Road Needs Study Report - 2016

Township of Cavan Monaghan

D.M. Wills Project No.16-4597

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PARTNERS IN ENGINEERING

Peterborough
North Bay

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Prepared for
Township of Cavan Monaghan

Executive Summary

The Township of Cavan Monaghan (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 complete road infrastructure system spans a total of 239 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 32 km of gravel roads, 183 km of surface treated roads (Low class bituminous (LCB)), and 24 km of hot mix asphalt paved roads (high class bituminous (HCB)).

An overall road system adequacy has been calculated, consistent with the Ministry of Transportation's (MTO) Inventory Manual for Municipal Road (February 1991) (Inventory Manual) based on a number of road characteristics including:

- Capacity
- Geometrics
- Surface Condition
- Shoulder and Road Widths
- Structural Adequacy
- Drainage
- Maintenance Demand

The overall system adequacy for the 2016 Road Needs Assessment is 65%, considering roads with greater than 50 AADT, per the Inventory Manual methodology.

It should be noted that a significant portion of the roads identified as deficient are such due to inadequate surface widths or surface types; their overall structural adequacy generally being good. These road(s) sections are identified in the document.

The overall system adequacy, excluding roads with inadequate surface widths or surface types, is 92%.

Roads with less than 50 AADT (Annual Average Daily Traffic) exhibiting deficiencies are also identified in this document, however, are excluded from the system adequacy calculations as per the inventory manual methodology.

Capital Improvements

Prioritization and recommendations for planned capital improvements have been developed based on the condition rating and traffic demands on each road. Those roads identified as having a "NOW" or 1-5 year need have been included in the capital improvement plan for reconstruction.

A total length of approximately 66 km of roads were identified as having surface type or structural needs in the "NOW," or 1 – 5 year periods. The estimated cost to improve these roads is approximately $ 10.5 M. An additional length of approximately 68 km of road is identified as having inadequate surface widths or surface type. Generally, provided no operational or safety concerns are identified, roads with surface width and/or type deficiencies are typically addressed / considered at the next full reconstruction cycle.

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. Ultimately the goal of preservation management is to extend the useful life of a road, maximizing the municipality's investment over the road life-cycle.

Road resurfacing is an effective way of extending the overall life of the pavement structure. A road resurfacing program is therefore recommended in addition to capital improvements.

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

Hot Mix Paved Roads:

- 24.4 km of paved roads (HCB).
- Degradation rate 0.25 / year (rating drops from 10 to 5, over a 20-year period).
- Annual resurfacing 1.2 km / year.
- **Annual budget $333,600**: (1.2 km / year x $139,000 / ln **RMP1** x 2 lanes).

Surface Treated Roads:

- 182.8 km of surface treated roads (LCB).
- Degradation rate 0.625 / year (rating drops from 10 to 5, over a 7-year period).
- Annual resurfacing 26.1 km / year.
- **Annual budget $652,500** (26.1 km / year x $25,000 / 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:

- 32.4 km of earth / gravel roads.
- 75mm gravel every 3-5 years.

- Annual gravelling of 10.8 km.
- Granular A ($12,000 / km).
- **Annual budget $129,600** (10.8 km / year x $12,000 **G**) **.

*** Cost based on supply and application of gravel by external forces.*

The total resurfacing program, (hot mix, surface treatment and gravel) is estimated at $1,115,700 per year.

The time of inspection plays a significant role in assessing a road's condition. Certain deficiencies, particularly for gravel roads, typically manifest during the "spring break-up" period. By midsummer, any evidence to suggest these deficiencies may have disappeared due to regular grading and grooming activities and general drying of the roadbed. The field work for this study was carried out in September 2016, by which time the municipality had already completed spring grading. Recently graded roads may be rated higher than their actual structural adequacy.

Further, it is recommended that regular maintenance in the form of roadside ditch cleanout and clearing be undertaken in order to extend the useful service life of the existing roads.

Road System Inventory

Township of Cavan Monaghan Road System in Kilometers (As of September 2016)		
A.	**Surface Type**	**Totals***
	Earth	0
	Gravel (loose Top Gravel)	32
	Surface Treatment (LCB & ICB)	183
	Hot Mix Asphalt (HCB)	24
	Total A	**239 km**
B.	**Roadside Environment**	
(i)	**Rural**	
	Earth	0
	Gravel (loose Top Gravel)	32
	Surface Treatment (LCB & ICB)	178
	Hot Mix Asphalt (HCB)	19
	Total Rural	**229 km**
(ii)	**Semi-Urban**	
	Gravel (loose Top Gravel)	0
	Surface Treatment (LCB)	5
	Hot Mix Asphalt (HCB)	2
	Total Semi-Urban	**7 km**
(iii)	**Urban**	
	Gravel (loose Top Gravel)	0
	Surface Treatment (LCB)	0
	Hot Mix Asphalt (HCB)	3
	Total Urban	**3 km**
	Total B	**239 km**
**Estimated to the nearest kilometre.*		

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1.0 Purpose, Background and Study Method

1.1 Purpose

The purpose of the 2016 Road Needs Study Report is to update the current road inventory and road condition assessments within the Township of Cavan Monaghan (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 budget.

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 and sidewalk network needs, the results of which are documented in this report.

1.2 Background

The Township of Cavan Monaghan is located in Peterborough County and is bisected by Highway 115. The Village of Millbrook is the Township's largest and main population centre. Outside of Millbrook, the Township is largely rural with some scattered semi-urban developments.

In 2010, a Road Needs Study Report was performed to inventory and document the Township's existing road assets. Additionally, in 2013 an Asset Management Plan was produced, which included an updated road asset inventory. This current study (2016) utilizes and builds from the road asset information documented in both the 2010 Road Needs Study, and the 2013 Asset Management Plan.

1.3 Study Objectives

Based on the Request for Proposal and 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.

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 generally in accordance with the Ministry of Transportation's Inventory Manual for Municipal Roads (February 1991).

During the field study the following road characteristics were reviewed and 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

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 (1) 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.

<u>Surface Type</u>

The following parameters were used to assess the adequacy of the road surface type. Roads with traffic volumes (AADT) in excess of the values recommended below for various surface types were noted as critically deficient triggering a "Now" need.

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

AADT	Surface Type Recommended
0 – 200	Gravel (G)
201 – 400	Low Class Bituminous (LCB)
> 400	High Class Bituminous (HCB)

Note that these ranges are guidelines and not necessarily meant to be rigidly applied. If a Low Class Bituminous (LCB) road has a higher than recommended AADT (Annual Average Daily Traffic), but is performing at a desirable level, it may not need to be upgraded to High Class Bituminous (HCB). Similarly, if a section of gravel road requires excessive maintenance (for example, on steep grades); LCB may be justified at lower traffic levels. Additionally, urban roads may require consideration for HCB surfaces to support drainage infrastructure i.e. curb & gutter, despite having low AADT.

Surface Width

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

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.

Structural Adequacy

In cases where road base or structure is showing distress over more than 20% of the length of the road section, a "Now" need is assessed.

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 50% of the frontage) without curb and gutter or curb and gutter on one (1) 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, traffic volumes were adopted or estimated from existing traffic data, and previous estimates provided by the Township.

Table 2 summarizes the total road length in kilometres by surface type and road environment as of September, 2016.

The existing road system consists of 239 km of roadway, 32 km of gravel roads, 183 km of surface treated roads (LCB) and 24 km of HCB (asphalt paved) roads; with all calculations being approximate and rounded to the nearest kilometre.

Table 2 - Road System Inventory

Township of Cavan Monaghan Road System in Kilometres (As of September 2016)		
A.	**Surface Type**	**Totals***
	Earth	0
	Gravel (loose Top Gravel)	32
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	Total A	**239 km**
B.	**Roadside Environment**	
(i)	**Rural**	
	Earth	0
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	Gravel (loose Top Gravel)	0
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(iii)	**Urban**	
	Gravel (loose Top Gravel)	0
	Surface Treatment (LCB)	0
	Hot Mix Asphalt (HCB)	3
	Total Urban	**3 km**
	Total B	**239 km**
**Estimated to the nearest 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 239 km of roads inventoried, a total of 90 km were found to be critically deficient in one (1) or more areas. Of the 90 km, approximately 7 km represents roads with AADT of less than 50 vehicles. Regardless of condition, roads with AADT of fifty (50) or less are typically assigned as “Adequate” (as per the Ministry protocol) for the purpose of the system adequacy calculation.

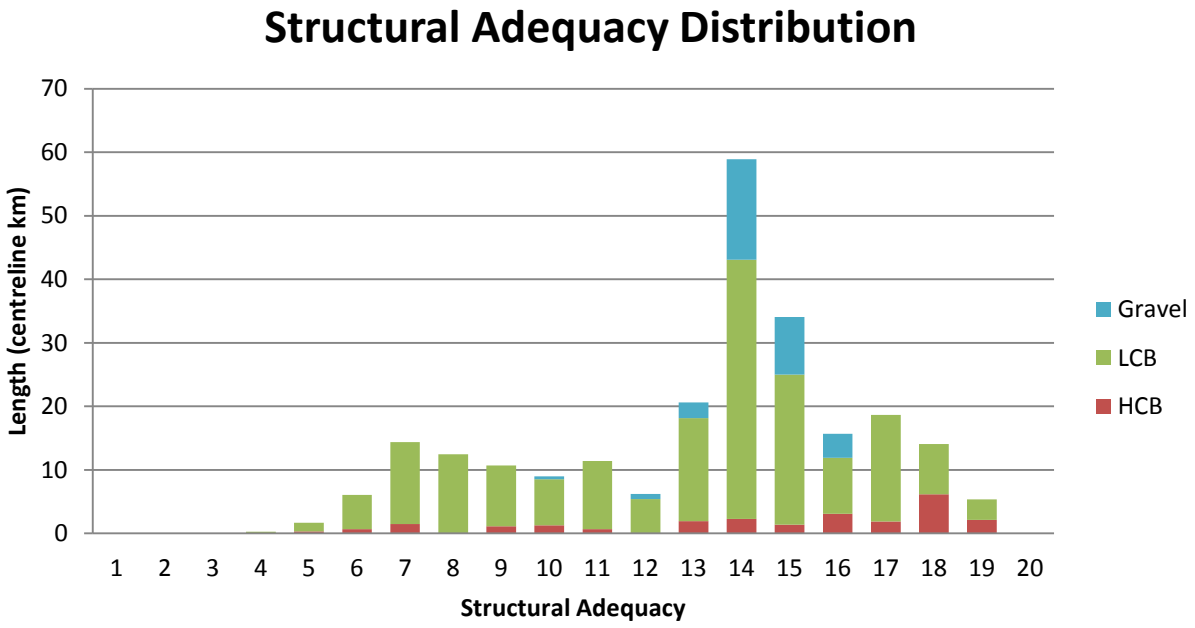
The overall system adequacy for the Township's road network, which is based upon the total road kilometres less the identified critically deficient ("NOW" needs) roads, is as follows:

$$\textbf{2016 System Adequacy} = \frac{239 - (90 - 7)}{239} \times 100\% = 65\%$$

The average surface condition rating of all roads is 7.4/10 while the average structural adequacy rating is 13.2/20. 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.

