Township of Nipissing

Road Needs Study Report – 2023

D.M. Wills Project No. 23-4873

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January 2024

Prepared for:
The Township of Nipissing

Executive Summary

The Corporation of the Township of Nipissing (Township) retained the services of D.M. Wills Associates (Wills) to undertake a review of the Township's existing road network, and assess its physical condition as well as confirm various road attributes. Data collected during the field review was used to develop a prioritized listing of the road network needs, the results of which are documented in this report.

The Township's road infrastructure system spans a total of 151.2 km primarily within a rural setting, with small areas of urban and semi-urban development. The road network includes surfaces ranging from gravel to hot mix paved (asphalt). The Township has approximately 116.9 km of gravel roads, 33.2 km of surface treated roads (low class bituminous (LCB)), and 1.2 km of hot mix asphalt paved roads (high class bituminous (HCB)).

Two primary indicators of the relative health of a road are the structural adequacy and surface condition ratings. The current average structural adequacy rating for the Township's road network is 13.5/20. The current average surface condition rating for the Township's road network is 6.9/10.

1% (1.2 km) of the road network has a Structural "NOW" need, 5% (8.2 km) has a Structural "1-5" year need, and 6% (8.8 km) of the road network has a Structural "6-10" year need.

It should be noted that a structural "NOW" need does not explicitly mean that work must be undertaken on the road immediately (although this may be so in some cases). A structural "NOW" need means that a significant portion of the road is showing distress of the road bed and requires significant intervention i.e. reconstruction or major rehabilitation to renew it service life. A structural "1–5" year need is expected to become a "NOW" need in the next five years, and a "6–10" year need is expected to become a "NOW" need in the next 10 years.

Note that many "6–10" year reconstruction needs may be deferred by timely resurfacing, extending their service lives. As highlighted above, the Township has a notable portion of their roads (6%) with a" 6–10" Year Structural Need.

Resurfacing and Preservation Management

In addition to addressing currently deficient roads (i.e. capital reconstruction), a dedicated preservation management approach is required, **and perhaps even more important**, to "keep the good roads good"; the fundamental principle being that it costs much less to maintain a good road than it does to let it fail and then reconstruct it, from a life cycle cost perspective. Ultimately, the goal of preservation management is to extend the useful life of a road and road network, maximizing the Township's investment over the road life-cycle.

Road resurfacing is an effective way of extending the overall life of the pavement structure and therefore a road resurfacing program is highly recommended. Roads

with a structural adequacy of 12/20 or greater are included as candidates for potential resurfacing. Preliminary recommendations and prioritization for road resurfacing are based on condition rating and traffic demands on each road section, as per the Inventory Manual. A road with higher traffic volumes and fair structural adequacy is given priority over a road with moderate traffic and good structural adequacy score, in an attempt to intervene and extend the life of the road before it deteriorates to a level that can no longer be resurfaced (i.e. more expensive reconstruction is required). Specific resurfacing treatment recommendations must be assessed through further field investigation and detail design effort, prior to selecting and implementing the resurfacing strategy.

Based on typical degradation rates for gravel roads, surface treatment, and hot mix, a resurfacing program and related budget is recommended as follows:

Hot Mix Paved Roads:

- 1.2 km of paved roads (HCB).
- Degradation rate 0.25 / year (rating drops from 10 to 5, over a 20-year period).
- Annual resurfacing 0.1 km / year.
- **Annual budget $41,800**: (0.1 km / year x $209,000 / ln **RMP1** x 2 lanes).

Surface Treated Roads:

- 33.2 km of surface treated roads (LCB).
- Degradation rate 0.625 / year (rating drops from 10 to 5, over a 7-year period).
- Annual resurfacing 4.7 km / year.
- **Annual budget $164,500** (4.7 km / year x $35,000 / km **ST1**).

Gravel roads require regular maintenance. Maintenance includes regular grading and reapplication of new gravel. Typically, gravel roads should be resurfaced on a 3 - 5 year cycle.

Gravel Roads:

- 116.9 km of earth / gravel roads
- 150 mm gravel every 8 years
- Annual gravelling of 14.6 km
- Granular A ($30,000 / km)
- **Annual budget $438,000** (14.6 km / year x $30,000 **G**) **

** *Cost based on supply of Gravel only with application of gravel by internal forces.*

Based on typical degradation rates for gravel roads, surface treatment, and hot mix, a total resurfacing program, (hot mix, surface treatment and gravel) is estimated at $644,300 per year.

Further to the recommendations above with respect to resurfacing, it is also recommended that regular maintenance in the form of roadside ditch cleanout and brush clearing be undertaken as a critical component to preservation management in order to extend the useful service life of the existing roads.

Capital Improvements

Preliminary recommendations and prioritization for planned capital improvements i.e. reconstruction, have been developed based on the condition rating and traffic demands on each road section, as per the Inventory Manual. Those roads identified as having a "NOW", 1–5, or 6–10 year need have been included in the capital improvement plan for reconstruction.

A total length of 20.2 km of roads were identified as having structural needs in the "NOW", 1–5 or 6–10 year periods. The estimated cost to improve these roads is approximately $1.9 M.

It is important to highlight the network's average structural adequacy score of 13.5/20, as noted previously. A significant portion of the Township's roads are approaching a condition that will require reconstruction, as opposed to less costly resurfacing.

A fully funded 10 year plan following the recommendations in this report includes $644 K/year for resurfacing needs and $190 K/year for the capital needs over ten years.

Given that a majority of the Township's Road network have a structural need of 6–10 years or no structural need, Wills recommends that priority should be given to resurfacing and preservation over capital needs should funding fall short of ideal levels.

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1.0 Purpose, Background and Study Method

1.1 Purpose

The purpose of the 2023 Road Needs Study Report is to update the current road inventory and road condition assessments within the Township of Nipissing (Township). Using this information, a prioritized listing of the road network needs is developed. The information derived from the study and documented in this report will provide assistance to the Township for developing and executing a planned road maintenance and improvement program.

The Township retained the services of D.M. Wills Associates (Wills) to undertake a review of the existing road network and assess its physical condition as well as confirm various attributes. Data collected as a result of the field review is used to develop a prioritized listing of the road network needs, the results of which are documented in this report.

1.2 Background

The Township of Nipissing is located in Northeastern Ontario on Lake Nipissing, south of North Bay on Highway 11. A majority of the Township is largely rural and hosts cottages and residential housing for the Township's 1,700 residents.

In 2023, the Township retained Wills to undertake a road condition assessment for the Township's road network. This study utilizes both the Inventory Manual for Municipal Roads inspection methodology, and the PCI methodology.

1.3 Study Objectives

Based on discussion with Township staff, the following study objectives were identified:

- Provide a current inventory and value of the Township's roads, assess road conditions and needs, and develop a priority listing for construction needs and improvements.
- Provide a prioritized list of capital projects for the Township to invest in.
- Provide an inventory and full condition assessment of Municipally owned guide rail sections.

To ensure compliance with the latest Ministry of Transportation (MTO) guidelines, the inventories were completed in accordance with the most current edition of the Inventory Manual for Municipal Roads.

1.4 Study Methodology

The procedure utilized to complete the study was in accordance with the Ministry of Transportation's Inventory Manual for Municipal Roads (February 1991).

Additionally, field reviews for the purpose of Pavement Condition Index (PCI) were undertaken in accordance with:

- MTO Manual for Condition Rating of Flexible Pavements, SP-024.
- MTO Manual for Condition Rating of Surface-Treated Roads, SP-021.

There are two key observations when using PCI methods: the Ride Condition Rating (RCR), and the Distress Manifestation Index (DMI). RCR is a subjective measurement of how smooth a travelled surface is, rated from 0 to 10, with 10 representing excellent, new surfaces, and 0 representing an extremely rough, impassible road. DMI aggregates various forms of visible pavement distress into a rating from 0 to 10, with 10 representing a new surface and 0 representing a destroyed surface.

RCR and DMI are rated strictly independently. A rough road may have relatively few visible distresses while a fairly smooth road may display many distresses. In general, rough roads display associated visible distresses.

The combined approach facilitates comparing all the Township's roads, as the Inventory Manual prescribes the same rating system regardless of surface type, while also providing detailed descriptions of the types of distress encountered on surfaces as per the PCI ratings. This approach is compliant with O. Reg. 588/17. Wills undertook the field study in August of 2023.

During the field study, a visual assessment of the following road characteristics was documented to assess the current adequacy of the road:

- Platform Width (overall width of road)
- Surface Width (width of pavement surface)
- Shoulder Width
- Surface Type (gravel, low class bituminous, or high class bituminous)
- Drainage Type (open ditches vs. storm sewers etc.)
- Surface Condition (assigned based on Ride Condition Rating for this Study)
- Maintenance Demand
- Roadside Environment
- Capacity
- Alignment

1.4.1 Critical Deficiencies

Critical deficiencies represent road characteristics that result in increased maintenance costs or lead to an inadequate level of service. Road sections may be assessed as critically deficient if any one of the following characteristics fall below the minimum tolerable standards defined in the MTO Inventory Manual:

- Surface type - Insufficient surface type for traffic volumes
- Surface width - Insufficient width of the road surface excluding the shoulders
- Capacity - Inability of the road to accommodate traffic volumes at peak periods
- Structural Adequacy - Inability of the road base to support vehicular traffic
- Drainage - Increased frequency of flooding or excessive maintenance effort required to prevent flooding

Critically deficient roads have generally reached the end of their service life and /or require major work to improve e.g. widening or new surface type. As such, reconstruction is generally required.

Surface Type

The following parameters were used to assess the adequacy of the road surface type. Road sections with traffic volumes (AADT) in excess of the minimum tolerable values for Earth and Gravel in **Table 1**, were noted as critically deficient triggering a "NOW" surface type need as per the Inventory Manual Method.

Table 1 - Surface Type by Annual Average Daily Traffic (AADT)

Surface Type	AADT		
	Inventory Manual		MTO Pavement Design and Rehabilitation Manual*
	Tolerable Range	Design Standard	
Earth (E)	<50	-	-
Gravel (G)	<400	0-199	0 - 199
Low Class Bituminous (LCB) / Surface Treatment	-	200-399	200 - 1500
High Class Bituminous (HCB) / Hot Mix	-	400+	>1500

* Ministry of Transportation. Pavement Design and Rehabilitation Manual, Second Edition, 2013, Table 3.3.3 Structural Design Guidelines for Flexible Pavement – Secondary Highways

Table 1 provides further guidance with respect to surface type from both the Inventory Manual as well as the MTO Pavement Design and Rehabilitation Manual.

As detailed in **Table 1**, Gravel surfaces are generally considered acceptable for AADT of less than 200 vehicles but may be tolerable up to 400 AADT. Transition to Surface Treatment should be considered above 200 AADT. Gravel road maintenance costs (resurfacing, grading, dust suppression, etc.) versus surface treatment costs are key considerations.

Low Class Bituminous (LCB) i.e. Surface Treatment may be acceptable for traffic volumes between 200 and 1500 AADT. A transition to a Hot Mix or High Class Bituminous surface from Surface Treatment must be considered on a case by case basis. The following factors require consideration:

- Surface Treatment Maintenance Costs
- Commercial Vehicle Loading
- Roadside Environment (Urban, Semi-urban, vs. Rural)
- On-street Parking
- Adjacent Drainage Infrastructure i.e. curb and gutter, catch basins etc.
- Asphalt Availability / Cost
- Surface / Platform Width
- Traffic Volume Growth
- Sub-base Quality
- Roadbed Frost Susceptibility
- Future Resurfacing / Rehabilitation Costs

Vehicle loading is one of the key considerations for pavement design and ultimately the decision between Hot Mix and Surface Treatment. Roads with high levels of commercial traffic require a more substantial pavement structure. The values noted in Table 1, for the "MTO Method" are generally reflective of a highway with 10% commercial vehicles. Roads with AADT in excess of 400 vehicles with a good sub-base and commercial vehicles up to 10% may still perform very well with a Surface Treatment. Existing/past performance of a Surface Treatment can be an excellent indicator when considering the upgrade to Hot Mix.

Surface Width

Surface widths that fall below minimum tolerable standards, as detailed in the MTO Inventory Manual are noted as critically deficient triggering a "NOW" need.

The Default Minimum Surface Widths for Rural roads are included in **Table 2**:

Table 2 – Rural Road Surface Width by Annual Average Daily Traffic (AADT)

	AADT							
	1-49	40-199	200-399	400-999	1000-1999	2000-2999	3000-3999	4000+
Road Width (m)	5.0	5.5	5.5	6.0	6.0	6.0	6.5	6.5

Capacity

An in-depth traffic capacity analysis was not completed as part of the scope of this Road Needs Study. Decisions with respect to expansion of roads should be made within the context of a Transportation Master Plan or Official Plan for the Township.

However, from a general perspective, a two-lane road can typically provide adequate service up to an AADT of approximately 12,000 vehicles. The functionality of a road from a capacity standpoint is of course dependent upon other factors in combination with volume. Adjacent land uses, number of access points i.e. entrances and side roads etc. also have a significant impact on how the road functions.

A rural road with limited entrances and side roads will have a much greater capacity to flow traffic versus an urban street with many entrances and side road intersections. The AADT of 12,000 can be used as a 'rule of thumb' to trigger further analysis on the road capacity and operation. For the purposes of this study, a detailed capacity analysis was not undertaken as part of the scope of work. All roads were assigned to be adequate from a capacity perspective noting that no road section had an AADT greater than 6,000.

