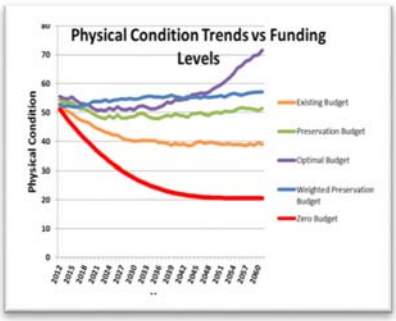
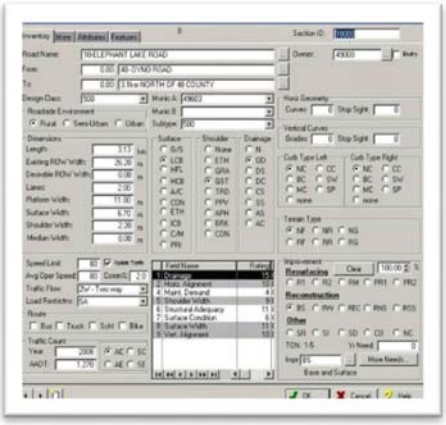
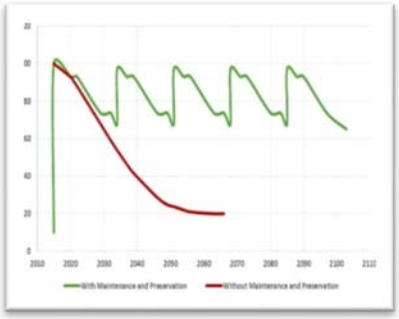
Town of Petrolia
2015 State of the Infrastructure - Roads







Roads Management Services Inc.

7 Candle Crescent, Kitchener Ontario, N2P 2K7

www.4roads.ca

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Kitchener Ontario, N2P 2K7

October 25, 2015

Town of Petrolia
411 Greenfield Street
P.O. Box 1270
Petrolia, Ontario N0N 1R0

Attention: **Mr. Mike Thompson, Director of Operations**

Mr. Rick Charlebois, Director of Corporate Services / Treasurer

Subject: **Town of Petrolia, 2015 State of the Infrastructure -Roads**

Dear Mr. Thompson and Mr. Charlebois,

4 Roads Management Services Inc. (4 Roads) is pleased to provide this report on the 2015 Town of Petrolia State of the Infrastructure project for the road system.

The 2015 project updated the condition data on the entire road system and updated costing and analysis and reports on same.

All road sections have been reviewed and have updated estimated improvement and replacement costs. Calculations for Time of Need, Improvement and Replacement Costs and Performance modeling were developed utilizing WorkTech Asset Manager Foundation Software.

We trust that the information provided in this report will be beneficial to the Town of Petrolia in the evolution of their Asset Management Plans.

Please do not hesitate to call or email if you require any further information or discussion on any aspect of the report. Thank you for the opportunity to prepare this report. If 4 Roads Management Services Inc. may be of any further service, please do not hesitate to contact the undersigned.

Yours truly,

David Anderson, CET
President,
4 Roads Management Services Inc.
Dave.anderson@4roads.ca
519 505 5065

Town of Petrolia

2015 State of the Infrastructure - Roads

Executive Summary Report

Roads Management Services Inc.

7 Candle Crescent, Kitchener Ontario, N2P 2K7

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Executive Summary

In the fall of 2012, the Province of Ontario, introduced a requirement for an Asset Management Plan (AMP) as a prerequisite for municipalities seeking funding assistance for capital projects, from the province; effectively creating a conditional grant. To qualify for future infrastructure grants, an AMP had to be developed and approved by a municipal council by December 2013.

On April 26, 2013 the province announced that it had created a $100 million Infrastructure Fund for small, rural and northern municipalities. Subsequently, the province has introduced further initiatives for infrastructure funding: Ontario Community Infrastructure Fund (OCIF) and the Small Communities Fund (SCF). An Asset Management Plan approved by Council is required as part of the submission for OCIF Applications. Asset Management Plans will be reviewed for comprehensiveness.

The Town of Petrolia is currently evolving their AMP for the various asset groups, roads being one of them. A key component of the AMP is a *'State of the Infrastructure'* (SotI) review of the asset or asset group. This report provides the SotI review of the Town of Petrolia road system and also provides recommendations for budgets and road asset management.

The scope of this report is to prepare a State of the Infrastructure (SotI) executive summary report for Roads that includes:

- Review and condition rating on the road assets within the Town of Petrolia road system
- Develop current replacement costs for each road asset
- Develop/review recommendations for improvement and associated costing on deficient assets
- Develop recommendations for annual budgets based on current costs for amortization/capital depreciation and major program areas based on updated unit costs provided by the Town.
- Develop analysis on the effect of current and recommended budgets on overall system performance.
- Provide Level of Service recommendations
- Provide Asset Management Strategy recommendations

The 2015 State of the Infrastructure for Roads Report summarizes the road system survey conducted during the spring of 2015 The survey identifies the condition of each road asset by its time of need and recommended maintenance, rehabilitation or reconstruction treatment.

Further, the report provides an overview of the physical and financial needs of the road system in its entirety as well as by road section. Both information sources are used to develop programming and budgets. However, once a road section reaches the project design stage, further detailed review, investigation, and design will be required to address the specific requirements of the specific project.

This report should not be confused with a road safety audit. A road safety audit is the formal safety performance examination of an existing or future road or intersection, which qualitatively estimates and reports on potential road safety issues, and identifies opportunities for improvements for all road users. Typically, and more predominantly in a lower tier, rural area on lower volume road sections, the road system has some deficiencies with the existing horizontal and vertical alignment.

The Town provided the existing database which included traffic counts, the majority of which are estimated. Accurate and current traffic counts, including accurate truck counts, are critical in managing

a road system and their importance cannot be emphasized enough. Traffic counts establish road maintenance classifications for Minimum Maintenance Standards purposes, as per Ontario Regulation 239/02 (*Minimum Maintenance Standards for Municipal Roads*), as well as determining appropriate geometry, structure, and cross-section when the road is rehabilitated or reconstructed. The Town of Petrolia continues to experience growth and the increased traffic, including truck counts, should be identified and continue to be updated on a regular cycle, as a risk management exercise.

Road sections should be reasonably consistent throughout their length, according to roadside environment, surface type, condition, cross section, speed limit, traffic count or a combination of these factors. For example, new sections should be created as surface type, surface condition, cross-section, or speed limit changes.

Data collection and road ratings were completed generally in accordance with the Ministry of Transportation Ontario (MTO) *Inventory Manual for Municipal Roads* from 1991 (*Inventory Manual or IM*). Road conditions are evaluated during a field inspection. The ratings are either as a standalone value or incorporated into calculations performed by the software, that then classify the road section as a 'Now', '1 to 5', or '6 to 10' year need for maintenance, rehabilitation or reconstruction in six critical areas. The Time of Need is a prediction of the time until the road requires reconstruction*, not the time frame until action is required.* Generally, the closer the timeline to reconstruction, the greater the deterioration of the road is. For example, a road may be categorized as a '6 to 10' year need with a resurfacing recommendation. This road should be resurfaced as soon as possible to further defer the need to reconstruct.

Improvement recommendations are made based on the defects observed and other information available in the database at the time of preparation of the report. Once a road asset reaches the project level, the municipality may have selected another alternative based on additional information, asset management strategy, development considerations or available funding.

'NOW' needs represent road sections that require reconstruction or major rehabilitation. 'NOW' needs are the backlog of work required on the road system; however, 'NOW' needs may not necessarily be the priority, depending on funding levels. Construction improvements identified within this time period are representative of roads that have little or no service life left and are in poor condition. Resurfacing treatments are never 'NOW' need, with the following exceptions;

- RW (Resurface and Widen)
- PR1 or PR2 (Pulverize and resurface 1 or 2 lifts of asphalt)
- When the surface type is inadequate for the traffic volume (gravel road over 400AADT)
- When the surface is gravel and the roadside environment is Urban or Semi-Urban

'1 to 5' identifies road sections where reconstruction is anticipated within the next five years, based upon a review of their current condition. These roads can be good candidates for resurfacing treatments that would extend the life of the road (depending on any other deficiencies), deferring the need to reconstruct.

'6 to 10' identifies road sections where reconstruction improvements are anticipated within six to ten years, based upon a review of their current condition. These roads can be good candidates for resurfacing treatments that would extend the life of the road (depending on any other deficiencies), thus deferring the need to reconstruct.

