Road Needs Study Report

The Corporation of the Township of Stone Mills

2014 Road Needs Study Update

D.M. Wills Project No.14-4498

D.M. Wills Associates Limited
PARTNERS IN ENGINEERING

Peterborough
North Bay

FINAL REPORT

June 2015

Executive Summary

The Township of Stone Mills 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 as a result of 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 approximately 367 km primarily within a rural setting, with urban and semi-urban centres. The road network includes surfaces ranging from gravel to hot mix paved (asphalt). The Town has approximately 223 km of gravel roads, 134 km of surface treated roads (low class bituminous (LCB)), and 10 km of hot mix asphalt paved roads (high class bituminous (HCB)).

An overall road system adequacy has been calculated, consistent with the 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 2014 Road Needs Assessment is 92%.

This adequacy rating does not consider the "NOW" needs of roads with AADT's of 50 or less, per the Inventory Manual practice. Roads with less than 50 AADT exhibiting deficiencies are identified in the document, however are excluded from the system adequacy calculation.

Capital Improvements

Prioritization and recommendations for planned capital improvements have been developed based on condition rating and traffic demands on each road. Those roads identified as having a "NOW", "1-5" and "6-10" year Need (with the exception of drainage improvements) have been included in the capital improvement plan.

A total length of approximately 40 km of road was identified as having needs in the surface type and structural "NOW," 1-5, and 6-10 year periods, including roads with AADT less than or equal to 50. The estimated cost to improve these roads is approximately $ 4.2 M. An additional length of 26 km of road was identified as having inadequate surface widths only. Generally, provided no operational or safety concerns are identified, roads with surface width deficiencies are typically addressed/considered at the next full reconstruction cycle.

Preservation Management

In addition to addressing currently deficient roads (i.e. capital improvements), 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:

- 10 km of paved roads (HCB)
- Degradation rate 0.25/year (rating drops from "10" to "5" over a 20 year period)
- Annual Resurfacing 0.5 km/year
- Annual Budget $169,000 (0.5 km/yr. x $169,000/ln **RMP1** x 2 lanes)

Surface Treated Roads:

- 134 km of surface treated roads (LCB)
- Degradation rate 0.625/year (rating drops from "10" to "5" over a 7 year period)
- Annual Resurfacing 19.1 km/year
- Annual Budget $420,200 (18.7 km/yr. x $22,000/km ST1)

Gravel roads require regular maintenance. Maintenance includes regular grading and reapplication of new gravel. 75mm of new gravel is recommended every 3-5 years.

Gravel Roads:

- 223 km of earth/gravel roads
- 75mm gravel every 3 years
- Annual Gravelling of 74.3 km
- Annual Budget $1,486,000 (74.3 km/yr. x $20,000/km **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 $2,075,200 per year.

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 Stone Mills Road System in Kilometres as of April 2014		
A.	**Surface Type**	
		Totals*
	Earth	0
	Gravel (Loose Top Gravel)	223
	Surface Treatment (LCB)	134
	Hot Mix Asphalt (HCB)	10
	Total A	**367**
B.	**Roadside Environment**	
(i)	**Rural**	
	Earth	0
	Gravel (Loose Top Gravel)	223
	Surface Treatment (LCB)	123
	Hot Mix Asphalt (HCB)	1
	Total Rural	**347 km**
(ii)	**Semi-Urban**	
	Gravel (Loose Top Gravel)	0
	Surface Treatment (LCB)	11
	Hot Mix Asphalt (HCB)	2
	Total Semi-Urban	**13 km**
(iii)	**Urban**	
	Gravel (Loose Top Gravel)	0
	Surface Treatment (LCB)	0
	Hot Mix Asphalt (HCB)	7
	Total Urban	**7 km**
	Totals B	**367 km**
*Estimated to the nearest kilometre.		

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1.0 Purpose, Background and Study Method

1.1 Purpose

The purpose of the 2014 Road Needs Study Update is to update the current road inventory and road condition assessments within the Township of Stone Mills (the 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 and sidewalk 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 Stone Mills is located in South-Central Ontario in the southern part of the County of Lennox and Addington. The Township is largely a rural community with Newburgh as the primary urban centre. The Township of Stone Mills also consists of a number of other small urban to semi-urban communities.

In 2007 the Township commissioned a Road Needs Study to inventory and document their existing road and sidewalk assets. A formal update of the Road Needs Study has not been undertaken since the 2007 study. This current study (2014) utilizes and builds from the road asset information collected as part of the 2007 study undertaken by TSH (now AECOM).

1.3 Study Objectives

Based on the Request for Proposal and in discussion with Township staff the following study objectives were identified:

- Provide a current inventory and value of the Town's roads and sidewalks, assess road and sidewalk condition 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 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 and which 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.

Surface Type

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
201 – 400	Low Class Bituminous
>400	High Class Bituminous

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 Town.

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 sideroads etc. also have a significant impact on how the road functions.

A rural road with limited entrances and sideroads will have a much greater capacity to flow traffic versus an urban street with many entrances and sideroad 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. For the purposes of this study, a drainage score of "1" was adopted for roads which exhibited no formal drainage structures e.g. no ditches, catch basins and sewers etc.

Sidewalks

Sidewalks were assessed as good, fair or poor based on the presence of faulting, cracking, settlement/burial, and aging and weathering damage.

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 (1) side only.
- Rural — Roads with development over 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 anticipated growth rates provided by the Town.

Table 2 summarizes the total road length in kilometres by surface type and road environment as of April 2014.

The existing road system consists of 367 km of roadway, 223 km of gravel roads, 134 km of surface treated roads (LCB) and 10 km of HCB (asphalt paved) roads; with all calculations being approximate and rounded to the nearest kilometre.