Looking at the structural adequacy distribution of the township's roads paints a slightly different picture. A group of roads, over 60%, are in good condition (structural adequacy of 14 and over), and with regular resurfacing and preservative maintenance, should not require reconstruction in the next 10 years. The remaining 40% of the road network, on the other hand, is well distributed over the very poor to fair range (structural adequacy from 4 to 13). Most of these roads will require reconstruction over the next 10 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 good roads from becoming capital needs themselves.



3.2 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").

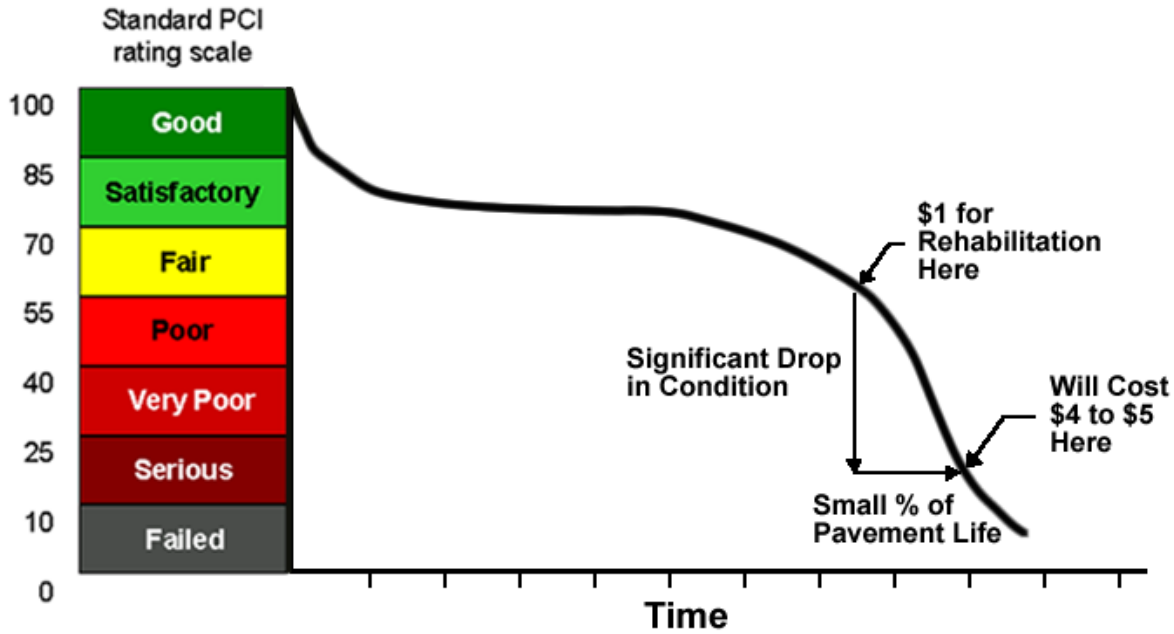
4.0 Roads Best Management Practices

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 **Figure 1** and are provided as an illustration of the benefit of a "preservation management approach".

Figure 1- Typical Service Life of an Asphalt Pavement



4.1 Example Life Cycle Cost Analysis

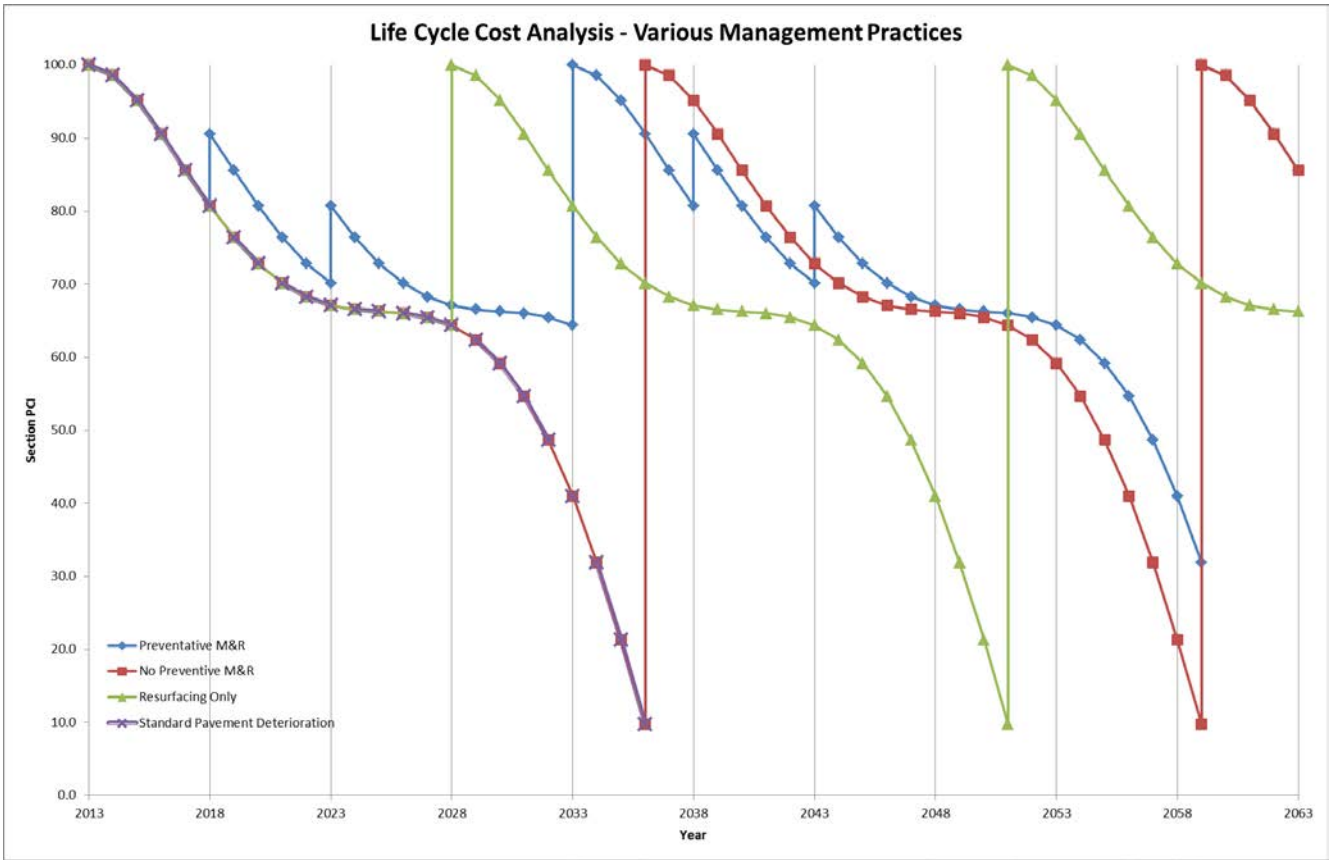
The following life cycle costs analysis compares three (3) different municipalities Municipality 1, Municipality 2 and Municipality 3; each with three (3) distinct approaches to pavement management. For this analysis we will assume each of the three (3) municipalities has 7000 m^2 of pavement, i.e. 1 km of asphalt paved road that is 7 m wide. In each scenario, the road is assumed to have been constructed in 2013 and will operate under normal traffic loading.

The Life Cycle Cost Analysis (LCCA) assumes no user costs. The LCCA uses a discount rate of 2.5% / year.

The LCCA shows the three (3) different municipalities and tracks their pavement management decisions and related condition over the specified time period. Municipality 1 represents decisions made based on strategic preventive maintenance and rehabilitation (M&R), Municipality 2 represents decisions based on no preventive M&R and Municipality 3 represents decisions based on resurfacing only.

Figure 2 below illustrates a time- pavement condition plot for each municipality.

Figure 2 - Time-Condition Plot for 3 Municipalities



The costs associated with the corresponding maintenance and rehabilitation decisions are outlined in the following three (3) tables:

Preventive M&R									
Year	**Age**	**Treatment**	**Δ PCI**	**PCI_q**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**	**Present Worth**
		-- Annual Ditching/Clearing --							
2018	**5**	**Localized Preventive - Rout and Seal**	81-90	Satisfactory-Good	1000	m	$1.50	$1,500.00	**$1,325.78**
2023	**10**	**Global Preventive - Slurry Seal**	70-81	Satisfactory-Good	7000	m^2	$6.50	$45,500.00	**$35,544.53**
2033	**20**	**Surface Course**	64-100	Poor-Good					
		Mill and Dispose of Surface Course			7000	m^2	$12.00	$84,000.00	
		50mm Surface Course			892.5	t	$135.00	$120,487.50	
								$204,487.50	**$124,792.78**
2038	**25**	**Localized Preventive - Rout and Seal**	81-88	Satisfactory-Good	4500	m	$1.50	$6,750.00	**$3,640.89**
2043	**30**	**Global Preventive - Slurry Seal**	68-78	Satisfactory-Good	7000	m^2	$6.50	$45,500.00	**$21,691.79**
2048	**35**	**Safety/Stopgap Maintenance - AC Patching/Leveling**	N/A	N/A	5%	m^2	$30.00	$10,500.00	**$4,424.40**
2053	**40**	**Safety/Stopgap Maintenance - AC Patching/Leveling**	N/A	N/A	10%	m^2	$30.00	$21,000.00	**$7,821.04**
2058	**45**	**Full Reconstruction**	32-100	Serious-Good					
		Remove Asphalt Full Depth			7000	m^2	$15.00	$105,000.00	
		Add and Compact Corrective Aggregate/Correct Crossfall (25mm avg.)			420	t	$35.00	$14,700.00	
		40mm Base Course			686	t	$125.00	$85,750.00	
		50mm Surface Course			892.5	t	$135.00	$120,487.50	
								$325,937.50	**$107,290.28**
2063	**5**	**Localized Preventive - Rout and Seal**	81-90	Satisfactory-Good	1000	m	$1.50	$1,500.00	**$436.41**
		Final PCI in 2063:	**90**	**Good**				**Net:**	**$306,967.90**
								Residual Value:	**$85,346.08**
								Total Cost:	**$221,621.82**

The policy of Municipality 1 is to strategically intervene with preventative maintenance measures over the course of the pavement's service life. Two (2) significant maintenance measures are performed on the pavement at various times and ultimately extend the service life of the pavement, prorating the total cost of the pavement over a longer period of time. Eventually, a full reconstruction is required and this cycle repeats. The total life cycle costs are substantially less when compared to Municipality 2 and 3, at a total of $221,622 over 50 years.