Structural Adequacy

In cases where road base or structure is showing distress over more than 20% of the length of the road section, a score between 1 and 7 (out of 20) is assessed and the road section is assigned a "NOW" need and considered Critically Deficient per the Inventory Manual. The structural adequacy rating is often the best indicator of the overall road section's health.

It should be noted that a structural "NOW" need does not explicitly mean that work must be undertaken on the road immediately (although this may be so in some cases). A structural "NOW" need means that a significant portion of the road is showing distress of the road bed and requires significant intervention i.e. reconstruction or major rehabilitation to renew it service life. A structural "1–5" year need is expected to become a "NOW" need in the next five years, and a "6–10" year need is expected to become a "NOW" need in the next 10 years.

Drainage

A road section is assessed as a "NOW" need for drainage generally when a road becomes impassible due to water one or more times a year. This information is not

readily accessible from inspection. Characteristics such as ditching, water ponding on or around the road, and evidence of past washouts were used to assess road drainage. As such, a road was given a "NOW" need for drainage if there were evident drainage problems that would likely lead to an impassable road during a heavy rain or a rapid snow melt.

2.0 The Road System

2.1 Inventory and Classification

All roads in the municipal road system were inventoried according to the methods outlined in the Inventory Manual for Municipal Roads.

The inventory procedure requires that each road in the system be studied as a separate unit. Initially, the road system was divided into sections so that each conformed, as close as possible, to the following requirements:

- Uniform traffic volume
- Uniform terrain
- Uniform physical conditions
- Uniform adjacent land

Depending on location with respect to the built up areas, roads were classified in a manner generally descriptive of the type of construction as follows:

- Urban - Roads with curb and gutter and storm sewer drainage.
- Semi-Urban - Roads in built up areas (development exceeds 50% of the frontage) without curb and gutter or curb and gutter on one side only.
- Rural - Roads with development on less than 50% of the frontage.

Rural roads were further evaluated based on estimated traffic volumes; such as 0 to 50 vehicles per day, 51 to 200, and 201 to 400 etc. For the purpose of this study, 20 two week counts were completed in September 2023. Where gaps existed in the data, traffic volumes were estimated using the 2023 traffic count data and/or using local characteristics for each road section.

Table 3 summarizes the total road length in kilometres by surface type and road environment as of August 2023.

The existing road system consists of 151.2 km of roadway, 116.9 km of gravel roads, 33.2 km of surface treated roads (LCB) and 1.2 km of HCB (asphalt paved) roads; with all calculations being approximate and rounded to the nearest kilometre.

Table 3 - Road System Inventory

Township of Nipissing		
Road System in Kilometres		
(As of August 2023)		
A.	**Surface Type**	**Totals***
	Earth	0
	Gravel (Loose Top Gravel)	116.9
	Surface Treatment (LCB & ICB)	33.2
	Hot Mix Asphalt (HCB)	1.2
	Total A	**151.2 km**
B.	**Roadside Environment**	
(i)	**Rural**	
	Earth	0
	Gravel (loose Top Gravel)	116.4
	Surface Treatment (LCB & ICB)	30.3
	Hot Mix Asphalt (HCB)	0.9
	Total Rural	**147.6 km**
(ii)	**Semi-Urban**	
	Gravel (loose Top Gravel)	0.4
	Surface Treatment (LCB)	2.9
	Hot Mix Asphalt (HCB)	0.3
	Total Semi-Urban	**3.6 km**
(iii)	**Urban**	
	Gravel (loose Top Gravel)	0
	Surface Treatment (LCB)	0
	Hot Mix Asphalt (HCB)	0
	Total Urban	**0 km**
	Total B	**151.2 km**
**Estimated to the nearest tenth of a kilometre.*		

3.0 Road Needs

The primary purpose of the study is to develop a list of all roads within the Township ranked according to priority with respect to road needs.

The method of evaluating road needs in terms of type, cost and timing of improvements is identified in the Inventory Manual for Municipal Roads.

It is important to note that budgetary restrictions will often influence the level of upgrades to the road system and therefore it is imperative to maximize the improvements based on availability of funds and needs priority.

3.1 Critical Deficiencies

The inventory of the road system revealed that certain road sections are now deficient or will become deficient during the study period.

As noted previously, critical deficiencies include road characteristics which result in increased maintenance costs and which inevitably lead to an inadequate level of service. A road section is critically deficient if any one of the following characteristics fall below the minimum tolerable standards defined in the Inventory Manual.

- Surface type - Incorrect surface type to suit traffic volumes on the roadway.
- Surface width - Insufficient width of the road surface excluding the shoulders.
- Capacity - Inability of the road to accommodate traffic volumes at peak periods.
- Structural Adequacy - Inability of the road base to support vehicular traffic.
- Drainage - Increased frequency of flooding or excessive maintenance effort required to prevent flooding.

Of the 151.2 km of roads inventoried, a total of 24.0 km were found to be critically deficient in one or more areas. Of the 24.0 km, approximately 22.2 km represents roads with AADT equal or less than 50 vehicles. Regardless of condition, roads with AADT of 50 or less are typically assigned as "Adequate" (as per the Ministry protocol) for the purpose of the system adequacy calculation.

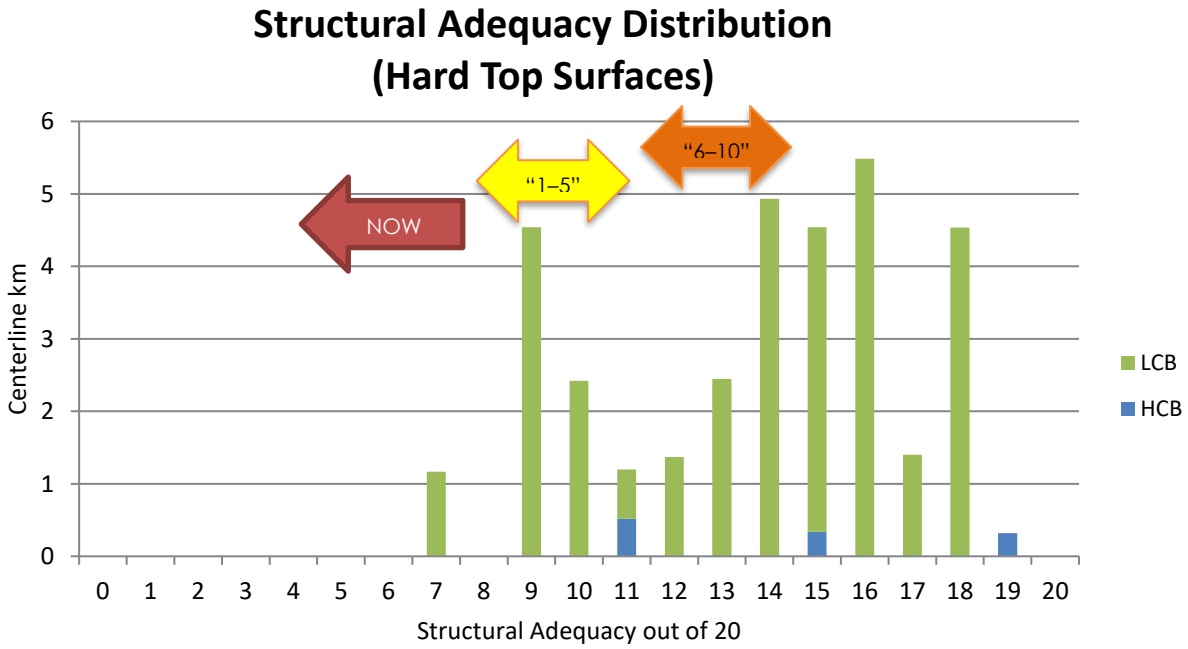
The overall system adequacy for the Township's road network, which is based upon the total road kilometres less the identified critically deficient ("NOW" needs) roads, is as follows:

$$\textbf{2023 System Adequacy} = \frac{151.2 - (24.0 - 22.2)}{151.2} \text{ x } 100\% = 99\%$$

The average surface condition rating of all roads is 6.9/10 while the average structural adequacy rating is 13.5/20. This suggests that the typical road has a fair to good riding quality, but just at the point where significant rehabilitation or reconstruction is required.

A review of the structural adequacy distribution of the Township's hard top roads identifies a group of roads, 16.3 km, that are in very good condition (structural adequacy of 15 and over), and with regular resurfacing and preservative maintenance, should not require reconstruction in the next 10 years. Another cohort of roads, approximately 8.8 km, are in average condition (Structural Adequacy from 12 to 14). Some of these roads may continue to perform well, but without timely resurfacing and preventative maintenance, many of them are expected to become NOW or 1–5 year needs. The remaining 9.3 km of hard top road network is well distributed over the very poor to poor range (structural adequacy from 1 to 11). Most of these roads will require reconstruction over the next 5 years to fully repair them.

It is therefore recommended that, while the Township endeavors to repair these poor roads as part of its 10-year capital plan, every reasonable effort is made, through preservation management, to prevent the current cohort of fair to very good roads (14.8 km) from becoming capital reconstruction needs themselves.



3.2 Pavement Condition Index (PCI)

Pavement Condition Index (PCI) was calculated based on the same MTO PCI methodologies, using the following empirical formula:

$$\mathbf{PCI} = \mathbf{10} \times \sqrt{\frac{\mathbf{RCR}}{\mathbf{10}}} \times \mathbf{DMI} \times \mathbf{w_c}$$

Where DMI is the Distress Manifestation Index (0 to 10), calculated based on distress severity and density, RCR is the assigned Ride Condition Rating out of 10, $\boldsymbol{w_c}$ is the weighting constant to adjust for pavement bias (1.088 for HCB and 0.962 for LCB and gravel surfaces).

The overall weighted PCI for the Township's road network is as follows:

$$\mathbf{Overall\ Weighted\ Condition} = \frac{\sum \mathbf{length} \times \mathbf{PCI}}{\sum \mathbf{length}} = \mathbf{69.5}$$

3.3 Priority Ratings of Roads

A mathematical empirical formula was used to calculate the priority rating for each road section. The priority rating is a weighted calculation which takes into account the existing traffic volume and overall condition rating of the road.

This priority analysis is an impartial procedure to place the deficiencies in order of relative need. **A higher Priority Rating number indicates a relatively greater need for improvement.**

The formula takes into account the current traffic volume (AADT), whether it is from actual road counts or estimated road counts and the Condition Rating (CR) of the road at the time of this Road Needs Study Report. The formula is as follows:

$$\textbf{Priority Rating} = 0.2 \times (100 - CR) \times (AADT + 40)^{0.25}$$

In utilizing the above equation Wills identified a priority listing for review with Township staff. It is important to emphasize that the priority rating calculation considers only CR and traffic volumes.

When developing the recommended capital expenditure plan consideration may be given to the remaining useful service life of a road / roadbed with a view to coordinating major reconstruction efforts at / near the end of the road's life. Furthermore, while a priority rating will give a general idea of which roads should be improved before others, it does not prescribe an exact order for road improvements nor does it determine the timing of preservation and rehabilitation work. For example, it may be wise to defer the full reconstruction of a high priority road ("let the bad roads fail") in favour of resurfacing work on a medium priority road ("keep the good roads good").

4.0 Road Needs Study Summary Table

4.1 Types of Improvements

All roads were examined to appraise the extent and type of improvement necessary.

"Order of Magnitude" construction costs were developed for each of the below options on a per kilometre basis. An estimated cost for isolated frost heave repairs was also considered.

The below alternative rehabilitation strategies are considered preliminary in nature and are intended to assist in providing an order of magnitude cost estimate to rehabilitate the road. Further field investigations and engineering design is required to confirm and develop the rehabilitation strategies for each road.

4.1.1 Asphalt

High Class Bituminous roads (HCB) or hot mix asphalt roads have rehabilitation alternatives ranging from a simple overlay to complete reconstruction. The following is a listing of standard road rehabilitation techniques that were considered for HCB or hot mix asphalt roads.

RO1 Resurfacing, Single-Lift Overlay

RO2 Resurfacing, Double-Lift Overlay

RMP1 Resurfacing, Mill and Pave 1-Lift

RMP2 Resurfacing, Mill and Pave 2-Lifts

PP1 Pulverize and Pave 1-Lift

PP2 Pulverize and Pave 2-Lifts

Recon 1R Excavate and Reconstruct Road and Pave 1-Lift – Rural

Recon 1S Excavate and Reconstruct Road and Pave 1-Lift – Semi-Urban

Recon 2S Excavate and Reconstruct Road and Pave 2-Lifts – Semi-Urban

Recon 2U Excavate and Reconstruct Urban Road and Pave 2-Lifts – Urban

SS Slurry Seal (Preventative Maintenance)

MS Microsurfacing (Preventative Maintenance)

RS Route and Seal (Preventative Maintenance)

4.1.2 Surface Treatment

Surface treated roads are generally able to be rehabilitated with either a single or double Low Class Bituminous (LCB) overlay treatment. They may also be upgraded to HCB pavement or downgraded to gravel. In some cases, previous resurfacing of LCB roads has occurred or the LCB surface or road structure has deteriorated to a state where a simple overlay surface treatment is not feasible. In these cases consideration can be given to removal or pulverizing of the existing surface treatment and placement of a new application. In some cases, where it is necessary to improve the overall roadbed structure, the addition of Granular A to build up the road and the reapplication of a surface treatment is recommended. The following is a listing of standard road rehabilitation techniques that were considered for LCB (surface treated) roads:

ST1 Single Surface Treatment

ST2 Double Surface Treatment

ST2R Double Surface Treatment, with Removal of Existing

ST2A Double Surface Treatment, over New Granular A

ST2PA Double Surface Treatment, over Pulverized Existing and New Granular A.