Table 2 - Road System Inventory

Township of Stone Mills Road System in Kilometres as of April 2014		
A.	**Surface Type**	
		Totals*
	Earth	0
	Gravel (Loose Top Gravel)	223
	Surface Treatment (LCB)	134
	Hot Mix Asphalt (HCB)	10
	Total A	**367**
B.	**Roadside Environment**	
(i)	**Rural**	
	Earth	0
	Gravel (Loose Top Gravel)	223
	Surface Treatment (LCB)	123
	Hot Mix Asphalt (HCB)	1
	Total Rural	**344 km**
(ii)	**Semi-Urban**	
	Gravel (Loose Top Gravel)	0
	Surface Treatment (LCB)	11
	Hot Mix Asphalt (HCB)	2
	Total Semi-Urban	**13 km**
(iii)	**Urban**	
	Gravel (Loose Top Gravel)	0
	Surface Treatment (LCB)	0
	Hot Mix Asphalt (HCB)	7
	Total Urban	**7 km**
	Totals B	**367 km**
*Estimated to the nearest kilometre.		

2.2 Traffic Data

Annual Average Daily Traffic (AADT) is an important measure of annual vehicular use of any particular road section. Design standards, road classification and priority for improvements all depend to a large extent on this information.

The AADT for each road was derived from estimated or actual traffic counts as available by the Township. A Traffic Counting Program was not undertaken as part of the road needs study.

3.0 Sidewalk Inspections

15.2 km of sidewalk was inspected as part of this study. 2.5 km of sidewalk, as detailed below in Table 3, were found to be in poor condition or had previously been removed. It is recommended that these sidewalks be scheduled for replacement. A full list can be found in the electronic files accompanying the report.

Table 3 – Sidewalk Review (Poor Condition Only)

Rd Name	From	To	Location	Sidewalk No	Length (m)	Width (m)	Comments
Moscow							
Moscow Rd	County Rd 6	West End	S Side	SW 83-1	68	1.2	
Camden East							
Queen Victoria St	County Rd 4	West End	N Side	SW 311-1	62	1.1	
Riverview Dr	36 m E of County Rd 4	East End	N Side	SW 321-2	51	1.1	
County Rd 4	98 m S of County Rd 1	South End	E Side	SW 4173-2	132	1.2	
County Rd 4	Queen Victoria St	North End	E Side	SW 4176-2	46	1.2	
County Rd 4	Old Mill St	Riverview Dr	E Side	SW 4176-4	69	1.2	
Centreville							
Victoria St	County Rd 4	East End	S Side	SW 353-1	7	0.9	
Newburgh							
Front St	County Rd 11	South End	W Side	SW 411-1	17	0.9	
Front St	County Rd 11	Baldwin St	E Side	SW 413-2	236	0.9	
Baldwin St	Front St	County Rd 27	S Side	SW 414-1	110	0.9	
Water St	Front St	West End	N Side	SW 415-1	100	0.9	
Water St	Main St	Front St	N Side	SW 415-2	111	1.1	
Grove St	Main St	Front St	N Side	SW 417-1	107	0.9	
Academy St	East St	East End	N Side	SW 435-3	20	0.9	Buried
Homer St	County Rd 27	40 m East	S Side	SW 437-1	40	1.1	
Durham St	County Rd 27	Brock St	N Side	SW 439-1	186	0.9	
Baldwin St	County Rd 27	East End	S Side	SW 441-1	80	0.1	
Brock St	Academy St	Durham St	E Side	SW 443-1	148	1.0	
County Rd 27	County Rd 1	Harvey St	E Side	SW 27000-6	93	0.9	
County Rd 27	Harvey St	Earl St	E Side	SW 27000-7	98	0.9	
County Rd 27	Earl St	Factory St	E Side	SW 27000-8	123	0.9	

Rd Name	From	To	Location	Sidewalk No	Length (m)	Width (m)	Comments
County Rd 27	Grace St	Academy St	E Side	SW 27000-9	71	1.2	
Harvey St	County Rd 27	Elgin St	N Side	SW 407-1	85	1.1	Removed
Tamworth							
Bridge St E	Conc St	Peel St	N Side	SW 739-1	77	1.0	East End Fair
County Rd 4	Bridge St W	Addington St	W Side	SW 4393-3	79	1.5	
Bridge St E	Peel St	East End	N Side	SW 739-2	15	1.0	
County Rd 4	Chestnut St	30 m East	S Side	SW 4398-2	30	1.2	
County Rd 4	Neely St	34 m East	S Side	SW 4398-3	34	1.1	
Peel St	Addington St	North End	E Side	SW 711-1	130	0.9	Not in Inventory
Chestnut St	Addington St	South End	W Side	SW 733-2	15	0.9	Removed
Bridge St W	Bond St	10 m West	S Side	SW 737-5	10	1.2	Removed

4.0 Road Needs

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

The method of evaluating construction 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.

4.1 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. See **Table 1**.
- 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 367 km of roads inventoried, a total of 54 km were found to be critically deficient in one or more areas. Of the 54 km, approximately 24 km represents roads with AADT of less than 50 vehicles. Regardless of condition, roads with AADT of less than 50 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 roads, is as follows:

$$\textbf{2014 System Adequacy} = \frac{367 - (54 - 24)}{367} \times 100\% = 92\%$$

The average surface condition rating of all roads is 7/10 while the average structural adequacy rating is 15/20.

4.2 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 of the road at the time of this road needs study. 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 the condition rating 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 explicitly 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).