'ADEQ' identifies road sections that do not have reconstruction or resurfacing needs, although minor maintenance such as crack sealing or spot drainage may be required.

This report summarizes the needs identified through a number of tables appended to this summary report.

When the *Inventory Manual* was originally developed, the Province provided funding for municipal road systems; the road systems were measured by their system adequacy. The system adequacy is the percentage of the road system that is not a "NOW" need.

The *Inventory Manual* provides direction that roads with a traffic volume of less than 50 vehicles per day *are deemed to be adequate,* even if they have structural, geometric, or drainage deficiencies that would otherwise be identified as being in a Time of Need and were to be corrected within the maintenance budget. This approach is directly parallel to Regulation 239/02, *Minimum Maintenance Standards for Municipal Roads*, which states that roads with less than 50 vehicles per day, and a speed limit of less than 80 km/hr., are classified as Class 6 with no standard for repair. This factor has an effect on the system adequacy calculation for the Town of Petrolia. There are .1 centre line kilometres of road that have an estimated traffic volume of less than 50 vehicles per day (0.25% of the system).

However, for the purposes of this report, road sections with a traffic count of less than 50 vehicles per day have been provided with recommended treatment and associated improvement cost in order to provide a more accurate assessment of the total needs of the Town. (The calculations will rate them as adequate due to the traffic count)

During the field review, and in reviewing the data and the needs for the road network, there were several unique aspects of the network that came to light:

- The current System Adequacy measure for the Town of Petrolia road system is **78.4**%, which has been reduced slightly since the 2012 report (80.1%).
- The overall rating is a direct result of the length of roads constructed through development over the last 25-year period. These roads have only required maintenance to this point and have not been a significant financial demand on the system. These roads require or will require resurfacing now or in the near future. In order to ensure maintenance of the overall system condition, it will be import to review programming to ensure that the resurfacing is undertaken at the appropriate time.
- 5.532 km (14.2%) are identified as requiring some type of resurfacing or rehabilitation improvement, with 0.351 km in the 'NOW' time period.
- Approximately 11.6% (4.6 km) of the hot mix asphalt component of the road system has a structural adequacy score of 15 or 16, indicating the those roads would be an additional resurfacing need in the next 1 to 3 year period.
- There are 0.574km of road sections where the existing pavement width is narrower than the Ontario geometric design guidelines. In lieu of reconstruction, signage can reduce risk.
- Traffic data for this report is estimated only should not be relied upon to establish the Minimum Maintenance Standard Class. Accurate traffic counts or accurate estimates are essential to establish the MMS and reduce the risk to the municipality.

Based on the current review of the road system, the current system adequacy measure is **78.4** % meaning that, 21.6% of the road system is deficient in the 'NOW' time period meaning that they are in poor condition.

Based on the current unit costs being experienced, the estimated total cost of recommended improvements is **$17,014,059.** The improvement costs include **$9,506,376** for those roads identified as NOW needs and **$7,534,683** is for road work required in the '1 to 10' year time period or for maintenance. Included in those amounts is **$230,241** is for work on road sections that are Adequate and require only maintenance or roads with a traffic count of less than 50 vehicles per day.

Based on the composition of the road system, budget recommendations have been developed for annual capital and maintenance programs as follows:

- **$1,116,100** for the roads capital/depreciation, excluding resurfacing, based upon a 50-year life cycle. (This would be similar to the PSAB 3150 amortization value using current replacement costs.) The annualized value and 50 year life cycle assumes that there will be regular maintenance and resurfacing in addition to the depreciation costs.
- **$487,200** for average annual hot mix resurfacing, based upon a 19(18.9)-year cycle. (This would approximate an average of 1.63 km per year).
- **$17,700** annually, for single surface treatment of existing surface-treated roads, based on a seven-year cycle (this does not include additional padding or geometric correction).
- **$12,300** annually for crack sealing.
- **$2,481** annually for gravel road resurfacing.

For modeling purposes, 4 Roads has created a funding level described as the 'Preservation Budget'. The Preservation Budget is the total of the recommended funding levels for hot mix resurfacing, single surface treatment and crack sealing: **$519,600**. The premise being that if the preservation and resurfacing programs are adequately funded then the system should be sustained. To clarify, the required funding level to sustain or improve the road system; it is *not* the total of all of the above recommendations. Sustainable funding has to be between the Preservation Budget and the Capital Depreciation. The preservation budget and performance model thereof are computer derived. Intangible values and decisions and the effects of other external forces cannot be incorporated into the model. As such the preservation model is the minimum required to maintain the system - in theory. From a more pragmatic perspective and to deal with the real life realities of maintaining a road system, it should be greater.

Municipal pavement management strategies are critical to managing the performance of the road system, more so, if funding is limited. Funding constraints should push the strategy toward those programs that extend the life cycle of the road by providing the correct treatment at the optimum time. Resurfacing, rehabilitation, and preservation projects should be a higher priority than reconstruction projects. The objective is to "keep the good roads good".

As the municipality advances the development of their Asset Management Plan (AMP), a paradigm shift will be required in the way that we approach management of assets. Traditionally, municipalities have spent a fixed amount capital and maintenance each year. As evidenced by Table ES.9, programs are not at a consistent funding level on an annual basis. The annual budget overall is met, however, the distribution of costs between traditional capital and maintenance activities varies. That variance is being

driven by the demands of the road system based on condition and project selection is based on condition and best Return on Investment. This concept has to be applied to all assets. Graph ES.5 further illustrates this concept.

The prime goal of any pavement management strategy should be to maintain overall system adequacy. The funding level for road-related programming should be set at a sufficient level so as to ensure that overall system adequacy does not decrease over time.

In addition to the budgetary recommendations, the following recommendations are provided for the management of the road inventory.

1. The information included in this report should be utilized to continue to evolve the Town of Petrolia Asset Management Plan
2. Petrolia's asset management strategy should be reviewed to ensure that appropriate funding and programming are in place to deal with pending resurfacing demand. Preservation and resurfacing programs offer a better return on investment and should be prioritized.
3. The condition of the road system should continue to be reviewed on a regular basis, to measure the effectiveness of strategies and/or sufficiency of funding levels.
4. A regular traffic counting program should be implemented as soon as possible, completing the entire system on a three- to five-year cycle, on a continuing basis. The counting should include the percentage of trucks.
5. Further analysis should be undertaken on the gravel road system, with respect to the potential for conversion to a hardtop surface.

Summary Information

Table ES 1: Roadside Environment and Surface Type

	Roadside Environment									
	Rural		Semi-Urban		Urban		Total		% of Total	
Surface Type	Cl-km	Lane-km	Cl-km	Lane-km	Cl-km	Lane-km	Cl-km	Lane-km	Cl-km	Lane-km
Concrete	0	0	0	0	2.791	5.582	**2.791**	**5.582**	7.15%	7.15%
Gravel, Stone, Other Loosetop	0	0	0.352	0.704	0	0	**0.352**	**0.704**	0.90%	0.90%
High Class Bit.-asphalt	2.059	4.117	3.178	6.356	24.995	49.99	**30.232**	**60.463**	77.42%	77.42%
Low Class Bit.-surface treated	2.059	4.118	3.615	7.23	0	0	**5.674**	**11.348**	14.53%	14.53%
TOTAL	**4.118**	**8.235**	**7.145**	**14.29**	**27.786**	**55.572**	**39.049**	**78.097**		
% OF TOTAL	10.54%	10.54%	18.30%	18.30%	71.16%	71.16%				

Table ES 2: Roadside Environment and Functional Class

	Roadside Environment									
	Rural		Semi-Urban		Urban		Total		% of Total	
Road Classification	Cl-km	Lane-km	Cl-km	Lane-km	Cl-km	Lane-km	Cl-km	Lane-km	Cl-km	Lane-km
200	0.389	0.778					**0.389**	**0.778**	1.00%	1.00%
400	3.209	6.417					**3.209**	**6.417**	8.22%	8.22%
ALL (Alley)			0.391	0.782			**0.391**	**0.782**	1.00%	1.00%
C/R			0.984	1.968	2.857	5.714	**3.841**	**7.682**	9.84%	9.84%
L/R	0.474	0.948	3.819	7.638	24.411	48.822	**28.704**	**57.408**	73.51%	73.51%
LCI	0.046	0.092	1.951	3.902	0.518	1.036	**2.515**	**5.030**	6.44%	6.44%
TOTAL	**4.118**	**8.235**	**7.145**	**14.290**	**27.786**	**55.572**	**39.049**	**78.097**		
% OF TOTAL	10.54%	10.54%	18.30%	18.30%	71.16%	71.16%				

