DILLON CONSULTING

TOWNSHIP OF NORTH DUMFRIES

Roads State of Infrastructure Study 2022

July 2022 – 22-3722

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1.0 Introduction

1.1 Purpose

The purpose of the Roads State of Infrastructure Study was to assess the existing road system in the Township of North Dumfries (Township) and to prepare a comprehensive plan for improving and maintaining the road system for the next 10 year period. The condition of the Township's bridges and culverts are the subject of separate study.

In order to meet this objective, Dillon completed the following:

- Review the existing data;
- Inventory all roads and update the current road network database and geodatabase;
- Update select traffic counts;
- Evaluate the pavement and gravel condition by means of visual examination of pavement deficiencies and pavement and gravel roughness measurements, based on which road rehabilitation needs could be identified;
- Develop current replacement costs for roadway segments;
- Develop recommendations for annual budgets based on current costs and major programs;
- Analysis of effect of budgets on overall system; and
- Identify target (proposed) Level of Services and provide recommendations to the Asset Management Strategy.

1.1.1 Regulatory Alignment

This 2022 Roads State of Infrastructure Study is an update to the 2016 study which was completed prior to the requirements established by O. Reg. 588/17: Asset Management Planning for Municipal Infrastructure. This update is aligned with the requirements as defined in this new regulation which requires all core assets to be included in the asset management plan with current Level of Service (LOS) identified by July 2022. Core assets include roads as well as water, wastewater, stormwater and bridges/culverts.

By July 2024, municipalities will be required to include all assets owned by the Township, which will include buildings, fleet and equipment as well as green infrastructure assets. By July 2025, municipalities will have approved proposed LOS, lifecycle management and financial strategy for 10-year period to achieve the proposed LOS.

1.2 Background Reports

The background report is the Township's previous Roads Needs Study conducted by 4 Roads Management Services Inc. titled "2016 State of the Infrastructure – Roads". That report contained a

complete road needs assessment and updated the repair costs budget to 2016 construction prices. In this report, when referring to the previous study, it will be called "the 2016 study".

1.3 Study Methods

The visual defect study method utilized for paved roadways was the ASTM method used through the TotalPave software subscription. The roadway inventory and condition assessment was carried out based on the following manuals:

- ASTM D6433-18 – Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys; and
- Total Pave PCI Survey Training Manual.

The TotalPave PCI app is based on ASTM D6433 "Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys" which is used to determine general surface condition of paved assets. The method involves visually assessing a road for distresses. A score from 0 to 100 is calculated based on the different combination of distresses present, their severity, and density. The performance measure was developed by the U.S. Army Corps of Engineers in the late 1970's, and has since been widely adopted by road authorities around the world who use it to drive their road asset management planning.

The visual defect study method utilized for gravel roadways are those recommended by the Ministry of Transportation (MTO). The gravel roadway inventory and condition assessment was carried out based on the follow manual:

- Condition Rating of Gravel Surface Roads (SP-025), 1989

In addition, a measured International Roughness Index (IRI) was incorporated with the visual assessment of roadway defects to provide for a more objective determination of the overall pavement condition index. Dillon utilized data collected through a mobile application, which measured the vertical displacements of the vehicle's movements through a cellular device. This data was then processed to produce an IRI value which could then be used in determining the Pavement Condition Index (PCI) more objectively. Table 1 provides an overview of IRI scoring.

Table 1: International Roughness Index (IRI)

IRI	**Condition Description** of IRI Posted Speed	**Description**
0 - 2	Very Good	Very smooth ride.
2 - 4	Good	Smooth ride with just a few bumps or depressions.
4 – 6	Fair	Still comfortable with intermittent bumps or depressions.
6 - 8	Poor	Uncomfortable ride with frequent bumps or depressions.
8 – 10+	Very Poor	Uncomfortable ride with constant bumps or depressions resulting in rattle and shake of rating vehicles. Cannot maintain posted speed to avoid bumps or depressions. Dangerous at 80 km/hr.

The PCI is a numerical index between 0 and 100 which is used to indicate the general condition of the pavement. The PCI considers two main factors, including:

- Ride comfort (determined by IRI noted above); and
- Surface defects in the pavement, such as surface deformations and pavement cracking. These distress types are assessed based on their severity and density of occurrence.

1.3.1 Pavement Condition

The condition of roads is measured by using the Pavement Condition Index (PCI) which takes into account the physical condition of the road (e.g. cracking, potholes) measured by a visual inspection. A new road is assigned a PCI of 100, and over time, as the road ages and through wear and tear, the PCI number drops to 0, which is the worst possible condition. See Figure 1 which illustrates how the condition of the road deteriorates over time and the lifecycle activities recommended: preventative maintenance; maintenance and rehabilitation; and reconstruction.

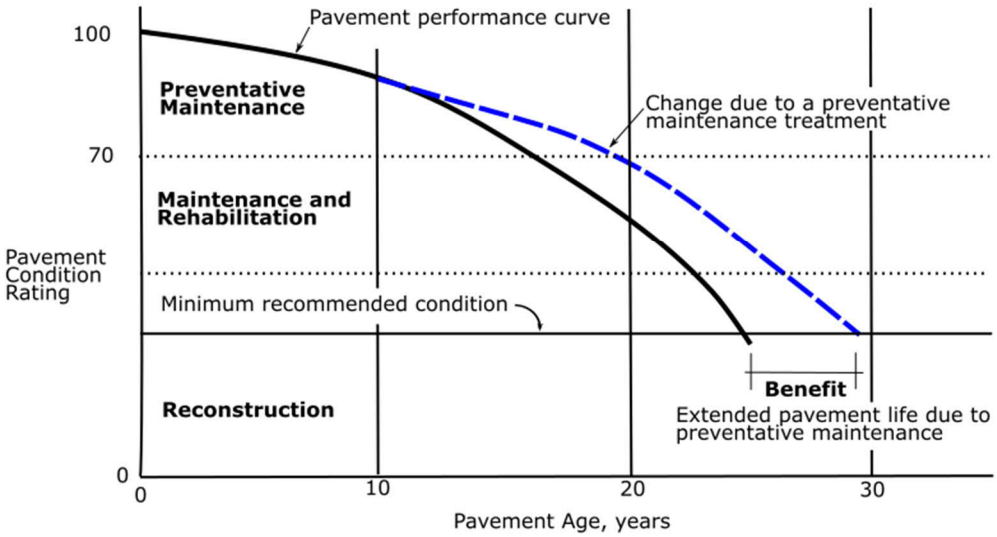


Figure 1: Pavement Condition and Lifecycle Activities

This is a common approach in asset management that reflects the decay of the asset over time. See Table 2 with PCI ranges and associated condition descriptions (ASTM D6433-90). The last column in presents a recommended 5-point scale for asset management reporting, which aligns with the 'Canadian Infrastructure Report Card'.

Table 2: Pavement Condition Index Description Groups (ASTM D6433-90)

Pavement Condition Index (PCI)	ASTM Condition Description	Recommended 5-point scale
100 to 86	Good	Very Good
85 to 71	Satisfactory	Good
70 to 56	Fair	Fair
55 to 41	Poor	Poor
40 to 26	Very Poor	Very Poor
25 to 11	Serious	Very Poor
10 to 0	Failed	Very Poor

According to Report SP-024 published in August 1989 by the Ministry of Transportation (Manual for condition rating of flexible pavements – Distress manifestations), there are eight categories for flexible pavement rating as presented in Table 3. Pavement Condition Rating (PCR) is an assessment of overall pavement performance, both functionally and structurally. It is derived from serviceability based on evaluation of pavement riding comfort and of pavement surface distresses.

Table 3: Description of Pavement Condition Rating (MTO SP-024)

Pavement Condition Rating	Description of Pavement	Rideability Description
90 to 100	Excellent condition with few cracks	Excellent with few areas of slight distortion
75 to 90	Good condition with frequent very slight or slight cracking	Good with few slightly rough and uneven sections
65 to 75	Fairly good condition with slight cracking, slight or very slight dishing and a few areas of slight alligatoring	Fairly good with intermittent rough and uneven sections
50 to 65	Fair condition with intermittent moderate and frequent slight cracking, and with intermittent slight or moderate alligatoring and dishing	Fair and surface is slightly rough and uneven
40 to 50	Poor to fair condition with frequent moderate cracking and dishing, and intermittent moderate alligatoring	Poor to fair and surface is moderately rough and uneven
30 to 40	Poor to fair condition with frequent moderate alligatoring and extensive moderate cracking and dishing	Poor to fair and surface is moderately rough and uneven
20 to 30	Poor condition with moderate alligatoring and extensive severe cracking and dishing	Poor and the surface is very rough and uneven
0 to 20	Poor to very poor condition with extensive sever cracking, alligatoring and dishing	Poor and surface is very rough and uneven

The comparison of the condition rating categories is presented in Figure 2.

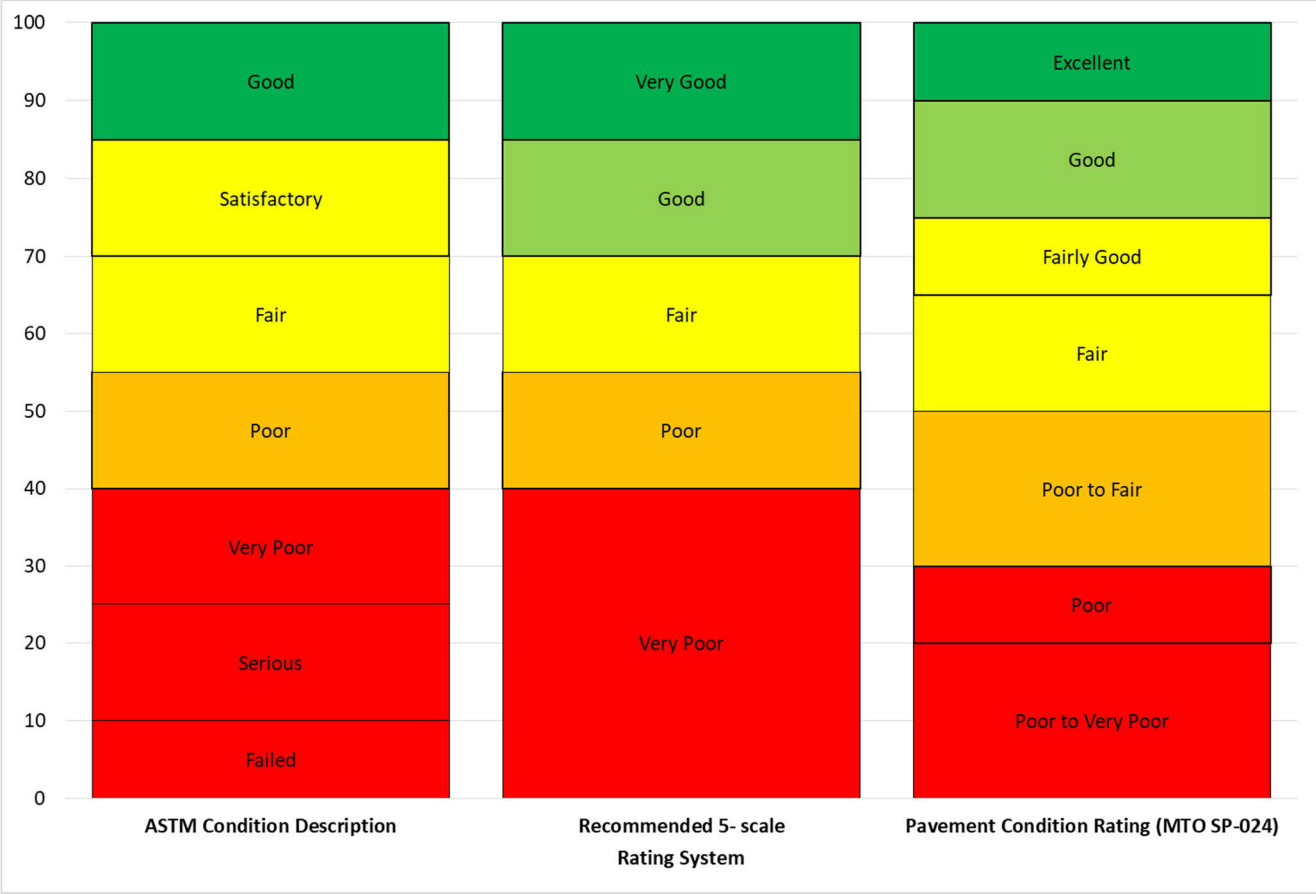


Figure 2: Comparison of the Condition Rating Categories

1.3.2 Traffic Counting Program

The annual average daily traffic (AADT) on specific roadway sections selected by the Township was determined through a traffic counting program carried out in May of 2022. Seventeen (17), 24 hour automatic counts were taken for road sections selected by the Township specifically to confirm AADT. The 2022 road counts were completed on various segments of Greenfield Road, Kings Road, and Industrial Road.