5.0 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 Town. Significant cost savings will result from proactive intervention rather than simply waiting as long as possible before performing maintenance.

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

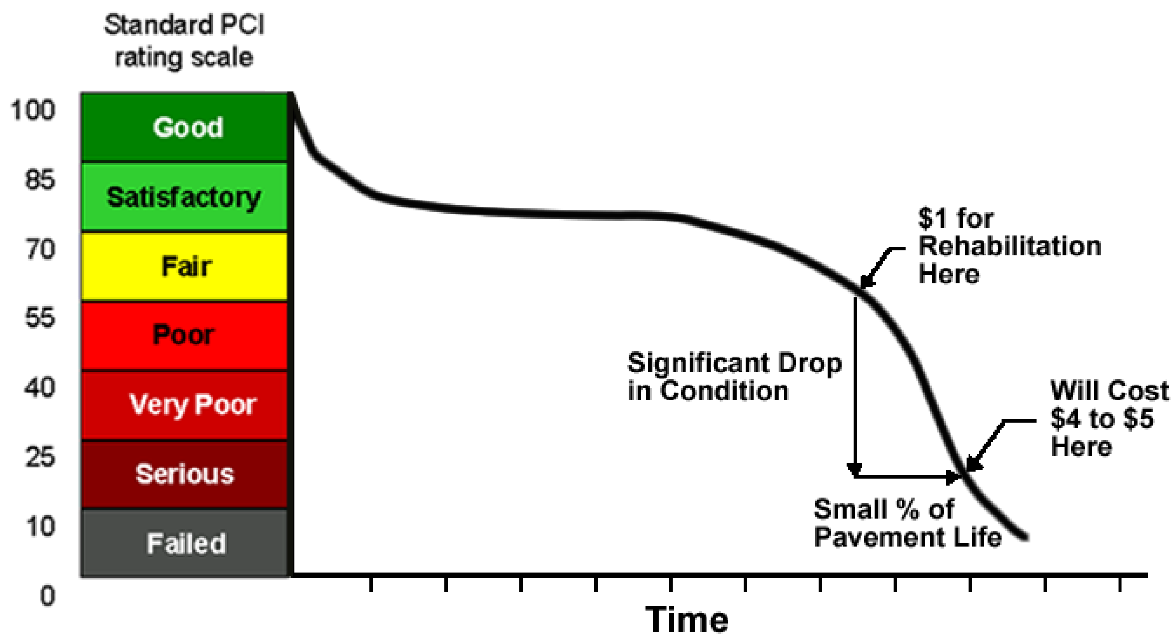

Figure 1 - Typical Service Life of an Asphalt Pavement

5.1 Example Life Cycle Cost Analysis

The following life cycle costs analysis compares three different municipalities Municipality 1, Municipality 2 and Municipality 3, each with three distinct approaches to pavement management. For this analysis we will assume each of the three municipalities have 7000 m^2 of pavement i.e. 1km of asphalt paved road that is 7m 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 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.

The figure below illustrates a time- pavement condition plot for each municipality.