Table ES 3: Roadside Environment and Lanes

	Roadside Environment									
	Rural		Semi-Urban		Urban		Total		% of Total	
Lanes	Cl-km	Lane-km	Cl-km	Lane-km	Cl-km	Lane-km	Cl-km	Lane-km	Cl-km	Lane-km
2	4.12	8.24	7.15	14.29	27.79	55.57	**39.05**	**78.10**	100.00%	100.00%
TOTAL	**4.12**	**8.24**	**7.15**	**14.29**	**27.79**	**55.57**	**39.05**	**78.10**		
% OF TOTAL	10.54%	10.54%	18.30%	18.30%	71.16%	71.16%				

Table ES 4: Roads with Sub-*Standard Width*

Asset ID	Street Name	From Desc	To Desc	Length	Width	Lanes
726	Barretts Lane	Petrolia Line	England Ave	0.294	3.3	2
744	Chestnut St	School St	south end	0.076	4.6	2
804A	Gem to Garfield Alley	Gem Ave	Garfield Ave	0.16	5	2
860A	Mutual St	South End	Third St	0.044	3.2	2

Table ES 5: Time of Need by Length and MMS Class

MMS Class	4		5		6		TOTAL	
Time of Need	Cl-km	Lane-km	Cl-km	Lane-km	Cl-km	Lane-km	Cl-km	Lane-km
NOW	1.06	2.12	3.86	7.71			**4.92**	**9.83**
1 to 5	3.37	6.75	3.29	6.58			**6.66**	**13.32**
6 to 10	6.65	13.29	12.3	24.6	0.1	0.19	**19.04**	**38.09**
ADEQ	3.85	7.7	4.58	9.16			**8.43**	**16.86**
TOTAL	**14.93**	**29.86**	**24.02**	**48.05**	**0.1**	**0.19**	**39.05**	**78.1**
% OF TOTAL	38.23%	38.23%	61.52%	61.52%	0.25%	0.25%		
System Adequacy %	74.2	74.2	80.9	80.9	100.0	100.0	78.4	78.4
Good to Very Good %	67.1	67.1	64.9	64.9	100.0	100.0	65.8	65.8

Table ES 6: Boundary Roads

Asset ID	Street Name	From Desc	To Desc	Length	Adjacent Agency
751	Discovery Line	West town limit	Stanley	0.3	Township of Enniskillen
752	Discovery Line	Stanley Ave	Eureka St	0.449	Township of Enniskillen
753	Discovery Line	Eureka St	Centre St	0.284	Township of Enniskillen
754	Discovery Line	Centre St	Former Railway Crossing	0.164	Township of Enniskillen

Table ES 7: Town Needs Summary by Road by Rehabilitation Type

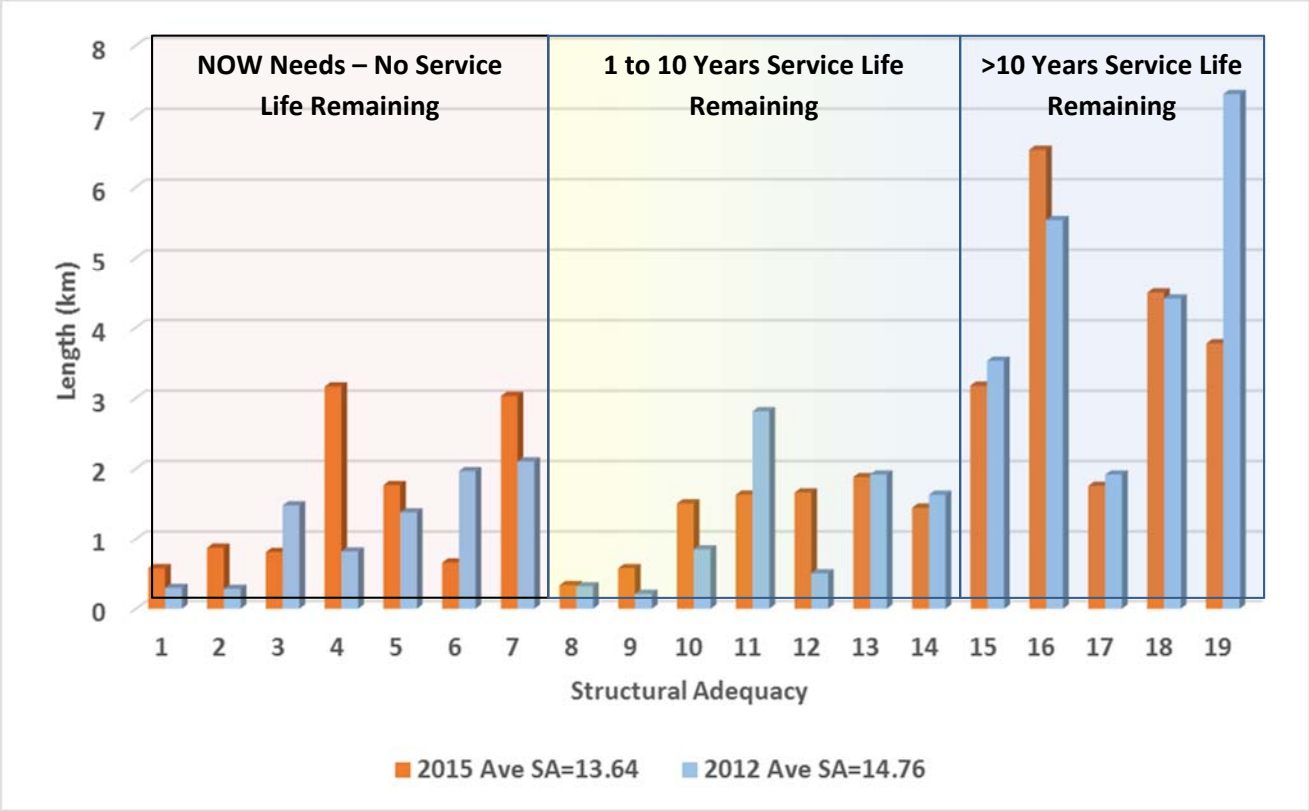
			Time of Need									
			1-5		*6-10*		*ADEQ*		*NOW*		TOTAL	
Imp. ID	Improvement Description	Imp. Class	Imp. Cost	CL Length	Imp. Cost	CL Length	Imp. Cost	CL Length	Imp. Cost	CL Length	Imp. Cost	CL Length
NONE	No Improvement Required	Const					0	6.274			**0**	**6.274**
REC	Reconstruction - Rural	Const			695,854	0.984			1,514,793	2.351	**2,210,647**	**3.335**
RNS	Reconstruction Nominal Storm Sewer	Const	390,322	0.367					2,450,039	2.501	**2,840,361**	**2.868**
RSS	Reconstruction with Storm Sewers	Const	2,185,761	1.262	2,051,493	1.220	160,854	0.097	5,327,669	3.149	**9,725,778**	**5.728**
RW	Resurface and Widen	Const							80,691	0.076	**80,691**	**0.076**
SRR	Storm Sewer and Road Reinstatement	Const	0	0.147							**0**	**0.147**
CRK	Crack Sealing	Maint					21,774	10.805			**21,774**	**10.805**
MICRO	Microsurfacing-Pavement Preservation	Maint					47,612	1.701			**47,612**	**1.701**
SD	Spot Drainage	Maint			0	1.549	0	0.065			**0**	**1.614**
SR	Spot Repairs	Maint			0	0.868	0	0.101			**0**	**0.969**
PR2	Pulverize and Resurface 2 - 100mm	Rehab							19,795	0.107	**19,795**	**0.107**
R1	Basic Resurfacing 1 - 50mm	Rehab	157,325	0.637	670,778	2.041					**828,103**	**2.678**
R2	Basic Resurfacing 2 - 100mm	Rehab	1,152,908	2.503					113,389	0.244	**1,266,297**	**2.747**
TOTAL			**3,886,317**	**4.916**	**3,418,125**	**6.662**	**230,241**	**19.043**	**9,506,376**	**8.428**	**17,041,059**	**39.049**

Note: costs are in current dollars and are not inflated.