The 2022 traffic counting program provided for a more thorough confirmation of traffic volumes throughout the Township and resulted in reclassification of two (2) road segments located on Greenfield Road, one (1) road segment on Kings Road, and one (1) road segment on Industrial Road. Table 4 summarizes the updated classes. Two road classifications are presented below, including: "Design Class" as defined in the "Inventory for Municipal Roads" by the Ontario Ministry of Transportation (1991) and the minimum maintenance standard (MMS) classes as defined by “O. Reg. 366/18: Minimum Maintenance standards for Municipal Highways”.

Table 4: Classification Changes Based on 2022 Traffic Counts

Roadway	Asset ID	2016 AADT	2022 AADT	2016 MTO Design Class	2022 MTO Design Class	2016 O.Reg 366/18 MMS	2022 O.Reg 366/18 MMS
Greenfield Road	407	3000	2699	700	600	4	4
Greenfield Road	408	1700	2092	500	600	4	4
Kings Road	432	1700	2416	500	600	3	3
Industrial Road	440	4000	3375	800	700	3	3

The AADT data utilized for the remaining roadway sections in the network were assumed by utilizing 2016 data from the 2016 Study. 2022 estimates were made through a general review by referencing regional 2019 traffic count data from the Municipality of Waterloo, where relevant data was applicable. 2022 AADT estimate values for select local roadways were provided by the Township.

It should be noted that these counts provide an order-of-magnitude traffic volume only and should not be solely relied on to identify road priorities.

1.3.3 Physical Inventory and Improvement Cost Estimates

Improvement costs were determined based on 2022 benchmark construction costs established for the various types and standards of improvement. An assumed inflation rate was used for this study to compare the projected replacement costs in 2022 to the 2016 study replacement costs. The assumed average annual inflation rate used within this study was 3%. This inflation rate was determined using monthly consumer price index (CPI) data from the Bank of Canada (which resulted in an inflation rate of 2.62%) and rounding up to 3% for contingency, as the price index for commodities such as asphalt has been known historically to be slightly higher.

1.3.4 Computer Applications

The database for the road system was developed using the TotalPave software platform. TotalPave offers extensive analytics for the road network, with the analytics package outputting recommended work plans for the road network down to the road segment level. For this project, the analytics package, current in its late-beta development was not employed. Users facilitate the inputting of study data, creation of the database, easy viewing of all data including data updating and spreadsheet cost reporting which can be customized to suit the Township's particular needs, including the ability to export the data electronically (Excel spreadsheets).

For this report, budget analysis and development was completed using Dillon's Predictive Scenario Software (DPSS). The Microsoft Access-based platform is able to consider multiple types of interventions and generate a capital plan for a given study period based on the needs of the road network with prioritization by PCI rating.

All figures in this report were prepared using ArcGIS. As new roads are assumed by the Township through development or improvements undertaken, the figures can be amended and kept up-to-date. The regular updating of the data and base map represents an integral component of a good Asset Management Plan.

All road section numbers for this State of Infrastructure Study were provided by the Township and correspond with the Town's GIS data. This will help to facilitate the entry of the State of Infrastructure Study data into the Town's GIS system.

All visual field evaluation data for paved roads was recorded using mobile applications developed by TotalPave.

2.0 State of Local Infrastructure

2.1 Roadway System

2.1.1 Road Inventory and Classification

The Township owns and maintains paved and unpaved road assets. In previous studies the asset inventory was classified as Urban, Semi-Urban, and Rural, with each defined as follows:

a) Urban: Roads having curb and gutter and storm sewer drainage;
b) Semi-Urban: Roads without curb and gutter in built-up urban areas; and
c) Rural: Roads without curb and gutter outside built-up urban areas.

A brief summary of the assets is presented in Table 5, including total length and construction materials.

Table 5: Summary of Road Assets

Roadside Environment	Construction Material	Total Length (km)	Total Lane Km
Urban	High Class Bituminous (Asphalt)	15.25	30.50
Semi-Urban	High Class Bituminous (Asphalt)	29.86	59.73
	Gravel	0.37	0.74
Rural	High Class Bituminous (Asphalt))	96.04	192.09
	Low Class Bituminous (Tar and Chip	0.60	1.20
	Gravel	25.46	50.92
	Total	167.58	335.17

All roads in the Township were evaluated according to the methods outlined in Section 1.3 – Study Methods.

For all roads, a pavement condition appraisal was completed. This evaluation excluded Provincial Highways and Regional roads. The physical appraisal of each road section including drainage, roadside environment, traffic lanes, surface type, road widths, shoulder types and widths, and curb and gutter were generally available from the previous 2016 study completed for the Township. New urban subdivision roads assumed by the Township were added to the inventory.

Each road section number corresponds with the Township's GIS database.

The visual assessment of all paved roads was carried out by Dillon staff utilizing the TotalPave software by TotalPave for data collection, and MTO Condition Rating of Gravel Surface Roads (SP-025), 1989.

2.1.2 Replacement Cost

Replacement costs for road segments were developed from the estimates provided in the 2016 study. The 2016 estimates were inflated to 2022 dollars by assuming a 3% average annual inflation. This inflation rate was determined using monthly consumer price index (CPI) data from the Bank of Canada (which resulted in an inflation rate of 2.62%) and rounding up to 3% for contingency, as the price index for commodities such as asphalt has been known historically to be slightly higher. A summary of the replacements costs by roadside environment and material are presented in Table 6.

Table 6: Road Replacement Cost (2022 Dollars)

Roadside Environment	Construction Material	Replacement Costs (2022)
Urban	High Class Bituminous (Asphalt)	$26,880,881
Semi-Urban	High Class Bituminous (Asphalt)	$17,914,761
	Gravel	$182,186
Rural	High Class Bituminous (Asphalt)	$73,669,645
	Low Class Bituminous (Tar and Chip)	$195,906
	Gravel	$12,531,883
Total Asset Inventory Replacement Cost (2022)		$131,375,262

Appendix B provides a comparison of benchmark unit prices used in the 2016 study and this 2022 report.

2.1.3 Average Age

The average age of the road network was calculated by roadside environment and material. The average age is presented in Table 7.

Table 7: Average Age of Road Assets

Roadside Environment	Construction Material	Average Age (years)
Urban	High Class Bituminous (Asphalt)	18.1
Semi-Urban	High Class Bituminous (Asphalt)	24.6
	Gravel	23.7
Rural	High Class Bituminous (Asphalt)	23.3
	Low Class Bituminous (Tar and Chip)	26.0
	Gravel	20.8
Average Total Asset Inventory Age (Years)		22.4

A summary of the age distribution for the road assets, by material type and length, is highlighted in Figure 3.

Figure 3: Age Distribution of Road Assets (2022)

2.1.4 Expected Useful Life

The expected useful life of the road assets is used to estimate the replacement schedule. The expected useful life values for each type of road surface within the network were provided and confirmed by the Township, and are summarized in Table 8.

Table 8: Expected Useful Life for Road Surfaces

Road Type	Material Types	Expected Useful Life (years)	Average Remaining Useful Life (Years)
Collector	Gravel, HCB	30	8
Local	Gravel, HCB, LCB	30	7

Based on *O. Reg. 588/17*, the road classifications are:

- Arterial road - Class 1 and Class 2 highway;
- Collector road - Class 3 and Class 4 highway; and,
- Local road - Class 5 and Class 6 highway.

The Township does not currently have any arterial class roads. The Township's Official Plan classifies roadways as Primary, Secondary, and Local Roads. Primary and Secondary roads are considered to fall in the Collector category of O.Reg 588/17.

2.2 Levels of Service

The current and proposed levels of service are described in terms of technical metrics and qualitative descriptions for each asset type. These descriptions are prescribed for core assets within Ontario Regulation (O. Reg.) 588/17.

Levels of Service (LOS) are defined as Community LOS and Technical LOS which includes Performance are presented in Figure 4 and defined as follows:

- Community Levels of Service: intended to be customer-focused, provide a qualitative description of scope and quality; and,
- Technical Levels of Service: provide technical metrics for scope and quality.

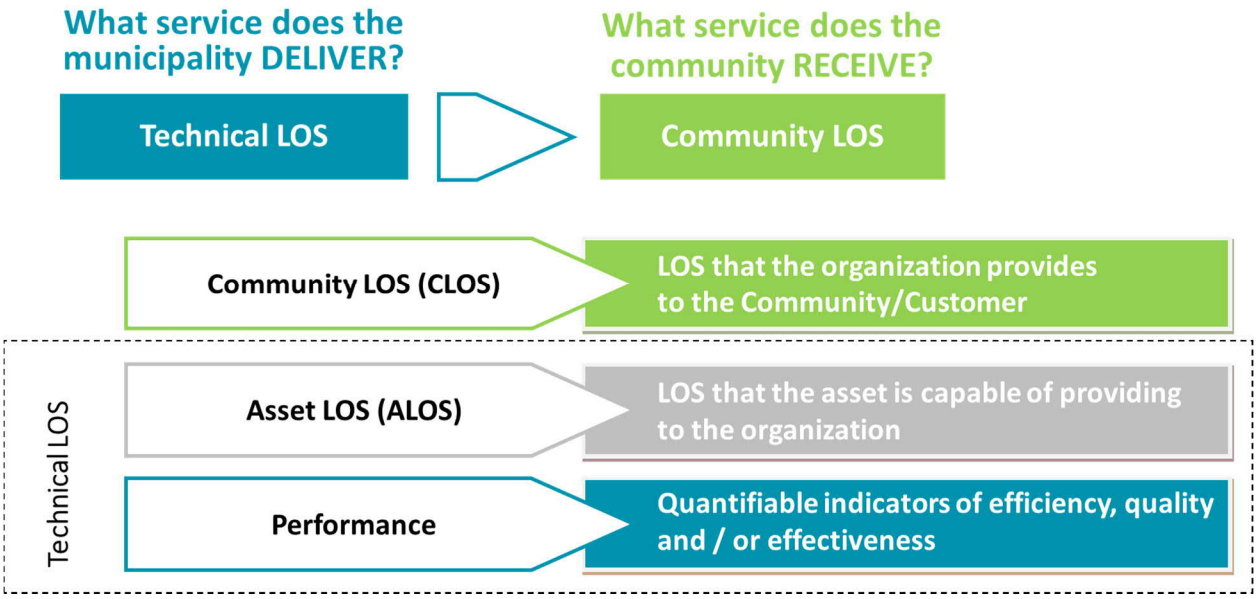


Figure 4: Levels of Service (Community LOS, Technical LOS and Performance)

Through this section of the report, the Township sought to establish the current and proposed levels of service (LOS), in accordance with O.Reg. 588/17.

2.2.1 Current Levels of Service

Levels of service for road assets are outlined in Table 4 of the regulation, *O.Reg. 588/17*. Table 9 and Table 10 outline the Township's current community and technical LOS for the roads.