ST2PAW Double Surface Treatment, over Pulverized Existing and New Granular A with 1 m Widening

SS Slurry Seal (Preventative Maintenance)

4.1.3 Gravel

Gravel roads can likewise be upgraded with the reapplication of Gravel (G) or surface treatments (ST1).

4.2 Benchmark Construction Costs

The Unit Price Form found in **Appendix A** is based on average prices for the local area. The unit prices were used to prepare an array of benchmark construction costs.

The design standards in **Table 4** were utilized for development of the benchmark cost estimates for reconstruction. It should be noted that these are suggested standards and therefore should not necessarily be used as standards for detail design of roadway improvements.

Table 4 - Design Standards for Construction Cost Estimates

Functional Classification	Surface Width (m)	Shoulder Width (m)	Granular A Depth (mm)	Granular B Depth (mm)	Hot Mix Depth (mm)*
Rural R200 (50 to 199 vpd)	6.0	1.5	150	450	-
Rural R300 (200 to 399 vpd)	6.0	1.5	150	450	16*
Rural R400 (400 to 999 vpd)	6.5	1.5	150	450	50
Semi - Urban Local Residential	6.0	1.5	150	450	50
Semi - Urban Local Industrial	6.5	1.5	150	450	50
Urban Local Residential	8.5	-	150	600	100
Urban Local Industrial	9.0	-	150	600	100

**Note - Prime and Double Surface Treatment is based on 16 mm of Hot Mix.*

5.0 Improvement Plan

In the following tables you will find three columns being used to describe the condition of the road; Surface Condition, Structural Adequacy, and Condition Rating. To better understand the prioritization of the lists, descriptions of these ratings can be found below.

Surface Condition: Surface conditions relate to driving ease, comfort and safety. Inadequacies for paved surface include excessive or uneven crowns, washboarding, raveling and bumpiness because of cracking, sealing, and rough patching. Inadequacies on loose top surfaces do not include situations that can be readily corrected by maintenance blading. They do include unconsolidated surfaces due to poorly graded or clean aggregate and permanent roughness due to insufficient depth of aggregate or weak subgrade. The effects of surface inadequacies in ascending order of seriousness are noise, vibration, sway, excessive steering effort and reduced speed. *Rated on a scale of 1 to 10*.

Structural Adequacy: The Structural Adequacy point rating relates to the capability of the surface and base courses to support a load and to resist deformation or rupture. Soft spots and frost boils are structural adequacy distress signs for loose top roads. For paved surfaces, distress signs may be cracking, rutting, heaving, pot-holing, roughness, alligatoring, dishing, breakup, distortion, frost boils, etc. *Rated on a scale of 1 to 20*.

Condition Rating: A holistic rating that sums point ratings from alignment, surface condition, surface width, level of service, structural adequacy, drainage and

maintenance demands. The condition rating is one of the major factors used to calculate the Priority Rating. *Rated on a scale of 1 to 100*.

5.1 Road Needs

The Township of Nipissing's Capital Improvement Plan is included on the next page, **Table 5.** This table notes the recommended capital improvements based on priorities throughout the Township. **All costs are based on 2023 dollars and should be adjusted for inflation based on program year, for budgeting purposes.** The capital improvements are listed in descending priority based on traffic volumes and Condition Rating, as described previously. All costs in the table below capture the cost to improve both lanes of the road.

Alsace Boundary Road (Section 7) was previously a poorly performing LCB surface. It was recently pulverized into gravel due to the condition of the wearing surface before inspections. An estimate to re-convert it to LCB has been provided based on frost heave / dig out treatment length of 310 m provided by Township Staff and our estimated unit costs.

Table 5 – Township of Nipissing Capital Improvement Plan

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Surface Condition	Structural Adequacy	Condition Rating
NOW Needs										
7	ALSACE BOUNDARY	HEMLOCK ROAD	SKI HILL ROAD	2.13	400	*Reconvert to LCB - including extensive digouts, ditching and culverts*	*$475*	8	16	80
158	WESTVIEW DRIVE	PINE DRIVE	SOUTH END	0.44	100	*ST2A - Double Surface Treatment with Granular A*	*$43*	5	7	49
109	PINE DRIVE	MARION DRIVE	WALTONIAN DRIVE	0.40	150	*ST2A - Double Surface Treatment with Granular A*	*$40*	5	7	63
110	PINE DRIVE	WALTONIAN DRIVE	NORTH END	0.10	50	*ST2A - Double Surface Treatment with Granular A*	*$9*	5	7	56
111	PINE DRIVE	WESTVIEW DRIVE	WEST END	0.23	50	*ST2A - Double Surface Treatment with Granular A*	*$23*	5	7	56
1 - 5 Year Needs										
79	JONES ROAD	SUNSET COVE ROAD	SOUTH END	0.55	100	*ST2A - Double Surface Treatment with Granular A*	*$54*	6	10	55
2	ALSACE ROAD	WOLFE LAKE ROAD	STILLAR SIDE ROAD	4.54	400	*ST2A - Double Surface Treatment with Granular A*	*$451*	6	9	68
157	WALTONIAN DRIVE	PINE DRIVE	TOWNSHIP BOUNDARY	0.52	150	*PP1 - Pulverize and Pave 1 Lift*	*$105*	6	11	63
118	ROCKY SHORE DRIVE	BIRCHGROVE DRIVE WEST	PIKE BAY ROAD	0.65	200	*ST2A - Double Surface Treatment with Granular A*	*$64*	6	10	56
77	HINCHBERGER BAY ROAD	PIKE BAY ROAD	NORTH END	0.68	100	*ST2A - Double Surface Treatment with Granular A*	*$68*	6	11	72
120	RUTH HAVEN DRIVE	ALSACE ROAD	SOUTH END	0.83	50	*ST2A - Double Surface Treatment with Granular A*	*$82*	6	10	55
104	PIKE BAY ROAD	ROCKY SHORE DRIVE	WEST END	0.40	100	*ST2A - Double Surface Treatment with Granular A*	*$40*	6	10	59
6 - 10 Year Needs										
112	PINE DRIVE	WESTVIEW DRIVE	MARION DRIVE	0.28	150	*ST2A - Double Surface Treatment with Granular A*	*$27*	6	12	70
1	ALSACE ROAD	STILLAR SIDE ROAD	STORIES ROAD	0.57	400	*ST1 - Single Surface Treatment*	*$20*	7	14	76

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Surface Condition	Structural Adequacy	Condition Rating
9	ALSACE ROAD	STORIES ROAD	BUSCHS MILL ROAD	1.47	400	*ST1 - Single Surface Treatment*	*$51*	7	14	76
4	ALSACE ROAD	BUSCHS MILL ROAD	HEMLOCK ROAD	2.07	377	*ST1 - Single Surface Treatment*	*$72*	7	14	76
133	SKI HILL ROAD	TOWNSHIP BOUNDARY	1.39 KM WEST OF ALSACE ROAD	1.10	197	*ST2A - Double Surface Treatment with Granular A*	*$109*	7	12	74
85	LAKE NIPISSING ROAD	HIGHWAY 654	PROMISED LAND ROAD	2.35	228	*ST1 - Single Surface Treatment*	*$82*	7	13	75
83	LAKE NIPISSING ROAD	PROMISED LAND ROAD	LAKE NIPISSING ROAD	0.10	150	*ST1 - Single Surface Treatment*	*$3*	7	13	75
86	LAKEVIEW DRIVE	BIRCHGROVE DRIVE WEST	LILLIAN COURT	0.43	53	*ST1 - Single Surface Treatment*	*$15*	7	14	77
87	LAKEVIEW DRIVE	LILLIAN COURT	WILLIAM ROAD	0.18	50	*ST1 - Single Surface Treatment*	*$6*	7	14	77
89	LILLIAN COURT	LAKEVIEW ROAD	WEST END	0.21	50	*ST1 - Single Surface Treatment*	*$7*	7	14	77

Notes:

1. *Rehabilitation strategy to be confirmed by geotechnical investigations at detail design.*

2. *Timing of storm sewer/culvert work should be considered in conjunction with road reconstruction and vice versa, where applicable.*

5.2 Annual Resurfacing Program

Based on typical degradation rates for gravel roads, surface treatment, and hot mix, a resurfacing program / budget is recommended, in addition to the noted capital construction works, as follows:

Hot Mix Paved Roads:

- 1.2 km of paved roads (HCB).
- Degradation rate 0.25 / year (rating drops from 10 to 5, over a 20-year period).
- Annual resurfacing 0.1 km / year.
- **Annual budget $41,800**: (0.1 km / year x $209,000 / ln **RMP1** x 2 lanes).

Surface Treated Roads:

- 33.2 km of surface treated roads (LCB).
- Degradation rate 0.625 / year (rating drops from 10 to 5, over a 7-year period).
- Annual resurfacing 4.7 km / year.
- **Annual budget $164,500** (4.7 km / year x $35,000 / km **ST1**).

Gravel roads require regular maintenance. Maintenance includes regular grading and reapplication of new gravel. The Township resurfaces its gravel network on an 8 year cycle.

Gravel Roads:

- 116.9 km of earth / gravel roads.
- 150 mm gravel every 8 years.
- Annual gravelling of 14.6km.
- Granular A ($30,000 / km).
- **Annual budget $290,000** (14.6 km / year x $30,000 **G**) **.

** *Cost based on supply of Gravel only with application of gravel by internal forces.*

Based on typical degradation rates for gravel roads, surface treatment, and hot mix, a total resurfacing program, (hot mix, surface treatment and gravel) is estimated at $644,300 per year.

Relative road preservation / resurfacing priorities for all roads not included in the previous Capital Improvement Plan are listed below in **Table 6,** Township of Nipissing Resurfacing Plan. Roads are listed in order of descending preservation priority. All costs in the table below capture the cost to resurface both lanes of the road. Sections listed below in italics are seasonally maintained roads.

Table 6 – Township of Nipissing Resurfacing Plan

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Surface Condition	Structural Adequacy	Condition Rating
46	BYERS ROAD	HIGHWAY 654	WEST END	0.55	50	*G - Gravel (150mm)*	*$19*	7	14	52
60	GRANITE HILL ROAD	2.94 KM WEST OF HIGHWAY 522	RYE ROAD	2.58	50	*G - Gravel (150mm)*	*$89*	5	10	48
137	SPRUCEDALE ROAD	0.93KM WEST OF BUTTERFIELD ROAD	BLACK CREEK ROAD N	1.12	50	*G - Gravel (150mm)*	*$39*	5	8	48
121	RYE ROAD	1.91 KM EAST OF BOOTH ROAD	GRANITE HILL ROAD	0.66	50	*G - Gravel (150mm)*	*$23*	5	10	50
23	BEAR CREEK ROAD	UNNAMED PRIVATE ROAD	ROCKVIEW ROAD	0.09	100	*G - Gravel (150mm)*	*$3*	7	14	59
41	BLAKE STREET	BEATTY STREET	FRONT STREET	0.12	100	*G - Gravel (150mm)*	*$4*	7	14	59
57	FRONT STREET	BLAKE STREET	BEATTY STREET	0.30	100	*G - Gravel (150mm)*	*$10*	7	14	59
124	RYE ROAD	GRANITE HILL ROAD	TOWNSHIP BOUNDARY	2.12	50	*G - Gravel (150mm)*	*$73*	5	10	50
53	DOWDELL ROAD	STILLAR SIDE ROAD	WEST END	1.11	50	*G - Gravel (150mm)*	*$38*	6	12	55
66	ARMSTRONG ROAD	HIGHWAY 534	HAMILTON FARM ROAD	1.00	50	*G - Gravel (150mm)*	*$35*	6	12	55
68	HAMILTON FARM ROAD	0.32 KM NORTH OF ARMSTRONG ROAD	1.66 KM NORTH OF ARMSTRONG ROAD	1.33	50	*G - Gravel (150mm)*	*$46*	6	12	55
142	STORIES ROAD	ALSACE ROAD	SOUTH END	1.26	50	*G - Gravel (150mm)*	*$44*	6	12	56
93	MCQUABY LAKE ROAD	HIGHWAY 534	WEST END	0.28	50	*G - Gravel (150mm)*	*$10*	7	14	59

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Surface Condition	Structural Adequacy	Condition Rating
100	OLD NIPISSING ROAD N	HIGHWAY 522	NORTH END	0.24	50	*G - Gravel (150mm)*	*$8*	7	14	60
116	PROMISED LAND ROAD	LAKE NIPISSING ROAD	EAST END	0.76	50	*G - Gravel (150mm)*	*$26*	7	14	60
43	BUSCHS MILL ROAD	ALSACE ROAD	NORTH END	0.33	50	*G - Gravel (150mm)*	*$12*	7	14	61
52	CULHAMS ROAD WEST	HIGHWAY 654	WEST END	1.11	50	*G - Gravel (150mm)*	*$38*	8	16	61
130	SIMPSON HILL ROAD	STILLAR SIDE ROAD	WEST END	0.64	50	*G - Gravel (150mm)*	*$22*	7	14	61
28	BEATTY STREET	BLAKE STREET	FRONT STREET	0.24	211	*Preventative Maintenance*	-	10	19	70
59	GRANITE HILL ROAD	HIGHWAY 522	2.94 KM WEST OF HIGHWAY 522	2.95	50	*G - Gravel (150mm)*	*$102*	8	16	62
122	RYE ROAD	BOOTH ROAD	1.91 KM EAST OF BOOTH ROAD	1.95	50	*G - Gravel (150mm)*	*$68*	8	16	63
44	BUTTERFIELD ROAD	SPRUCEDALE ROAD	PONDEROSA ROAD	1.99	50	*G - Gravel (150mm)*	*$69*	8	16	79
49	CHAPMANS LANDING ROAD	CHAPMAN'S LANDING ROAD	WEST END	0.61	50	*G - Gravel (150mm)*	*$21*	8	16	64
128	SETTLERS ROAD	HIGHWAY 534	EAST END	1.04	50	*G - Gravel (150mm)*	*$36*	8	16	64
97	MUSKEG ROAD	BEAR CREEK ROAD	HIGHWAY 654	0.34	800	*RO1 - Hot Mix Overlay, 1 Lift*	*$74*	8	15	80
27	BEATTY STREET	HIGHWAY 654	BLAKE STREET	0.08	250	*Preventative Maintenance*	-	10	19	74
20	BARBER VALLEY ROAD	HIGHWAY 534	NORTH END	1.33	50	*G - Gravel (150mm)*	*$46*	8	16	66