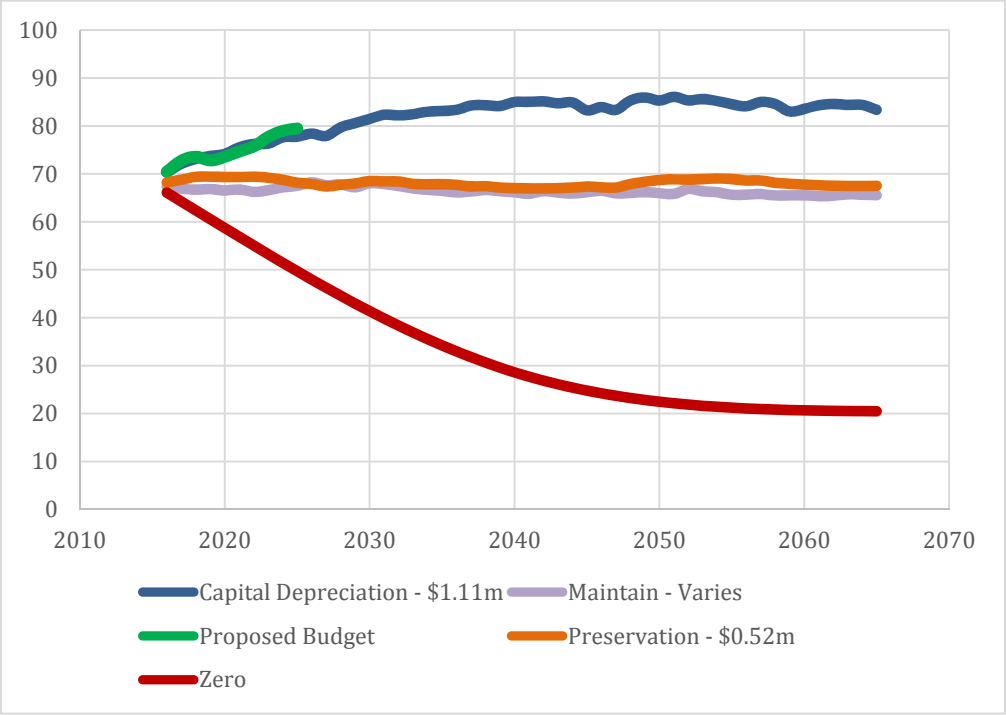
Table ES.8: Estimated AADT by Roadside and MMS Class

	MMS Class			
AVERAGES	4	5	6	AVERAGE
Rural	842	211		**526**
Semi - Urban	825	165	10	**333**
Urban	1,154	214		**684**
AVERAGE	**940**	**197**	**10**	**448**

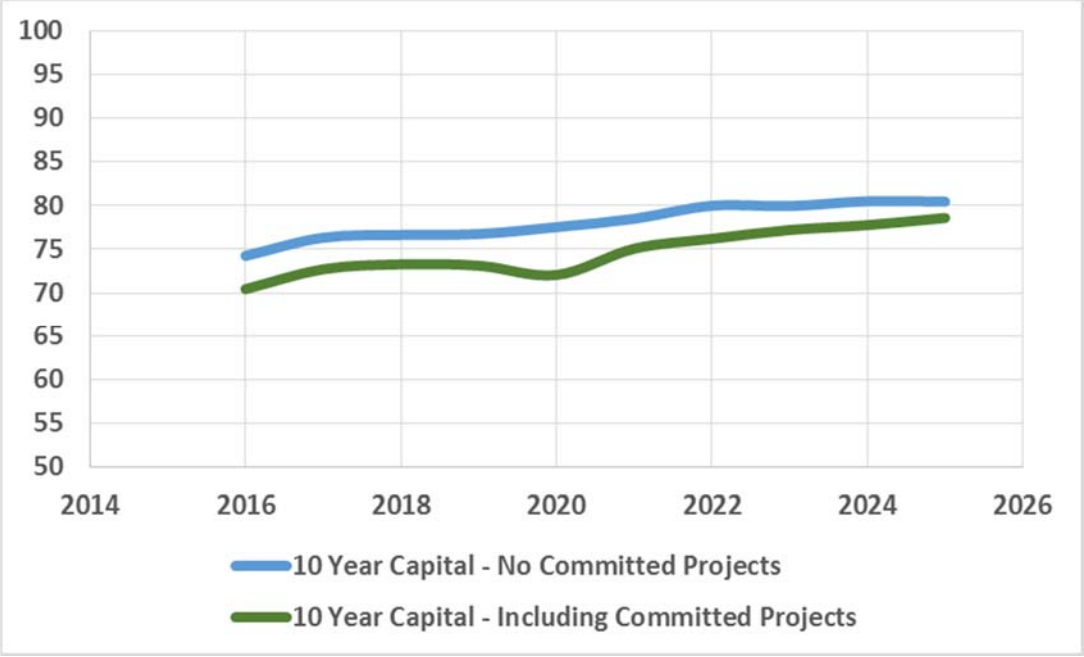
Graph ES1: Remaining Service Life: Structural Adequacy Rating vs. Length



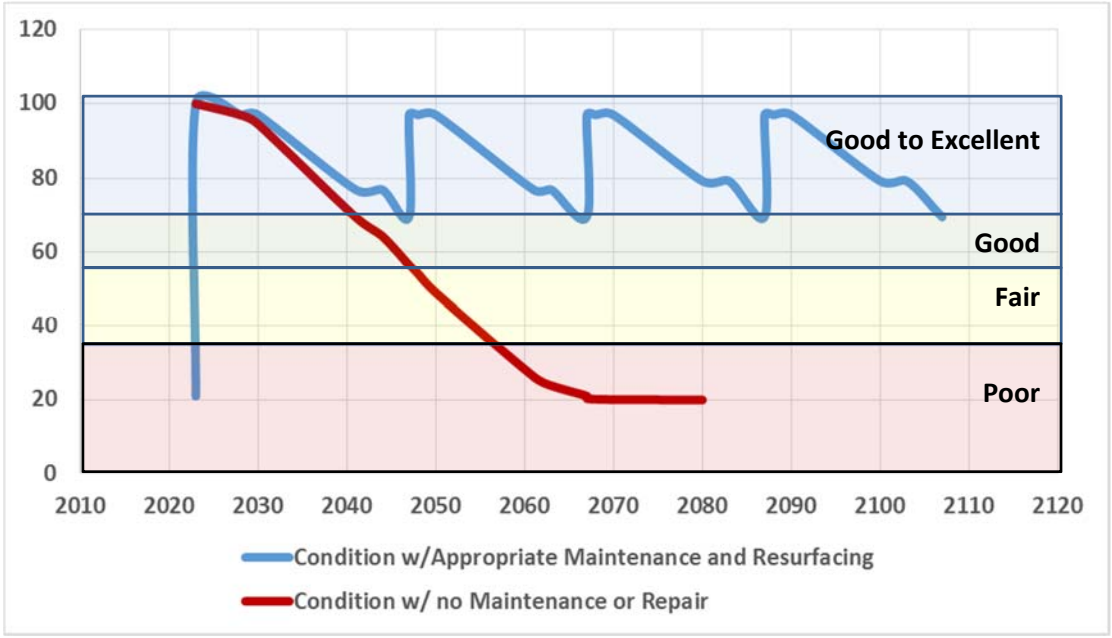
Graph ES.2: Predicted System Performance at Varying Funding Levels