Table 9: Community Level of Service – Roads

Service **Attribute**	Community Levels of Service *O.Reg. 588/17* **– Qualitative Description**	Community LOS
Scope	Description, which may include maps, of the road network in the Municipality and its level of connectivity.	The roads in the Township are intended to serve local and through traffic in urban and rural settings, throughout the Township. A map of the road network can be found in Appendix A.
Quality	Description or images that illustrate the different levels of road class pavement condition.	Pavement condition was assessed in 2022. The road segment surfaces were visually assessed using the TotalPave software and a PCI score which is between 0 and 100 was given to each segment. PCI of 100 is new condition and as the asset ages and the road condition deteriorates, the PCI score gets lower where PCI of 40 is very poor. A map can be found in Appendix A.

Table 10: Technical Level of Service – Roads

Service **Attribute**	Technical Levels of Service O.Reg. 588/17 – Technical Metrics	Technical LOS
Scope	Number of lane-kilometres of each of arterial roads, collector roads and local roads as a proportion of square kilometres of land area of the Municipality.	The number of lane-kilometres of roads as a proportion of square kilometres of land area of the Township is in Table 8 below.
Quality	1. For paved roads in the Municipality, the average pavement condition index value.	The technical metric for the condition of roads is the Pavement Condition Index (PCI). The average PCI value for the paved surfaces is 63.
	2. For unpaved roads in the Municipality, the average surface condition (e.g., Excellent, Good, Fair or Poor).	The average surface condition for the unpaved roads is Good.

See Table 11 for Roadway type length of lane kilometres.

Table 11: Proportion of Lane Kilometers

Street Type	Length of Lane-Kilometers	**Lane-Kilometers as Proportion** of sq. km of Land Area
Collector	231.4 km	1.2 km per 1 km^2
Local	103.8 km	0.55 km per 1 km^2

2.2.3 Proposed Levels of Service

The Proposed Levels of Service is an established target for the Township's LOS and are used to guide the municipality in their current and future asset management. Proposed Levels of Service are a requirement for compliance with O. Reg. 588/17. The Proposed LOS established within this report relates to the target to be utilized through to the year 2032.

The recommended proposed Levels of Service targets for 2032 are to maintain the established LOS values from 2022. The specific Proposed LOS are described as part of each asset categories in the sections that follow, and summarized in Table 12.

Table 12: Summary of LOS Parameters (2022 and Proposed 2032)

Asset Service	LOS Parameter	LOS Measure	2022 LOS Delivered	2032 Proposed LOS
Road Network	Quality	Average pavement condition index (PCI)	63 (Fair/Good)	63 (fair) or better
Road Network	Quality	Average international roughness index (IRI)	2.97 (Good)	2.97 (Good) or better
Unpaved Roads	Quality	Average surface condition (e.g., Excellent, Good, Fair or Poor)	Good	Good

The Township should continue to monitor levels of service being provided by road assets on an annual basis to monitor and adjust proposed levels of service accordingly in the future.

2.3 Current Performance

2.3.1 Pavement Condition Index (PCI)

The PCI value is used to rate the road segment. This PCI is a numerical index between 0 and 100 which and indicates the general condition of the pavement. The PCI considers surface defects in the pavement, such as surface deformations, and pavement cracking. These distress types are assessed based on their severity and density of occurrence.

2.3.2 Pavement Condition Rating – TotalPave Application

TotalPave is a software application for mobile devices which uses the Township's GIS network and the users GPS position to record field surveyed data for each road section. A screenshot of the application can be found in Figure 5.

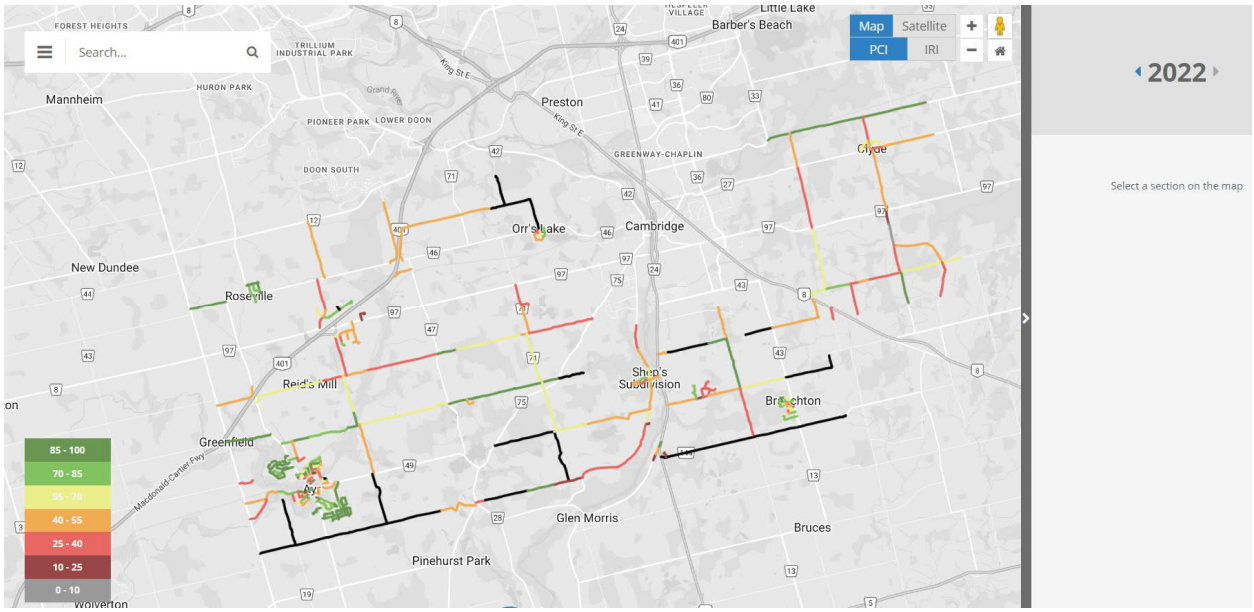


Figure 5: A screenshot of the TotalPave platform depicting the Township's road network with coloring established depending on PCI.

The application incorporates the Township's GIS network and the GPS location of the user to automatically identify which road section that is being evaluated, receives inputs from the user regarding pavement distresses and calculate a representative PCI score for the section.

2.3.3 Condition Categories

The condition categories were based on the level of service defined in ASTM manuals relative to the value of the Pavement Condition Index (PCI), as shown in Table 13 below.

Table 13: Condition Categories

Pavement Condition Index	Condition Categories
85 to 100	Very Good
70 to 85	Good
56 to 70	Fair
40 to 55	Poor
Less than 40	Very Poor

These values should be considered as guidelines should also consider other needs in the Township's overall budgeting program (For example, roads can be improved in conjunction with adjacent segments for a continuous section, or in consideration of other work being done in the roadway, such as replacement of culverts or pipe).

A summary of the Township's overall roadway condition is shown in Table 14.

Table 14: Condition of Road Network

PCI Range	Condition Categories	Length of Road (km)	Percentage of Total Road Network
Greater than 85	Very Good	30.9	19%
70 to 85	Good	37.5	22%
56 to 70	Fair	25.5	15%
40 to 55	Poor	39.7	24%
Less than 40	Very Poor	33.9	20%
	Total	167.5	100%

Based on the 2022 roadway evaluations, the average PCI value for the entire road network is 63. This places the overall road network in the "Fair" category.

2.3.4 Current Roughness

The international roughness index (IRI) is used to evaluate the vertical displacement experienced by a vehicle while driving on a road. Using the TotalPave mobile application, IRI values were calculated for all roads in the Township's network. Table 15 summarizes for findings for IRI values by roadside environment and material.

Table 15: IRI Values by Roadside Environment and Material

Roadside Environment	Construction Material	Average IRI
Urban	High Class Bituminous (Asphalt)	2.45
Semi-Urban	High Class Bituminous (Asphalt)	3.77
	Gravel	7.09
Rural	High Class Bituminous (Asphalt)	2.05
	Low Class Bituminous (Tar and Chip)	1.60
	Gravel	2.01
	Average Road Network IRI Score	2.84

2.3.5 Current Condition

Mobile applications were used to record the degree of surface distresses for each road sections and determine the PCI. Figure 6 breaks down the results of the 2022 condition assessment by condition category and length in kilometers.

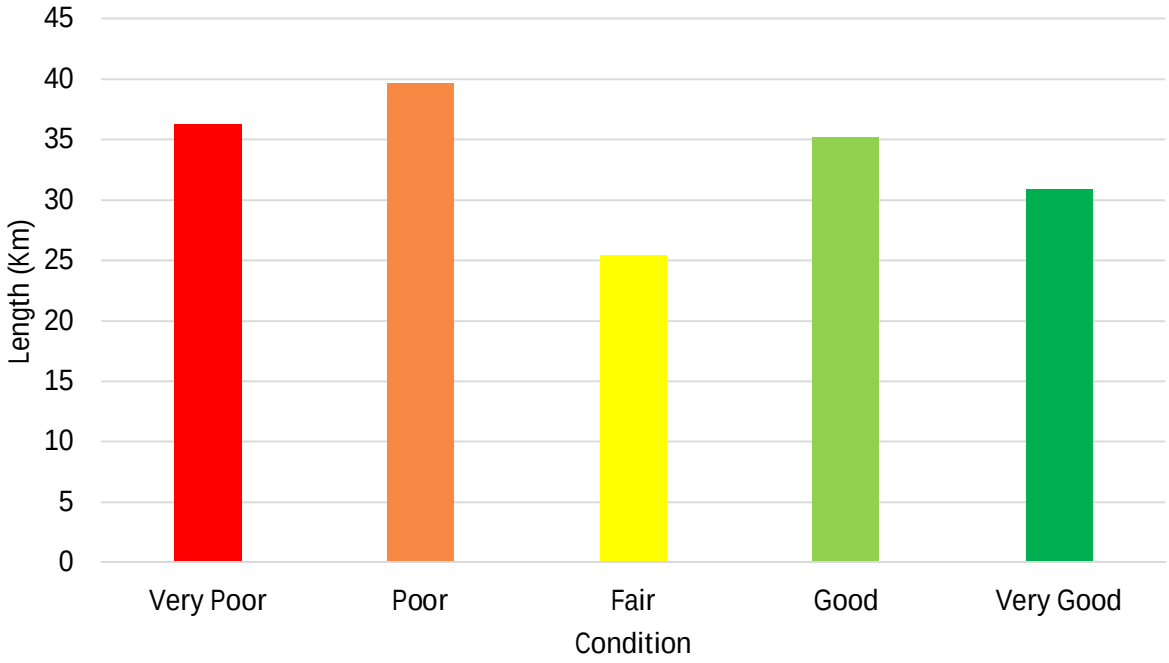


Figure 6: 2022 Condition Assessment - Breakdown of the Township's Road Network by Condition Category

3.0 Asset Management Strategy

3.1 Asset Management

The asset management strategy for the road assets seeks to use the lifecycle activities in a manner that will achieve cost-effective and sustainable management of the road assets. The road assets will deteriorate on a non-linear basis, and the lifecycle activities can be implemented at varying stages within an assets deterioration.

The condition and usage of the road assets is a key driver in the determination of lifecycle activities to use. The condition was determined in 2022 as part of this State of the Infrastructure Study for North Dumfries' road network, and should continue to be updated by the Township. Condition of the roads can be completed on scheduled basis wherein the entirety of the network is reviewed in annual portions over a defined duration (example five years). A variety of methods can be implemented for undertaking condition assessment of roads, including visual inspection and street scan technology. A condition rating program can also be implemented that considers the importance or risk of a road segment, and prioritizes frequency and timing of condition assessments to higher usage or higher importance roads. A condition assessment program is recommended for the Township.

Maintenance works should be undertaken throughout the lifecycle of an asset. Selection of the appropriate maintenance activity will depend on the type of deterioration being experienced on the asset, and the condition of the asset. Some activities, such as crack sealing, are best utilized on a road segment that is generally in "Good" condition. As the road segment continues to deteriorate, maintenance activities may become a less preferred option.

Rehabilitation activities should be undertaken on an asset when it has deteriorated past the point where maintenance activities would be adequate to address condition issues. Selection of the appropriate rehabilitation activity will depend on the road surface material, stage in lifecycle, and severity and type of deterioration.