No Preventive M&R									
Year	**Age**	**Treatment**	**Δ PCI**	**PCI_q**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**	**Present Worth**
2023	**10**	**Safety/Stopgap Maintenance - AC Patching/Leveling**	N/A	N/A	5%	m^2	$30.00	$10,500.00	**$8,202.58**
2028	**15**	**Safety/Stopgap Maintenance - AC Patching/Leveling**	N/A	N/A	10%	m^2	$30.00	$21,000.00	**$14,499.78**
2030	**17**	**Safety/Stopgap Maintenance - AC Patching/Leveling**	N/A	N/A	20%	m^2	$30.00	$42,000.00	**$27,602.19**
2036	**23**	**Full Reconstruction**	10-100	Poor-Good					
		Remove Asphalt Full Depth			7000	m^2	$15.00	$105,000.00	
		Add and Compact Corrective Aggregate/Correct Crossfall (25mm avg.)			420	t	$35.00	$14,700.00	
		40mm Base Course			686	t	$125.00	$85,750.00	
		50mm Surface Course			892.5	t	$135.00	$120,487.50	
								$325,937.50	**$184,707.88**
2043	**7**	**Safety/Stopgap Maintenance - AC Patching/Leveling**	N/A	N/A	5%	m^2	$30.00	$10,500.00	**$5,005.80**
2048	**12**	**Safety/Stopgap Maintenance - AC Patching/Leveling**	N/A	N/A	10%	m^2	$30.00	$21,000.00	**$8,848.79**
2053	**17**	**Safety/Stopgap Maintenance - AC Patching/Leveling**	N/A	N/A	20%	m^2	$30.00	$42,000.00	**$15,642.09**
2059	**23**	**Full Reconstruction**	10-100	Poor-Good					
		Remove Asphalt Full Depth			7000	m^2	$15.00	$105,000.00	
		Add and Compact Corrective Aggregate/Correct Crossfall (25mm avg.)			420	t	$35.00	$14,700.00	
		40mm Base Course			686	t	$125.00	$85,750.00	
		50mm Surface Course			892.5	t	$135.00	$120,487.50	
								$325,937.50	**$104,673.45**
		Final PCI in 2063:	**86**	**Good**				**Net:**	**$369,182.56**
								Residiual Value:	**$81,552.92**
								Total Cost:	**$287,629.64**

The policy of Municipality 2 is to simply construct the pavement and wait until serious deficiencies begin to appear before acting. This approach unfortunately remains common still today. Over the last period of the pavement's life, maintenance is required to ensure safety and operation until the pavement becomes completely destroyed. Once the pavement has failed, a complete reconstruction is carried out restoring the pavement to new condition. This cycle repeats again until a second reconstruction is required. The total costs are substantial and total $287,630 over 50 years.

Resurfacing Only									
Year	**Age**	**Treatment**	**Δ PCI**	**PCI_q**	**Quantity**	**Unit**	**Unit Cost**	**Total Cost**	**Present Worth**
2028	**15**	**Surface Course**	64-100	Poor-Good					
		Mill and Dispose of Surface Course			7000	m^2	$12.00	$84,000.00	
		50mm Surface Course			892.5	t	$135.00	$120,487.50	
								$204,487.50	**$141,191.58**
2051	**23**	**Full Reconstruction**	10-100	Serious-Good					
		Remove Asphalt Full Depth			7000	m^2	$15.00	$105,000.00	
		Add and Compact Corrective Aggregate/Correct Crossfall (25mm avg.)			420	t	$35.00	$14,700.00	
		40mm Base Course			686	t	$125.00	$85,750.00	
		50mm Surface Course			892.5	t	$135.00	$120,487.50	
								$325,937.50	**$127,534.43**
2067	**15**	**Surface Course**	64-100	Poor-Good					
		Mill and Dispose of Surface Course			7000	m^2	$12.00	$84,000.00	
		50mm Surface Course			892.5	t	$135.00	$120,487.50	
								$204,487.50	**$53,898.67**
		Final PCI in 2063:	**66**	**Good**				**Net:**	**$322,624.67**
								Residiual Value:	**$62,587.12**
								Total Cost:	**$260,037.55**

The policy of Municipality 3 is periodic resurfacing. The pavement is constructed and time passes until early signs of serious distress are observed. This occurs after the time when preventive maintenance is neither appropriate nor possible, but before the pavement becomes completely destroyed. Resurfacing is performed and restores the pavement to almost new condition. The pavement then deteriorates for the remainder of its life, requiring significant maintenance in the last years before it becomes completely destroyed. A full reconstruction is then carried out and the cycle continues. The total costs are in between that of Municipality 1 and 2 at $260,038 over 50 years.

It may be easy to see upfront cost savings by understanding that as long as any costs associated with maintaining the pavement are deferred as long as possible, money will be saved. The reality is that extending a pavements service life prorates the total cost of the pavement over a longer period of time and ultimately becomes more economical in the long run. If preventive maintenance measures are strategically planned and carried out then the service life of the pavement can be maximized and substantial reconstruction costs can be deferred for longer periods of time. In a time when economy and efficiency are becoming more and more important, this type of proactive management is essential in the management of infrastructure.

4.2 Preservation Management Approach

4.2.1 Gravel Roads

The Township currently maintains approximately 32 km of gravel road. The proposed preservation management approach for this class of road is outlined in the following Table 3 and **Table 4.**

Table 3 - Preservation Management Approach- Gravel Surface

Action	Frequency
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.
Add calcium to tighten surface, retain aggregate and reduce dust.	Each spring on all roads of higher volume and as needed during summer months.
Ditching and brushing of right-of-ways to improve roadbed drainage and safety.	Complete road network every 10 years.

Table 4 - Capital Activities – Gravel Roads

Action	Frequency
Add layer (75 mm) of granular material to road surface.	Every 3-5 years for gravel roads.
Base and sub-base improvements.	As needed or as dictated by traffic volumes.
Reconstruct / convert to hard top.	As dictated by traffic volumes.

4.2.2 Surface Treated Roads

Surface treated roads have a hard wearing surface that must be preserved in order to be effective. The Township currently maintains 183 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 5 - Preservation Management Approach – Surface Treated Roads

Activity	Age (Years)	Ride Condition Rating	Estimated Service Life Extension (Years)
Slurry Seal	3	8	4
Slurry Seal	6	7	3
Double Surface Treatment	10	6	5
Pulverize and DST	14	<4	8

In addition to the above noted preservation approach in **Table 5**, the following best management practices may be employed to preserve the surface, extend the service life and reduce life cycle costs of surface treated roads:

1. Surface treatment shall be applied to the entire road platform, from "grass to grass", including any shoulders. This will eliminate grading on surface treated roads, which has a tendency to damage the edge of the surface treatment and cause premature failure of the surface.
2. Suitable new technologies will be utilized where they can be demonstrated to reduce life cycle costs, such as fibre-reinforced surface treatment. This technology can be used to mitigate reflective cracking (if cracks are narrow and inactive) when a single or double surface treatment is applied over an aging surface. It can eliminate the need for pulverizing the underlying surface in certain situations and can reduce overall costs.
3. Assess drainage and culvert needs prior to any significant renewal or rehabilitation strategy and complete any improvements concurrently. This will eliminate the need to cut / excavate a relatively new surface to replace a culvert.
4. Ditching and clearing (brushing) of the right-of-ways (ROW) to improve roadbed drainage and safety.

4.2.3 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 24 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 6** below summarizes preservation management activities to be considered for asphalt roads:

Table 6 - Preservation Management Approach – Rural Asphalt Roads

Activity	Age (Years)	Ride Condition Rating	Estimated Service Life Extension (years)
Crack seal	2-6	9	2
Slurry Seal / Microsurface	4-8	8	4-6
Overlay	12-15	6-7	10
Pulverize and Pave	20-25	< 5	20
Reconstruct	30	< 4	30

Note: 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.

In addition to the above noted preservation approach, the following best management practices may be employed to extend the service life and reduce life cycle costs of asphalt roads:

1. Review the condition of other infrastructure, particularly underground infrastructure prior to implementing any major renewal or rehabilitation of the pavement. Any repairs or capital upgrades to other infrastructure should be coordinated. This should reduce utility cuts in newer asphalt.
2. Repair potholes in the surface in a timely fashion to prevent saturation and weakening of road base.
3. Undertake regular shouldering program of rural paved roads to promote proper drainage. Poorly maintained shoulders allow surface water to pond and saturate the road base, which weakens the base and leads to cracking at the edge of pavements.
4. Undertake a ditching program to ensure there is adequate drainage for road base on rural roads. This will reduce the likelihood of structural distresses caused by softening of the road base due to poor drainage.
5. Specify the appropriate type of performance graded asphalt cement for the location.
6. Undertake a clearing program to reduce shading of the roadbed and remove roots / vegetation from the road base.

4.3 Application of Preservation Management Approach

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 five (5) years. Recommendations on the specific treatments required shall be documented and prioritized in this Report.

5.0 Road Needs Study Summary Table

5.1 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.

5.1.1 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.

Upgrade 2U Excavate and Upgrade to Urban Cross-Section 2 Lifts – Urban.

SS Slurry Seal (Preventative Maintenance)

MS Microsurfacing (Preventative Maintenance)

RS Route and Seal (Preventative Maintenance)

5.1.2 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)

5.1.3 Gravel

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

5.2 Benchmark Construction Costs

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

For the Township of Cavan Monaghan, the following design standards, **Table 7,** were utilized for development of the benchmark cost estimate 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 7 - 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	1.5	150	450	50
Semi - Urban Local Industrial	6.5	1.5	150	450	50
Urban Local Residential	8.5	-	150	450	100
Urban Local Industrial	9.0	-	150	450	100

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

6.0 Improvement Plan

6.1 Road Needs

The Road Needs Summary Table is included on the next page, **Table 8** noting the recommended Capital Construction Plan in terms of priorities throughout the Township. AADT is based on previous counts / estimates provided by the Township. All costs are based on 2016 dollars and should be adjusted for inflation based on program year, for budgeting purposes. The capital improvements are listed based on need (NOW, 1-5 years, 6-10 years, surface upgrades and widening) and in descending priority based on traffic volumes and Condition Rating, as described previously.