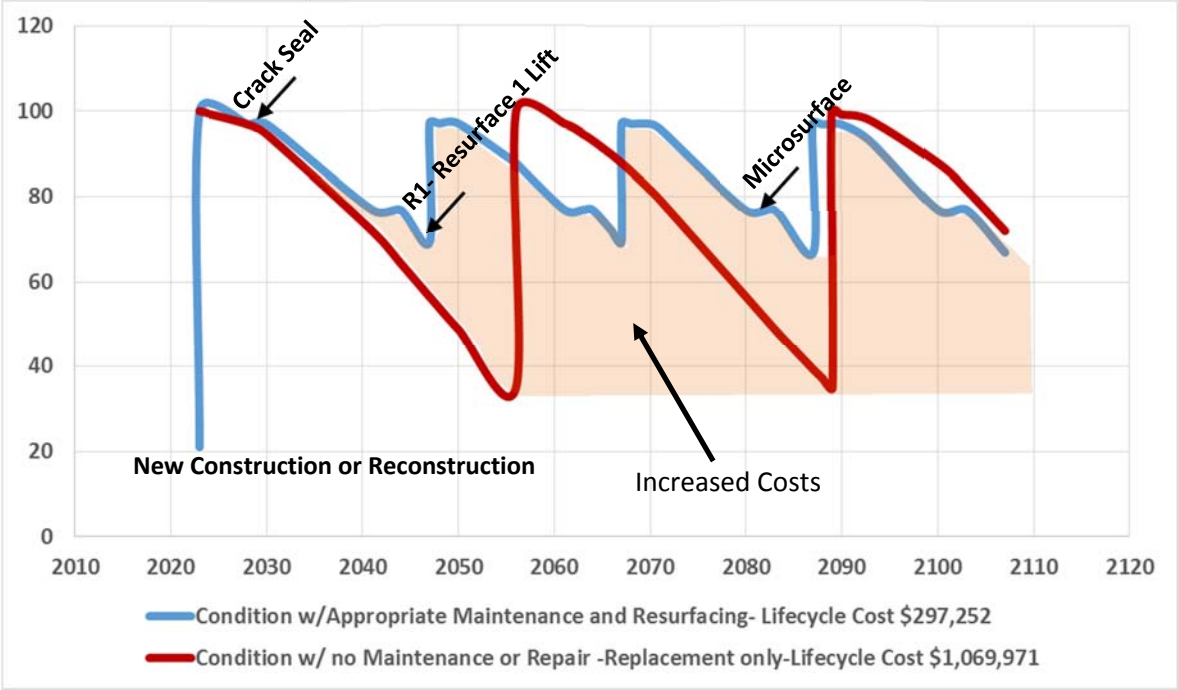
Graph ES.3: 10 Year Program with and without Committed Projects



Graph ES. 4: Sample Section Predicted Performance – Greenfield Road Section 810 Walnut to Dufferin



Graph ES.5: Sample Section Strategy Costs Differential



Note: The orange shaded area illustrates increased lifecycle costs between the two strategies

Table ES.9: 10 Year Capital and Maintenance Program from Performance Model- With Committed Projects

Capital Program (including Storm, Sewers, and Sanitary Sewers and Water)											
Improvement Type	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**Total**
REC								1,135,100			**1,135,100**
RNS									900,220	877,821	**1,778,041**
RSS		580,931	630,929		880,000	604,615					**2,696,475**
RW										80,691	
Stm Sewer		119,070	119,070		138,915	81,000					**458,055**
San Sewer		119,070	119,070			81,000					**319,140**
Water	1,059,098	90,000	90,000		100,000	100,000					
SRR	1,296,453										**1,296,453**
Sub-Total Capital	2,355,551	909,071	959,069	-	1,118,915	866,615	-	1,135,100	900,220	958,512	**7,683,264**
Maintenance Program											
CRK	20,198	2,691	4,066	2,022	870	10,022	1,824		3,758	3,876	**49,327**
MICRO	5,450	11,749	3,423		3,347	8,840	187,608		74,173	40,785	**335,375**
PR2						19,795					**19,795**
R1			30,273	129,654	156,661	163,770	734,609		315,068		**1,530,035**
R2	277,073	183,447	154,343	366,380	29,987	207,855	349,891				**1,568,976**
SST			3,186		27,824		1,480		3,186	40,155	**75,831**
Sub-Total Maintenance	302,721	197,887	195,291	498,056	218,689	410,282	1,275,412	-	396,185	84,816	3,579,339
Grand Total Expenditures	**2,658,272**	**1,106,958**	**1,154,360**	**498,056**	**1,337,604**	**1,276,897**	**1,275,412**	**1,135,100**	**1,296,405**	**1,043,328**	**11,262,603**
Funding Sources											
Levy - Roads	302,721	778,818	826,220	498,056	1,098,689	1,014,897	1,275,412	1,135,100	1,296,405	1,043,328	**9,188,955**
Stm Reserve	1,296,453	119,070	119,070	-	138,915	81,000	-	-	-	-	1,754,508
W&WW Reserve	1,059,098	209,070	209,070	-	100,000	181,000	-	-	-	-	319,140
Total Funding	**2,658,272**	**1,106,958**	**1,154,360**	**498,056**	**1,337,604**	**1,276,897**	**1,275,412**	**1,135,100**	**1,296,405**	**1,043,328**	**11,262,603**

Appendix A: Inventory Manual Methodology Overview

Asset Condition Rating Methodology

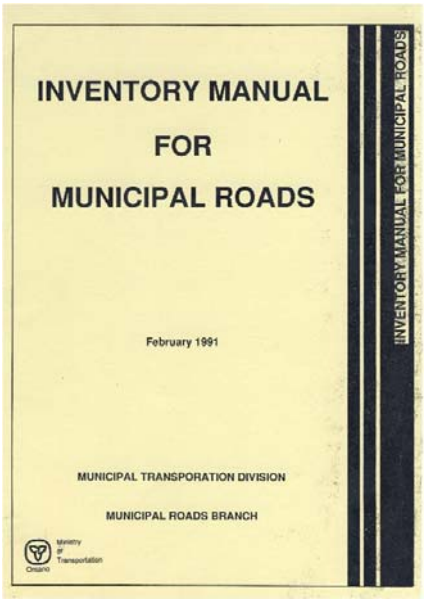
The provincial requirements for AMP's include asset condition assessment in accordance with standard engineering practices. The road section reviews follow the methodology of the Ministry of Transportation Inventory Manual for Municipal Roads, 1991.

Inventory Manual History

From the 1960's until the mid-1990's, the Ministry of Transportation (MTO) required municipalities to regularly update the condition ratings of their road systems in a number of key areas. The process was originally created by the MTO, as a means to distribute conditional funding, on an equitable basis, between municipalities. The reports were referred to as a 'Road Need Study' (RNS) and were required in order to receive a conditional grant to subsidize the municipal road programs. After the introduction in the 1960's by the MTO, the methodology evolved into the current format by the late 1970's. The most current version of the Inventory Manual is dated 1991, and is the methodology used for this report and supported by WorkTech Asset Manager Foundation Software. The practice was discontinued by a number of municipalities when conditional funding for roads was eliminated in the mid 1990's.

Inventory Manual Overview

The Inventory Manual Methodology is a sound, consistent, asset management practice that still works well today, and in view of the increasing demands on efficiency and asset management, represents a sound road asset inventorying and management system. Road system reviews should be repeated on a cyclical basis. The road section review identifies the condition of each road asset by its time of need and recommended rehabilitation strategy.



To put terminology in a current context, the past Road Needs Study is now *'The State of the Infrastructure Report (SotI)'.* The SotI analyzes and summarizes the road system survey data collected (or provided) and provides an overview of the overall condition of the road system by road section, including such factors as structural adequacy, drainage, and surface condition. The study also provides an indication of apparent deficiencies in horizontal and vertical alignment elements, as per the Ministry of Transportation's manual, "Geometric Design Standards for Ontario Highways".

The report provides an overview of the physical and financial needs of the road system, which may be used for programming and budgeting. However, once a road section reaches the project design stage, further detailed review, investigation, and design will be required to address the specific requirements of the project.

Asset Management by its' very nature is holistic. Managing a road network based solely on pavement condition would be critically deficient in scope in terms of the information required to make an informed decision as to the improvements required on a road section.

The *Inventory Manual* offers a holistic review of each road section, developing a Time of Need (TON) or an Adequate rating in six areas that are critical to municipal decision making:

- Geometrics
- Surface Type
- Surface Width
- Capacity
- Structural Adequacy
- Drainage

Evaluations of each road section were completed generally in accordance with the MTO's *Inventory Manual for Municipal Roads* (1991). Data collected was entered directly into WorkTech's Asset Manager Foundation software. Condition ratings, Time of Need, Priority Ratings, and associated costs were then calculated by the software, in accordance with the *Inventory Manual*. Unit costs for construction are typically provided by municipal staff.

Road sections should be reasonably consistent throughout their length, according to roadside environment, surface type, condition, cross section, speed limit, or a combination of these factors. As an example, section changes should occur as surface type, surface condition, cross-section, or speed limit changes.

The Condition Ratings, developed through the scoring in the *Inventory Manual*, classify roads as 'NOW', '1 to 5', or '6 to 10' year needs for reconstruction. **The Time of Need is a prediction of the time until the road requires reconstruction, *not the time frame until action is required***. For example, a road may be categorized as a '6 to 10' year need with a resurfacing recommendation. This road should be resurfaced as soon as possible, to further defer the need to reconstruct.

Field data is obtained through a visual examination of the road system and includes: structural adequacy, level of service, maintenance demand, horizontal and vertical alignment, surface and shoulder width, surface condition, and drainage. The Condition Rating is calculated based upon a combination of other calculations and data.