In general, the current strategy for the road assets at the Township is to allow the road surface asset to degrade near to the end of its expected lifecycle, and reconstruct the road surface when required. The road base has a much longer expected useful life than the road surface, and is dealt with as required during road works. The requirement for reconstruction of the road base is determined through a combination of staff knowledge of the road condition, and conducting boreholes to assess the viability of the road base. The Township does not currently undertake boreholes for every road segment to be reconstructed.

As for gravel roads, it is recommended that the gravel roads be graded regularly, and gravel applied annually. Localized repairs and maintenance should also be completed where required. Reconstruction of these roads may be required if condition is found to have deteriorated, however the expected lifespan is long.

3.2 Lifecycle Activities

The following section describes the lifecycle activities that can be implemented within the asset management strategy for road assets. The primary lifecycle activities after construction include reconstruction, rehabilitation, and maintenance.

The lifecycle activities presented below are consistent with best practices for road asset management and maintenance, and with the recommendations in the 2016 study. Additional description and details of the lifecycle activities can be found within the report.

Construction

The initial lifecycle activity of a road asset is its construction. The road asset should be constructed to adhere to applicable requirements, codes, and design guidelines. Design of the road asset should consider the level of service expected to be provided by that particular road asset, such as the anticipated speed or volume of traffic. Varying factors in construction include: the road classification, surface type, and roadside environment (e.g., rural, urban).

Reconstruction

Reconstruction lifecycle activities include works that encompass the full surface of a road segment. Reconstruction activities include:

- Full reconstruction (Varying cost and difficulty for rural, semi-urban, and urban roads);
    - Potential adjustments to existing storm sewer, manholes, catch basins, etc. (semi-urban and urban roads only); and
- Urban paving (typically more costly than paving for semi-urban and rural roads).

Selection of a reconstruction activity will depend on multiple factors, such as:

- Lifecycle stage of the asset (previous lifecycle activities undertaken);
- Condition and type of wear on road surface;
- Road surface material;
- Condition of underlying road base; and
- Roadside environment.

Rehabilitation

Rehabilitation lifecycle activities include works that encompass the full surface of a road segment. Rehabilitation activities include:

- Hot mix resurfacing (50 mm – 100 mm);

- Full depth pulverize and pave (100 mm – 150 mm); and
- Full depth removal and pave.

Selection of a reconstruction activity will depend on multiple factors, such as:

- Lifecycle stage of the asset (previous lifecycle activities undertaken);
- Condition and type of wear on road surface;
- Road surface material;
- Condition of underlying road base; and
- Roadside environment.

Maintenance

Maintenance lifecycle activities are smaller in scale than reconstruction or rehabilitation and can be used to address localized issues on the road surface ("spot maintenance"), or to improve or maintain road asset-adjacent components ("specific maintenance"). A spot maintenance activity is typically appropriate when the location for maintenance is less than 60 m in length. Specific maintenance activities are not length based, and address maintenance to non-road surface components. The types of maintenance under each of these categories can include:

- Specific Maintenance
    - Ditching improvements
    - Edge widening
    - Installation of sub drain
- Spot Maintenance
    - Ditch Spot Location
    - Paving Patch
    - Spot repair (paved or gravel road).

Crack sealing can be used on an ad-hoc basis, typically on better condition roads where the severity of the cracks is minimal. Where cracks are more advanced or widespread, more comprehensive maintenance or improvement works will be required.

Decommissioning/Disposal

Disposal activities can include the removal from service of a road segment. These activities can be implemented when a road segment has been determined to be no longer required. A road may be removed from service by removal and disposal of the asset components, or establishment of a barricade to prevent continued usage of the asset. Disposal activities should be conducted such that health and safety protocols are being followed, and spent materials are disposed of at an appropriate or approved facility.

3.3 Analysis of Potential Strategies

To understand the needs and projected capital work on the road network within the next 10-years, the reconstruction, rehabilitation and maintenance of the road surface were reviewed to determine the required budget and to understand the impact on the overall network condition. In this analysis, it was assumed that the roads anticipated to be rehabilitated or reconstructed in 2022 were complete and the PCI rating for those roads was reset to 100. The roads that were set to be reconstructed or rehabilitated in 2022 can be found in Table 16.

Table 16: Roads Paved in 2022

Asset Code	Street	From Street	To Street	Improvement Year
1446773	Maple Manor Rd	Misty Maple Trail	Silver Maple Cres	2022
1446937	Bute St	McCrae Street	Bute Street Bend	2022
1446824	Sheffield Rd	Seaton Rd	Morrison Rd	2022

For the purposes of this analysis, input from the Township was taken into account regarding existing budget and schedule for roadway rehabilitation already planned for 2022. The 10 year forecast analysis begins in the year 2023. A small number of select roadways that are currently part of the Township's government property network were removed from the budget capital forecast. These roadway sections have not been provided any maintenance for many years due to the actual lack of use of these sections, they serve as alleyways/driveways with no posted speed limit. Originally recorded as paved roadway sections they have deteriorated beyond repair to gravel/dirt access ways.

Based on the Townships existing improvement activities, it was assumed that any roads with a PCI less than 40 would be fully reconstructed (base and surface treatment), while any roads with a PCI between 40 and 55 would be rehabilitated (pulverized and/or resurfaced). The improvement types that were used for this analysis can be found in Table 17, below.

Table 17: Surface Improvement Types based on PCI

Surface Type	Improvement Type	**Improvement Description**	PCI Threshold	Effect on PCI
Hard Surface (Asphalt, Chip and Tar)	Reconstruction	Base and Surface Reconstruction	PCI < 40	100
	Rehabilitation	Pulverizing and Resurfacing	40 < PCI < 55	100
	Maintenance	Crack Sealing, Spot Drainage	55 < PCI <70	85
Gravel	Reconstruction	Adding a full lift of gravel	PCI < 40	100
	Maintenance	Spot Drainage	40 < PCI < 70	85

For costing, estimates for reconstruction, rehabilitation, and maintenance activities were inflated to 2022 dollars from the 2016 Study. The inflation used for this analysis was a 3% average annual inflation. This inflation rate was determined using monthly consumer price index (CPI) data from the Bank of Canada (which resulted in an inflation rate of 2.62%) and rounding up to 3% for contingency as the price index for commodities such as asphalt has been known historically to be slightly higher. The unit prices used can be found in Appendix B.

In 2022, the Township's budget for road resurfacing and reconstruction is $1,500,000, with an additional $550,000 for other road improvement projects (full road reconstructions, drainage improvements, etc.). The 2022 budget was used as a baseline for the analysis.

If the Township continues to use the 2022 budget for the next 10 years, the average PCI of the road network is predicted to decrease to an average of 51. The predicted cost and associated average PCI ratings can be found in Table 18 and Figure 7.

Table 18: Road Total Expenditures and Average PCI with 2022 Budget

2022 Budget	Total Program Cost	Average Annual Cost	**Resulting** Average PCI	% Change in PCI
$1,500,000, with an additional $550,000 for other road improvement projects	$20.1M	$2.01 M/yr	51	-19%

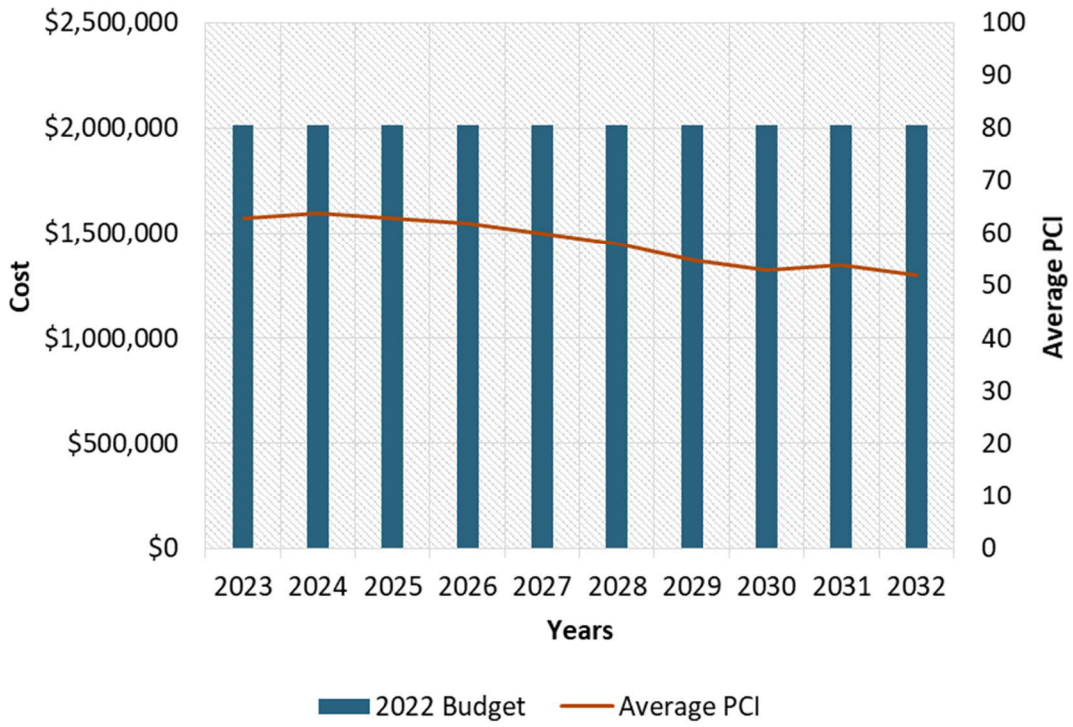


Figure 7: Average PCI for 2022 Budget

Based on the findings outlined in Table 13, it is anticipated that the Township's 2022 budget would not be sufficient to maintain the current LOS (PCI of 63) or proposed LOS (PCI of 70). There were three (3) options analyzed to determine the estimated budget that the Township would be required to achieve their proposed LOS. The options analyzed include:

- Increasing the 2022 budget by $250,000 a year;
- Increasing the 2022 budget by $500,000 a year; and
- Increasing the budget to achieve an average PCI of 70 within 5 years (2027) and an average PCI 75 in 10 years (2032).

The following subsections summarize the findings of a multi-year projection scenario run for each strategy using the budgets noted above.

3.3.1.1 Option #1

Option #1 is to increase the 2022 budget of $1,500,000 (with an additional $550,000 for other road improvement projects) by $250,000 a year. Based on the results outlined in Table 19 and Figure 8, it appears that increasing the Township's existing budget by $250,000 a year would not be sufficient to maintain its road network to the current LOS (PCI of 63) or achieving the proposed LOS of 70 in 10 years.