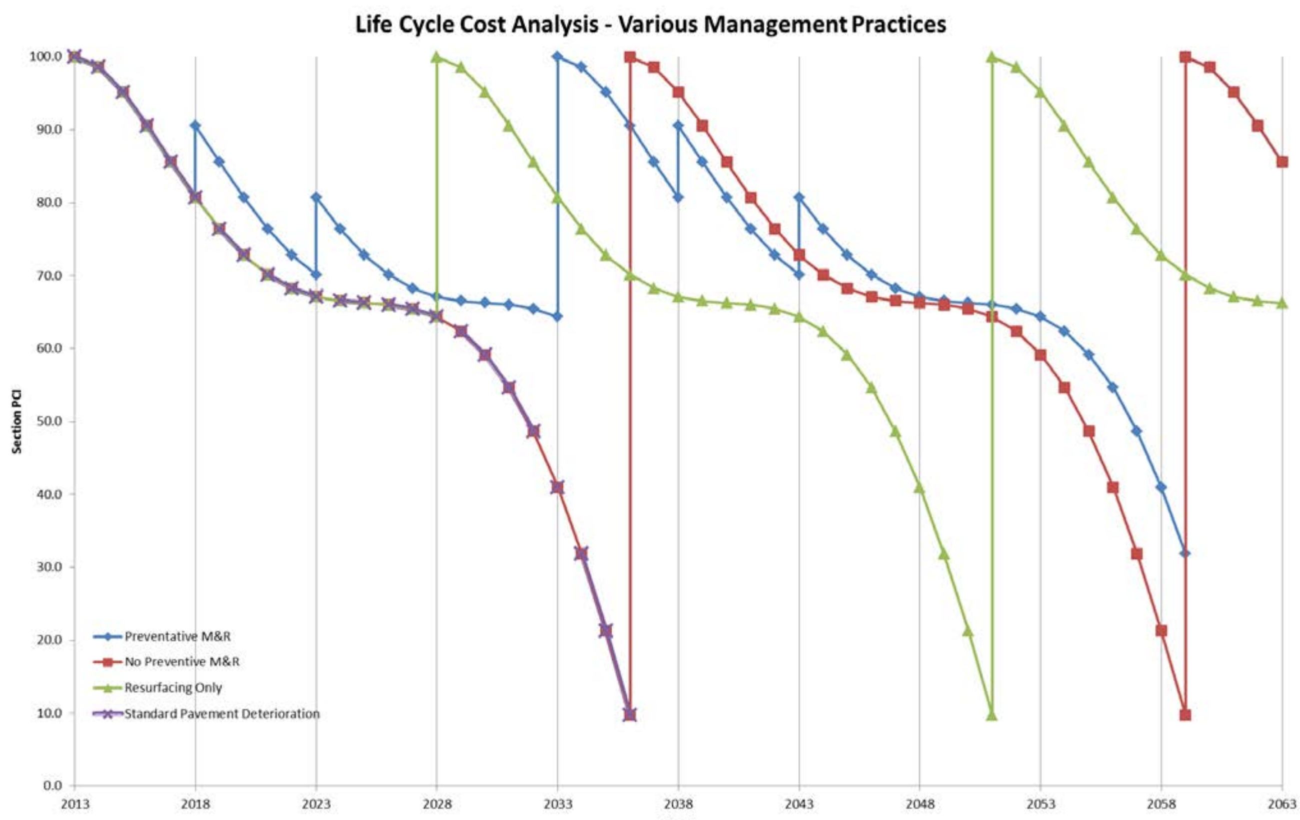

Figure 2 - Condition Plot for 3 Municipalities

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

Table 4 - Municipality 1

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 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.

Table 5 - Municipality 2

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.

Table 6 - Municipality 3

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.

5.2 Preservation Management Approach

5.2.1 Gravel Roads

The Township currently maintains 223 km of gravel road, the predominant road surface throughout the Township. The proposed preservation management approach for this class of road is outlined in the following Tables.

Table 7 - 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 8 - Capital Activities – Gravel Roads

Action	Frequency
Add layer (75mm) of granular material to road surface	Every 3 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

5.2.2 Surface Treated Roads

Surface treated roads have a hard wearing surface that must be preserved in order to be effective. The Township currently maintains 134 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)	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, 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 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 to improve roadbed drainage and safety.

It is noted that some “built-up” areas or Hamlets within the Township currently have an LCB surface. A pulverizing and resurface treating strategy is not a feasible treatment given the resulting increase in grade. In these cases, consideration for reconstruction is recommended.

5.2.3 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 Town currently maintains 10 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. The table below summarizes preservation management activities to be considered for asphalt roads:

Table 10 - 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

*Slurry seal can be used on lower volume paved roads (less than 1000 vehicles per day). For roads with volumes in excess of 1000 vpd, 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.

5.3 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 every 5 years. Recommendations on the specific treatments required shall be documented and prioritized in the Road Needs Study.

6.0 Road Needs Study Summary Table

The Road Needs Study Summary Table provides a complete priority listing of the Town's road system in descending order of priority rating, (highest priority to lowest). The Summary Table is included in with the report in electronic format.

6.1 Types of Improvements

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

Preliminary recommendations have been developed for each of the road segments. The recommendations and associated estimated costs are included in the Road Needs Summary Table.

6.1.1 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**

6.1.2 Surface Treatment

Surface treated roads are generally able to be rehabilitated with either a single or double 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 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**

6.1.3 Gravel

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

"Order of Magnitude" construction costs were developed for each of the above options on a per kilometer basis. An estimated cost for isolated frost heave repairs was also considered. The estimated costs for rehabilitation of each of the 10-Year Plan roads are included in the Road Needs Summary Table.

The above 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.

6.2 Benchmark Construction Costs

A Unit Price Form based on average prices for the local area was prepared. The unit prices were used to prepare an array of benchmark construction costs. The Unit Price Form for the 2014 Road Assessment Study is included electronically together with benchmark construction costs for various types and standards of road improvements.

The following design standards (**Table 11**) 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 11 - 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

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

7.0 Improvement Plan

7.1 Road Needs

An *excerpt* from the Road Needs Study Summary Table is included on the next page noting the recommended Capital Construction Plan in terms of priorities throughout the Township. AADT is based on previous estimates/counts provided by the Township. All costs are based on 2014 dollars and should be adjusted for inflation based on program year, for budgeting purposes. The full Roads Needs Study Summary Table is included in the electronic format. Note that the capital improvements included in the plan are listed in priority order based on traffic volumes and condition rating, as described previously. Roads with less than 50 AADT requiring reconstruction are included at the bottom of the table in their respective sections.

Township of Stone Mills Road Needs (AADT ≥ 50)

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Surface Rating (10)	Structural Adequacy (20)
Structural NOW Needs									
625	Gilmore Road	Mountain Road	Thompson Hill Road	3.5	120	Recon G - Full Reconstruction 6m Gravel Road	$364	3	6
553	Flanagan Road West	O'Brien Road	County Road 41	1.1	55	Recon G - Full Reconstruction 6m Gravel Road	$115	5	7
569	Woodcock's Mills Road	County Road 15	North End	2.0	60	Recon G - Full Reconstruction 6m Gravel Road	$208	6	7
3	Robinson Road	County Road 4	West End	0.7	50	Recon G - Full Reconstruction 6m Gravel Road	$73	5	7
627	Ballahack Road	Mountain Road	Thompson Hill Road	3.7	55	Recon G - Full Reconstruction 6m Gravel Road	$385	5	7
181	Dowdle Road	Craigen Road	Wartman Road	0.8	55	Recon G - Full Reconstruction 6m Gravel Road	$83	6	3
Structural 1-5 Year Needs									
439	Durham Street, Newburgh	County Road 27	Brock Street	0.2	55	Recon 2U - Full Reconstruction + 2 Lifts	$193	6	8
101	Huffman Road	0.1 km East Of County Road 6	German Road	2.5	250	ST2A - Double Surface Treatment with Granular A	$272	4	10
589	Howes Road	County Road 41	Miller Road	1.5	140	ST2A - Double Surface Treatment with Granular A	$163	4	10
99	Huffman Road, Moscow	County Road 6	0.1 km East Of County Road 6	0.1	250	Recon 2U - Full Reconstruction + 2 Lifts	$96	7	10
Structural 6-10 Year Needs									
581	Cedarstone Road	2.3 km North Of County Road 4	County Road 15	1.3	220	ST2A - Double Surface Treatment with Granular A	$141	6	12