To best utilize the database information and modern asset management concepts, it has to be understood that the Time of Need (TON) ratings are the estimated time before the road would require reconstruction. NOW needs are still roads that require reconstruction; however, it is not intended that '1 to 5' and '6 to 10' year needs are to be acted on in that timeframe. The '1 to 5' and '6 to 10' year needs are current candidates for resurfacing treatments that will elevate their structural status to 'ADEQ', and offer the greatest return on investment for a road authority(notwithstanding a drainage or capacity need, etc.).

‘NOW’ Needs

‘NOW’ needs represent the backlog of work required on the road system. A ‘NOW’ need is not necessarily the highest priority from asset management or return on investment perspectives. Construction improvements identified within this time period are representative of roads that have little or no service life left and are in poor condition. F Theoretically a resurfacing strategy is never a ‘NOW’ need, with the exceptions of a PR1 or PR2 treatment recommendation (Pulverize and resurface one or two lifts of asphalt) and where the surface type is inadequate for the traffic volume.

If a road with an improvement recommendation of “resurface” deteriorates too far, it becomes a ‘NOW’ construction need. A ‘NOW’ need rating may be triggered by substandard ratings in any of the Structural Adequacy, Surface Type, Surface Width, Capacity, Drainage, or Geometrics data fields.

‘1 to 5’ Year Needs

‘1 to 5’ Identifies road sections where reconstruction is anticipated within the next five years, based upon a review of their current condition. These roads can be good candidates for resurfacing treatments that would extend the life of the road (depending on any other deficiencies), thus deferring the need to reconstruct.

‘6 to 10’ Year Needs

‘6 to 10’ Identifies road sections where reconstruction improvements are anticipated within six to ten years, based upon a review of their current condition. These roads can be good candidates for resurfacing treatments that would extend the life of the road (depending on any other deficiencies), thus deferring the need to reconstruct.

‘ADEQ’

An ***‘ADEQ’*** rating encompasses a wide range of conditions that include the following:

- Roads with a traffic volume of less than 50 vehicles per day will be deemed adequate, and deficiencies on those roads are to be corrected with the maintenance budgets
- Gravel Roads with a structural adequacy rating that is not a ‘NOW’ need (more than 25% distress) is adequate; there is no further differentiation by time period
- Roads that do not require improvement other than maintenance

INVENTORY MANUAL TREATMENTS

Table A.1: Road Improvement Types

Code	Description
R1	Basic Resurfacing
R2	Basic Resurfacing – Double Lift
RM	Major Resurfacing
PR1	Pulverizing and Resurfacing
PR2	Pulverizing and Resurfacing – Double Lift
BS	Tolerable standard for lower volume roads – Rural and Semi-Urban Cross sections only
RW	Resurface and Widen
REC	Reconstruction
RNS	Reconstruction Nominal Storm Sewers (Urban: no new sewer, adjust manholes, catch basins, add sub-drain, remove and replace curb and gutter, granular, and hot mix)
RSS	Reconstruction including Installation of Storm Sewers (New storm sewers and manholes in addition to the above)
NC	Proposed Road Construction
SRR	Storm Sewer Installation and Road Reinstatement
Micro*	Microsurfacing (Preservation Activity)
SST*	Application of a Single Surface Treatment
SSTplus*	Single Surface Treatment, Geometric Padding/Correction, Ditch improvements
DST*	Double Surface Treatment

*Additional Improvement Types not included in the Inventory Manual

Types of Improvements

For each Type of Improvement **(Item 104)**, there are a number of specific road improvements that are included in the total cost relative to the Roadside Environment **(Item 32)** and the Design Class **(Item 105)**. The computer will check a number of Items on the appraisal sheet in order to select the appropriate factors and cross section standards and then calculate the Bench Mark Cost. For example, a Resurfacing and Widening improvement coded under Item 104 is a significantly different road cross section and cost when applied to a rural road vs. an urban arterial. The computer will make all of the necessary checks to arrive at the recommended improvement cost.

Described in the following pages are the road improvements and associated construction activities costed for each Type of Improvement listed under Item 104. Please note, that the Codes **(CO)** – Carry Over, **(SR)** – Spot Road, **(SI)** – Spot Intersection and **(SD)** – Spot Drainage are direct cost inputs and **are not** included in the Bench Mark Cost system.

(R1) - BASIC RESURFACING

(Single Lift of Hot Mix – 50 mm)

Rural and Semi-Urban Roads (Cross Section A)

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

Urban Roads – Granular Base (Cross Section B-1)

– Concrete Base (Cross Section C-1)

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

(R2) - BASIC RESURFACING

(Double Lift of Hot Mix – 100 mm)

Rural and Semi-Urban Roads (Cross Section A)

(a) Hot mix padding for 20% of area to be resurfaced
(b) Double lift of hot mix (100 mm)
(c) Granular materials to raise shoulder to new surface grade

Urban Roads – Granular Base (Cross Section B-1)

– Concrete Base (Cross Section C-1)

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

(RM) - MAJOR RESURFACING

(Double Lift of Hot Mix – 100 mm)

Urban Roads (Arterials and Collectors) – Granular Base (Cross Section B-1)

– Concrete Base (Cross Section C-1)

(a) Base repairs for 50% of area to be resurfaced
(b) Planning for 50% of area to be resurfaced
(c) Curb removal and replacement on both sides for 50% of section length
(d) Adjust manholes and catch basins to new surface grade
(e) Double lift of hot mix (100 mm)

(PR1) - PULVERIZING AND RESURFACING

(Single lift of Hot Mix – 50 mm)

Rural Roads (Cross Section A)

(a) Pulverize existing hard top surface
(b) Single lift of hot mix (50 mm)
(c) Granular material to raise shoulders to new surface grade

(**PR2) - PULVERIZING AND RESURFACING (Double Lift of Hot Mix – 100 mm**)

Rural Roads (Cross Section A)

(a) Pulverize existing hard top surface
(b) Double lift of hot mix (100 mm)
(c) Granular material to raise shoulders to new surface grade

(BS) - BASE AND SURFACE

Rural Roads – Tolerable Standard (50 to 100 AADT) (Cross Section D)

(a) Granular material for base
(b) Granular material for loose top surface
(c) Minimal shoulder widening
(d) Minor Ditching

Rural Roads – Design Standard (200 to 399 AADT) (Cross Section D)

(a) Placing granular material
(b) Minimal shoulder widening
(c) Double surface treatment
(d) Minor ditching

Rural Roads – Design Standard (400 plus AADT) (Cross Section D)

and

Semi-Urban Roads – Design Standard (Cross Section D)

(a) Placing granular material
(b) Minimal shoulder widening
(c) Hot mix (50/100 mm, see table F-1)
(d) Minor ditching

(RW) - RESURFACE AND WIDEN

Rural Roads – Tolerable Standard (50 to 199 AADT) (Cross Section E)

(a) Excavating for widening
(b) Ditching and side culvert replacement
(c) Granular material for widening base
(d) Granular material for loose top surface

Rural Roads – Design Standard (200 to 399 AADT) (Cross Section E)

(a) Excavating for widening
(b) Ditching and side culvert replacement
(c) Granular material for widening base
(d) Double surface treatment

Rural Road – Design Standard (400 plus AADT) (Cross Section E)
and
Semi-Urban Roads – Design Standard (Cross Section E)

(a) Excavating for widening
(b) Ditching and side culvert replacement
(c) Granular material for widening base
(d) Base Course of hot mix for widening
(e) Hot mix Padding for 20% of existing surface area
(f) Single life of hot mix (50 mm)

Urban Roads – Design Standard – Granular Base (Cross Section F)

(a) Excavating for widening
(b) Curb and Gutter removal
(c) Catch Basin removal
(d) Base repair 10% of existing surface area
(e) Granular material for widening
(f) Place catch basins and leads
(g) New curb and gutter
(h) New sub-drains
(i) Base course of hot mix for widening
(j) Hot mix padding for 20% of existing surface area
(k) Adjust manholes to new surface grade
(l) Single lift of hot mix (50 mm) curb to curb

Urban Roads – Design Standard – Concrete Base (Cross section G)

(a) Excavating for widening
(b) Curb and gutter removal
(c) Catch basin removal
(d) Base repair for 10% of existing surface area
(e) Place new catch basins and leads
(f) Granular material for widening
(g) Concrete base for widening
(h) New curb and gutter
(i) New subdrains
(j) Base course of hot mix for widening
(k) Hot mix padding for 20% of existing surface area
(l) Adjust manholes to new surface grade
(m) Single lift of hot mix (50 mm) curb to curb