Table 19: Option #1 - Increasing annual budget by $250,000 a year

Option #1	Total Program Cost	Average Annual Cost	Resulting Average PCI	% Change in PCI
Increasing annual budget by $250,000 a year	$31.4 M	$3.14 M/yr	58	-8%

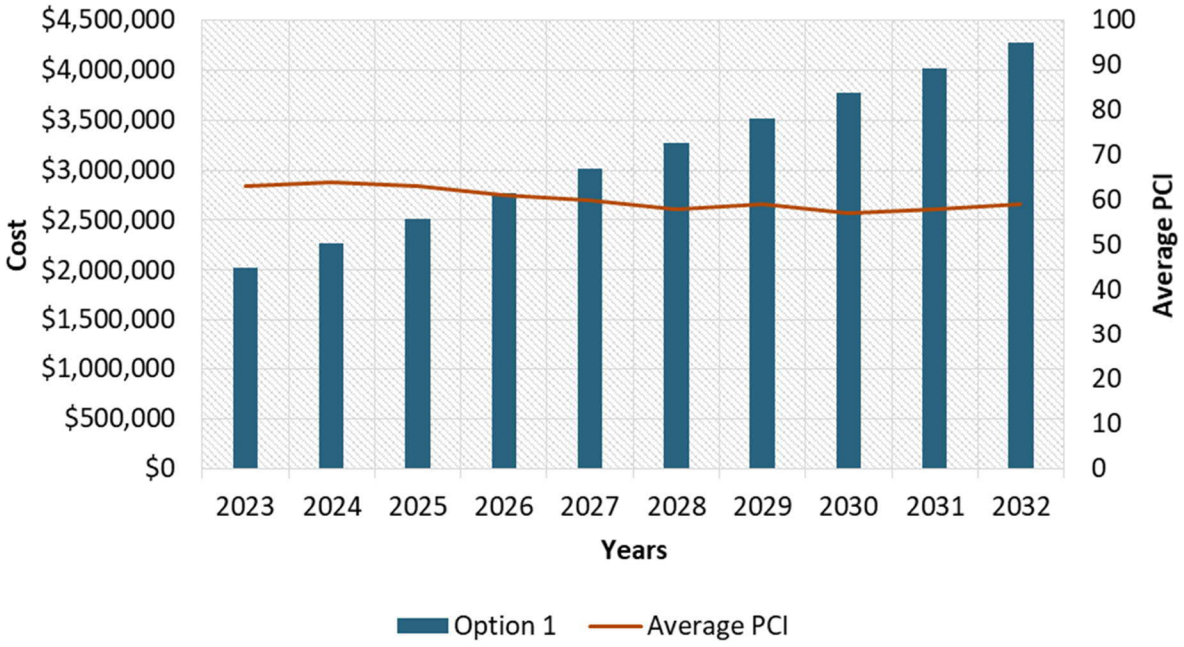


Figure 8: Average PCI for Option 1

3.3.1.2 Option #2

Option #2 is to increase the 2022 budget of $1,500,000 (with an additional $550,000 for other road improvements) by $500,000 a year. Based on the summary outlined in Table 20 and Figure 9, it appears that increasing the Township's existing budget by $500,000 a year would be enough for maintaining the existing current LOS, however, would not be sufficient for achieving the proposed LOS of 70 within 10 years.

Table 20: Option #2 - Increasing annual budget by $500,000 a year

Option #2	Total Program Cost	Average Annual Cost	Resulting Average PCI	% Change in PCI
Increasing annual budget by $500,000 a year	$42.6 M	$4.3 M/yr	66	+5%

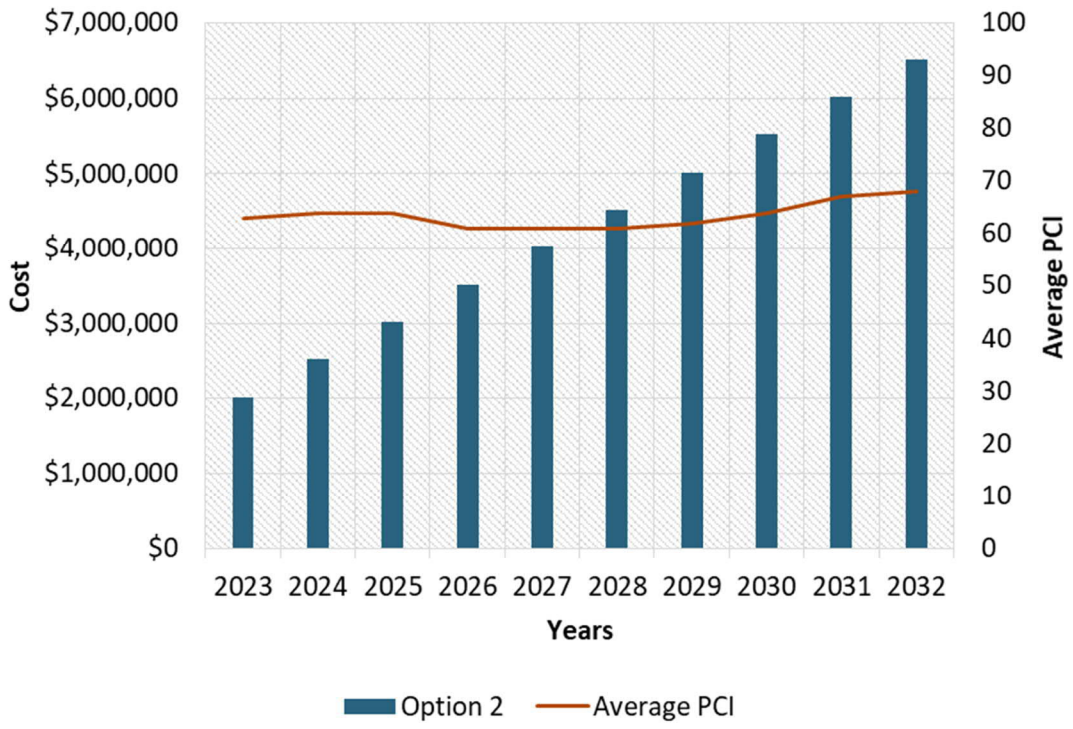


Figure 9: Average PCI for Option 2

3.3.1.3 Option #3

Option #3 is to increase the annual budget to achieve an average PCI of 70 for the road network within 5 years (2027) and to achieve an average of 75 of the roads within 10 years (2032). As presented in Table 21 and Figure 10, to achieve an average PCI rating of 70 within 5 years a total of $29.5 million would be required with a total of $22.5 million required between 2028 and 2032. The average annual cost for this option would be $5.19 million which equates to approximately 4% of the total network value of $131 million. A 4% investment rate is a common average best practices for road networks in other Municipalities.

Table 21: Option #3 - Obtaining an average PCI of 70 in 2027 and an average PCI 75 in 2032

Option #3	Total Program Cost	Average Annual Cost	Resulting Average PCI	% Change in PCI
Obtaining an average PCI of 70 in 2027 and an average PCI 75 in 2032	$51.9 M	$5.19 M/yr	75	+19%

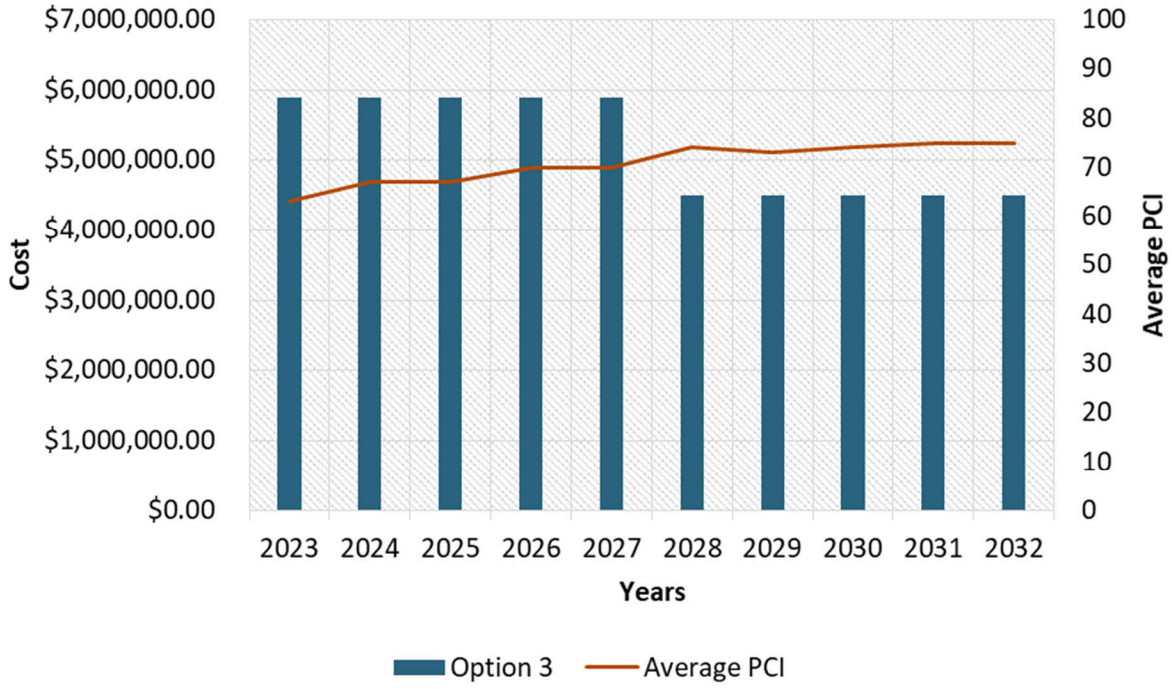


Figure 10: Average PCI for Option 3

3.4 Discussion and Recommendations

The average PCI rating in 2022 for the Township's road network is 63. A summary of the three (3) analysis options is presented in Table 22.

Table 22: Summary of Proposed Budgets

Options	Total Program Cost	Average Annual Cost	Resulting Average PCI	% Change in PCI
2022 BUDGET $1,500,000, with an additional $550,000 in other road improvement projects	$20.1M	$2.01 M/yr	51	-19%
OPTION #1 Increasing annual budget by $250,000 a year	$31.4 M	$3.14 M/yr	58	-8%
OPTION #2 Increasing annual budget by $500,000 a year	$42.6 M	$4.26 M/yr	66	+5%
OPTION #3 Obtaining an average PCI of 70 in 2027 and an average PCI 75 in 2032	$51.9 M	$5.19 M/yr	75	+19%

Assumptions made for this Analysis:

- Plan would start in 2023, and
- Roads that were set to be paved in 2022 have had a PCI set to 100.

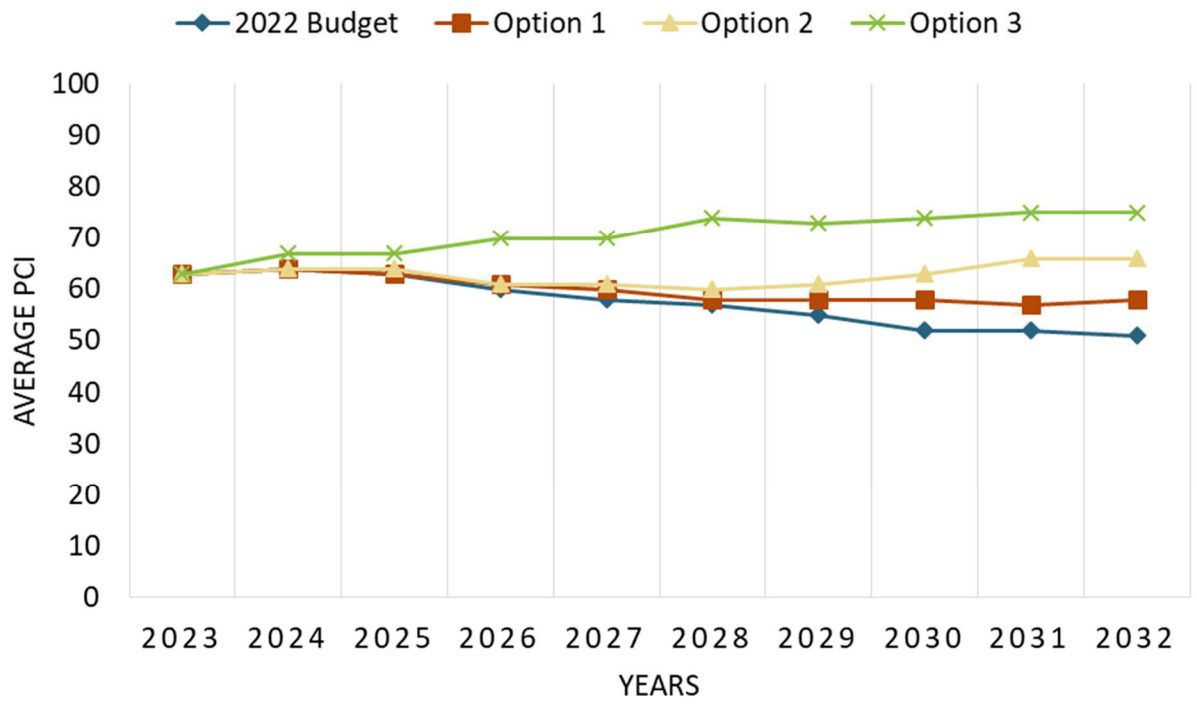


Figure 11: Strategy Options Life Cycles

Based on the analysis, it is recommended on approaching the network with Option #2. It is recommend setting the target (proposed) LOS following a 10 year program at an overall average PCI of 68.