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Surface Rating (10)	Structural Adequacy (20)
Structural 6-10 Year Needs									
443	Brock Street, Newburgh	Academy Street	Durham Street	0.2	80	Recon 2U - Full Reconstruction + 2 Lifts	$145	6	12
579	Cedarstone Road	County Road 4	2.3 km North Of County Road 4	3.6	250	ST2 - Double Surface Treatment	$157	7	14
707	Rose Street, Tamworth	County Road 15	West End	0.1	55	Recon 2U - Full Reconstruction + 2 Lifts	$58	5	12
715	Mill Pond Drive, Tamworth	Peel Street	Bridge Street East	0.1	200	RMP1 - Mill & Pave, 1 Lift	$47	5	14
444	Brock Street, Newburgh	Durham Street	Baldwin Street	0.1	50	Recon 2U - Full Reconstruction + 2 Lifts	$96	6	12
414	Baldwin Street, Newburgh	Front Street	County Road 27	0.1	120	Recon 2U - Full Reconstruction + 2 Lifts	$96	7	12
413	Front Street, Newburgh	County Road 11	Baldwin Street	0.3	120	Recon 2U - Full Reconstruction + 2 Lifts	$241	7	12
565	Thomas St, Erinsville	County Road 41	North Beaver Lake Road	0.2	60	ST2 - Double Surface Treatment	$9	7	14
585	Miller Road	Frizzell Road	County Road 4	3.1	250	ST2 - Double Surface Treatment	$135	6	14
709	Peel Street, Tamworth	Bridge Street East	Addington Street	0.1	55	RMP1 - Mill & Pave, 1 Lift	$31	5	14
735	Ball Park Drive, Tamworth	Addington Street	Bridge Street West	0.1	80	Recon 2U - Full Reconstruction + 2 Lifts	$77	4	12
187	Embury Road	County Road 11	Martin Drive	2.0	100	ST2 - Double Surface Treatment	$87	6	13
567	North Beaver Lake Road	County Road 41	Donohue Road	2.1	110	ST2 - Double Surface Treatment	$91	7	13

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Surface Rating (10)	Structural Adequacy (20)
Structural 6-10 Year Needs									
717	Wheeler Street, Tamworth	County Road 4	Bridge Street East	0.1	300	RMP1 - Mill & Pave, 1 Lift	$47	6	14
517	Furlong Road	County Road 13	County Road 41	0.8	55	ST2 - Double Surface Treatment	$35	6	14
Surface Type Needs									
5	Bethel Road	County Road 4	Cutler Road	3.4	450	Slurry Seal	$43	8	17
Surface Width Needs									
633	Thompson Hill Road	Gilmore Road	Ballahack Road	2.5	60	GW - Gravel Road Widening	$76	4	10
739	Bridge Street East, Tamworth	Concession Street South	Wheeler Street	0.2	150	RMP1 - Mill & Pave, 1 Lift	$78	6	15
575	Bradshaw Road	County Road 4	North End	1.1	220	Slurry Seal	$14	8	16
221	Holden Road	County Road 41	East End	2.3	75	GW - Gravel Road Widening	$70	6	15
415	Water Street, Newburgh	County Road 27	West End	0.3	120	ST2 - Double Surface Treatment	$15	7	15
403	Earl Street, Newburgh	County Road 27	County Road 1	0.4	80	ST2 - Double Surface Treatment	$16	7	15
323	Old Mill Street, Camden East	County Road 4	County Road 1	0.2	80	Rout and Seal	$1	8	17
417	Grove Street, Newburgh	Front Street	County Road 27	0.1	70	ST2 - Double Surface Treatment	$5	7	15
411	Front Street, Newburgh	Water Street	County Road 11	0.2	55	ST2 - Double Surface Treatment	$8	7	15
419	Centre Street, Newburgh	Front Street	West End	0.2	100	Slurry Seal	$3	8	17
409	Front Street, Newburgh	County Road 27	Water Street	0.2	50	Slurry Seal	$2	8	16
421	William Street, Newburgh	County Road 11	Centre Street	0.1	60	Slurry Seal	$2	8	17

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

Township of Stone Mills Road Needs (AADT < 50)									
Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Surface Rating (10)	Structural Adequacy (20)
Structural NOW Needs									
623	Ballahack Road	Mountain Road	South End	0.5	15	Recon G - Full Reconstruction 6m Gravel Road	$52	5	7
629	Eddie Way Road	Ballahack Road	West End	0.6	5	Drainage Improvements	$0	6	6
554	Flanagan Road East	County Road 41	County Road 41	0.5	20	Recon G - Full Reconstruction 6m Gravel Road	$52	7	6
195	Hooper Road	County Road 1	County Road 1	0.3	25	ST2A - Double Surface Treatment with Granular A	$33	7	7
73	Hunt Road	Wartman Road	County Road 27	0.8	30	Recon G - Full Reconstruction 6m Gravel Road	$83	6	7
171	Joyce Road	Brady Road	Craigen Road	2.1	20	Recon G - Full Reconstruction 6m Gravel Road	$219	6	6
227	McLaughlin Road	Frizzell Road	County Road 41	1.4	20	Recon G - Full Reconstruction 6m Gravel Road	$146	4	5
Structural 1-5 Year Needs									
440	Durham Street, Newburgh	Brock Street	East Street	0.1	30	Recon 2U - Full Reconstruction + 2 Lifts	$96	6	8
Structural 6-10 Year Needs									
703	Calvin Street, Tamworth	County Road 15	Peel Street	0.1	30	RMP1 - Mill & Pave, 1 Lift	$34	4	13
719	John Street, Tamworth	County Road 4	East End	0.1	15	ST2 - Double Surface Treatment	$3	7	14
245	Union Street, Croydon	County Road 14	South End	0.1	20	ST2 - Double Surface Treatment	$4	6	14
Surface Type Needs									
5	Bethel Road	County Road 4	Cutler Road	3.4	450	Slurry Seal	$43	8	17