(REC) - RECONSTRUCTION (RURAL and SEMI-URBAN)

Rural Roads – Design Standard (200 to 399 AADT) (Cross Section H)

(a) Excavate base material
(b) Ditching and side culvert replacement
(c) Grading
(d) Granular material
(e) Double surface treatment

Rural Roads – Design Standard (400 plus AADT) Cross Section H)

and

Semi-Urban Roads – Design Standard (Cross Section H)

(a) Excavate base material
(b) Ditching and side culvert replacement
(c) Grading
(d) Granular material
(e) Hot mix (50/100 mm, see Table F-1)

Rural and Semi-Urban Roads – Design Standard (Concrete Surface)

(Cross Section P)

(a) Excavate base material
(b) Ditching and side culvert replacement
(c) Grading
(d) Granular Material
(e) Concrete base and surface

(RNS) - RECONSTRUCTION NOMINAL STORM SEWERS (URBAN)

Urban Roads – Design Standard – Granular Base (Cross Section I)

(a) Excavate base material
(b) Curb and gutter removal
(c) Granular base
(d) New curb and gutter
(e) New sub-drains
(f) Adjust manholes and catch basins
(g) Hot mix (50/100 mm, see Table F-1)

Urban Roads – Design Standard – Concrete Base (Cross Section J)

(a) Excavate base material
(b) Curb and gutter removal
(c) Granular base
(d) Concrete base
(e) New curb and gutter
(f) New sub-drains
(g) Adjust manholes and catch basins
(h) Hot mix (50/100 mm, see Table H-5)

Urban Roads – Design Standard – Concrete Surface (Cross Section O)

(a) Excavate base material
(b) Curb and gutter removal
(c) Granular base
(d) Concrete base and surface
(e) New curb and gutter
(f) New sub-drains
(g) Adjust manholes and catch basins

(RSS) - RECONSTRUCTION INCLUDING INSTALLATION OF STORM SEWERS

Urban Roads – Design Standard – Granular Base (Cross Section K)

(a) Excavate base material
(b) Curb and gutter removal
(c) Storm sewer removal
(d) Manhole and Catch Basin removal including leads
(e) New storm sewers
(f) New manhole and catch basins including leads
(g) New curb and gutter
(h) New sub-drains
(i) Granular base
(j) Hot mix (100/150 mm, see Table F-1

Urban Roads – Design Standard – Concrete Base (Cross Section L)

(a) Excavate base material
(b) Curb and gutter removal
(c) Storm sewer removal
(d) Manhole and Catch Basin removal including leads
(e) New storm sewers
(f) New manhole and catch basins including leads
(g) New curb and gutter
(h) New sub-drains
(i) Granular base
(j) Concrete base
(k) Hot mix (50/100 mm, see Table F-1)

Urban Roads – Design Standard – Concrete Surface (Cross Section Q)

(a) Excavate base material
(b) Curb and gutter removal
(c) Storm sewer removal
(d) Manhole and Catch Basin removal including leads
(e) New storm sewers
(f) New manhole and catch basins including leads
(g) New curb and gutter
(h) New sub-drains
(i) Granular base
(j) Concrete base and surface

(NC) - PROPOSED ROAD CONSTRUCTION

Rural Roads – Design Standard (200 – 399 AADT) (Cross Section H)

(a) Grading
(b) Ditching and cross culverts
(c) Granular base
(d) Double surface treatment

Rural Roads – Design Standard (400 plus AADT) (Cross Section H)

(a) Grading
(b) Ditching and cross culverts
(c) Granular base
(d) Hot mix (50.100 mm, see Table F-1)

Semi-Urban Roads

New Construction does not apply to semi-urban roads as there is no existing frontage development.

Urban Roads – Design Standard – Granular Base (Cross Section K)

(a) Grading
(b) Storm Sewers
(c) Manholes and catch basins including leads
(d) Curb and gutter
(e) Sub-drains
(f) Granular base
(g) Hot mix (100 mm/150 mm, see Table F-1)

Urban Roads – Design Standard – Concrete Base (Cross Section L)

(a) Grading
(b) Storm Sewers
(c) Manholes and catch basins including leads
(d) Curb and gutter
(e) Sub-drains
(f) Granular base
(g) Concrete base
(h) Hot mix (50 mm/100 mm , see Table F-1)

(SRR) - STORM SEWER INSTALLATION AND ROAD REINSTATEMENT (URBAN AND SEMI-URBAN)

Urban and Semi-Urban Roads – Granular Base (Cross Section M)

(a) Trenching and removal of existing storm sewers
(b) New manholes and adjust catch basin leads
(c) New storm sewer including bedding
(d) Granular materials in trench
(e) Hot mix to restore surface grade (100/150 mm, see Table F-1)

Urban and Semi-Urban Roads – Concrete Base (Cross Section N)

(a) Trenching and removal of existing storm sewers
(b) New manholes and adjust catch basin leads
(c) New storm sewers including bedding
(d) Granular material in trench
(e) Concrete base for trenched area
(f) Hot mix to restore surface grade (50/100 mm, See Table F-1)

Urban and Semi-Urban Roads – Concrete Surface (Cross Section R)

(a) Trenching and removal of existing storm sewers
(b) New manholes and adjust catch basin leads
(c) New storm sewers including bedding
(d) Granular material in trench
(e) Concrete base and surface for trenched area

(MICRO) SINGLE LIFT OF MICROSURFACING

Urban, Semi-Urban and Rural Roads with a HCB (High Class Bituminous) surface type

(a) Unit cost per square metre of Microsurfacing

(SST) SINGLE LIFT OF SURFACE TREATMENT

Urban, Semi-Urban and Rural Roads with a LCB (Low Class Bituminous) surface type

(a) Unit cost per square metre of Single Surface Treatment

(SSTplus) SINGLE LIFT OF SURFACE TREATMENT, GEOMETRIC CORRECTION DITCHING IMPROVEMENTS

Semi-Urban and Rural Roads with a LCB (Low Class Bituminous) surface type

(a) Unit cost per square metre of Single Surface Treatment
(b) 20% Surface area padding to 50mm to correct geometric deficiencies
(c) Earth Excavation allowance to provide for minor ditch improvements and berm removal

(DST) DOUBLE LIFT OF SURFACE TREATMENT

Urban, Semi-Urban and Rural Roads with a LCB (Low Class Bituminous) surface type

(a) Unit cost per square metre of Double Surface Treatment

Appendix B: Pavement Structure and Defects

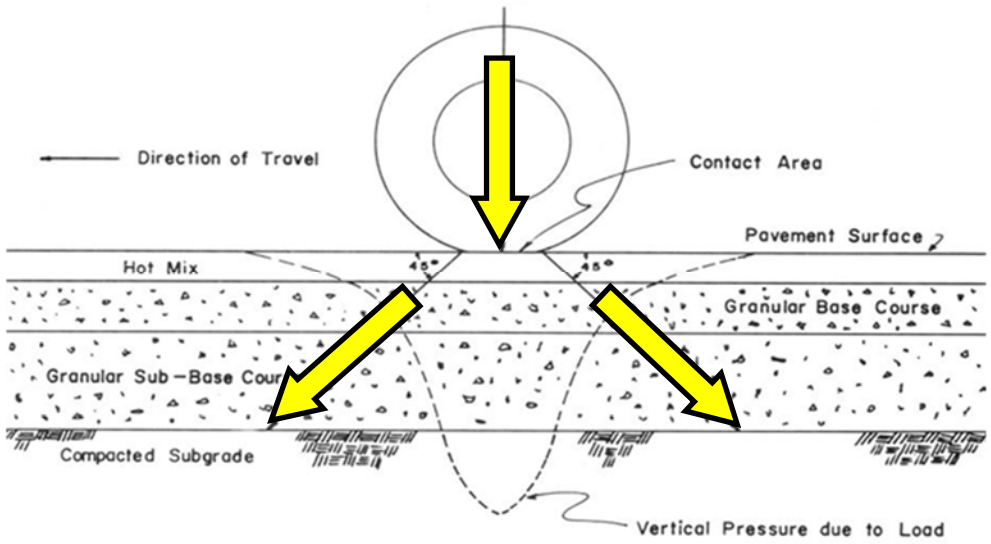
Pavement Structure

To assist in understanding the content and methodology of the report, the following discussion provides an overview of how flexible and rigid pavement structures are designed and function. The majority of municipal roads would be described as having a flexible pavement structure. Hot mix asphalt, surface treatment, and gravel road surfaces are typical flexible pavement road structures. Other pavement structure types include rigid and composite, and are more typically found on 400 series highways, or on arterial roads of larger urban centres.