Table 8 - Township of Cavan Monaghan Road Needs – Capital Reconstruction

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Structural Adequacy	Surface Type Need	Surface Width Need
1410	Hay St	Anne St	King Street West	0.10	595	*Recon 1R - Full Reconstruction + 1 Lift*	*$34*	NOW	ADEQ	ADEQ
1575	Larmer Li	Hutchinson Dr	1820m East	1.82	342	*ST2A - Double Surface Treatment with Granular A*	*$160*	NOW	ADEQ	ADEQ
1180	Cathcart Cr	Stewart Li	Highway 7	1.15	350	*ST2A - Double Surface Treatment with Granular A*	*$101*	NOW	ADEQ	ADEQ
1905	Syer Li	Highview Cres	Tapley 1/4 Li	1.18	227	*ST2A - Double Surface Treatment with Granular A*	*$104*	NOW	ADEQ	ADEQ
1580	Larmer Li	Cty Rd 28	925m West	0.93	342	*ST2A - Double Surface Treatment with Granular A*	*$81*	NOW	ADEQ	ADEQ
1895	Syer Li	Highway 115 Ramp	Hutchinson Dr	3.50	566	*ST2PAW - Widening by 1 m, Double Surface Treatment, with Pulverization of Existing and Granular A*	*$438*	1-5	NOW	NOW
1420	Hayes Li	Cnty Rd 10	Howden 1/4 Unopened	3.50	284	*ST2A - Double Surface Treatment with Granular A*	*$308*	NOW	ADEQ	ADEQ
2000	Whitfield Rd	Cty Rd 28	740m East	0.74	375	*ST2A - Double Surface Treatment with Granular A*	*$65*	1-5	ADEQ	ADEQ
1415	Hayes Li	Howden 1/4 Unopened	Highway 7	2.80	559	*ST2A - Double Surface Treatment with Granular A*	*$247*	1-5	NOW	ADEQ
1890	Syer Li	Hutchinson Dr	Cnty Rd 28	2.85	633	*ST2PAW - Widening by 1 m, Double Surface Treatment, with Pulverization of Existing and Granular A*	*$357*	1-5	NOW	NOW
1540	Johnston Dr	Worboy Ct	Carolyn St	0.42	400	*Recon 1R - Full Reconstruction + 1 Lift*	*$149*	NOW	ADEQ	ADEQ
1570	Larmer Li	Highway 115	Cnty Rd 10	1.30	397	*ST2A - Double Surface Treatment with Granular A*	*$114*	1-5	ADEQ	ADEQ

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Structural Adequacy	Surface Type Need	Surface Width Need
1365	Fallis Li	Tapley 1/4 Line	Valleyview Drive East	1.37	527	*ST2PAW - Widening by 1 m, Double Surface Treatment, with Pulverization of Existing and Granular A*	*$172*	6 - 10	NOW	NOW
1060	Beardsmore Dr	Cnty Rd 11	Johnston Dr	1.55	400	*ST2PAW - Widening by 1 m, Double Surface Treatment, with Pulverization of Existing and Granular A*	*$194*	NOW	ADEQ	NOW
1690	Morton Li	Highway 7A	520m West	0.52	254	*ST2PAW - Widening by 1 m, Double Surface Treatment, with Pulverization of Existing and Granular A*	*$65*	NOW	ADEQ	NOW
1425	Hayes Li	Jones 1/4 Line	Cnty Rd 10	3.50	252	*ST2A - Double Surface Treatment with Granular A*	*$308*	NOW	ADEQ	ADEQ
1520	Hutchison Dr	Deyell Li	Zion Li	1.51	162	*ST2A - Double Surface Treatment with Granular A*	*$133*	NOW	ADEQ	ADEQ
2010	Whittington Dr	750m East	East End	0.75	210	*Recon 1R - Full Reconstruction + 1 Lift*	*$266*	NOW	ADEQ	ADEQ
1970	Valley Rd	Larmer Li	Tapley 1/4 Li	2.20	185	*ST2A - Double Surface Treatment with Granular A*	*$194*	1-5	ADEQ	ADEQ
1405	Gravel Rd	King St E	End	0.30	400	*ST2PAW - Widening by 1 m, Double Surface Treatment, with Pulverization of Existing and Granular A*	*$38*	1-5	ADEQ	NOW
2020	Whittington Dr	600m East	750m East	0.15	275	*Recon 1R - Full Reconstruction + 1 Lift*	*$53*	1-5	ADEQ	ADEQ
1600	Main St	King Street West	South end	0.60	350	*Upgrade 2U - Upgrade to Urban*	*$453*	1-5	ADEQ	ADEQ
1270	Deyell Li	T-Way Dr	Hutchinson Dr	1.33	182	*ST2A - Double Surface Treatment with Granular A*	*$117*	1-5	ADEQ	ADEQ

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Structural Adequacy	Surface Type Need	Surface Width Need
1260	Deer Ave.	Larmer Li	Plains Cl	0.76	200	*ST2A - Double Surface Treatment with Granular A*	*$67*	1-5	ADEQ	ADEQ
1695	Morton Li	520m West	Cnty Rd 10	5.66	196	*ST2PAW - Widening by 1 m, Double Surface Treatment, with Pulverization of Existing and Granular A*	*$709*	1-5	ADEQ	NOW
1375	Fallis Li	Tapley 1/4 Line	West End	3.89	240	*ST2A - Double Surface Treatment with Granular A*	*$343*	1-5	ADEQ	ADEQ
1150	Carmel Li	Brackenridge Dr	Cnty Rd 28	3.11	353	*ST2A - Double Surface Treatment with Granular A*	*$274*	1-5	ADEQ	ADEQ
1460	Hooton Dr	1500m East	Fieldview Dr	2.52	150	*ST2A - Double Surface Treatment with Granular A*	*$222*	1-5	ADEQ	ADEQ
1020	Anne St	Needler's Lane	Cavan Street	0.47	350	*Upgrade 2U - Upgrade to Urban*	*$355*	1-5	ADEQ	ADEQ
1995	Whitfield Rd	740m East of Cty Rd 28	End	1.89	200	*ST2A - Double Surface Treatment with Granular A*	*$166*	1-5	ADEQ	ADEQ
1585	Larmer Li	Highway 115	Tapley 1/4 Li	2.08	224	*ST2A - Double Surface Treatment with Granular A*	*$183*	6 - 10	ADEQ	ADEQ
1535	Johnston Dr	Carolyn St	North End	0.91	400	*Recon 1R - Full Reconstruction + 1 Lift*	*$323*	1-5	ADEQ	ADEQ
1955	Turner St	Hunter Street	King Street West	0.18	80	*Upgrade 2U - Upgrade to Urban*	*$136*	1-5	ADEQ	ADEQ
1740	Poplar Plains Dr	Cnty Rd 10	East End	0.18	70	*ST2A - Double Surface Treatment with Granular A*	*$16*	NOW	ADEQ	ADEQ
1345	Elgar Dr	White Birch Rd	South End	0.48	125	*ST2A - Double Surface Treatment with Granular A*	*$42*	1-5	ADEQ	ADEQ
1490	Hunter St	Queen St	Turner St	0.26	80	*Upgrade 2U - Upgrade to Urban*	*$196*	NOW	ADEQ	ADEQ
1480	Howden 1/4 Li	Stewart Li	Hooton Dr	1.45	90	*ST2A - Double Surface Treatment with Granular A*	*$128*	1-5	ADEQ	ADEQ

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Structural Adequacy	Surface Type Need	Surface Width Need
1735	Plains Cl	Deer Avenue	Deer Avenue Loop	0.84	110	*ST2A - Double Surface Treatment with Granular A*	*$74*	1-5	ADEQ	ADEQ
1035	Ava Cres	Deyell Li	North End	1.41	60	*ST2A - Double Surface Treatment with Granular A*	*$124*	1-5	ADEQ	ADEQ
1315	Dufferin St	Gravel Rd	End	0.15	390	*Upgrade 2U - Upgrade to Urban*	*$113*	1-5	ADEQ	ADEQ
1605	Manor Dr	Cnty Rd 10	Union Street	0.18	750	*Upgrade 2U - Upgrade to Urban*	*$132*	1-5	NOW	ADEQ
1990	White Birch Rd	Elgar Dr	End	0.85	65	*ST2A - Double Surface Treatment with Granular A*	*$75*	NOW	ADEQ	ADEQ
1185	Cavan St	King Street West	Anne St	0.30	110	*Upgrade 2U - Upgrade to Urban*	*$227*	1-5	ADEQ	ADEQ
1775	Rothesay Av	South End	Lansdowne St W	0.54	125	*ST2A - Double Surface Treatment with Granular A*	*$48*	1-5	ADEQ	ADEQ
1465	Hooton Dr	2480m East	1500m East	1.52	71	*ST2PAW - Widening by 1 m, Double Surface Treatment, with Pulverization of Existing and Granular A*	*$190*	6 - 10	ADEQ	NOW
1015	Allen Ln	Needler's Lane	King Street West	0.12	250	*Upgrade 2U - Upgrade to Urban*	*$91*	1-5	ADEQ	ADEQ
1555	Kennedy Dr	Mount Pleasant Rd	South End	0.44	50	*Recon 1R - Full Reconstruction + 1 Lift*	*$156*	NOW	ADEQ	ADEQ
1395	Frederick St	Main St	Anne St	0.42	260	*ST2A - Double Surface Treatment with Granular A*	*$37*	6 - 10	ADEQ	ADEQ
1765	Queen St	King Street West	Hunter Street	0.18	85	*Upgrade 2U - Upgrade to Urban*	*$132*	1-5	ADEQ	ADEQ
1080	Bland Li	Albert St	Cty Rd 10	0.08	222	*Recon 1R - Full Reconstruction + 1 Lift*	*$28*	1-5	ADEQ	ADEQ
1280	Dobbin Rd	Cnty Rd 15	North End	1.12	500	*Upgrade 2U - Upgrade to Urban*	*$846*	1-5	ADEQ	ADEQ

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Structural Adequacy	Surface Type Need	Surface Width Need
1010	Alexander St.	Blue Jay St.	North End	0.09	20	*Recon 1R - Full Reconstruction + 1 Lift*	*$32*	NOW	ADEQ	ADEQ
1030	Ashley Cres	Cathcart Cres	South End	0.30	40	*Recon 1R - Full Reconstruction + 1 Lift*	*$106*	NOW	ADEQ	ADEQ
1065	Bee Dr	Deyell Li	South End	0.71	45	*ST2A - Double Surface Treatment with Granular A*	*$62*	1-5	ADEQ	ADEQ
1095	Blue Jay St.	County Rd 10	Alexander Dr	0.22	30	*Recon 1R - Full Reconstruction + 1 Lift*	*$78*	NOW	ADEQ	ADEQ
1145	Carmel Cres	Cty Rd 10	West end	0.56	45	*ST2A - Double Surface Treatment with Granular A*	*$49*	NOW	ADEQ	ADEQ
1190	Cavan Wood Dr	Cnty Rd 10	East End	0.18	45	*ST2A - Double Surface Treatment with Granular A*	*$16*	1-5	ADEQ	ADEQ
1230	Charles St	West End	East End	0.15	35	*Upgrade 2U - Upgrade to Urban*	*$110*	NOW	ADEQ	NOW
1350	Elizabeth St	King George St	Miller St	0.12	20	*ST2PAW - Widening by 1 m, Double Surface Treatment, with Pulverization of Existing and Granular A*	*$15*	NOW	ADEQ	NOW
1360	Fallingbrook Dr	Poplar Plains Dr	Cavan Wood Dr	0.12	45	*ST2A - Double Surface Treatment with Granular A*	*$10*	NOW	ADEQ	ADEQ
1560	King George St	Cty Rd 10	Elizabeth Street	0.12	45	*ST2PAW - Widening by 1 m, Double Surface Treatment, with Pulverization of Existing and Granular A*	*$14*	NOW	ADEQ	NOW
1590	Lisa Crt	King Street West	South End	0.22	45	*Upgrade 2U - Upgrade to Urban*	*$166*	1-5	ADEQ	ADEQ
1615	Maple Tree Crt	Pine Tree Court	West End	0.29	45	*ST2A - Double Surface Treatment with Granular A*	*$26*	NOW	ADEQ	ADEQ
1620	Marshall St	West End	East End	0.22	40	*Upgrade 2U - Upgrade to Urban*	*$166*	NOW	ADEQ	NOW