4.0 Continuing Improvements

4.1 Study Updating

The basic information assembled in this study, particularly with respect to inventory and construction needs, is subject to continual change. To ensure the reliability of the base data, a system of regular updating should be established to include the following:

- A review of the road system and new subdivision roads to identify any significant changes;
- An updating of the condition records for roads and structures which have been improved, or on which the previous deficiency time has changed or other changes have occurred; and
- Identification of new deficiencies which have not been apparent and the provision of estimated costs for improvements required to address those deficiencies. In this respect, revisions to the original appraisal sheets which identify new deficiencies or time period changes should be carried out.

The updating should be done within a 3 to 5 year time. It is recommended that Township-wide traffic counting be done at least every 5 years or as new developments begin to come online.

The study content can remain relevant for at least five years and possibly ten years, with the implementation of these update procedures.

4.2 Road Upgrading for Future Development

This State of Infrastructure Study has identified roads that are deficient now or will become deficient within the 10 year study period. These deficiencies are the result of the existing condition of the roads and future deterioration.

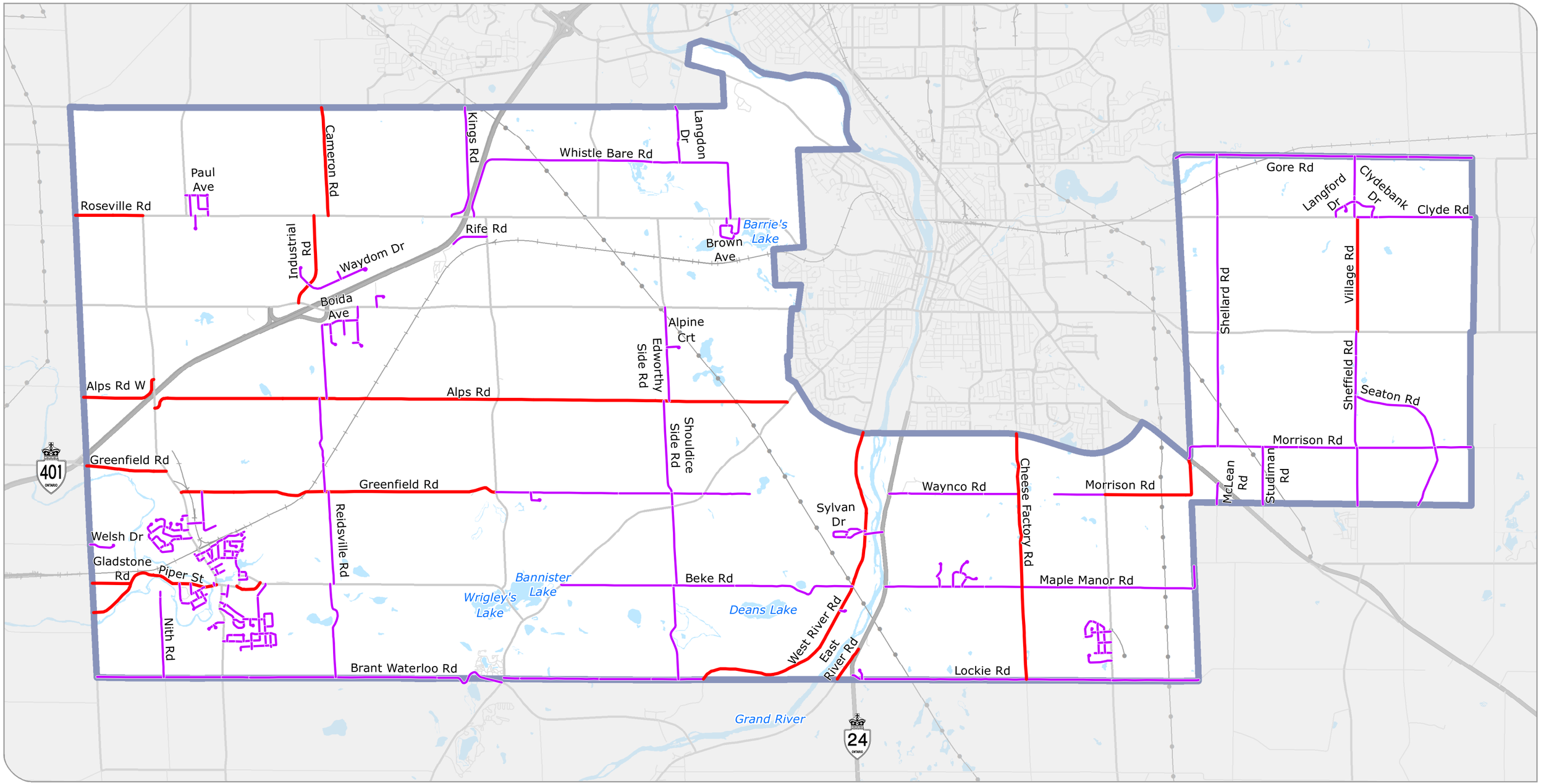
This study has recognized historical traffic growth only. However, large scale land development can generate increased traffic volumes above those estimated in this study, and thus alter the priority of the needs by accelerating the deterioration of some roads.

DILLON CONSULTING LIMITED

Carston Gregory, P.Eng.
Project Manager

Appendix A

Road Maps



NORTH DUMFRIES
Infrastructure Study

GENERAL ROAD NETWORK INVENTORY

FIGURE 1

Surveyed Road
- Collector (Primary or Secondary Township Designation)
- Local

Base Data
- Highway
- Major Road
- Minor Road
- Railway
- Utlitiy Line
- Municipal Boundary
- Water Body

SCALE 1:65,000

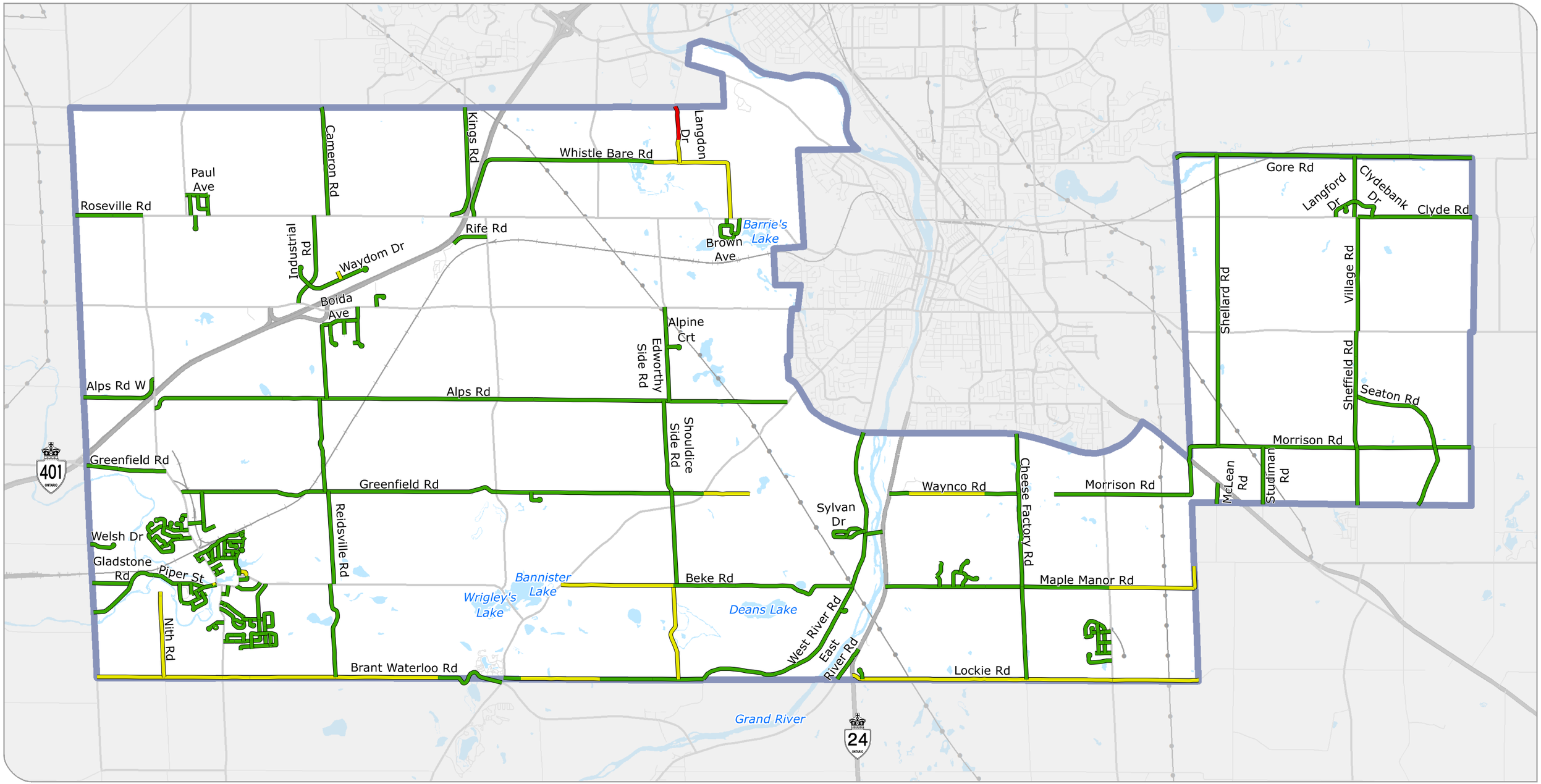
0 750 1,500 3,000 m

MAP DRAWING INFORMATION:
Base Data by MNRF, Data provided by Dillon Consulting Limted and Total Pave

MAP CREATED BY: LMM
MAP CHECKED BY: -
MAP PROJECTION: NAD 1983 UTM Zone 17N

PROJECT: 22-3722 STATUS: DRAFT DATE: 2022-07-28

FILE LOCATION: K:\2022\223722\Product\Client\Report_May2022\223722_F1_GeneralRoadNetworkInventory.mxd



NORTH DUMFRIES
Infrastructure Study

ROAD NETWORK BY SURFACE TYPE

FIGURE 2

Surface Type
- Gravel, Stone, Other Loosetop
- High Class Bituminous
- Low Class Bituminous

Base Data
- Highway
- Major Road
- Minor Road
- Railway
- Utlitiy Line
- Municipal Boundary
- Water Body