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Surface Condition	Structural Adequacy	Condition Rating
22	BARTON LAKE ROAD	HIGHWAY 534	HIGHWAY 534	0.85	50	*G - Gravel (150mm)*	*$30*	8	16	66
148	SUNSET COVE ROAD	BEAR CREEK ROAD	MUSKEG ROAD	1.04	672	*ST1 - Single Surface Treatment*	*$36*	8	15	80
21	BARRETT ROAD	ALSACE ROAD	EAST END	6.18	50	*G - Gravel (150mm)*	*$214*	8	16	67
106	PILGER ROAD	TOWNSHIP BOUNDARY	BAILEY BRIDGE ROAD	0.63	50	*G - Gravel (150mm)*	*$22*	8	16	68
140	STILLAR SIDE ROAD	SIMPSON HILL ROAD	DOWDELL ROAD	2.08	100	*G - Gravel (150mm)*	*$72*	8	16	72
141	STONE CUTTERS ROAD	HIGHWAY 654	HART ROAD	2.07	100	*G - Gravel (150mm)*	*$72*	8	16	73
123	RYE ROAD	HIGHWAY 522	BOOTH ROAD	2.76	50	*G - Gravel (150mm)*	*$96*	8	16	74
42	BOOTH ROAD	RYE ROAD	WEST END	0.70	50	*G - Gravel (150mm)*	*$24*	8	16	72
88	LAMBS ROAD	BLACK CREEK ROAD N	WEST END	0.87	50	*G - Gravel (150mm)*	*$30*	8	16	72
101	OLD NIPISSING ROAD S	HIGHWAY 522	SOUTH END / TOWNSHIP BOUNDARY	1.69	50	*G - Gravel (150mm)*	*$58*	7	14	72
139	STILLAR SIDE ROAD	DOWDELL ROAD	ALSACE ROAD	2.16	100	*G - Gravel (150mm)*	*$75*	8	16	75
32	BIRCHGROVE DRIVE WEST	ROCKY SHORE DRIVE	LAKEVIEW ROAD	1.30	150	*Preventative Maintenance*	-	9	18	77
63	GREEN ACRES ROAD	GERBER ROAD	ROSSEAU-NIPISSING ROAD	2.00	75	*G - Gravel (150mm)*	*$69*	8	16	74
33	BIRCHGROVE DRIVE WEST	KERVINS BAY ROAD	CLAIR'S LANE	0.64	143	*Preventative Maintenance*	-	9	18	77
62	GREEN ACRES ROAD	WOLFE LAKE ROAD	GERBER ROAD	1.12	84	*G - Gravel (150mm)*	*$39*	8	16	75
127	SCHLOSSER ROAD	HEMLOCK ROAD	WEST END	2.04	50	*G - Gravel (150mm)*	*$71*	8	16	73

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Surface Condition	Structural Adequacy	Condition Rating
132	SKI HILL ROAD	MOUNTAINVIEW ROAD	WEST END	0.45	50	*G - Gravel (150mm)*	*$15*	8	16	73
147	SUNSET COVE ROAD	SANDY BAY ROAD	JONES ROAD	0.51	250	*ST1 - Single Surface Treatment*	*$18*	8	15	80
149	SUNSET COVE ROAD	JONES ROAD	BEAR CREEK ROAD	0.71	250	*ST1 - Single Surface Treatment*	*$25*	8	15	80
150	SUNSET COVE ROAD	BIRCHGROVE DRIVE WEST	SANDY BAY ROAD	1.31	250	*ST1 - Single Surface Treatment*	*$46*	8	15	80
17	BAILEY BRIDGE ROAD	PILGERS RD	TOWNSHIP BOUNDARY	0.35	50	*G - Gravel (150mm)*	*$12*	8	16	74
72	HART ROAD	STONE CUTTER ROAD	HAZEL GLEN ROAD	2.02	100	*G - Gravel (150mm)*	*$70*	8	16	77
134	SKI HILL ROAD	1.39 KM WEST OF ALSACE ROAD	MOUNTAINVIEW ROAD	1.45	200	*G - Gravel (150mm)*	*$50*	8	16	80
135	SOUTH RIVER ROAD	HIGHWAY 534	NORTH END	3.91	115	*G - Gravel (150mm)*	*$136*	8	16	78
98	MUSKEG ROAD	BIRCHGROVE DRIVE WEST	BEAR CREEK ROAD	2.06	237	*ST1 - Single Surface Treatment*	*$72*	8	16	81
90	LINGENFELTERS ROAD	HIGHWAY 522	NORTH END	1.45	50	*G - Gravel (150mm)*	*$50*	8	16	75
92	MARION DRIVE	BRICHGROVE DRIVE WEST	PINE DRIVE	1.17	228	*ST1 - Single Surface Treatment*	*$41*	8	16	81
48	CHAPMANS LANDING ROAD	HIGHWAY 654	CHAPMAN'S LANDING ROAD	0.96	100	*G - Gravel (150mm)*	*$33*	8	16	78
138	STILLAR SIDE ROAD	HIGHWAY 534	SIMPSON HILL ROAD	0.15	100	*G - Gravel (150mm)*	*$5*	8	16	78
161	WOLFE LAKE ROAD	GREEN ACRES ROAD	ALSACE ROAD	3.51	100	*G - Gravel (150mm)*	*$122*	8	16	78
6	ALSACE ROAD	BALSAM LANE	0.23 KM EAST OF BALSAM LANE	0.22	200	*G - Gravel (150mm)*	*$8*	8	16	81

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Surface Condition	Structural Adequacy	Condition Rating
30	BELLA HILL ROAD	HIGHWAY 534	SOUTH END	0.39	50	*G - Gravel (150mm)*	*$13*	9	18	76
31	BENNETT ROAD	HIGHWAY 522	TOWNSHIP BOUNDARY	0.21	50	*G - Gravel (150mm)*	*$7*	7	14	76
40	BLACK CREEK ROAD SOUTH	HIGHWAY 522	SOUTH END	1.21	50	*G - Gravel (150mm)*	*$42*	8	16	76
99	NIAGARA ROAD	GREEN ACRES ROAD	WEST END	1.23	50	*G - Gravel (150mm)*	*$43*	8	16	76
162	WOLFE LAKE ROAD	KINGS ROAD	GREEN ACRES ROAD	0.80	173	*G - Gravel (150mm)*	*$28*	8	16	81
78	HUNTERS BAY	BEAR CREEK ROAD	SOUTH END	0.64	100	*ST1 - Single Surface Treatment*	*$22*	8	15	79
107	PILGERS ROAD	SIMULIUM DRIVE	HIGHWAY 522	2.17	50	*G - Gravel (150mm)*	*$75*	8	16	75
108	PILGERS ROAD	BAILEY BRIDGE ROAD	SIMULIUM DRIVE	4.25	50	*G - Gravel (150mm)*	*$147*	8	16	77
114	PONDEROSA ROAD	BLACK CREEK ROAD N	WEST END	2.60	50	*G - Gravel (150mm)*	*$90*	8	16	77
39	BLACK CREEK ROAD NORTH	SPRUCEDALE ROAD	HIGHWAY 522	2.10	61	*G - Gravel (150mm)*	*$73*	8	16	78
76	TAMARACK ROAD / HEMLOCK ROAD	ALSACE ROAD	SCHLOSSER LINE	2.13	134	*G - Gravel (150mm)*	*$74*	8	16	81
3	ALSACE ROAD	BARRETT ROAD	SWALLWELLS DRIVE	7.98	100	*G - Gravel (150mm)*	*$277*	8	16	80
84	LAKE NIPISSING ROAD	LAKE NIPISSING ROAD	WEST END	1.94	100	*G - Gravel (150mm)*	*$67*	8	16	80
125	SANDY BAY ROAD	SUNSET COVE ROAD	SOUTH END	0.57	100	*ST1 - Single Surface Treatment*	*$20*	8	16	65
73	HAZEL GLEN ROAD	HIGHWAY 654	HART ROAD	2.21	124	*G - Gravel (150mm)*	*$77*	8	16	81

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Surface Condition	Structural Adequacy	Condition Rating
38	BLACK CREEK ROAD NORTH	PONDEROSA ROAD	SPRUCEDALE ROAD	2.03	50	*G - Gravel (150mm)*	*$70*	8	16	78
50	CHAPMANS LANDING ROAD	CHAPMAN'S LANDING ROAD	NORTH END	0.10	50	*G - Gravel (150mm)*	*$3*	8	16	78
81	KINGS ROAD	WOLFE LAKE ROAD	HIGHWAY 534	4.20	50	*G - Gravel (150mm)*	*$146*	8	16	78
34	BIRCHGROVE DRIVE WEST	GREENING BAY ROAD	MARION DRIVE	0.81	150	*ST1 - Single Surface Treatment*	*$28*	8	16	82
36	BIRCHGROVE DRIVE WEST	MARION DRIVE	TOWNSHIP BOUNDARY	0.41	150	*ST1 - Single Surface Treatment*	*$14*	8	16	82
37	BIRCHGROVE DRIVE WEST	CLAIR'S LANE	GREENING BAY ROAD	0.22	150	*ST1 - Single Surface Treatment*	*$8*	8	16	82
12	ALSACE ROAD	HIGHWAY 522	BARRETT ROAD	0.62	112	*G - Gravel (150mm)*	*$21*	8	16	81
5	ALSACE ROAD	SWALLWELLS DRIVE	BALSAM LANE	1.37	100	*G - Gravel (150mm)*	*$47*	8	16	81
15	ARMSTRONG ROAD	HIGHWAY 534	HAMILTON FARM ROAD	1.15	100	*G - Gravel (150mm)*	*$40*	8	16	81
115	POWER PLANT ROAD	BEATTY STREET	HAMILTON FARM ROAD	3.32	100	*G - Gravel (150mm)*	*$115*	8	16	81
163	WOLFE LAKE ROAD	HIGHWAY 534	KINGS ROAD	0.37	100	*G - Gravel (150mm)*	*$13*	8	16	81
45	BUTTERFIELD ROAD	HIGHWAY 522	SPRUCEDALE ROAD	1.86	50	*G - Gravel (150mm)*	*$64*	8	16	79
69	HAMILTON FARM ROAD	1.66 KM NORTH OF ARMSTRONG ROAD	POWER PLANT ROAD	0.36	50	*G - Gravel (150mm)*	*$12*	8	16	79
136	SPRUCEDALE ROAD	BUTTERFIELD ROAD	0.93KM WEST OF BUTTERFIELD ROAD	0.93	50	*G - Gravel (150mm)*	*$32*	8	16	79

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Surface Condition	Structural Adequacy	Condition Rating
24	BEAR CREEK ROAD	SUNSET COVE ROAD	RUSTON ROAD	1.08	300	*Preventative Maintenance*	-	9	18	85
8	ALSACE ROAD	SUNRISE DRIVE	RUTH HAVEN DRIVE	0.75	200	*Preventative Maintenance*	-	9	17	84
10	ALSACE ROAD	OUR LANE	TOEPPNER BOULEVARD	0.04	200	*Preventative Maintenance*	-	9	17	84
11	ALSACE ROAD	RUTH HAVEN DRIVE	WOLFE LAKE ROAD	0.14	200	*Preventative Maintenance*	-	9	17	84
13	ALSACE ROAD	TOEPPNER BOULEVARD	SUNRISE DRIVE	0.12	200	*Preventative Maintenance*	-	9	17	84
14	ALSACE ROAD	0.23 KM EAST OF BALSAM LANE	OUR LANE	0.36	200	*Preventative Maintenance*	-	9	17	84
61	GREEN ACRES ROAD	ROSSEAU-NIPISSING ROAD	NIAGARA ROAD	0.55	75	*G - Gravel (150mm)*	*$19*	8	16	81
25	BEAR CREEK ROAD	RUSTON ROAD	HUNTERS BAY ROAD	0.71	200	*Preventative Maintenance*	-	9	18	85
94	MOUNTAINVIEW ROAD	SUN VALLEY ROAD	ASPEN LANE	0.16	75	*G - Gravel (150mm)*	*$6*	8	16	82
95	MOUNTAINVIEW ROAD	SKI HILL ROAD	SUN VALLEY ROAD	0.09	75	*G - Gravel (150mm)*	*$3*	8	16	82
96	MOUNTAINVIEW ROAD	ASPEN LANE	MAPLE RDIGE	0.18	75	*G - Gravel (150mm)*	*$6*	8	16	82
16	ASPEN LANE	MOUNTAINVIEW ROAD	WEST END	0.14	50	*G - Gravel (150mm)*	*$5*	8	16	81
67	HAMILTON FARM ROAD	ARMSTRONG ROAD	0.32 KM NORTH OF ARMSTRONG ROAD	0.33	50	*G - Gravel (150mm)*	*$11*	8	16	81
82	KINGS ROAD	HIGHWAY 534	WOLFE LAKE ROAD	0.32	50	*G - Gravel (150mm)*	*$11*	8	16	81