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Structural Adequacy	Surface Type Need	Surface Width Need
1665	Mill St	Cty Rd 10	West End	0.15	25	*ST2PAW - Widening by 1 m, Double Surface Treatment, with Pulverization of Existing and Granular A*	*$19*	NOW	ADEQ	NOW
1670	Miller St	Cty Rd 10	South End	0.32	45	*ST2PAW - Widening by 1 m, Double Surface Treatment, with Pulverization of Existing and Granular A*	*$40*	NOW	ADEQ	NOW
1730	Pine Tree Crt	Valley Rd	West End	0.19	45	*ST2A - Double Surface Treatment with Granular A*	*$17*	NOW	ADEQ	ADEQ
1770	Rose Cres	Mount Pleasant Rd	South End	0.13	40	*Recon 1R - Full Reconstruction + 1 Lift*	*$46*	NOW	ADEQ	ADEQ
1780	Scout Cr	Tapley 1/4 Line	East End	0.22	25	*ST2A - Double Surface Treatment with Granular A*	*$19*	NOW	ADEQ	ADEQ
1830	Skiview Dr	Hillview Dr	North End	0.37	45	*ST2A - Double Surface Treatment with Granular A*	*$33*	NOW	ADEQ	ADEQ
1835	Sowden Ln	Main St	East End	0.13	20	*ST2PAW - Widening by 1 m, Double Surface Treatment, with Pulverization of Existing and Granular A*	*$16*	NOW	ADEQ	NOW
2035	Wing St	Bank Street South	East End	0.10	30	*Upgrade 2U - Upgrade to Urban*	*$76*	NOW	ADEQ	ADEQ

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.*

3. *Costing is zero for roads within the network but maintained by others (i.e. boundary roads).*

6.2 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:

- 24.4 km of paved roads (HCB).
- Degradation rate 0.25 / year (rating drops from 10 to 5, over a 20-year period).
- Annual resurfacing 1.2 km / year.
- Annual budget $333,600: (1.2 km / year x $139,000 / ln **RMP1** x 2 lanes).

Surface Treated Roads:

- 182.8 km of surface treated roads (LCB).
- Degradation rate 0.625 / year (rating drops from 10 to 5, over a 7-year period).
- Annual resurfacing 26.1 km / year.
- Annual budget $652,500 (26.1 km / year x $25,000 / 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:

- 32.4 km of earth / gravel roads.
- 75mm gravel every 3-5 years.
- Annual gravelling of 10.8 km.
- Granular A ($12,000 / km).
- Annual budget $129,600 (10.8 km / year x $12,000 **G**) **.

*** Cost based on supply and application of gravel by external forces.*

The total resurfacing program, (hot mix, surface treatment and gravel) is estimated at $1,115,700 per year.

Relative road preservation / resurfacing priorities for all roads not included in the previous Capital Reconstruction priorities table are listed below in **Table 9,** Township of Cavan Monaghan's Resurfacing Priorities. Roads are listed in order of descending preservation priorities.

Table 9 - Township of Cavan Monaghan, Resurfacing Priorities

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Structural Adequacy	Surface Type Need	Surface Width Need
1965	Union St	King Street West	Manor Dr	0.22	1400	*RMP1 - Mill & Pave, 1 Lift*	*$61*	6 - 10	ADEQ	ADEQ
1920	Tapley 1/4 Li	Highway 115 Ramp	Cnty Rd 21	1.30	858	*ST2 - Double Surface Treatment*	*$51*	6 - 10	NOW	ADEQ
2055	Zion Li	Cty Rd 10	Carveth Dr	2.15	433	*ST2 - Double Surface Treatment*	*$85*	ADEQ	NOW	ADEQ
1785	Sharpe Li	Howden 1/4 Li	1100m West of Hwy 7	1.68	562	*ST2 - Double Surface Treatment*	*$66*	6 - 10	NOW	ADEQ
1200	Cedar Valley Rd	Hutchinson Dr	Cntry Rd 28	3.01	302	*ST2 - Double Surface Treatment*	*$119*	6 - 10	ADEQ	ADEQ
1565	Larmer Li	Cnty Rd 10	Hutchinson Dr	3.52	521	*ST2 - Double Surface Treatment*	*$139*	6 - 10	NOW	NOW
1925	Tapley 1/4 Li	Highway 115 Ramp	Fallis Li	0.22	858	*RMP1 - Mill & Pave, 1 Lift*	*$61*	6 - 10	ADEQ	ADEQ
1370	Fallis Li	Valleyview East	Cty Rd 10	2.11	495	*ST2 - Double Surface Treatment*	*$83*	6 - 10	NOW	NOW
1845	Stewart Li	Cnty Rd 10	Howden 1/4 Line	3.55	755	*ST2 - Double Surface Treatment*	*$140*	6 - 10	NOW	ADEQ
1210	Centre St	Tupper St	Union Street	0.16	1700	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
1610	Maple Grove Rd	Preston Rd	Highway 7	0.45	400	*ST2 - Double Surface Treatment*	*$18*	6 - 10	ADEQ	NOW
1930	Tapley 1/4 Li	Fallis Li	Larmer Li	1.11	655	*ST2 - Double Surface Treatment*	*$44*	6 - 10	NOW	ADEQ
1120	Brown Li	Elmdale Rd	Country Rd 11	1.76	417	*ST2 - Double Surface Treatment*	*$70*	6 - 10	NOW	NOW
1455	Hooton Dr	Fieldview Dr	Preston Rd	0.30	408	*ST2 - Double Surface Treatment*	*$12*	6 - 10	NOW	NOW
1355	Elmdale Rd	Brown Li	Cnty Rd 15	1.40	350	*ST2 - Double Surface Treatment*	*$55*	6 - 10	ADEQ	ADEQ

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Structural Adequacy	Surface Type Need	Surface Width Need
1795	Sharpe Li	Cnty Rd 10	Howden 1/4 Li	3.52	392	*ST2 - Double Surface Treatment*	*$139*	6 - 10	ADEQ	ADEQ
1935	Tapley 1/4 Li	Larmer Li	Syer Li	1.33	517	*ST2 - Double Surface Treatment*	*$53*	ADEQ	NOW	ADEQ
1940	Tapley 1/4 Li	Syer Li	Highway 7A	1.32	453	*ST2 - Double Surface Treatment*	*$52*	ADEQ	NOW	ADEQ
1220	Century Bv	Centennial Ln	Nina Ct	0.19	450	*RMP1 - Mill & Pave, 1 Lift*	*$51*	6 - 10	ADEQ	ADEQ
1860	Stewart Li	1320 West of Cty Rd 10	2220m West of Cty Rd 10	0.90	393	*ST2 - Double Surface Treatment*	*$36*	ADEQ	ADEQ	ADEQ
1865	Stewart Li	1040m West of Cty Rd 10	1320m West of Cty Rd 10	0.28	393	*ST2 - Double Surface Treatment*	*$11*	ADEQ	ADEQ	ADEQ
1840	Stewart Li	Howden 1/4 Li	Preston Rd	2.82	755	*ST2 - Double Surface Treatment*	*$112*	ADEQ	NOW	ADEQ
1115	Brown Li	Hwy 7	Elmdale Rd	1.80	440	*ST2 - Double Surface Treatment*	*$71*	6 - 10	NOW	ADEQ
2015	Whittington Dr	Elmdale Rd	West End	1.48	350	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
1265	Deyell Li	Cnty Rd 10	T-Way Dr	2.11	237	*ST2 - Double Surface Treatment*	*$83*	6 - 10	ADEQ	ADEQ
1500	Hutchison Dr	Cnty Rd 21	Cedar Valley Rd	1.55	278	*ST2 - Double Surface Treatment*	*$61*	6 - 10	ADEQ	ADEQ
1205	Centennial Ln	Cty Rd 10	East End	0.32	800	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
1900	Syer Li	Vista Cresc	Cty Rd 10	1.05	351	*ST2 - Double Surface Treatment*	*$42*	ADEQ	ADEQ	ADEQ
1510	Hutchison Dr	Larmer Li	Syer Li	1.32	211	*ST2 - Double Surface Treatment*	*$52*	6 - 10	ADEQ	ADEQ
1910	Syer Li	Tapley 1/4 Line	Vista Cres	2.53	201	*ST2 - Double Surface Treatment*	*$100*	6 - 10	ADEQ	ADEQ
1790	Sharpe Li	1100m West of Hwy 7	Highway 7	1.10	562	*Preventative Maintenance*	-	ADEQ	NOW	ADEQ