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Surface Rating (10)	Structural Adequacy (20)
Surface Width Needs									
253	9th Concession Road	Tower Road	West End	0.5	5	GW - Gravel Road Widening	$15	6	13
369	Amos Street, Enterprise	County Road 14	North End Turnaround	0.1	10	Slurry Seal	$1	8	17
177	Barrett Road	1.2 km North Of Centreville Rd	Concession Vi/Vii	0.9	20	GW - Gravel Road Widening	$27	6	14
613	California Road	Detlor Road	Mountain Road	9.7	5	Drainage Improvements	$0	2	8
179	Concession Vi/Vii	Barrett Road	East End	1.0	5	GW - Gravel Road Widening	$30	5	10
545	Devil Lake Road	Tweed Road	North End	0.4	10	GW - Gravel Road Widening	$12	7	14
313	Dow Street, Camden East	County Road 4	West End	0.1	10	GW - Gravel Road Widening	$3	5	10
447	George Street N, Newburgh	County Road 27	South End	0.1	10	ST2 - Double Surface Treatment	$4	7	15
513	Kendall Road	Fraser Road	West End Turnaround	0.8	10	GW - Gravel Road Widening	$24	8	16
731	Neely Street, Tamworth	Bridge Street West	South End Turnaround	0.1	20	ST2 - Double Surface Treatment	$4	7	15
568	North Beaver Lake Road	Donohue Road	East End	0.8	10	GW - Gravel Road Widening	$24	7	14
551	O'Brien Road	0.9 km North Of Flanagan Rd W	North End	0.5	10	GW - Gravel Road Widening	$15	5	8
705	Rose Street, Tamworth	County Road 15	Peel Street	0.1	30	RMP1 - Mill & Pave, 1 Lift	$34	6	15
541	Sulphide Road	Tweed/Stone Mills Bdry.	East End	2.3	5	GW - Gravel Road Widening	$70	6	13
543	Turcotte Road	Hungerford Boundary	East End	0.5	10	Drainage Improvements	$0	4	13
225	Young's Road Sideroad	County Road 41	Young's Road	0.2	20	GW - Gravel Road Widening	$6	7	17

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

7.2 Drainage Improvements

During the study, ten (10) sections of road were found to have severe drainage issues such as water overtopping the road resulting in a “NOW” need for drainage improvement. As the causes and solutions for poor drainage are numerous, further investigation is required to determine the cost for correcting these issues. The ten (10) sections are listed below:

- White Lake Rd from County Rd 41 to the west end
- Teskey Road from County Rd 27 to County Rd 14
- Waddell Road from County Road 13 to Deshane Rd
- Fraser Rd from 50 m north of Kendall Rd to the north end
- Wartman Rd from Hunt Rd to Hinch Rd
- Clareview Rd from Deshane Rd to 2.6 km north of Deshane Rd
- Turcotte Rd from Hungerford BNDY to east end
- California Rd from Detlor Rd to Mountain Rd
- Norway Lake Rd from Ballahack Rd to east end
- Eddie Way Rd from Ballahack Rd to west end

7.3 Resurfacing

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:

- 10 km of paved roads (HCB)
- Degradation rate 0.25/year (rating drops from “10” to “5” over a 20 year period)
- Annual Resurfacing 0.5 km/year
- Annual Budget $169,000 (0.5 km/yr. x $169,000/ln **RMP1** x 2 lanes)

Surface Treated Roads:

- 134 km of surface treated roads (LCB)
- Degradation rate 0.625/year (rating drops from “10” to “5” over a 7 year period)
- Annual Resurfacing 19.1 km/year
- Annual Budget $420,200 (18.7 km/yr. x $22,000/km ST1)

Gravel roads require regular maintenance. Maintenance includes regular grading and reapplication of new gravel. 75mm of new gravel is recommended every 3-5 years.

Gravel Roads:

- 223 km of earth/gravel roads
- 75mm gravel every 3 years

- Annual Gravelling of 74.3 km
- Annual Budget $1,486,000 (74.3 km/yr. x $20,000/km **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 $2,075,200 per year.

An excerpt of the road resurfacing priorities (the top twenty) is noted in the following Table, Resurfacing Priorities. **Note the higher the priority rating, the higher the need, i.e. the largest priority rating is the top priority.** It is recognized that the actual program year for various resurfacings may be subject to fiscal pressure and other Town priorities. Should the full annual resurfacing plan, as proposed, not be achieved in the intended year, priority should be given to these projects in the subsequent year(s), with consideration to the then current road condition(s).