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Surface Condition	Structural Adequacy	Condition Rating
144	SUN VALLEY WAY	MOUNTAINVIEW ROAD	WEST END	0.15	50	*G - Gravel (150mm)*	*$5*	8	16	81
159	WILLIAM ROAD	LAKEVIEW ROAD	EAST END	0.16	50	*ST1 - Single Surface Treatment*	*$5*	8	16	81
160	WILLIAM ROAD	LAKEVIEW ROAD	WEST END	0.09	50	*ST1 - Single Surface Treatment*	*$3*	8	16	81
91	MAPLE RIDGE	MOUNTAINVIEW ROAD	WEST END	0.14	50	*G - Gravel (150mm)*	*$5*	8	16	82
113	PONDEROSA ROAD	BLACK CREEK ROAD N	BUTTERFIELD ROAD	2.05	50	*G - Gravel (150mm)*	*$71*	8	16	80
35	BIRCHGROVE DRIVE WEST	LAKEVIEW ROAD	KERVINS BAY ROAD	0.75	150	*Preventative Maintenance*	-	9	18	86
26	BEAR CREEK ROAD	HUNTERS BAY ROAD	UNNAMED PRIVATE ROAD	0.07	100	*Preventative Maintenance*	-	9	18	85

Notes:

1. *Priorities in descending order. The higher the priority rating the greater the need.*
2. *Rehabilitation strategy to be confirmed by geotechnical investigations at detail design.*
3. *Sections listed in italics are seasonally maintained roads.*

5.3 Roadside Maintenance

Preventative road and roadside maintenance is critical to prolonging the useful service life of a road and maximizing the capital investment. A continuous road and roadside maintenance program is recommended to reduce the road degradation rates. Ditch cleanout and clearing of vegetation from the right-of-way should be carried out on a regular basis. This can either be accomplished through dedicated internal Township forces or sub-contracting to private contractors. Consideration may be given to a dedicated capital program of ditch cleanout and clearing, to ensure resources are dedicated to these important activities.

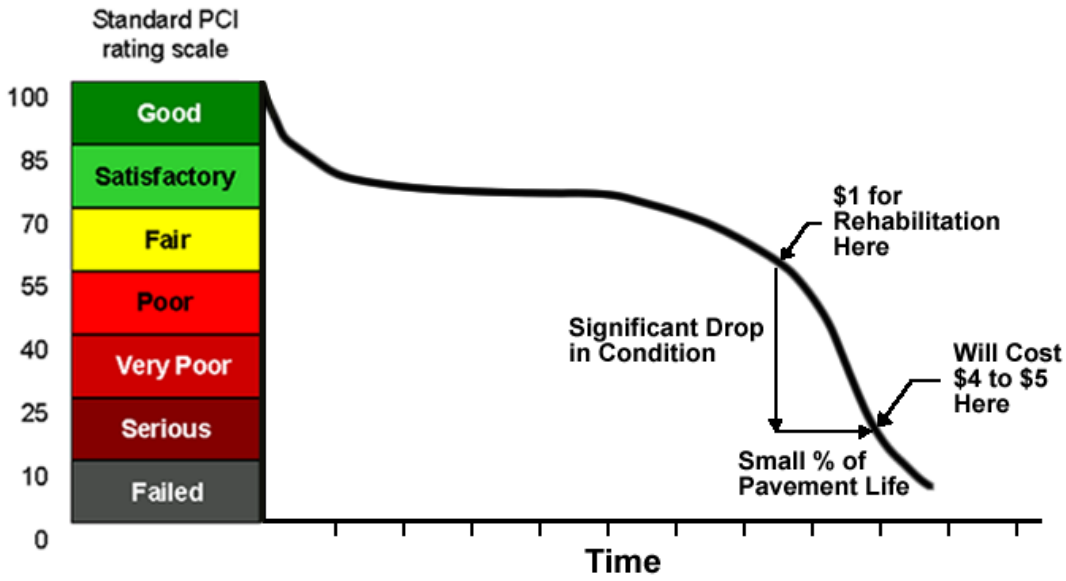
6.0 Lifecycle Road Rehabilitation and Maintenance Approach

The key to managing a pavement / road network is the timing of maintenance and rehabilitation activities. This idea evolves from the fact that a pavement's structural integrity does not fall constantly with time. A pavement generally provides a constant, acceptable condition for the first part of its service life and then begins to deteriorate very rapidly. In many cases, maintenance and rehabilitation measures are not taken until structural failure or noticeable changes in ride quality become apparent. This is the "fix it once it is already broken" approach.

The unfortunate consequence of this decision is that maintenance and rehabilitation becomes exponentially more expensive over the life of the pavement and is often overlooked until the pavement condition reaches a severe state of distress. There is opportunity for substantial cost savings when intervention is made *before* the pavement becomes severely compromised; i.e. "fix it before it breaks". **Figure 1** illustrates the underlying principle in support of a preservation management approach to pavement infrastructure. The principle also has application to each of the classes of roads maintained by the Township. Significant cost savings will result from proactive intervention rather than simply waiting as long as possible before performing maintenance.

Examples of approach to roads management with their associated cost implications over the lifecycle of a road are set out below in **Section 4.1** and are provided as an illustration of the benefit of a "preservation management approach".

Figure 1 – Typical Service Life of an Asphalt Pavement



A summary of general lifecycle management activities for roads are included in the following table.

6.1 Ideal PCI Deterioration Curves

For the purposes of this report, three ideal PCI Deterioration Curves were created to estimate the future PCI ratings and remaining useful life of the Township's Roads.[2]

Sigmoidal curves were used to characterize the S-shaped PCI curve typical of hard-topped surfaces as detailed below:

$$PCI(t) = a + \frac{b}{1 + e^{c \times t + d}}$$

Where a, b, c, and d are constants used to fit the curve to the data, e is Euler's Number, and t represents the effective age. The constants used in this report are indicated in the table below:

[2] Generally, it is best practice to fit PCI deterioration curves with real field data. As this requires at least three data points over time, this was not possible for this report. As all predictions of PCI in this report is based on these unfitted curves, it is expected that there will be discrepancies between predicted and actual future PCI values.

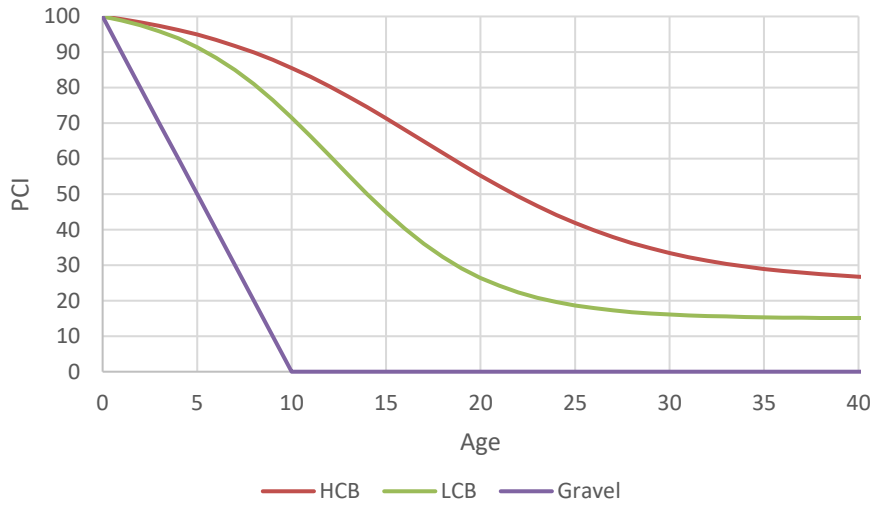
Table 7 – Ideal PCI Deterioration Curve Constants

Constant	HCB	LCB	Description
a	25	15	Although PCI can technically reach zero (representing an impassible road), from a practical standpoint, ad hoc maintenance (potholes, patches) will keep a pavement's terminal PCI above zero.
b	79.56	89.15	The difference between the higher and lower asymptotes of the sigmoidal curve.
c	0.1645	0.2469	Represents the steepness of the curve. The higher the value, the steeper the curve
d	-2.800	-3.020	Shifts the deterioration curve to the left or right. A value of 0 places the inflection point of the sigmoidal curve on the y-axis.

In this report, potential treatments do not improve the PCI by a constant amount but reduce the effective age of the pavement by the specified service life extension. This can lead to scenarios where a pavement's effective age is less than zero. In these cases, the PCI is set to 100.

Gravel roads can be maintained indefinitely as long as surface gravel is regularly refreshed and the crown is maintained properly by grading. Therefore, a straight line deterioration is used in lieu of a curve to account for lost material. Note that gravel roads were not inspected based on a PCI approach in the report.

Figure 2 – Ideal PCI Deterioration Curves



6.2 Life Cycle Cost Analysis

For the purposes of this report, a discount rate of 2.5% is used in determining the equivalent annual cost of each treatment strategy. Lifecycle costs are calculated until (and including) the next full reconstruction of each road type. Operational costs (i.e.

annual maintenance activities, road inspections) are simplified into one flat annual estimate per surface type for the purposes of this analysis. Externalities and are not included in this analysis.

6.2.1 Asphalt Roads

Asphalt surfaces are the smoothest and most durable hard top surface used by the Township, however; they are also the most expensive. The Township currently maintains 1.2 km of asphalt surface roads. Asphalt provides a constant, acceptable condition for the initial portion of its service life but then begins to deteriorate rapidly as it ages. Surface defects such as cracking and raveling are the first signs of the deterioration. If left untreated, the pavement will rapidly deteriorate to the point where reconstruction is the only option. A preservation management strategy can mitigate this by applying renewal treatments earlier in the pavements life before the conditions begin to deteriorate too far. **Table 8** below summarizes preservation management activities to be considered for asphalt roads:

Table 8 – Preservation Management Approach – Asphalt Roads

Activity		Age (Years)	PCI Range (Trigger)	Estimated Service Life Extension (Years)	Risk if Application Window is Missed	Cost
Operational	Line Painting	Annually for latex based paints	-	-	Faded and inconsistent line painting can result in driver error. Not all roads require line painting.	$200 / km
	Patching	Limited when new, increases with age	-	-	Dangerous driving conditions and complete loss of surface	

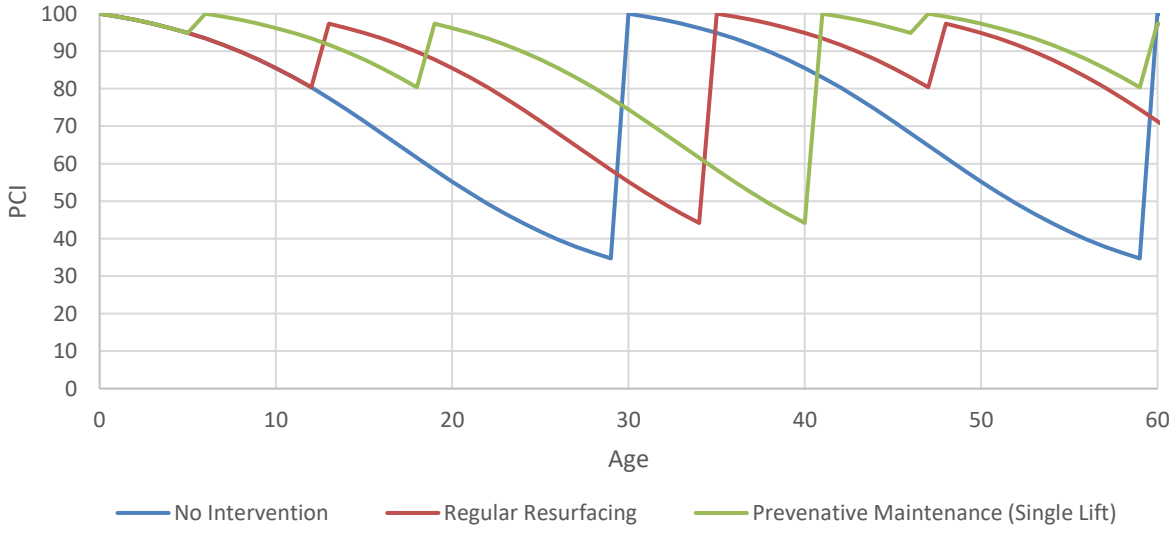
Activity		Age (Years)	PCI Range (Trigger)	Estimated Service Life Extension (Years)	Risk if Application Window is Missed	Cost
Preservation	**RS:** Route and Seal (Double Lift Only)*	2-6	90-100 (97)	2	Unsealed cracks will allow moisture in the base granular and accelerate aging.	$4,000 / km
	SS: Slurry Seal*	4-8	88 – 96 (93)	4-6	Preventative maintenance may fail prematurely if applied. No further action until the road becomes a candidate for overlays or mill and paving, which is less cost effective.	$22,000 / km
	MS: Microsurface*					$42,000 / km
**Preservation Treatments not currently used by the Township*						
Rehabilitation	**RO1:** Overlay 1 lift	12-15	70-80 (77)	10	Overlays / Mill and Pave may fail prematurely if applied. No further action until the road becomes a candidate for major rehabilitation which is less cost effective.	$218,000 / km
	RMP1: Mill and Pave 1 lift					$418,000 / km
	PP1: Pulverize and Pave 1 lift	20-25	<55 (42)	20-25	Restoring HCB may require more intensive rehabilitation up to complete reconstruction, which is less cost effective.	$202,000 / km
	PP2: Pulverize and Pave 2 lifts					$362,000 / km
Replacement	**RECON 1R:** Reconstruct Rural section and pave 1 lift	30	<40 (33)	30	Road may revert to a loose top surface.	$622,000 / km

Activity		Age (Years)	PCI Range (Trigger)	Estimated Service Life Extension (Years)	Risk if Application Window is Missed	Cost
	RECON 2R: Reconstruct rural section and pave 2 lifts					$777,000 / km
	Recon 2S: Reconstruct semi-urban section and pave 2 lifts					$777,000 / km
	RECON 2U: Reconstruct urban section and pave 2 lifts					$1,496,000 / km

Notes: 1. Slurry seal can be used on lower volume paved roads (less than 1000 vehicles per day). For roads with volumes in excess of 1000 AADT, microsurfacing should be considered. 2. Recon 2S and Recon 2U are used when there is curb and gutter. This represents a minority of the roads in North Frontenac and Recon 1R and Recon 2R are used for life cycle analysis.