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Structural Adequacy	Surface Type Need	Surface Width Need
1090	Bland Li	Jones 1/4 Line	1850m West	1.85	150	*G - Gravel (75mm)*	*$22*	ADEQ	ADEQ	ADEQ
1720	Needler's Ln	Anne St	Distillery St	0.22	350	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
2060	Zion Li	Hutchison Dr	Cty Rd 28	2.87	323	*ST2 - Double Surface Treatment*	*$114*	ADEQ	ADEQ	ADEQ
2005	Whittington Dr	Elmdale Rd	600m East	0.60	275	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
1050	Bartlett Rd	Moncrief Li	Whitfield Rd	1.45	275	*ST2 - Double Surface Treatment*	*$57*	6 - 10	ADEQ	NOW
1725	Nina Crt	West End	East End	0.23	175	*RMP1 - Mill & Pave, 1 Lift*	*$64*	6 - 10	ADEQ	ADEQ
1675	Moore Dr	2440m West of Cty Rd 28	West End	1.70	694	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
1505	Hutchison Dr	Cedar Valley Rd	Larmer Li	1.09	270	*ST2 - Double Surface Treatment*	*$43*	ADEQ	ADEQ	ADEQ
1515	Hutchison Dr	Zion Li	Cnty Rd 21	1.50	178	*ST2 - Double Surface Treatment*	*$59*	6 - 10	ADEQ	ADEQ
1320	Eagleson Li	McCamus 1/4 Line	Cty Rd 28	2.85	136	*ST2 - Double Surface Treatment*	*$113*	6 - 10	ADEQ	ADEQ
1975	Valleyview Dr	Fallis Li East	Morningside Pl	0.75	155	*ST2 - Double Surface Treatment*	*$30*	6 - 10	ADEQ	ADEQ
1855	Stewart Li	Cty Rd 10	1040m West of Cty Rd 10	1.04	393	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
1850	Stewart Li	Winslow 1/4 Li	1300m East	1.30	393	*ST2 - Double Surface Treatment*	*$51*	ADEQ	ADEQ	ADEQ
1160	Carmel Li	Cty Rd 10	1400m West	1.40	120	*ST2 - Double Surface Treatment*	*$55*	6 - 10	ADEQ	ADEQ
2065	Zion Li	Hutchinson Dr	Cnty Rd 10	3.25	211	*ST2 - Double Surface Treatment*	*$129*	6 - 10	ADEQ	ADEQ
1700	Morton Li	Tapley 1/4 Line	1300m East	1.30	165	*G - Gravel (75mm)*	*$16*	ADEQ	ADEQ	ADEQ
1475	Howden 1/4 Li	Sharpe Li	Stewart Li	1.45	121	*ST2 - Double Surface Treatment*	*$57*	6 - 10	ADEQ	ADEQ

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Structural Adequacy	Surface Type Need	Surface Width Need
1680	Moore Dr	Cty Rd 28	2440m West	2.44	526	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
1750	Preston Rd	Hooton Dr	Cnty Rd 9	1.52	211	*G - Gravel (75mm)*	*$18*	ADEQ	NOW	ADEQ
1175	Carveth Dr	Zion Li	Huston Street	1.39	450	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
1915	Syer Li	Dranoel Rd	Highview Cres	2.48	90	*G - Gravel (75mm)*	*$30*	ADEQ	ADEQ	ADEQ
1165	Carmel Li	1400m West of Cty Rd 10	West end	1.35	100	*ST2 - Double Surface Treatment*	*$53*	6 - 10	ADEQ	ADEQ
1390	Ford Dr	Highway 7A	South End	0.74	100	*RMP1 - Mill & Pave, 1 Lift*	*$205*	6 - 10	ADEQ	ADEQ
1290	Dranoel Rd	Highway 7A	Morton Li	0.83	251	*ST2 - Double Surface Treatment*	*$33*	ADEQ	ADEQ	ADEQ
1495	Huston St	Carveth Dr	King Street West	0.35	400	*ST2 - Double Surface Treatment*	*$14*	6 - 10	ADEQ	ADEQ
1275	Distillery St	Needler's Lane	South End	0.16	150	*ST2 - Double Surface Treatment*	*$6*	6 - 10	ADEQ	ADEQ
2080	Zion Li	Carveth Dr	Elgar Dr	0.35	115	*ST2 - Double Surface Treatment*	*$14*	6 - 10	ADEQ	ADEQ
2025	Wilson Li	West End	1000m West of Cnty Rd 10	1.78	150	*ST2 - Double Surface Treatment*	*$70*	ADEQ	ADEQ	ADEQ
2030	Wilson Li	1000m West of Cnty Rd 10	Cnty Rd 10	1.00	150	*ST2 - Double Surface Treatment*	*$40*	ADEQ	ADEQ	ADEQ
1235	Clifford Li	Highway 7A	East End	1.54	200	*Preventative Maintenance*	-	ADEQ	ADEQ	NOW
1400	George St	Cnty Rd 21	South End	0.23	60	*RMP1 - Mill & Pave, 1 Lift*	*$64*	6 - 10	ADEQ	ADEQ
1870	Stewart Li	2850m West of Winslow 1/4	300m West	0.30	254	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
1875	Stewart Li	Winslow 1/4 Li	2850m West	2.85	254	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
1880	Stewart Li	Dranoel Rd	300m East	0.30	254	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
1685	Morningside Pl	Valleyview Drive	End	0.27	90	*ST2 - Double Surface Treatment*	*$11*	6 - 10	ADEQ	ADEQ

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Structural Adequacy	Surface Type Need	Surface Width Need
1980	Valleyview Dr	Fallis Li West	Morningside Pl	0.85	155	*ST2 - Double Surface Treatment*	*$34*	ADEQ	ADEQ	ADEQ
1225	Challice Li	Cty Rd 10	End	2.05	150	*ST2 - Double Surface Treatment*	*$81*	ADEQ	ADEQ	ADEQ
2070	Zion Li	Elgar Dr	2500m West	2.50	115	*ST2 - Double Surface Treatment*	*$99*	6 - 10	ADEQ	ADEQ
1435	Hayes Li	Cty Rd 38	1500m East of Cty Rd 38	1.50	200	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
1100	Brackenridge Dr	Deyell Li	Carmel Li	1.33	212	*ST2 - Double Surface Treatment*	*$53*	6 - 10	ADEQ	ADEQ
1325	Eagleson Li	McCamus 1/4 Line	Cty Rd 10	3.00	55	*ST2 - Double Surface Treatment*	*$119*	6 - 10	ADEQ	ADEQ
1960	T-Way Dr	Deyell Li	South End	0.60	65	*ST2 - Double Surface Treatment*	*$24*	6 - 10	ADEQ	NOW
1075	Bland Li	925m East	Albert St	0.93	222	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
1745	Preston Rd	Stewart Li	Hooton Dr	1.46	461	*ST2 - Double Surface Treatment*	*$58*	ADEQ	NOW	NOW
1630	McGuire Dr	Manor Dr	West End	0.47	250	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
2075	Zion Li	2500m West of Elgar	Glamorgan Rd	2.50	115	*ST2 - Double Surface Treatment*	*$99*	ADEQ	ADEQ	ADEQ
1330	Edgewood Park Dr	Mount Pleasant Rd	North End	0.52	175	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
1085	Bland Li	Jones 1/4 Line	2500m East	2.50	222	*Preventative Maintenance*	-	ADEQ	ADEQ	NOW
1430	Hayes Li	1500 East of Cty Rd 38	Jones 1/4 Li	1.84	207	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
1335	Edgewood Park Dr	Loop	Loop	0.48	150	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
1110	Brookside St	Cnty Rd 10	Cnty Rd 10	0.86	275	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
1885	Sunset Dr	Highway 7A	South End	0.74	90	*RMP1 - Mill & Pave, 1 Lift*	*$205*	6 - 10	ADEQ	ADEQ

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Structural Adequacy	Surface Type Need	Surface Width Need
1705	Morton Li	Cnty Rd 10	2150m West	2.15	165	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
1245	Cora Dr	Sharpe Li	South End	0.37	60	*ST2 - Double Surface Treatment*	*$15*	6 - 10	ADEQ	ADEQ
1385	Ford Cres	Highway 7A	East End	1.37	100	*RO1 - Hot Mix Overlay, 1 Lift*	*$214*	ADEQ	ADEQ	ADEQ
1025	Anne St	Bend	South End	0.24	70	*ST2 - Double Surface Treatment*	*$9*	6 - 10	ADEQ	ADEQ
1040	Bank St N	Cty Rd 10	End	0.28	70	*RMP1 - Mill & Pave, 1 Lift*	*$78*	6 - 10	ADEQ	ADEQ
1450	Hillview Dr	South End	North End	0.93	115	*ST2 - Double Surface Treatment*	*$37*	ADEQ	ADEQ	ADEQ
1810	Sharpe Li	Jack Lane	700m West of Winslow 1/4	1.32	92	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
1340	Elgar Dr	Zion Li	White Birch rd	0.74	125	*ST2 - Double Surface Treatment*	*$29*	ADEQ	ADEQ	ADEQ
1300	Dranoel Rd	Morton Li	Sharpe Li	2.02	171	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
2040	Winslow 1/4 Li	Sharpe Li	North End	1.67	61	*G - Gravel (75mm)*	*$20*	ADEQ	ADEQ	ADEQ
1155	Carmel Li	Brackenridge Dr	Cty rd 10	3.19	322	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
1945	Tapley 1/4 Li	Highway 7A	Morton Li	1.40	82	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
1800	Sharpe Li	Winslow 1/4 Li	1780m East	1.78	93	*G - Gravel (75mm)*	*$22*	ADEQ	ADEQ	ADEQ
1815	Sharpe Li	700m West of Winslow 1/4	Winslow 1/4 Li	0.70	92	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
1305	Dranoel Rd	Sharpe Li	Stewart Li	1.44	108	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
1215	Centre St	Union St	West End	0.44	250	*RMP1 - Mill & Pave, 1 Lift*	*$122*	6 - 10	ADEQ	ADEQ
1805	Sharpe Li	1780m East of Winslow	Cty Rd 10	1.75	93	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
1820	Sharpe Li	Dranoel Rd	Jack Lane	1.50	92	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
1550	Kalman Dr	Carmel Li	South End	0.51	75	*RMP1 - Mill & Pave, 1 Lift*	*$141*	6 - 10	ADEQ	ADEQ

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Structural Adequacy	Surface Type Need	Surface Width Need
1255	Davis Rd	Stewart Li	Maple Grove Rd	1.48	350	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
1595	Longview Dr	Cnty Rd 9	North End	0.48	150	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
1140	Campbell Av	Longview Dr	Longview Dr	1.00	110	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
1380	Filman Cr	Longview Dr	Longview Dr	0.38	75	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
1000	Acadia Crt	Valley Rd	South end	0.21	40	*ST2 - Double Surface Treatment*	*$8*	ADEQ	ADEQ	ADEQ
1005	Albert St	Mount Pleasant Rd	Bland Li	0.31	40	*RMP1 - Mill & Pave, 1 Lift*	*$85*	6 - 10	ADEQ	NOW
1045	Bank St S	Cty Rd 21	North End	0.19	40	*ST2 - Double Surface Treatment*	*$8*	6 - 10	ADEQ	ADEQ
1055	Baxter Creek Crt N	Brook Street	South End	0.10	25	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
1070	Best Rd	Mount Pleasant Rd	Hayes Li	1.42	37	*G - Gravel (75mm)*	*$17*	ADEQ	ADEQ	ADEQ
1105	Brewda Cres	Kalman Dr	East End	0.11	35	*RMP1 - Mill & Pave, 1 Lift*	*$30*	6 - 10	ADEQ	ADEQ
1125	Brown Li	Cty Rd 11	East End	0.53	40	*ST2 - Double Surface Treatment*	*$21*	6 - 10	ADEQ	ADEQ
1135	Burnham Crt	McGuire Dr	North End	0.06	40	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
1170	Carolyn St	Johnston Dr	South End	0.30	30	*ST2 - Double Surface Treatment*	*$12*	ADEQ	ADEQ	ADEQ
1195	Cedar Cres	Hutchinson Dr	South End	0.07	5	*ST2 - Double Surface Treatment*	*$3*	ADEQ	ADEQ	ADEQ
1250	Darling Cres	Stewart Li	South End	0.93	45	*G - Gravel (75mm)*	*$11*	ADEQ	ADEQ	ADEQ
1445	Highview Cres	Syer Li	North End	0.70	45	*ST2 - Double Surface Treatment*	*$28*	ADEQ	ADEQ	ADEQ
1525	Jack Ln	Sharpe Li	North End	0.60	45	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
1530	Jill Ln	Stewart Li	South End	0.22	20	*G - Gravel (75mm)*	*$3*	ADEQ	ADEQ	ADEQ