Township of Stone Mills Preservation Priorities

Sect. No.	Road Name	From	To	Length (km)	AADT	Preliminary Improvement Type Recommendation	Cost (x1000)	Surface Rating (10)	Structural Adequacy (20)
149	Teskey Road	County Road 27	County Road 14	2.0	55	Drainage Improvements	$0	5	8
505	White Lake Road	County Road 41	West End	0.7	50	Drainage Improvements	$0	3	15
599	Rogers Road	County Road 4	Potchett Road	1.6	150	G - Gravel (75mm)	$32	7	11
511	Fraser Road	County Road 13	0.05 Km North Of Kendall Road	0.3	55	ST2 - Double Surface Treatment	$13	6	16
251	Tower Road	1.1 Km North Of County Rd 14	9th Concession Road	1.2	100	G - Gravel (75mm)	$24	7	15
603	Rogers Road	Potchett Road	Breen Road	5.1	120	G - Gravel (75mm)	$103	6	13
519	Waddell Road	County Road 13	Deshane Road	3.0	100	Drainage Improvements	$0	5	12
609	Carroll Road	Rogers Road	2.0 Km North Of Rogers Road	2.0	55	G - Gravel (75mm)	$40	6	13
555	Mcguire ROAD	COUNTY ROAD 41	DONOHUE ROAD	1.4	120	G - Gravel (75mm)	$28	6	14
321	Riverview Drive, Camden East	County Road 4	East End	0.6	150	Slurry Seal	$7	8	17
285	Breen Road	9th Concession Road	Rogers Road	2.0	55	G - Gravel (75mm)	$40	6	8
512	Fraser Road	0.05 Km North Of Kendall Road	North End	1.3	55	Drainage Improvements	$0	7	15
239	Camden/Sheffield Boundary Road	Murphy Road	County Road 4	0.6	60	G - Gravel (75mm)	$12	6	14
229	Miller Road	County Road 14	0.3 Km South Of Haggerty Rd W	1.5	250	ST2 - Double Surface Treatment	$65	7	15
507	Young's Road	County Road 41	Hungerford Boundary	1.5	60	G - Gravel (75mm)	$30	6	14

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.

7.4 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. This can either be accomplished through dedicated internal Town forces or sub-contracting to private contractors. Ditch cleanout and clearing of vegetation from the right-of-way should be carried out on a regular basis. Consideration may be given to a dedicated capital program of ditch cleanout and clearing, to ensure resources are dedicated to these important activities.

Clearing and Grubbing

Regular clearing and grubbing of a ROW ensures that sightlines and clear zones remain unobstructed by vegetation. Many townships choose to do this on a ten-year cycle (i.e. clear and grub 10% of their rural roads every year. For Stone Mills, this would mean 36 km of annual clearing and grubbing.

Ditch Cleanout

Ditch cleanout maintains ditching grades which ensures proper drainage by removing deposited sediment and overgrown vegetation. Many townships choose to do this on a 10 year cycle. For Stone Mills, with approximately 500 km of ditches, this relates to 50 km of ditch cleanout per year, or 25 km of road with ditches on both sides. It should be noted that the Township has approximately 100 km of road with no ditches, storm sewers or other system for road drainage. Consideration should be given to providing new ditches for these roads.

Shoulder Maintenance

Shoulders need regular maintenance to preserve proper cross fall and repair erosion damage from road run-off. Winter maintenance activities, such as sanding and plowing, often leave small berms on the shoulder which prevents proper surface drainage. For this reason, all sand berms should be removed every spring. Spot repairs for shoulder erosion should be addressed as soon as possible to prevent progressive damage.

8.0 Alternate Budget Scenarios

The Road Needs and Resurfacing Program, as detailed above, should be considered the 'ideal' budget: enough to fix bad roads while maintaining good roads. The ideal budget is referred to as Scenario A. Adhering to Scenario A is most likely to result in a high level of service while lowering the life-cycle cost of the road. It is recognized that budget constraints will often lead to funding shortfalls. An additional three funding scenarios are considered in this report:

- **Scenario A**: Ideal level of funding allows road needs to be addressed alongside preservation and regular resurfacing (All Roads)
- **Scenario B**: Allow the period between resurfacings to increase, while still taking care of structural road needs (exclude surface width deficiencies) (All Roads)
- **Scenario C**: Allow the period between resurfacings to increase, address high-volume priority road needs only (exclude surface width deficiencies).
- **Scenario D**: Allow the period between resurfacings to increase, address highest volume priority road needs only, lower the minimum level of acceptable service that would trigger reconstruction.

8.1 Scenario B

In low volume situations, surface width deficiencies, unlike structural or surface deficiencies, do not tend to lead to further road distress. As they are not progressive, leaving them as is will not create future costs of maintaining the road to rise. It should be noted that surface width deficiencies can be a safety hazard and wider roads reduce driver stress. Addressing only structural and surface type needs would cost $4.2 M.

Based on optimistic degradation rates for gravel roads, surface treatment, and hot mix, a resurfacing program/budget could be revised as follows:

Hot Mix Paved Roads:

- 10 km of paved roads (HCB)
- Degradation rate 0.20/year (rating drops from “10” to “5” over a **25** year period)
- Annual Resurfacing 0.4 km/year
- Annual Budget $135,200 (0.4 km/yr. x $169,000/ln **RMP1** x 2 lanes)

Surface Treated Roads:

- 134 km of surface treated roads (LCB)
- Degradation rate 0.5/year (rating drops from “10” to “5” over a **10** year period)
- Annual Resurfacing 13.4 km/year
- Annual Budget $294,800 (13.1 km/yr. x $22,000/km ST1)

Gravel Roads:

- 223 km of earth/gravel roads
- 75mm gravel every **5** years
- Annual Gravelling of 44.6 km
- Annual Budget $892,000 (44.6 km/yr. x $20,000/km **G**)**

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

The total resurfacing program for Scenario B, (hot mix, surface treatment and gravel) is estimated at $1,322,000 per year. It should be noted that this resurfacing program carries the risk that roads won't be resurfaced in time and will degrade to a point where resurfacing is not an option and full reconstruction is required. When using optimistic degradation rates, it is even more important that proper preservation techniques such as route and seal, slurry seal, or micro-surfacing, and ditching and clearing are rigorously applied in order to extend service lives.