Figure 3 shows the expected deterioration of an HCB road with No Interventions, Regular Resurfacing, Preventative Maintenance with equivalent annual costs of $14,010, $12,310, and $10,350 / year / km of HCB road for each respective approach.

Figure 3 – HCB Road Asset Management Approach



6.2.2 Surface Treated Roads

Surface treated roads have a hard wearing surface that must be preserved in order to be effective. The Township currently maintains 33.2 km of surface treated roads. Unlike gravel roads, a significant investment has been made in the surface and consequently

these roads must be managed properly to obtain the longest possible service life from the surface.

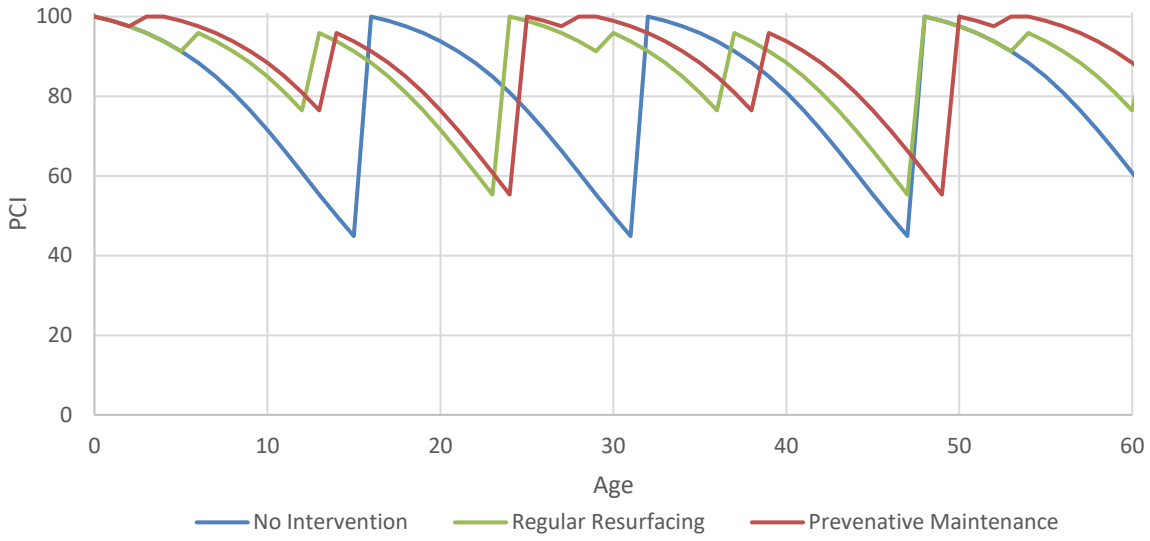
Table 9 – Preservation Management Approach – Surface Treated Roads

Activity		Age (Years)	PCI Range (Trigger)	Estimated Service Life Extension (Years)	Risk if Application Window is Missed	Cost
Operational	Line Painting	Annually for latex based paints	-	-	Faded and inconsistent line painting can result in driver error. Not all roads need line painting	$500 / km
	Patching	Limited when new, increases with age	-	-	Dangerous driving conditions and complete loss of surface	
Preservation	**ST1:** Single Surface Treatment (preventative overlay)	3	92-100 (95)	4	ST1 may be still be applied, may not be as effective	$35,000 / km
Rehabilitation	**ST1:** Single Surface Treatment (rehabilitative overlay)	6	80-92 (85)	3	ST2 may be applied instead, which is less cost effective.	$35,000 / km
	ST2: Double Surface Treatment (overlay)	10	65-80 (72)	7	Overlays may fail prematurely. Rehabilitation should be applied as the current surface reaches the end of its useful life, which is less cost effective.	$65,000 / km
	ST2PA: Pulverize and DST with Minor Grade Raise	14	<50 (50)	14	Road may revert to a loose top surface. Restoring LCB may require more intensive rehabilitation up to complete reconstruction.	$104 / km

Replacement	**RECON LCB:** Full Reconstruction	14+	<50 (40)	14	Road will revert to a loose top surface if not extensively patched.	$421,000 / km

Figure 4 shows the expected deterioration of an LCB road with No Interventions, Regular Resurfacing, and Preventative Maintenance with equivalent annual costs of $16,930, $8,930, and $7,340 / year / km of LCB road for each respective approach.

Figure 4 – LCB Road Asset Management Plan



6.2.3 Gravel Roads

The Township currently maintains approximately 116.9 km of gravel roads. The proposed preservation management approach for this class of road is outlined in **Table 10**.

Table 10 – Preservation Management Approach- Gravel Surface

Action		Frequency	Risk if not Undertaken	Cost
Operational	Regrade surfaces to maintain smooth / safe driving surface and proper crossfall.	As needed, generally 2-3 times per year for higher volume gravel, or more frequently as necessary; 1-2 for lower volume.	Surface will become dangerously rough. Surface runoff may form gullies and secondary ditches and quickly erode the road base.	$2,000 / km
	Add calcium to tighten surface, retain aggregate and reduce dust.	Each spring on all roads of higher volume and as needed during summer months.	Aggregate will be lost at a greater rate. Excessive dust may reduce the safety of the travelling public.	
Preservation	**G (150mm):** Add layer (150 mm) of granular material to road surface.	Every 8 years for gravel roads.[3]	Loose-Top surfaces loose aggregate over time. If the gravel supply on the surface is gone, the road will effectively become an earth road and require reconstruction.	$30,000 / km if done by outside contractors (This is done by Township Staff as part of their operations budget)
Replacement	Base and sub-base improvements.	As needed or as dictated by traffic volumes.	Spot Reconstruction is appropriate to repair localized areas of distress.	See below
	Recon G: Reconstructed road using existing embankment	As required due to extensive distress areas.	Road requires excessive maintenance or must be closed.	$356,000 / km
	Convert to Hard Top	As dictated by traffic volumes.	For high traffic roads, loose top surfaces require frequent maintenance and will likely lose aggregate at an accelerated rate.	Highly Variable depending on existing structure and new surface type.

6.3 Application of Asset Management Approaches

Table 11 summarizes the theoretical outcomes of each strategy. The preventative maintenance approach is both less expensive and provides a higher average PCI over time. The expected cost assumes that the municipality is starting with a brand new

[3] Actual rate may vary. Generally, 50-75mm of a loose topped surface is lost every 3-5 years.

surface, has no plans for expansion, and will perfectly implement each treatment on schedule – i.e. these are the theoretical minimum costs for each strategy.

Table 11 – Treatment Strategies

	HCB	LCB	Gravel	Total
Length	1.2	33.2	116.9	-
No Intervention				
Equivalent Annual Cost / km ($K)	$14.01	$16.93	$8.59	-
Expected Cost ($K)	16.47	561.89	1,004.41	1,582.77
Average PCI (Hardtop Only)	70.39	78.57	-	78.29
Regular Resurfacing				
Equivalent Annual Cost / km ($K)	$12.31	$8.93	$8.59	-
Expected Cost ($K)	14.48	296.39	1,004.41	1,315.28
Average PCI (Hardtop Only)	77.77	84.85	-	84.60
Preventantive Maintanance				
Equivalent Annual Cost / km ($K)	10.35	$7.34	$8.59	-
Expected Cost ($K)	12.17	243.67	1,004.41	1,260.25
Average PCI (Hardtop Only)	80.52	86.05	-	85.86

The preservation management activities detailed in each of the tables above are not necessarily intended or required to be completed on each and every road. Road deterioration rates and the type of deterioration will dictate when action should be taken and what kind of treatment is most appropriate. The intention of the above is to outline the series of techniques to be considered in an effort to realize and extend the useful service life of the road asset for the lowest overall lifecycle cost while maintaining the highest overall condition. As detailed in the life cycle costs analysis presented above, the preservation management approach to roads is proven to yield the lowest overall life-cycle costs.

Each of the preservation management activities for gravel, surface treatment and asphalt roads identified above (including route and seal, slurry seal, resurfacing etc.), shall be considered as part of the regular Road Needs Study Report every 5 years.

7.0 Surface Type Conversion

Surface type selection is multi-factorial, as previously discussed in Section 1.4.1. The following Surface Type Conversion policies should be considered as high-level

guidance, with final decisions based on geotechnical investigation and recommendations from a pavement engineer.

7.1 Conversion of a Rural Gravel Road to LCB

Candidates for gravel-to-LCB conversion should meet one of the following conditions: have a confirmed traffic load intolerable for loose top surfaces (AADT greater than 400); feature a problematic slope that may be stabilized by hard-topping, or is an isolated section of gravel road, making it inefficient to include in the overall gravel maintenance operations.

No gravel road section is known to have an AADT above 400 within the Township, although Alsace Road, from Hemlock to Ski Hill Road, is estimated to have an AADT of around 400. This road had been previously surface treated and a cost estimate to re-convert it to LCB is included in the capital plan.

Furthermore, converting a gravel road to LCB is rarely as simple as installing a double surface treatment over the existing gravel. Prior to considering a candidate, it is recommended that ditching and brushing are undertaken, drainage issues are identified and addressed and cross culverts are inspected and replaced if in poor condition. If the platform width (edge of shoulder to edge of shoulder) is less than 7.0m, widening the road is highly recommended.

Hardtopping a road tends to encourage higher speeds. Therefore, the speed limit, alignment, curve superelevation (or lack thereof), entrance visibility, and roadside hazards need to be reviewed prior to converting a road to LCB. These efforts are highly variable.

7.2 Conversion of a Rural LCB Road to HCB

Candidates for rural LCB-to-HCB conversion should meet one of the following conditions: have a confirmed traffic load intolerable for LCB (see Section 1.4.1 for further guidance); or is an isolated section of LCB road surrounded by HCB road.

No rural LCB roads have been identified as candidates for converting to HCB.

Furthermore, converting an LCB road to HCB is rarely as simple as laying asphalt over pulverized LCB. Prior to considering a candidate, it is recommended that ditching and brushing are undertaken, drainage issues are identified and addressed, and cross culverts are inspected and replaced if in poor condition. If the platform width (edge of shoulder to edge of shoulder) is less than recommended based on the road's class, widening the road is highly recommended.

Converting an LCB road to HCB tends to encourage higher speeds. Therefore, the speed limit, alignment, curve superelevation (or lack thereof), entrance visibility, and roadside hazards need to be reviewed prior to converting a road to LCB. These efforts are highly variable.

7.3 Conversion of a Rural LCB or HCB Road to Gravel

Candidates for converting a rural hard-top road to gravel should both have a low traffic level and be currently in rough to very rough condition. Although not part of the scope of this report, it should be noted that the public reaction of gravelling a paved road can be much more contentious than paving a graveled road.

Furthermore, as gravel roads require frequent maintenance, the Township needs to ensure that road can be integrated into their gravel maintenance program.

Converting a paved road to gravel tends to encourage lower speeds. Signage should be installed at the limits informing drivers of the change in surface type. Furthermore, the speed limit, alignment, curve superelevation (or lack thereof), and reduced speed curves need to be reviewed in detail prior to converting a road to gravel. These efforts are highly variable.

7.4 Semi-Urban LCB to HCB Conversion

The Township of Nipissing has a number of semi-urban roads with existing LCB surfaces.

Replacing these surfaces with HCB pavements is unlikely to be as simple as pulverizing / removing the surface treatment and laying a lift of HCB pavement. Depth (and therefore cost) of treatment cannot be known without geotechnical investigation.

Three scenarios are therefore considered for these roads:

1. Maintain surface as LCB.
2. Convert surface to HCB – best case scenario: remove LCB and pave 1 lift of HCB.
3. Convert Surface to HCB – worst case scenario: full depth reconstruction.

Before converting an LCB surface to HCB, it is recommended that ditching and brushing are undertaken, drainage issues are identified and addressed, and cross culverts are inspected and replaced if in poor condition. If ditching of sufficient depth is not possible within the ROW, it is recommended drainage is supplemented with subdrains or storm sewers. If the platform width (edge of shoulder to edge of shoulder) is less than recommended based on the road's class, widening the road is highly recommended if converting to HCB.