SCALE 1:65,000

0 750 1,500 3,000 m

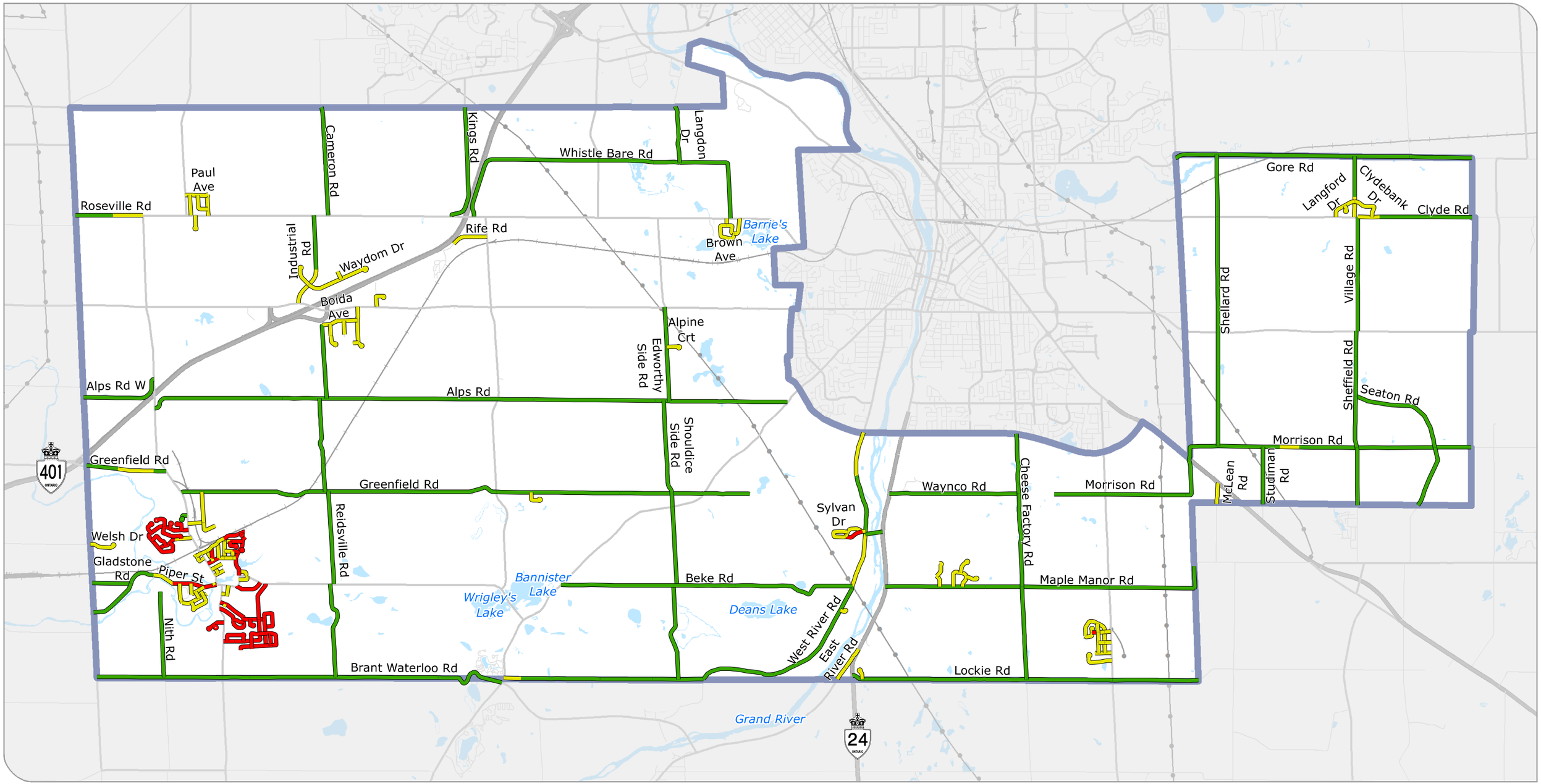
MAP DRAWING INFORMATION:
Base Data by MNRF, Data provided by Dillon Consulting Limted and Total Pave

MAP CREATED BY: LMM
MAP CHECKED BY: -
MAP PROJECTION: NAD 1983 UTM Zone 17N

PROJECT: 22-3722 STATUS: DRAFT DATE: 2022-05-27

DILLON CONSULTING

FILE LOCATION: K:\2022\223722\Product\Client\Report_May2022\223722_F2_RoadNetworkbySurfaceType.mxd



NORTH DUMFRIES
Infrastructure Study

ROAD NETWORK BY ROADSIDE ENVIRONMENT

FIGURE 3

Roadside Environment
- Rural
- Semi-Urban
- Urban

Base Data
- Highway
- Major Road
- Minor Road
- Railway
- Utlitiy Line
- Municipal Boundary
- Water Body

SCALE 1:65,000

0 750 1,500 3,000 m

MAP DRAWING INFORMATION:
Base Data by MNRF, Data provided by Dillon Consulting Limted and Total Pave

MAP CREATED BY: LMM
MAP CHECKED BY: -
MAP PROJECTION: NAD 1983 UTM Zone 17N

PROJECT: 22-3722 STATUS: DRAFT DATE: 2022-05-27

DILLON CONSULTING

FILE LOCATION: K:\2022\223722\Product\Client\Report_May2022\223722_F3_RoadNetworkbyRoadsideEnvironment.mxd

Roseville Rd
Paul Ave
Cameron Rd
Kings Rd
Whistle Bare Rd
Langdon Dr
Rife Rd
Industrial Rd
Waydom Dr
Boida Ave
Brown Ave
Barrie's Lake
Alpine Crt
Edworthy Side Rd
Alps Rd W
Alps Rd
Shouldice Side Rd
Greenfield Rd
Greenfield Rd
Reidsville Rd
Welsh Dr
Gladstone Rd
Piper St
Nith Rd
Bannister Lake
Wrigley's Lake
Beke Rd
Deans Lake
West River Rd
East River Rd
Brant Waterloo Rd
Grand River
Sylvan Dr
Waynco Rd
Cheese Factory Rd
Maple Manor Rd
Lockie Rd
Morrison Rd
Gore Rd
Langford Dr
Clydebank Dr
Clyde Rd
Shellard Rd
Village Rd
Sheffield Rd
Seaton Rd
Morrison Rd
McLean Rd
Studiman Rd
401
24

NORTH DUMFRIES
Infrastructure Study

ROAD NETWORK BY CONDITION 2022

FIGURE 4

Condition 2022
- Very Poor
- Poor
- Fair
- Good
- Very Good

Base Data
- Highway
- Major Road
- Minor Road
- Railway
- Utlitiy Line
- Municipal Boundary
- Water Body

SCALE 1:65,000

0 750 1,500 3,000 m

MAP DRAWING INFORMATION:
Base Data by MNRF, Data provided by Dillon Consulting Limted and Total Pave

MAP CREATED BY: LMM
MAP CHECKED BY: -
MAP PROJECTION: NAD 1983 UTM Zone 17N

PROJECT: 22-3722 STATUS: DRAFT DATE: 2022-06-10

DILLON CONSULTING

FILE LOCATION: K:\2022\223722\Product\Client\Report_May2022\223722_F4_RoadNetworkbyTimeofNeed.mxd

Roseville Rd
Paul Ave
Cameron Rd
Kings Rd
Whistle Bare Rd
Langdon Dr
Industrial Rd
Waydom Dr
Rife Rd
Barrie's Lake
Brown Ave
Boida Ave
Alpine Crt
Edworthy Side Rd
Alps Rd W
Alps Rd
Shouldice Side Rd
Greenfield Rd
Greenfield Rd
Reidsville Rd
Welsh Dr
Gladstone Rd
Piper St
Nith Rd
Bannister Lake
Wrigley's Lake
Beke Rd
Deans Lake
West River Rd
East River Rd
Brant Waterloo Rd
Grand River
Sylvan Dr
Waynco Rd
Cheese Factory Rd
Maple Manor Rd
Lockie Rd
Morrison Rd
Gore Rd
Langford Dr
Clydebank Dr
Clyde Rd
Shellard Rd
Village Rd
Sheffield Rd
Seaton Rd
Morrison Rd
McLean Rd
Studiman Rd
401
24

NORTH DUMFRIES
Infrastructure Study

ROAD NETWORK BY CONDITION 2023

FIGURE 5

Condition 2023
- Very Poor
- Poor
- Fair
- Good
- Very Good

Base Data
- Highway
- Major Road
- Minor Road
- Railway
- Utlitiy Line
- Municipal Boundary
- Water Body

SCALE 1:65,000

0 750 1,500 3,000 m

N W E S

MAP DRAWING INFORMATION:
Base Data by MNRF, Data provided by Dillon Consulting Limted and Total Pave

MAP CREATED BY: LMM
MAP CHECKED BY: -
MAP PROJECTION: NAD 1983 UTM Zone 17N

DILLON CONSULTING

PROJECT: 22-3722 STATUS: DRAFT DATE: 2022-07-28

FILE LOCATION: K:\2022\223722\Product\Client\Report_May2022\223722_F4_RoadNetworkbyCondition2023.mxd

Appendix B

Unit Prices

Table 3.1.1
Benchmark Unit Prices
Years 2003, 2008, and 2014

Unit Prices/Factors

Items	Unit	Year: 2003	Year: 2013	Year: 2016
Excavation (including Disposal)	Cubic Metre	$10.00	$13.00	$13.00
Hot Mix (Aver. Base & Top Course) Asphalt	Tonne	$55.00	$72.00	$100.00
Granular A (in place)	Tonne	$19.00	$19.00	$21.00
Granular B (in place)	Tonne	$12.00	$17.00	$19.00
Concrete Base (placed)	Cubic Metre	$200.00	$258.00	$260.00
Curb & Gutter (removal)	Lineal Metre	$7.00	$7.50	$7.50
Curb & Gutter (placed)	Lineal Metre	$38.00	$39.00	$45.00
Sub. Drains (placed)	Lineal Metre	$20.00	$21.00	$21.00
Storm Sewer (525mm dia. placed)	Lineal Metre	$260.00	$268.00	$300.00
Catch Basin Leads (placed)	Lineal Metre	$135.00	$139.00	$200.00
Manholes (removed)	Each	$500.00	$1,030.00	$1,200.00
Manholes (placed)	Each	$3,500.00	$4,000.00	$5,000.00
Catch basins (removed)	Each	$275.00	$361.00	$750.00
Catch basins (placed)	Each	$1,200.00	$1,236.00	$1,650.00
Adjust Manhole	Each	$240.00	$285.00	$500.00
Adjust Catch basins	Each	$285.00	$295.00	$350.00
Asphalt Planning	Square Metre	$5.00	$5.00	$10.00
Asphalt Pulverizing	Square Metre	$1.00	$1.00	$1.00

Appendix C

List of Abbreviations

Roadside Environment:
U- Urban
S- Semi-urban
R- Rural

Surface Material:
- G/S – Granular Surface
- LCB – Low Class Bituminous
- HCB – High Class Bituminous

AADT – Annual Average Daily Traffic

PCI – Pavement Condition Index

IRI – International Roughness Index

Road Class:
- L/R – Local Road
- C/R – Collector Road
- LCI – Local Commercial or Industrial
- 100 – 01-49 AADT
- 200 – 50-199 AADT
- 300 – 200-399 AADT
- 400 – 400-999 AADT
- 500 – 1000-1999 AADT
- 600 – 2000-2999 AADT
- 700 – 3000-3999 AADT
- 800 – 4000 and Over AADT

Rural and Semi Urban Roads (no curbed gutter)

Pulverizing and Resurfacing (PR1):

- Pulverize existing hard top surface
- Double lift of tar and chip (16mm) or single lift of asphalt
- Granular material to raise shoulders to new surface grade

Pulverizing and Resurfacing (PR2):

- Pulverize existing hard top surface
- Double lift of lift of asphalt (100mm)
- Granular material to raise shoulders to new surface grade

Basic Resurfacing (R1):

- Hot mix padding for 20% of area to be resurfaced
- Single lift of hot mix (50 mm)
- Granular material to raise shoulders to new surface grade

Basic Resurfacing (R2):

- Hot mix padding for 20% of area to be resurfaced
- Double lift of hot mix (100 mm)
- Granular material to raise shoulders to new surface grade

Cold in Place Resurfacing (R3):

- Cold in Place Recycling of existing asphalt (100 mm)
- Single lift of hot mix (50 mm)
- Granular material to raise shoulders to new surface grade

Reconstruction (REC):

- Excavate base material
- Ditching and side culvert replacement
- Grading
- Granular Material
- Double lift of hot mix (100mm)

Urban Roads

Basic Resurfacing (R1):

- Minor base repairs for 10% of area to be resurfaced
- Hot mix padding for 20% of area to be resurfaced
- Curb removal and replacement on both sides for 50% of section length
- Planning 1.0 m of existing pavement along both curbs
- Adjust manholes and catchbasins to new surface grade
- Single lift of hot mix (50 mm)

Basic Resurfacing (R2):

- Minor base repairs for 10% of area to be resurfaced
- Hot mix padding for 20% of area to be resurfaced
- Curb removal and replacement on both sides for 50% of section length
- Planning 1.0 m of existing pavement along both curbs
- Adjust manholes and catchbasins to new surface grade
- Double lift of hot mix (100 mm)

Major Resurfacing (RM):