Scenario B could be more economic in the long term than Scenario A, but is higher risk. Furthermore, Scenario B would not be able to fund widening projects which means that deficient surface widths will remain so indefinitely.

8.2 Scenario C

Addressing only those road needs when the AADT is equal to or greater than 50 would reduce the capital improvement budget to approximately $3.49 M. Roads in need with AADT less than 50 would essentially be repaired to minimum standards by maintenance only.

The resurfacing program is $1,322,000 per year, the same as Scenario B.

8.3 Scenario D

Addressing only the highest priority road needs (priority rating greater than 20) would reduce the capital improvement budget to approximately $2.97 M. Lowering the minimum level of service (that is, the trigger to perform reconstruction) results in longer periods between reconstructions but requires increased maintenance for both the road and the vehicles that drive it.

The resurfacing program is $1,322,000 per year, the same as Scenario B.

Scenario D is not sustainable as road needs and maintenance costs increase year over year. It is essentially deferring work for later years. Therefore it is only acceptable to have a budget within Scenario D's parameters for a short period of time.

8.4 Project Coordination

Road program costs will naturally fluctuate while funding is typically flat. Some years, the cohort of preservation, resurfacing, and reconstruction projects will coincide. These years will effectively resemble a Scenario D budget even if the typical budget is well funded. Counterintuitively, it is not wise to use road priorities to decide which programs to continue. Road priorities give a good indication of which roads are most important to fix or maintain. They do not give a good comparison of the cost of deferring road work.

An illustrative example would be to compare many km of low-volume HCB roads (AADT=100) with a condition rating of 80 compared to a short section of moderate-volume HCB road (AADT=1000) with a condition rating of 40. The low-volume roads are in good shape and the recommended work is route-and-sealing. The moderate-volume road, however, is in poor shape and requires full reconstruction. It can be assumed that the cost of route and sealing these many km of the low-volume HCB roads is equal to the cost of reconstructing a short length of high-volume HCB road.

The priority ratings of the roads are 14 and 68 respectively and suggest that the poor road is reconstructed before the many good roads are route-and-sealed. On the other hand the two projects have vastly different consequences for deferment. Deferring the reconstruction project for next year will simply incur an increased cost in maintenance. It will unlikely have much effect on the overall life cycle cost of the road, although users will have to endure a poor riding surface for another year. On the other hand, deferring route and sealing for a year may very well cause the road to deteriorate to a point where route and sealing is not applicable. As mentioned earlier, preservation techniques, when properly used, are extremely cost effective compared to resurfacing or reconstruction. In such cases, where funding is limited, allocations toward pavement preservation management, versus funding capital improvements should be considered.

In general, time sensitive applications should take precedence in a given year's program. Preservation techniques are the most sensitive, and also the most cost-effective. Resurfacings are ideally done just before a road starts to deteriorate rapidly. Resurfacing becomes less effective with successive applications (a road's first resurfacing should take precedence over another's second resurfacing). In contrast, reconstruction can be deferred as long as maintenance can reasonably be used to bring the road up to minimum standards.

8.5 Scenario Comparison

The following table outlines the differences between Scenarios A, B, C, and D.

Table 5: Comparison of Funding Levels

Scenario	10-Year Road Needs Cost	Annual Resurfacing Budget	Notes
A	$10.46M	$2.07M	-"Ideal" scenario, all road needs can be addressed, preservation practices are fully implemented, and resurfacing program is well funded. Long term costs decrease as pavements last longer.
B	$4.2M	$1.32M	-Most road needs can be addressed and resurfacing program is adequately funded.
C	$3.49M	$1.32M	-Most road needs can be addressed on moderate to high volume roads and the resurfacing program is adequately funded. Lack of funding for low-volume road needs may cause long-term costs to go up.
D	$2.97M	$1.32M	-Only the most important road needs are addressed while resurfacing programs are adequately funded. Unsustainable in the long term as more and more road needs will develop.

9.0 Replacement Cost

In conjunction with the road assessment study, 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 3 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 Town's road infrastructure is approximately $ 62.1 Million.

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.

10.0 Summary

D.M. Wills Associates (Wills) undertook a review of the Township of Stone Mills' 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 April 2014. A visual assessment of each road within the Township was undertaken in accordance with the MTO Inventory Manual for Municipal Roads, 1991.

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:

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

The overall system adequacy for the 2014 Road Needs Assessment is 92%.

Capital Improvements

Prioritization and recommendations for planned capital improvements have been developed based on the condition rating and traffic demands on each road. Priority is given to roads with higher volumes and poorer condition ratings. This approach coincides with the previous road needs assessment for the Township, completed in 2007.

A total length of approximately 40 km of road was identified as having needs in the surface type and structural "NOW," 1-5, and 6-10 year periods, **including roads with AADT less than or equal to 50**. The estimated cost to improve these roads is approximately $ 4.2 M. An additional length of 26 km of road was 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.

Resurfacing

The total resurfacing program, (hot mix, surface treatment and gravel) is estimated at $2,075,200 per year.

Implementation/continuation of a road and roadside preventative maintenance program is strongly recommended. This 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 roads maintenance can reduce the annual resurfacing/reconstruction requirements by prolonging the useful service life of the roads.

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,

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Manager, Transportation Engineering

Statement of Limitations

This report has been prepared by D.M. Wills Associates on behalf of the Township of Stone Mills. 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 2014 Roads Needs Study 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 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 2014 Road Needs Study findings.