The expected cost calculations assumes that the municipality is starting with an LCB surface in need of replacement. An equivalent annual cost is calculated for a 25-year time horizon. As per Section 6, this analysis assumes that the ideal preservation management approach is used. Furthermore, it assumes that there are no concurrent plans for expansion, and will perfectly implement each treatment on schedule – i.e. these are the theoretical minimum costs for each strategy.

7.4.1 Scenario 1: Maintain Surface as LCB

Maintaining these surfaces as LCB is feasible but has the following drawbacks:

- With age, LCB roads take on a superficial similarity to HCB roads, as surface aggregate is polished down by road traffic. Residents may believe the brand new LCB surface, with its excess granular, is a worse surface than the old one.
- The excess granular from the surface often finds itself in resident's lawns and grassed ditches.
- As LCB relies on traffic to work the aggregate into the bituminous emulsion, turning movements from frequent entrances may interfere with this process.

To address these concerns, the following strategies should be considered:

- Apply a slurry seal or similar thin sealing surface within two years of construction;
- Place and maintain silt fencing along manicured lawn frontages to capture excess aggregate before it migrates off-road, to be removed with final clean-up; and
- Following removal of excess aggregate, entrance locations should be inspected and repaired if necessary.

It should be noted that many of Nipissing's Semi-Urban LCB roads have stretches that are characteristically rural, and are connected to rural LCB sections. Maintaining these as LCB has the added benefit of maintaining surface continuity within the network.

Table 12 – Treatment Regimen for Maintaining a km of Semi-Urban LCB Road

Year	Intervention	Cost (x1000)
0	Remove Existing, Place Double Surface Treatment	$68
2	Single Surface Treatment	$35
20	Remove Existing, Place Double Surface Treatment	$68
22	Single Surface Treatment	$35

Based on the above treatment regimen and a flat annual operational cost of $0.5 K / year, the Equivalent Annual Cost over 25 years is expected to be $8.83 K / km.

7.4.2 Scenario 2: Convert to HCB: Best Case Scenario

If supported by a geotechnical investigation, removing the existing pavement and pave 1 lift would be the most effective method to convert the surface to HCB.

Table 13 – Treatment Regimen for Maintaining a km of Semi-Urban LCB Road

Year	Intervention	Cost (x1000)
0	Pulverize or remove LCB, Place Single lift of HCB	$203
13	Overlay single lift of HCB	$219

Based on the above treatment regimen and a flat annual operational cost of $0.2 K / year for HCB, the Equivalent Annual Cost over 25 years is expected to be $19.35 K / km.

7.4.3 Scenario 3: Convert to HCB: Worst Case Scenario

Replacing these roads with HCB pavements is unlikely to be as simple as pulverizing / removing the surface treatment and laying a lift of HCB pavement. Depth (and therefore cost) of treatment cannot be known without geotechnical investigation.

Table 14 – Treatment Regimen for Maintaining a km of Semi-Urban LCB Road

Year	Intervention	Cost (x1000)
0	Full Depth Reconstruction, Semi-Urban, No Curb and Gutter	$621
13	Overlay single lift of HCB	$219

Based on the above treatment regimen and a flat annual operational cost of $0.2 K / year, the Equivalent Annual Cost over 25 years is expected to be $41.50 K / km.

8.0 O. Reg. 588/17 Reporting Requirements

This study meets the reporting requirements under Table 4 of O. Reg. 588/17. For convenience, all items required under Table 4 are presented below, with the exception of mapping.

Table 15 – Road Class Density

Class	Lane-kilometres	Lane-kilometres / Municipal Area*
Arterial	0.00	0.00
Collector Roads	2.75	0.01
Local Roads	299.67	0.76
All	302.42	0.77

**Municipal area taken as 393.80 km²*

The average PCI for hard top surfaces in the Township is 69.5.

The average surface condition of unpaved roads is 7.7 as per the inventory Manual. This would broadly translate into a road with "good" rating.

Descriptions that illustrate the different levels of road pavement condition are presented in the tables below:

Table 16 - Qualitative Descriptions of PCI for HCB Roads[4]

PCI Range	Qualitative Description
90 - 100	Pavement is in excellent condition with few cracks. The Ride Condition Rating is excellent with few areas of very slight to slight distortion.
75 - 90	The pavement is in good condition with frequent very slight or slight cracking. The Ride Condition Rating is good with a few slightly rough and uneven sections.
65 - 75	The pavement is in fairly good condition with slight cracking, slight or very slight distortion and a few areas of slight alligatoring. The Ride Condition Rating is fairly good with intermittent rough and uneven sections.
50 - 65	The pavement is in fair condition with intermittent moderate and frequent slight cracking, and with intermittent slight or moderate alligatoring and distortion. The Ride Condition Rating is fair and the surface is slightly rough and uneven.
40 - 50	The pavement is in poor to fair condition with frequent moderate cracking and distortion, and intermittent moderate alligatoring. The Ride Condition Rating is poor to fair and the surface is moderately rough and uneven.
30 - 40	The pavement is in poor to fair condition with frequent moderate alligatoring and extensive moderate cracking and distortion. The Ride Condition Rating is poor to fair and the surface is moderately rough and uneven.
20 - 30	The pavement is in poor condition with moderate alligatoring and extensive severe cracking and distortion. The Ride Condition Rating is poor and the surface is very rough and uneven.
0 - 20	The pavement is in poor to very poor condition with extensive severe cracking, alligatoring and distortion. The Ride Condition Rating is very poor and the surface is very rough and uneven.

[4] Adapted from Table B-1 of the MTO's Manual for Condition Rating of Flexible Pavements, SP-024.

Table 17 - Qualitative Descriptions of PCI for LCB Roads[5]

PCI Range	Qualitative Description
80 - 100	Pavement is in excellent condition with just a few bumps or depressions from slight surface deformation. No surface defects such as streaking, potholes or cracking distresses. The Ride Condition Rating is very good.
60 - 79	Pavement is in good condition with just a few bumps or depressions from slight to moderate surface deformation. Intermittent slight to moderate surface defects and/or cracking distresses. The Ride Condition Rating is good.
40 - 59	Pavement is in fair condition with intermittent to frequent bumps or depressions from slight to moderate surface deformation. Intermittent to frequent moderate surface defects and/or cracking distresses. The Ride Condition Rating is fair.
20 - 39	Pavement is in poor condition with frequent bumps or depressions from moderate surface deformation. Frequent moderate to severe surface defects and/or cracking distresses. Localized slight to moderate alligatoring may be present indicating pavement structural failure. The Ride Condition Rating is poor.
0 - 19	Pavement is in very poor condition with extensive bumps or depressions from moderate to sever surface deformation. Extensive to severe surface defects and/or cracking distresses. Frequent slight to moderate alligatoring may be present, indicating pavement structural failure. The Ride Condition Rating is very poor.

[5] Adapted from Table B-1 of the MTO's Manual for Condition Rating of Surface-Treated Roads, SP-021.

Table 18 - Qualitative Descriptions of Surface Condition for Gravel Roads[6]

Surface Condition	Qualitative Description
10	If the section affords a fully adequate standard of service, with no annoyance or discomfort. Gravel roads rarely score a "10" rating due to their inherent roughness.
7 - 9	If it is possible to maintain the lesser of the Minimum Tolerable Average Operating Speed or the legal Speed Limit with only a noticeable amount of annoyance to the driver due to sway, vibration or steering effort, but with no noticeable feeling of hazard.
4 - 6	If maintaining even the lesser of the Minimum Tolerable Average Speed or the legal Speed Limit results in either a "tug-of-war" with a too-steep crown, or a feeling that the car is taking undue punishment.
1 - 3	If the surface irregularities are so severe that a driver will tend to reduce speed considerably, possibly even steering an irregular course, or if the crown is so steep as to be hazardous in winter.

8.1 Replacement Cost

In conjunction with this Road Needs Study Report, a replacement cost for the road asset was calculated based strictly on roadbed materials i.e. sub-base, base and surface. Road design standards noted in **Table 4** were used to estimate the existing depth of road bed materials for the purpose of the replacement cost calculation.

The total replacement cost for the Township's road infrastructure is approximately $31.7 M.

Note this cost represents the theoretical road bed materials costs only and does not include items such as removal of the existing road bed, installation of signs, pavement markings, lighting, drainage infrastructure, property etc.

9.0 Summary

D.M. Wills Associates (Wills) undertook a review of the Township of Nipissing (Township) existing road network to assess its physical condition and confirm various road attributes. Data collected as a result of the field review was used to develop a prioritized listing of the road network needs based primarily on condition and traffic volumes.

Wills undertook the field study in August of 2023. A visual assessment of each road within the Township was undertaken to assess the current condition of the road.

Two primary indicators of the relative health of a road are the structural adequacy and surface condition ratings. The current average structural adequacy rating for the

[6] Adapted from Item 83 from the MTO's Ministry of Transportation's Inventory Manual for Municipal Roads (February 1991).

Township's road network is 13.5/20. The current average surface condition rating for the Township's road network is 6.9/10.

1% (1.2 km) of the road network has a Structural "NOW" need, 5% (8.2 km) has a Structural "1-5" year need, and 6% (8.8 km) of the road network has a Structural "6-10" year need.

Preservation Management

In addition to addressing currently deficient roads (i.e. capital reconstruction), a dedicated preservation management approach is required, **and perhaps even more importantly**, to "keep the good roads good"; the fundamental principle being that it costs much less to maintain a good road than it does to let it fail and then reconstruct it, from a life cycle cost perspective. Ultimately, the goal of preservation management is to extend the useful life of a road and road network, maximizing the Township's investment over the road life-cycle.

Road resurfacing is an effective way of extending the overall life of the pavement structure and therefore a road resurfacing program is highly recommended. Roads with a structural adequacy of 12/20 or greater are included as candidates for potential resurfacing. Preliminary recommendations and prioritization for road resurfacing are based on condition rating and traffic demands on each road section, as per the Inventory Manual. A road with higher traffic volumes and fair structural adequacy is given priority over a road with moderate traffic and good structural adequacy score, in an attempt to intervene and extend the life of the road before it deteriorates to a level that can no longer be resurfaced (i.e. more expensive reconstruction is required). Specific resurfacing treatment recommendations must be assessed through further field investigation and detail design effort, prior to selecting and implementing the resurfacing strategy.

Based on typical degradation rates for gravel roads, surface treatment, and hot mix, a

total resurfacing program, (hot mix, surface treatment and gravel) is estimated at $644,300 per year.

Further to the recommendations above with respect to resurfacing, it is also recommended that regular maintenance in the form of roadside ditch cleanout and clearing be undertaken as a critical component to preservation management in order to extend the useful service life of the existing roads.

Capital Improvements

Preliminary recommendations and prioritization for planned capital improvements i.e. reconstruction, have been developed based on the condition rating and traffic demands on each road section, as per the Inventory Manual. Those roads identified as having a "NOW", 1–5 year, or 6–10 year need have been included in the capital improvement plan for reconstruction.

A total length of 20.1 km of roads were identified as having structural needs in the "NOW", 1–5 or 6-10 year periods. The estimated cost to improve these roads is approximately $1.9 M.

A fully funded 10 year plan following the recommendations in this report includes $644 K/year for resurfacing needs and $185 K/year for the capital needs over ten years.

An additional length of approximately 22.8 km of road is identified as having inadequate surface widths. Generally, provided no operational or safety concerns are identified, roads with surface width deficiencies are typically addressed / considered at the next full reconstruction cycle.

The time of inspection plays a significant role in assessing a road's condition. The field work for this study was carried out in August of 2023.

We trust the above and attached information will be of benefit to the Township and appreciate the opportunity to assist the Township in developing its road improvement plan.

Respectfully submitted,

Eric St. Pierre, P.Eng
Transportation Engineer

Turner Kuhlmeyer, EIT
Transportation Engineering Intern

Statement of Limitations

This report has been prepared by D.M. Wills Associates on behalf of the Township of Nipissing. The conclusions and recommendations in this report are based on available background documentation and discussions with applicable Township staff at the time of preparation.

The report is intended to document the 2023 Roads Needs Study Report findings and assist the Township in developing budgetary plans for investment into their road network.

Any use which a third party makes of this report, other than as a Road Needs Study Report is the responsibility of such third parties. D.M. Wills Associates Limited accepts no responsibility for damages, if any, suffered by a third party as a result of decisions made or action taken based on using this report for purposes other than as a summary of the 2023 Road Needs Study Report findings.

