>
<td>MINOR ARTERIAL</td>
<td>0.26</td>
<td>97</td>
</tr>
<tr>
<td>BRAINARD RD</td>
<td>ORANGE/WOODMERE CORP LINE</td>
<td>0.13 MILES S OF SR 87</td>
<td>MINOR ARTERIAL</td>
<td>0.68</td>
<td>95</td>
</tr>
<tr>
<td>W BRAINARD AVE</td>
<td>SR 87</td>
<td>BRAINARD RD</td>
<td>MINOR ARTERIAL</td>
<td>0.40</td>
<td>97</td>
</tr>
</tbody>
</table>
PART II: 2018 CURRENT BACKLOG

The backlog is defined as the cost of pavement rehabilitation of all roads within the current year (2018) 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 pavement preventive maintenance treatments, but instead considers rehabilitation or reconstruction 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.

Result of the analysis indicate that there is no recommendation for pavement reconstruction treatments under the current 2018 backlog strategy. As illustrated, the average network PCR for the current year (2018) is 92.7, and all pavement conditions are above the minimum acceptable PCR.
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 2 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 2: 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 2018 to 2022 and the “M&R” program cost includes all the deferred maintenance cost.
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%.
- 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 Woodmere. 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-mile weighted average.
### Table 4: Performance Comparison of the Constraint Scenarios

<table>
<thead>
<tr>
<th>Maintenance Strategy</th>
<th>Strategy Group</th>
<th>5-Year Total Required Dollars</th>
<th>Network Average PCR</th>
<th>Network PCR at the End of the 5-Year Period</th>
<th>Percent of Pavement below the Minimum PCR</th>
</tr>
</thead>
<tbody>
<tr>
<td>2018 Current Backlog</td>
<td>2018 Backlog</td>
<td>0</td>
<td>92.7</td>
<td>-</td>
<td>0%</td>
</tr>
<tr>
<td>Maintain 15% Deficiency</td>
<td>NOACA Transportation Asset Management Targets</td>
<td>0</td>
<td>90.4</td>
<td>88</td>
<td>7.5%</td>
</tr>
<tr>
<td>Maintain an Average Network PCR of 80</td>
<td></td>
<td>0</td>
<td>90.4</td>
<td>88</td>
<td>7.5%</td>
</tr>
<tr>
<td>M&amp;R Program</td>
<td>Scenarios</td>
<td>16,513</td>
<td>91</td>
<td>91.4</td>
<td>0%</td>
</tr>
<tr>
<td>Maintain Lowest Standard PCR</td>
<td></td>
<td>0</td>
<td>90.4</td>
<td>88</td>
<td>7.5%</td>
</tr>
</tbody>
</table>

Note: The backlog required budget is for the year of 2018 only.

The Appendix lists all the treatments with their implementation years in the period of 2018 to 2022 for the above maintenance strategies.

Figure 3 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 92.7 for 2018.
Figure 3: Average PCR Comparison by the Constraint Scenarios and by Year
The pavement segments are currently in a good condition and therefore the “M&R” program requires a small budget of over 16 thousand dollars during the analysis period. Its network average PCR is 91 and then end of the five year period.

The “Maintain an Average Network PCR of 80”, the “Maintain 15% deficiency”, and the “Maintain Lowest Standard PCR” scenarios do not recommend any treatment and therefore the network average PCR is a few point lower at the end of the analysis period. Also, over seven percent of the pavement will be below the minimum acceptable PCR.

Due to the current good condition of the pavement, the backlog cost does not recommend any treatment and its network average PCR is similar to that of the “M&R” program. In order to maintain the current good pavement condition, it is recommended to invest on the annual maintenance policy with much smaller budget than the reconstruction treatment with high cost.
2018 Current Backlog

As indicated in Table 4, the “2018 Current Backlog” cost is zero. Results of the analysis indicate that there is no recommendation for pavement reconstruction treatments under the 2018 current backlog strategy. As illustrated, the average network PCR for the current year (2018) is 92.7, and all pavement conditions are above the minimum acceptable PCR.
Maintain 15% Deficiency

As indicated in Table 4, the “Maintain 15% Deficiency” cost is zero and therefore, this strategy does not recommend any pavement maintenance treatments.
Maintain an Average Network PCR of 80

As indicated in Table 4, the “Maintain an Average Network PCR of 80” cost is zero and therefore, this strategy does not recommend any pavement maintenance treatments.
The “M&R” Pavement Treatment List

<table>
<thead>
<tr>
<th>ROAD NAME</th>
<th>FROM</th>
<th>TO</th>
<th>RECOMMENDED TREATMENT</th>
<th>LANE-MILES</th>
<th>IMPLEMENTATION</th>
<th>COST (2022$)</th>
<th>YEAR</th>
</tr>
</thead>
<tbody>
<tr>
<td>BRAINARD RD</td>
<td>SR 87 (CHAGRIN BLVD)</td>
<td>0.06 MILES NORTH OF SR 87 (CHAGRIN BLVD)</td>
<td>SELECTIVE PATCH, MILL &amp; 1.5&quot; OIL</td>
<td>0.12</td>
<td>16,513</td>
<td></td>
<td>2022</td>
</tr>
</tbody>
</table>

THE 2022 REQUIRED BUDGET FOR THE “M&R” PROGRAM $16,513

Note: The “M&R” program does not have any pavement maintenance treatments with the recommended implementation years of 2018, 2019, 2020 and 2021.
Maintain Lowest Standard PCR

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