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Structural Adequacy	Surface Type Need	Surface Width Need
1655	Mervin Li	550m West of Cty Rd 11	West end	1.48	25	*G - Gravel (75mm)*	*$18*	ADEQ	ADEQ	ADEQ
1660	Mill St	Cnty Rd 10	Workman St.	0.29	45	*Preventative Maintenance*	-	ADEQ	ADEQ	NOW
1710	Morton Li	Dranoel Rd	1550m East	1.55	47	*G - Gravel (75mm)*	*$19*	ADEQ	ADEQ	ADEQ
1715	Morton Li	Tapley1/4	2220m West	2.22	47	*G - Gravel (75mm)*	*$27*	ADEQ	ADEQ	ADEQ
1755	Prince St	Anne St	South End	0.13	45	*ST2 - Double Surface Treatment*	*$5*	6 - 10	ADEQ	ADEQ
1760	Princess St	Anne St	South End	0.13	45	*Preventative Maintenance*	-	ADEQ	ADEQ	ADEQ
1985	Vista Cres	Syer Li	North End	0.37	45	*ST2 - Double Surface Treatment*	*$15*	ADEQ	ADEQ	ADEQ
2045	Worboy Crt	Beardsmore Dr	West End	0.19	5	*G - Gravel (75mm)*	*$2*	ADEQ	ADEQ	ADEQ
2050	Workman St.	Mount Pleasant Rd	Mill St.	0.19	45	*Preventative Maintenance*	-	ADEQ	ADEQ	NOW

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. *Costing is zero for roads within the network but maintained by others (i.e. boundary roads).*

6.3 Preservation Management

Preservation techniques seal the surface as to prevent water infiltration into the granular base. Route and Seal is used on HCB pavements to seal individual cracks. Slurry Seal / Microsurfacing is used on LCB and HCB pavements to seal large areas, although wide / active cracks will reflect through the treatment. An annual preservation management budget has been estimated as follows:

Route and Seal

- 24.4 km of paved roads (HCB).
- Assume that route and seal will be applied, on average, once per resurfacing cycle.
- 1.2 km of road to route and seal each year
- **Annual budget $9,600** (1.2 km x $4,000 / km In **Route and Seal** x 2 lanes).

Given the Township's short total length of HCB roads, it may not be practical to fund a Route and Seal program.

Slurry Seal / Microsurfacing

- 24.4 km of paved roads (HCB).
- 182.8 km of surface treated roads (LCB).
- Assume that slurry seal / microsurfacing will be applied, on average, once per resurfacing cycle.
- 27.3 km of road to preserve per year (1.2 km HCB and 26.1 km of LCB).
- **Annual budget $546,000** (27.3 km x $20,000 / km **Slurry Sealing / Microsurfacing**).

6.4 Road 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.

6.5 Hooton Drive Assessment

The gravel section of Hooton Drive from County Road 10 to 2.5 kilometers east of County Road 10 is located just south of Mount Pleasant and is within the Cavan Swamp Wildlife Area. See Figure 3 below. The proximity to the wetlands creates drainage problems and requires the section be closed in the winter when flooding is prominent.

This section then needs to be maintained in the spring to open the road for the summer and fall. The yearly required maintenance represents a significant cost for a rural section with a low AADT (65).

There are three options the Township may consider for this section of road:

1) Continue closing the road section in the winter and reopen each spring, with the necessary maintenance,

2) Upgrade (raise) the road section to prevent drainage issues, or

3) Close the road section permanently.

Figure 3 - Hooton Drive Location

Option 1: Close Seasonally

This option is currently employed by the Township and requires fresh gravel to be applied to the section every spring. The yearly cost to apply 150 mm of gravel along the length of this section is $60,200. For a 20 year period, the net present value (NPV) of this option is $809,800.

Option 2: Upgrade/Raise Road

Upgrading/raising the road will have a large upfront cost but will significantly reduce the yearly maintenance costs for the section. The estimated cost for full reconstruction, including 700mm grade raise is approximately $975,000. It is important to note that this value represents an estimate based on shallow excavation and granular backfilling/grade raise. Sensitive or highly compressive soils beneath the surface through the wetland may necessitate deep excavations or enhanced pavement structure to "float" the road over the swamp. Should the Township pursue this option, a complete geotechnical investigation is recommended to confirm the scope of upgrade and ultimately confirm the cost. Additionally, environmental permitting/approvals could be challenging to acquire given the significance of the wetland.

Using life cycle cost analysis, with gravel resurfacing every 5 years, the NPV of this option for a 20 year period is $1.037,000.

Option 3: Permanent Closure

The third option would be to close the section year round. While this option would allow the township to reallocate the maintenance funds associated with this section, it is important to consider the adverse effects associated with its' closure. Closing this road would have a direct impact on residents in the area. There are approximately 15 residential homes that would have access to their homes negatively impacted due to the closure of this road section. The worst case scenario would lead to an additional 3-5 minute detour, south along County Road 10, east on Stewart line, and north onto Howden ¼ Line.

7.0 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 7** 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 $ 28.8 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.

8.0 Summary

D.M. Wills Associates (Wills) undertook a review of the Township of Cavan Monaghan's (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 September of 2016. A visual assessment of each road within the Township was undertaken to assess surface and structural distress. A Condition Rating (CR) was calculated based on the identified deficiencies.

An overall road system adequacy has been calculated, consistent with the MTO Inventory Manual for Municipal Road (February 1991), based on a number of road characteristics including:

- Capacity
- Geometrics
- Surface Condition
- Shoulder and Road Widths
- Structural Adequacy
- Drainage
- Maintenance Demand

The overall system adequacy for the 2016 Road Needs Assessment is 65%, considering roads with greater than 50 AADT, per the Inventory Manual methodology.

It should be noted that a significant portion of the roads identified as deficient are such due to inadequate surface widths or surface types; their overall structural adequacy generally being good. These road(s) sections are identified in the document.

The overall system adequacy, excluding roads with inadequate surface widths or surface types, is 92%.

Roads with less than 50 AADT (Annual Average Daily Traffic) exhibiting deficiencies are also identified in this document, however, are excluded from the system adequacy calculations as per the inventory manual methodology.

Capital Improvements

Prioritization and recommendations for planned capital improvements have been developed based on the condition rating and traffic demands on each road. Those roads identified as having a "NOW" or 1-5 year need have been included in the capital improvement plan for reconstruction.

A total length of approximately 66 km of roads were identified as having surface type or structural needs in the "NOW," or 1 – 5 year periods. The estimated cost to improve these roads is approximately $ 10.5 M. An additional length of approximately 68 km of road is identified as having inadequate surface widths or surface type. Generally,

provided no operational or safety concerns are identified, roads with surface width and/or type deficiencies are typically addressed / considered at the next full reconstruction cycle.

Resurfacing

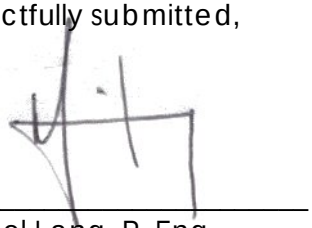
The total resurfacing program, (hot mix, surface treatment and gravel) is estimated at $1,115,700 per year.

Implementation / continuation of a road and roadside preventative maintenance program are strongly recommended. In addition, an annual budget of $546,000 is recommended for Preservation Management activities such as Slurry Seal / Microsurfacing. Due to the short length of the HCB network, a Route and Sealing program may be infeasible. Preservation Management activities will help to decrease or slow the typical degradation rates of the roads and to maintain system adequacy. A concerted effort and funding for regular road maintenance can reduce the annual resurfacing / reconstruction requirements by prolonging the useful service life of a road.

The time of inspection plays a significant role in assessing a road's condition. Certain deficiencies, particularly for gravel roads, are only obvious during the "spring break-up" period. By midsummer, any evidence to suggest these deficiencies may have disappeared due to regular grading and grooming activities and general drying of the roadbed. The field work for this study was carried out in September 2016, by which time the municipality had already begun spring grading. Recently graded roads may be rated higher than their actual structural adequacy.

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,



Michael Lang, P. Eng.
Manager, Transportation Engineering

ML/ESP/ms

Statement of Limitations

This report has been prepared by D.M. Wills Associates on behalf of the Township of Cavan Monaghan. 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 2016 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 2016 Road Needs Study Report findings.

Appendix A

Unit Price Form

ROAD IMPROVEMENT COSTS
Township of Cavan Monaghan

Unit Costs	Units	Unit Cost
Granular A	t	$10.50
Granular B	t	$10.00
Hot Mix	t	$150.00
Earth Excavation	m3	$10.00
Asphalt Removal	m2	$6.00
Asphalt Removal - Partial Depth	m2	$3.00
Removal of Concrete Curb & Gutter	m	$25.00
Concrete Curb & Gutter	m	$75.00
In-Place Full Depth Reclamation	m2	$2.10
Surface Treatment - Single	m2	$3.50
Surface Treatment - Double	m2	$5.65
Granular A Conversion	2.2	t/m3
Granular B Conversion	2	t/m3
Hot Mix Conversion	2.45	t/m3

Gravel (75mm)

Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*		*Quantity*	*Unit Cost*	*Cost/km (x 1000)*	
Granular A	7.0	75	2.2	t		1155	$10.50	$ 12	
							G	**12**	**(per Kilometre)**

Frost Heave Treatment

Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*		*Quantity*	*Unit Cost*	*Cost/50m Digout (x 1000)*	
Earth Excavation	8.0	800		m3		320	$10.00	$ 3	
Granular A	7.0	150	2.2	t		115.5	$10.50	$ 1	
Granular B	8.0	650	2	t		520	$10.00	$ 5	
							FT	**10**	**(per Kilometre)**

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

Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*		*Quantity*	*Unit Cost*	*Cost/km (x 1000)*	
Surface Treatment - Single (Overlay)	7.0			m2		7000	$3.50	$ 25	
							ST1	**25**	**(per Kilometre)**

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

Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*		*Quantity*	*Unit Cost*	*Cost/km (x 1000)*	
Surface Treatment - Double (Overlay)	7.0			m2		7000	$5.65	$ 40	
							ST2	**40**	**(per Kilometre)**