Appendix A

Unit Price Form

ROAD IMPROVEMENT COSTS
Nipissing Township

Unit Costs	Units	Unit Cost
Granular A	t	$15.00
Granular B	t	$15.00
Hot Mix	t	$210.00
Earth Excavation	m3	$20.00
Asphalt Removal	m2	$8.00
Asphalt Removal - Partial Depth	m2	$4.00
Removal of Concrete Curb & Gutter	m	$30.00
Concrete Curb & Gutter	m	$175.00
Pulverizing	m2	$0.50
Surface Treatment - Single	m2	$5.00
Surface Treatment - Double	m2	$9.25
Granular A Conversion	2.2	t/m3
Granular B Conversion	2	t/m3
Hot Mix Conversion	2.45	t/m3

Gravel (50mm)

Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*		*Quantity*	*Unit Cost*	*Cost/km, both lanes (x 1000)*
Granular A	7.0	150	2.2	t		2310	$15.00	$ 35
							G	**35**

Frost Heave Treatment

Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*		*Quantity*	*Unit Cost*	*Cost/50m Digout (x 1000)*
Earth Excavation	9.0	1000		m3		450	$20.00	$ 9
Granular A	7.5	150	2.2	t		123.75	$15.00	$ 2
Granular B	8.5	850	2	t		722.5	$15.00	$ 11
Minor Items @ 50%								$ 11
							FT	**33**

Surface Treatment - Rural/Semi Urban - Single [ST1]

Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*		*Quantity*	*Unit Cost*	*Cost/km, both lanes (x 1000)*
Surface Treatment - Single (Overlay)	7.0			m2		7000	$5.00	$ 35
							ST1	**35**

Surface Treatment - Rural/Semi Urban - Double [ST2]

Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*		*Quantity*	*Unit Cost*	*Cost/km, both lanes (x 1000)*
Surface Treatment - Double (Overla	7.0			m2		7000	$9.25	$ 65
							ST2	**65**

Surface Treatment - Rural/Semi Urban - Double with Removal of Existing [ST2R]

Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*	*Crossfall Correction*	*Quantity*	*Unit Cost*	*Cost/km, both lanes (x 1000)*
Surface Treatment - Double	7.0			m2		7000	$9.25	$ 65
Pulverizing	7.0	16		m2		7000	$0.50	$ 4
							ST2R	**68**

Surface Treatment - Rural/Semi Urban - Double with Granular Base [ST2A]

Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*	*Crossfall Correction*	*Quantity*	*Unit Cost*	*Cost/km, both lanes (x 1000)*
Surface Treatment - Double	7.0			m2		7000	$9.25	$ 65
Granular A	7.0	150	2.2	t		2310	$15.00	$ 35

Surface Treatment - Rural/Semi Urban - Double with Pulverization and Granular Base [ST2PA]								
Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*	*Crossfall Correction*	*Quantity*	*Unit Cost*	*Cost/km, both lanes (x 1000)*
Surface Treatment - Double	7.0			m2		7000	$9.25	$ 65
Granular A	7.0	150	2.2	t		2310	$15.00	$ 35
Pulverizing	7.0			m2		7000.0	$0.50	$ 4
Minor Items @ 25%								$ 1
							ST2PA	**104**

Surface Treatment - Rural/Semi Urban - Widening and Double with Pulverization and Granular Base [ST2PAW]								
Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*	*Crossfall Correction*	*Quantity*	*Unit Cost*	*Cost/km, both lanes (x 1000)*
Surface Treatment - Double	7.0			m2		7000	$9.25	$ 65
Granular A	7.0	150	2.2	t		2310	$15.00	$ 35
Pulverizing	7.0			m2		7000.0	$0.50	$ 4
Earth Excavation	2	450		m3		900	$20.00	$ 18
Granular B	1	450	2	t		900	$15.00	$ 14
Minor Items @ 25%								$ 9
							ST2PAW	**143**

Resurfacing - Rural/Semi Urban Single Lift Overlay [RO1]								
Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*	*Crossfall Correction ** *	*Quantity*	*Unit Cost*	*Cost/km, one lane (x 1000)*
Hot Mix	3	50	2.45	t	74	441	$210.00	$ 93
Granular A	1.5	50	2.2	t		165	$15.00	$ 2
Minor Items @ 15%								$ 14
							RO1	**109**

Resurfacing - Rural/Semi Urban - Double Lift Overlay [RO2]								
Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*	*Crossfall Correction ** *	*Quantity*	*Unit Cost*	*Cost/km, one lane (x 1000)*
Hot Mix	3	90	2.45	t	66	728	$210.00	$ 153
Granular A	1.5	90	2.2	t		297	$15.00	$ 4
Minor Items @ 15%								$ 24
							RO2	**181**

Resurfacing - Urban - Single Lift Mill and Pave [RMP1]								
Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*	*Crossfall Correction*	*Quantity*	*Unit Cost*	*Cost/km, one lane (x 1000)*
Hot Mix	4.25	50	2.45	t		521	$210.00	$ 109
Remove Curb and Gutter				m		200	$30.00	$ 6.00
Curb and Gutter - 20%				m		200	$175.00	$ 35.00
Milling	4.25			m2		4250	$4.00	$ 17.00
Minor Items @ 25%								$ 42
							RMP1	**209**

Resurfacing - Urban - Double Lift Mill and Pave [RMP2]								
Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*	*Crossfall Correction*	*Quantity*	*Unit Cost*	*Cost/km, one lane (x 1000)*
Hot Mix	4.25	90	2.45	t		937	$210.00	$ 197
Remove Curb and Gutter				m		200	$30.00	$ 6.00
Curb and Gutter - 20%				m		200	$175.00	$ 35.00
Milling	4.25			m2		4250	$4.00	$ 17.00
Minor Items @ 25%								$ 64
							RMP2	**318**

Pulverize and Pave One Lift [PP1] Rural/Semi-Urban								
Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*	*Crossfall Correction*	*Quantity*	*Unit Cost*	*Cost/km, one lane (x 1000)*
Hot Mix	3	50	2.45	t		367.5	$210.00	$ 77
Granular A	1.5	50	2.2	t		165	$15.00	$ 2
Pulverize	3			m2		3000	$0.50	$ 1.50
Minor Items @ 25%								$ 20
							PP1	**101**

Pulverize and Pave Two Lifts [PP2] Rural/Semi-Urban								
Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*	*Crossfall Correction*	*Quantity*	*Unit Cost*	*Cost/km, one lane (x 1000)*
Hot Mix	3	90	2.45	t		661.5	$210.00	$ 139
Granular A	1.5	90	2.2	t		297	$15.00	$ 4
Pulverize	3			m2		3000	$0.50	$ 2
Minor Items @ 25%								$ 36
							PP2	**181**

Semi-Urban: Resurfacing and Widening - Residential (Single Lift Widening)								
Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*	*Crossfall Correction *****	*Quantity*	*Unit Cost*	*Cost/km, one side (x 1000)*
Earth Excavation	2	600		m3		1200	$20.00	$ 24
Granular A	5	150	2.2	t		1650	$15.00	$ 25
Granular B	5	450	2	t		4500	$15.00	$ 68
Hot Mix	8	50	2.45	t	196	1176	$210.00	$ 247
Milling	4			m2		4000	$4.00	$ 16
Minor Items @ 25%								$ 95
							RW1	**474**

Commercial and Industrial (Double Lift Widening)								
Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*	*Crossfall Correction*	*Quantity*	*Unit Cost*	*Cost/km, one side (x 1000)*
Earth Excavation	2	600		m3		1200	$20.00	$ 24
Granular A	5	150	2.2	t		1650	$15.00	$ 25
Granular B	5	450	2	t		4500	$15.00	$ 68
Hot Mix	8	90	2.45	t	353	2117	$210.00	$ 445
Milling	4			m2		4000	$4.00	$ 16
Minor Items @ 25%								$ 144
							RW2	**721**

Gravel Road Widening

Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*	*Crossfall Correction*	*Quantity*	*Unit Cost*	*Cost/km, one side (x 1000)*
Earth Excavation	2	600		m3		1200	$20.00	$ 24
Granular A	1	150	2.2	t		330	$15.00	$ 5
Granular B	1	450	2	t		900	$15.00	$ 14
Minor Items @ 25%								$ 11
							GW	**53**

Rural: Full Excavation and Reconstruction - Gravel (6 m surface width)

Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*	*Crossfall Correction*	*Quantity*	*Unit Cost*	*Cost/km, one lane (x 1000)*
Earth Excavation	5	600		m3		3000	$20.00	$ 60
Granular A	3	150	2.2	t		990	$15.00	$ 15
Granular B	5	450	2	t		4500	$15.00	$ 68
Minor Items @ 25%								$ 36
							Recon G	**178**

Rural: Full Excavation and Reconstruction - 1 Lift

Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*	*Crossfall Correction*	*Quantity*	*Unit Cost*	*Cost/km, one lane (x 1000)*
Asphalt Removal - Full Depth	3			m2		3000	$8.00	$ 24
Earth Excavation	5	600		m3		3000	$20.00	$ 60
Granular A	4	150	2.2	t		1320	$15.00	$ 20
Granular B	5	450	2	t		4500	$15.00	$ 68
Hot Mix	3	50	2.45	t		368	$210.00	$ 77
Minor Items @ 25%								$ 62
							Recon 1R	**311**

Semi-Urban: Full Excavation and Reconstruction - 1 Lift

Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*	*Crossfall Correction*	*Quantity*	*Unit Cost*	*Cost/km, one lane (x 1000)*
Asphalt Removal - Full Depth	3			m2		3000	$8.00	$ 24
Earth Excavation	5	600		m3		3000	$20.00	$ 60
Granular A	4	150	2.2	t		1320	$15.00	$ 20
Granular B	5	450	2	t		4500	$15.00	$ 68
Hot Mix	3	50	2.45	t		368	$210.00	$ 77
Minor Items @ 25%								$ 62
							Recon 1S	**311**

Semi-Urban: Full Excavation and Reconstruction - 2 Lift

Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*	*Crossfall Correction*	*Quantity*	*Unit Cost*	*Cost/km, one lane (x 1000)*
Asphalt Removal - Full Depth	3			m2		3000	$8.00	$ 24
Earth Excavation	5	600		m3		3000	$20.00	$ 60
Granular A	4	150	2.2	t		1320	$15.00	$ 20
Granular B	5	450	2	t		4500	$15.00	$ 68
Hot Mix	3	90	2.45	t		662	$210.00	$ 139
Minor Items @ 25%								$ 78
							Recon 2S	**388**

Urban: Full Excavation and Reconstruction - 2 Lift

Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*	*Crossfall Correction*	*Quantity*	*Unit Cost*	*Cost/km, one lane (x 1000)*
Asphalt Removal - Full Depth	4.25			m2		4250	$8.00	$ 34
Earth Excavation	5.5	750		m3		4125	$20.00	$ 83
Granular A	4.5	150	2.2	t		1485	$15.00	$ 22
Granular B	5.5	600	2	t		6600	$15.00	$ 99
Hot Mix	4.25	90	2.45	t		937	$210.00	$ 197
Remove Curb and Gutter				m		1000	$30.00	$ 30.00
Curb and Gutter				m		1000	$175.00	$ 175.00
Minor Items @ 25%								$ 109
							Recon 2U	**748**

Rout and Seal

Item				*Unit*		*Quantity*	*Unit Cost*	*Cost/km, both lanes (x 1000)*
Rout and Seal				m		1000	$4.00	$ 4
							RS	**4**

Slurry Seal

Item	*Width - m*			*Unit*		*Quantity*	*Unit Cost*	*Cost/km, both lanes (x 1000)*
Slurry Seal	7			m2		7000	$3.15	$ 22
							SS	**22**

Microsurfacing

Item	*Width - m*			*Unit*		*Quantity*	*Unit Cost*	*Cost/km, both lanes (x 1000)*
Microsurfacing	7			m2		7000	$6.00	$ 42
							MS	**42**

Appendix B

Inadequate Surface Widths

Township of Nipissing

Inadequate Surface Width

Sect. No.	Road Name	From	To	Length (km)	AADT	Surface Width (m)	Surface Width Required (m)
60	GRANITE HILL ROAD	2.94 KM WEST OF HIGHWAY 522	RYE ROAD	2.58	50	3	5.5
137	SPRUCEDALE ROAD	0.93KM WEST OF BUTTERFIELD ROAD	BLACK CREEK ROAD N	1.12	50	2.5	5.5
79	JONES ROAD	SUNSET COVE ROAD	SOUTH END	0.55	100	5	5.5
121	RYE ROAD	1.91 KM EAST OF BOOTH ROAD	GRANITE HILL ROAD	0.66	50	3.5	5.5
46	BYERS ROAD	HIGHWAY 654	WEST END	0.55	50	5	5.5
23	BEAR CREEK ROAD	UNNAMED PRIVATE ROAD	ROCKVIEW ROAD	0.09	100	4	5.5
57	FRONT STREET	BLAKE STREET	BEATTY STREET	0.30	100	4	5
124	RYE ROAD	GRANITE HILL ROAD	TOWNSHIP BOUNDARY	2.12	23	3.5	5
53	DOWDELL ROAD	STILLAR SIDE ROAD	WEST END	1.11	50	3	5.5
68	HAMILTON FARM ROAD	0.32 KM NORTH OF ARMSTRONG ROAD	1.66 KM NORTH OF ARMSTRONG ROAD	1.33	50	3	5.5
66	ARMSTRONG ROAD	HIGHWAY 534	HAMILTON FARM ROAD	1.00	50	3	5.5
142	STORIES ROAD	ALSACE ROAD	SOUTH END	1.26	50	4.5	5.5
93	MCQUABY LAKE ROAD	HIGHWAY 534	WEST END	0.28	50	4	5.5
100	OLD NIPISSING ROAD N	HIGHWAY 522	NORTH END	0.24	50	4	5.5
116	PROMISED LAND ROAD	LAKE NIPISSING ROAD	EAST END	0.76	50	5	5.5
43	BUSCHS MILL ROAD	ALSACE ROAD	NORTH END	0.33	50	4	5.5
52	CULHAMS ROAD WEST	HIGHWAY 654	WEST END	1.11	50	5	5.5
130	SIMPSON HILL ROAD	STILLAR SIDE ROAD	WEST END	0.64	50	4	5.5
59	GRANITE HILL ROAD	HIGHWAY 522	2.94 KM WEST OF HIGHWAY 522	2.95	50	5	5.5
49	CHAPMANS LANDING ROAD	CHAPMAN'S LANDING ROAD	WEST END	0.61	50	5	5.5
128	SETTLERS ROAD	HIGHWAY 534	EAST END	1.04	50	4.5	5.5
20	BARBER VALLEY ROAD	HIGHWAY 534	NORTH END	1.33	50	5	5.5