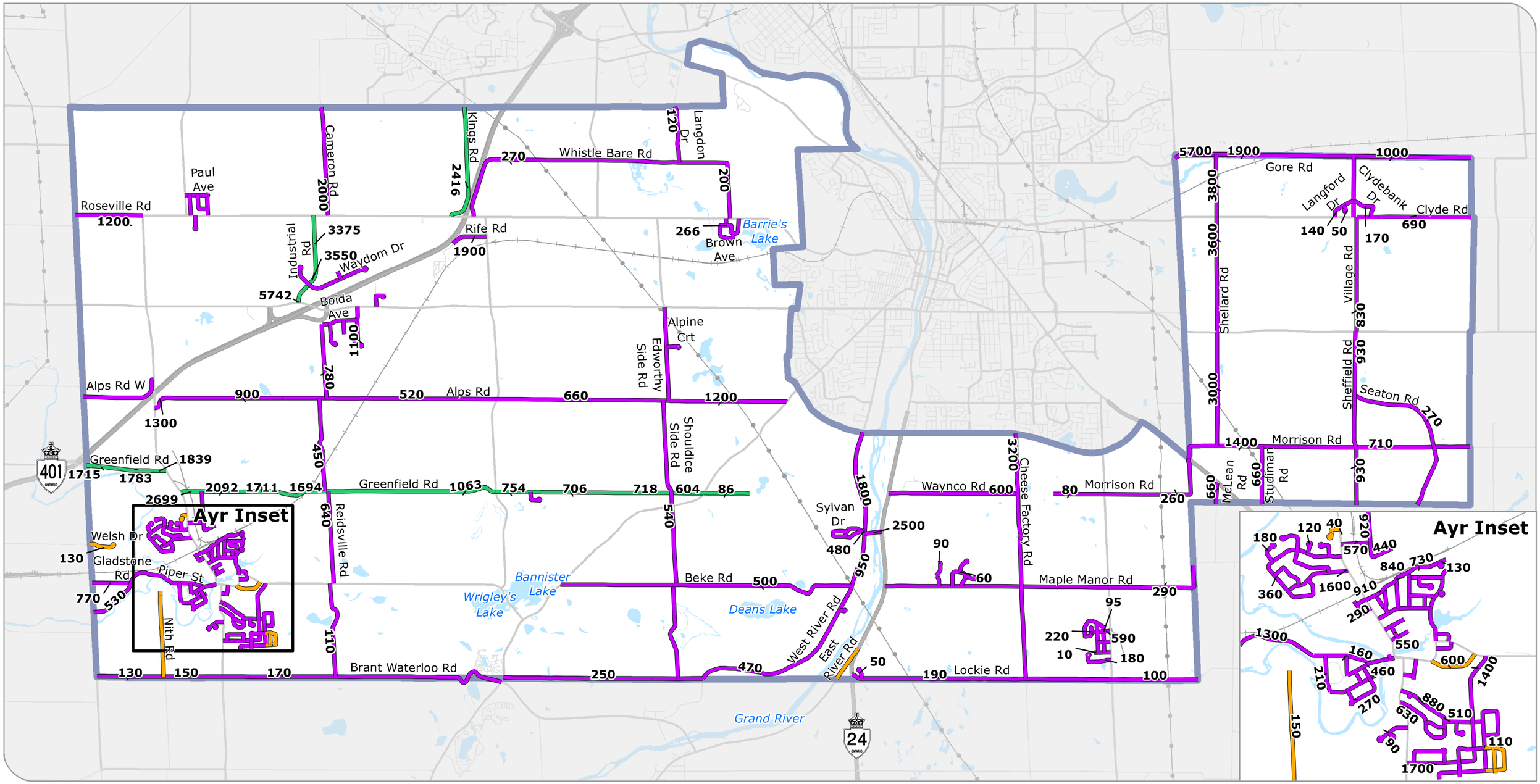
- Base repairs for 50% of area to be resurfaced
- Planning for 50% of area to be resurfaced
- Curb removal and replacement on both sides for 50% of section length
- Adjust manholes and catchbasins to new surface grade
- Double lift of hot mix (100 mm)

Reconstruction Nominal Storm Sewers (RNS):

- Excavate base material
- Curb and gutter removal
- Granular base
- New curb and gutter
- New sub-drains
- Adjust manholes and catch basins
- Hot mix asphalt (100/150 mm, depending on Road Class)

Appendix D

Traffic Count Maps



NORTH DUMFRIES

Infrastructure Study

ANNUAL AVERAGE DAILY TRAFFIC (AADT) SOURCE

FIGURE 6

Annual Average Daily Traffic (AADT) Source

- 2016 Estimate
- 2022 Count
- 2022 Estimate

Base Data

- Highway
- Major Road
- Minor Road
- Railway
- Utlitiy Line
- Municipal Boundary
- Water Body

SCALE 1:65,000

0 750 1,500 3,000 m

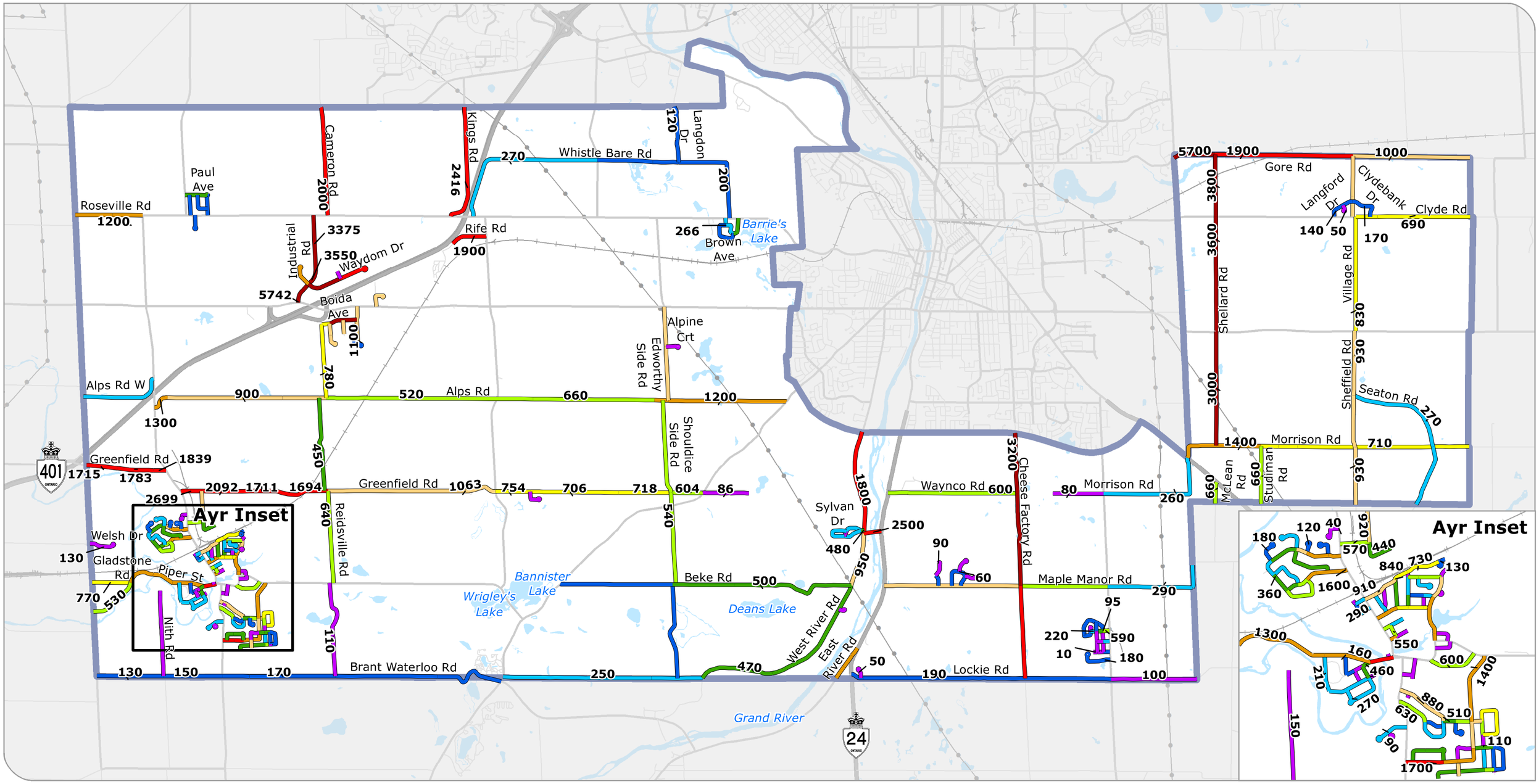
MAP DRAWING INFORMATION:
Base Data by MNRF, Data provided by Dillon Consulting Limted and Total Pave

MAP CREATED BY: LMM
MAP CHECKED BY: -
MAP PROJECTION: NAD 1983 UTM Zone 17N

DILLON CONSULTING

PROJECT: 22-3722 STATUS: DRAFT DATE: 2022-07-28

FILE LOCATION: K:\2022\223722\Product\Client\Report_May2022\223722_F5_AnnualAverageDailyTrafficSource.mxd



NORTH DUMFRIES
Infrastructure Study

ANNUAL AVERAGE DAILY TRAFFIC (AADT) COUNT

FIGURE 7

Annual Average Daily Traffic (AADT) Count

10 - 110	661 - 840
111 - 200	841 - 1100
201 - 320	1101 - 1600
321 - 510	1601 - 2700
511 - 660	2701 - 5742

Base Data

- Highway
- Major Road
- Minor Road
- Railway
- Utlitiy Line
- Municipal Boundary
- Water Body

SCALE 1:65,000

0 750 1,500 3,000 m

MAP DRAWING INFORMATION:
Base Data by MNRF, Data provided by Dillon Consulting Limted and Total Pave

MAP CREATED BY: LMM
MAP CHECKED BY: -
MAP PROJECTION: NAD 1983 UTM Zone 17N

DILLON CONSULTING

PROJECT: 22-3722 STATUS: DRAFT DATE: 2022-07-28

FILE LOCATION: K:\2022\223722\Product\Client\Report_May2022\223722_F6_AnnualAverageDailyTrafficCount.mxd

Roseville Rd
Paul Ave
Cameron Rd
Kings Rd
Whistle Bare Rd
Langdon Dr
Rife Rd
Industrial Rd
Waydom Dr
Boida Ave
Barrie's Lake
Brown Ave
Alpine Crt
Edworthy Side Rd
Alps Rd W
Alps Rd
Shouldice Side Rd
Greenfield Rd
Reidsville Rd
Welsh Dr
Gladstone Rd
Piper St
Nith Rd
Bannister Lake
Wrigley's Lake
Beke Rd
Deans Lake
West River Rd
East River Rd
Brant Waterloo Rd
Grand River
Sylvan Dr
Waynco Rd
Cheese Factory Rd
Maple Manor Rd
Lockie Rd
Morrison Rd
Gore Rd
Langford Dr
Clydebank Dr
Clyde Rd
Shellard Rd
Village Rd
Sheffield Rd
Seaton Rd
McLean Rd
Studiman Rd
401
24

NORTH DUMFRIES
Infrastructure Study

MINIMUM MAINTENANCE CLASS

FIGURE 8

Minimum Maintenance Class
- 3
- 4
- 5
- 6

Base Data
- Highway
- Major Road
- Minor Road
- Railway
- Utlitiy Line
- Municipal Boundary
- Water Body

SCALE 1:65,000

0 750 1,500 3,000 m

N W E S

MAP DRAWING INFORMATION:
Base Data by MNRF, Data provided by Dillon Consulting Limted and Total Pave

MAP CREATED BY: LMM
MAP CHECKED BY: -
MAP PROJECTION: NAD 1983 UTM Zone 17N

DILLON CONSULTING

PROJECT: 22-3722 STATUS: DRAFT DATE: 2022-07-28

FILE LOCATION: K:\2022\223722\Product\Client\Report_May2022\223722_F7_MinimumMaintenanceClass.mxd