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 (x 1000)*	
Surface Treatment - Double	7.0			m2		7000	$5.65	$ 40	
Removal Asphalt Pavement	7.0	16		m2		7000	$6.00	$ 42	
							ST2R	**82**	**(per Kilometre)**

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 (x 1000)*	
Surface Treatment - Double	7.0			m2		7000	$5.65	$ 40	
Granular A	7.0	300	2.2	t		4620	$10.50	$ 49	
							ST2A	**88**	**(per Kilometre)**

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 (x 1000)*	
Surface Treatment - Double	7.0			m2		7000	$5.65	$ 40	
Granular A	7.0	300	2.2	t		4620	$10.50	$ 49	
Pulverizing	7.0			m2		7000.0	$2.10	$ 15	
Minor Items @ 25%								$ 4	
							ST2PA	**106**	**(per Kilometre)**

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 (x 1000)*	
Surface Treatment - Double	7.0			m2		7000	$5.65	$ 40	
Granular A	7.0	300	2.2	t		4620	$10.50	$ 49	
Pulverizing	7.0			m2		7000.0	$2.10	$ 15	
Earth Excavation	2	450		m3		900	$10.00	$ 9	
Granular B	1	300	2	t		600	$10.00	$ 6	
Minor Items @ 25%								$ 7	
							ST2PAW	**125**	**(per Kilometre)**

Resurfacing - Rural/Semi Urban Single Lift Overlay [RO1]									
Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*	*Crossfall Correction ** *	*Quantity*	*Unit Cost*	*Cost/km (x 1000)*	
Hot Mix	3	50	2.45	t	74	441	$150.00	$ 66	
Granular A	1.5	50	2.2	t		165	$10.50	$ 2	
Minor Items @ 15%								$ 10	
							RO1	**78**	**(per Lane Kilometre)**

Resurfacing - Rural/Semi Urban - Double Lift Overlay [RO2]									
Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*	*Crossfall Correction ** *	*Quantity*	*Unit Cost*	*Cost/km (x 1000)*	
Hot Mix	3	90	2.45	t	66	728	$150.00	$ 109	
Granular A	1.5	90	2.2	t		297	$10.50	$ 3	
Minor Items @ 15%								$ 17	
							RO2	**129**	**(per Lane Kilometre)**

Resurfacing - Urban - Single Lift Mill and Pave [RMP1]									
Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*	*Crossfall Correction*	*Quantity*	*Unit Cost*	*Cost/km (x 1000)*	
Hot Mix	4.25	50	2.45	t		521	$150.00	$ 78	
Remove Curb and Gutter				m		200	$25.00	$ 5.00	
Curb and Gutter - 20%				m		200	$75.00	$ 15.00	
Milling	4.25			m2		4250	$3.00	$ 12.75	
Minor Items @ 25%								$ 28	
							RMP1	**139**	**(per Lane Kilometre)**

Resurfacing - Urban - Double Lift Mill and Pave [RMP2]									
Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*	*Crossfall Correction*	*Quantity*	*Unit Cost*	*Cost/km (x 1000)*	
Hot Mix	4.25	90	2.45	t		937	$150.00	$ 141	
Remove Curb and Gutter				m		200	$25.00	$ 5.00	
Curb and Gutter - 20%				m		200	$75.00	$ 15.00	
Milling	4.25			m2		4250	$3.00	$ 12.75	
Minor Items @ 25%								$ 43	
							RMP2	**217**	**(per Lane Kilometre)**

Pulverize and Pave One Lift [PP1] Rural/Semi-Urban									
Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*	*Crossfall Correction*	*Quantity*	*Unit Cost*	*Cost/km (x 1000)*	
Hot Mix	3	50	2.45	t		367.5	$150.00	$ 55	
Granular A	1.5	50	2.2	t		165	$10.50	$ 2	
Pulverize	3			m2		3000	$2.10	$ 6.30	
Minor Items @ 25%								$ 16	
							PP1	**79**	**(per Lane Kilometre)**

Pulverize and Pave Two Lifts [PP2] Rural/Semi-Urban									
Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*	*Crossfall Correction*	*Quantity*	*Unit Cost*	*Cost/km (x 1000)*	
Hot Mix	3	90	2.45	t		661.5	$150.00	$ 99	
Granular A	1.5	90	2.2	t		297	$10.50	$ 3	
Pulverize	3			m2		3000	$2.10	$ 6	
Minor Items @ 25%								$ 27	
							PP2	**136**	**(per Lane Kilometre)**

Semi-Urban: Resurfacing and Widening - Residential (Single Lift Widening)

Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*	*Crossfall Correction* **	*Quantity*	*Unit Cost*	*Cost/km (x 1000)*	
Earth Excavation	2	500		m3		1000	$10.00	$ 10	
Granular A	5	150	2.2	t		1650	$10.50	$ 17	
Granular B	5	300	2	t		3000	$10.00	$ 30	
Hot Mix	8	50	2.45	t	196	1176	$150.00	$ 176	
Milling	4			m2		4000	$3.00	$ 12	
Minor Items @ 25%								$ 61	
							RW1	**307**	**(widening one side)**

Commercial and Industrial (Double Lift Widening)

Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*	*Crossfall Correction*	*Quantity*	*Unit Cost*	*Cost/km (x 1000)*	
Earth Excavation	2	600		m3		1200	$10.00	$ 12	
Granular A	5	150	2.2	t		1650	$10.50	$ 17	
Granular B	5	450	2	t		4500	$10.00	$ 45	
Hot Mix	8	90	2.45	t	353	2117	$150.00	$ 318	
Milling	4			m2		4000	$3.00	$ 12	
Minor Items @ 25%								$ 101	
							RW2	**505**	**(widening one side)**

Gravel Road Widening

Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*	*Crossfall Correction*	*Quantity*	*Unit Cost*	*Cost/km (x 1000)*	
Earth Excavation	2	450		m3		900	$10.00	$ 9	
Granular A	1	150	2.2	t		330	$10.50	$ 3	
Granular B	1	300	2	t		600	$10.00	$ 6	
Minor Items @ 25%								$ 5	
							GW	**23**	**(widening one side)**

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 (x 1000)*	
Earth Excavation	5	450		m3		2250	$10.00	$ 23	
Granular A	3	150	2.2	t		990	$10.50	$ 10	
Granular B	5	300	2	t		3000	$10.00	$ 30	
Minor Items @ 25%								$ 16	
							Recon G	**79**	**(per Lane Kilometre)**

Rural: Full Excavation and Reconstruction - 1 Lift

Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*	*Crossfall Correction*	*Quantity*	*Unit Cost*	*Cost/km (x 1000)*	
Asphalt Removal - Full Depth	3			m2		3000	$6.00	$ 18	
Earth Excavation	5	500		m3		2500	$10.00	$ 25	
Granular A	4	150	2.2	t		1320	$10.50	$ 14	
Granular B	5	300	2	t		3000	$10.00	$ 30	
Hot Mix	3	50	2.45	t		368	$150.00	$ 55	
Minor Items @ 25%								$ 35	
							Recon 1R	**177**	**(per Lane Kilometre)**

Semi-Urban: Full Excavation and Reconstruction - 1 Lift

Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*	*Crossfall Correction*	*Quantity*	*Unit Cost*	*Cost/km (x 1000)*	
Asphalt Removal - Full Depth	3			m2		3000	$6.00	$ 18	
Earth Excavation	5	500		m3		2500	$10.00	$ 25	
Granular A	4	150	2.2	t		1320	$10.50	$ 14	
Granular B	5	300	2	t		3000	$10.00	$ 30	
Hot Mix	3	50	2.45	t		368	$150.00	$ 55	
Minor Items @ 25%								$ 35	
							Recon 1S	**177**	**(per Lane Kilometre)**

Semi-Urban: Full Excavation and Reconstruction - 2 Lift

Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*	*Crossfall Correction*	*Quantity*	*Unit Cost*	*Cost/km (x 1000)*	
Asphalt Removal - Full Depth	3			m2		3000	$6.00	$ 18	
Earth Excavation	5	500		m3		2500	$10.00	$ 25	
Granular A	4	150	2.2	t		1320	$10.50	$ 14	
Granular B	5	300	2	t		3000	$10.00	$ 30	
Hot Mix	3	90	2.45	t		662	$150.00	$ 99	
Minor Items @ 25%								$ 47	
							Recon 2S	**233**	**(per Lane Kilometre)**

Urban: Full Excavation and Reconstruction - 2 Lift

Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*	*Crossfall Correction*	*Quantity*	*Unit Cost*	*Cost/km (x 1000)*	
Asphalt Removal - Full Depth	4.25			m2		4250	$6.00	$ 26	
Earth Excavation	5.5	500		m3		2750	$10.00	$ 28	
Granular A	4.5	150	2.2	t		1485	$10.50	$ 16	
Granular B	5.5	300	2	t		3300	$10.00	$ 33	
Hot Mix	4.25	90	2.45	t		937	$150.00	$ 141	
Remove Curb and Gutter				m		1000	$25.00	$ 25.00	
Curb and Gutter				m		1000	$75.00	$ 75.00	
Minor Items @ 25%								$ 61	
							Recon 2U	**403**	**(per Lane Kilometre)**

Rout and Seal

Item				*Unit*		*Quantity*	*Unit Cost*	*Cost/km (x 1000)*	
Rout and Seal				m		1000	$4.00	$ 4	
							RS	**4**	**(per Lane Kilometre)**

Slurry Seal

Item	*Width - m*			*Unit*		*Quantity*	*Unit Cost*	*Cost/km (x 1000)*	
Slurry Seal	7			m2		7000	$2.90	$ 20	
							SS	**20**	**(per Lane Kilometre)**

Microsurfacing

Item	*Width - m*			*Unit*		*Quantity*	*Unit Cost*	*Cost/km (x 1000)*	
Microsurfacing	7			m2		7000	$2.90	$ 20	
							MS	**20**	**(per Lane Kilometre)**

Semi-Urban: Upgrade to Urban - 2 Lift

Item	*Width - m*	*Depth - mm*	*Conversion Factor*	*Unit*	*Crossfall Correction*	*Quantity*	*Unit Cost*	*Cost/km (x 1000)*	
Asphalt Removal - Full Depth	4.25			m2		4250	$6.00	$ 26	
Earth Excavation	5.5	500		m3		2750	$10.00	$ 28	
Granular A	4.5	150	2.2	t		1485	$10.50	$ 16	
Granular B	5.5	300	2	t		3300	$10.00	$ 33	
Hot Mix	4.25	90	2.45	t		937	$150.00	$ 141	
Curb and Gutter				m		1000	$75.00	$ 75.00	
Minor Items @ 25%								$ 61	
							Recon 2U	**378**	**(per Lane Kilometre)**