Flexible Pavement Road Structure

Load is applied to the pavement structure, and ultimately to the native sub-grade, via wheel loads of vehicles. The pavement structure between the native sub-grade and the load application point has to be designed such that the load that is transmitted to the sub-grade is not greater than the sub-grade's ability to support the load. The figure below shows a typical flexible pavement structure and how applied load dissipates.

Load Distribution through Pavement Structure



Depth Below Surface	Stress (psi)	Stress (Kpa)
At Surface	90	620.50
8" (200 mm) Below	11	75.84
11" (275 mm) Below	7	48.26
16" (400 mm) Below	4	27.58

Surface materials experience the highest loading at the point of contact with the vehicle's tire. Radial truck tires, running from 110 psi to 120 psi, can have an impact 20 times higher at the surface, than at the compacted sub-grade. The loading actually occurs in three dimensions, in a conical fashion, dissipating both vertically and horizontally as it passes through the pavement structure. Loading

decreases exponentially as it passes through the road structure. Therefore, materials of lesser strength or lesser quality can be used deeper in the road structure.

As a rule of thumb, the closer the road building materials are placed to the surface of the road, the higher the quality required. Similarly, the poorer the sub-grade or native material, the deeper/stronger the road structure has to be to carry the same loads.

Traffic counts, and the percentage of trucks, are critical to structural design of the pavement. Depending upon the source, the effect of a single truck on the pavement structure can be equivalent to 2,000 to 8,000 passenger cars. The effect of farm machinery would be very similar to that of heavy trucks. However, the Highway Traffic does permit certain types of farm machinery and equipment to use the roads even during half load season, so this is an additional consideration when designing rural roads.

Pavement evaluation involves a review of each road section and an assessment of the type and extent of the distress(es) observed. Treatment recommendations are predicated by whether the cause of the major distress(es) is structural or non-structural.

Flexible pavements will have age-related distresses and wearing such as thermal cracking and oxidation. These distresses are non-structural; however, once a crack develops and water enters the pavement structure, deterioration will accelerate. Poor construction practices, quality control, or materials may produce other non-structural surface defects, such as segregation and raveling, which will also result in a reduced life expectancy of the surface asphalt.

Fatigue cracking indicates structural failure and can manifest itself in many forms, such as wheel path, alligator, and edge cracking. It can be localized or throughout a road section. When roads that have exhibited fatigue cracking are rehabilitated, there should be particular attention paid to the rehabilitation treatment, to ensure that the upgraded facility has sufficient structure.

Wheelpath Fatigue Cracking

Flexible Pavement Road Structure Design

There are a number of flexible pavement structural design methodologies and associated software. The simplest way to describe structural design may be the Granular Base Equivalency (GBE) Methodology. This GBE methodology is still used in Ontario, by a number of agencies, and is frequently used as a cross-check where more sophisticated analysis has been undertaken.

The measurement is unit-less and relates to the structural value of one millimetre of Granular 'A' material. The relationship of the typical road building materials is expressed in either of the two following ways:

- **1 mm of HMA = 2 mm of Granular A = 3 mm of Granular B**

Or

- **HMA = 2, Granular A = 1, Granular B = 0.67**

To gain some perspective on what this means in terms of typical construction activities, the following table indicates a typical subdivision road construction as expressed in GBE.

Granular Base Equivalency

Material	Example 1 Depth	Granular Base Equivalency	Example 2 Depth	Granular Base Equivalency
Hot Mix Asphalt (HMA)	100	200	150	300
Granular A	150	150	300	300
Granular B	300	200	0	0
TOTAL	**550**	**550**	**450**	**600**

When reconstruction and rehabilitation projects are undertaken, and use of alternate materials and/or road structure is contemplated, the GBE concept is important to bear in mind, as different treatments such as Expanded Asphalt and Cold in Place recycling also have a structural value. For design purposes, it may be prudent to use a conservative equivalency of 1.5 for these products (although, some sources indicate GBE's of up to 1.8).

As an example, if a 200 mm pavement is replaced with 150 mm of Expanded Asphalt or Cold in Place Recycling, with a 50 mm overlay of Hot Mix asphalt, a pavement structure with a GBE of 400 is replaced by a pavement structure with a GBE of 325; a significant difference. Premature failure will be the result of an under-designed pavement structure, wasting resources and available funding.

The purpose of this example is to illustrate the different structural values that products have. Expanded Asphalt and Cold in Place recycling are both excellent products to rehabilitate pavement structures.

The MTO's *Pavement Design and Rehabilitation Manual* is an excellent resource for use in pavement structure design and rehabilitation, and is available from the online MTO Catalog.

Thin Lift Pavements

Hot mix asphalt mixes are designed in Ontario either by the Marshall Method or the Superpave Method. Through time, this has resulted in a number of commonly used mixes that are typically sorted by size. One of the parameters used to describe that sizing is the Nominal Maximum Aggregate Size (NMAS).

In the Marshall Mix Method, typical mix designations are HL1, HL2, HL3, HL4, and HL8. In the Superpave mix design methodology, mixes are designated by the NMAS.

The following table identifies the NMAS for the more commonly used mixes, and indicates recommended minimum lift thicknesses for them.

Recommended Minimum Lift Thicknesses

Mix Type	NMAS (mm)	Lift Thickness Range (mm)
SP 9.5	9.5	30 to 40
SP 12.5	12.5	40 to 50
SP 19	19.0	60 to 80
HL3	13.2	40 to 55
HL4	16.0	50 to 65
HL8	19.0	60 to 80

Thin Lift Pavement

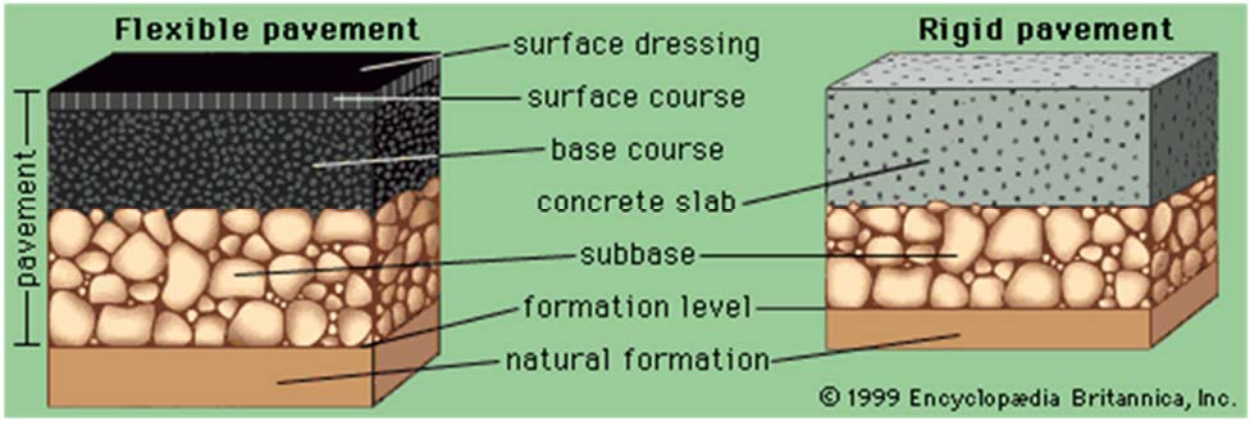
Rigid Pavement Structure

Rigid Pavements are constructed of concrete, or concrete with an asphalt wearing surface. The fundamental difference between a flexible pavement and a rigid pavement is the method in which the load is transferred. Whereas the flexible pavement disperses load through the pavement structure in a conical fashion, with a higher point load directly beneath the loading point, the rigid pavement structure distributes that load in a beam-like fashion, more evenly across the pavement structure. Rigid pavements may have an exposed concrete wearing surface, or they may be covered with an asphaltic concrete wearing surface.

The resulting rigid pavement structure is usually thinner overall, when compared to a flexible pavement, designed to accommodate the same traffic loading. This does not necessarily translate into a reduced cost of construction. Any comparison of costs between flexible and rigid pavements should be on a life cycle basis, for the most accurate assessment.

Older concrete pavements were prone to failure at joints, as load transfer caused a slight movement in the concrete slab, and with the intrusion of water, a structural failure. Newer concrete pavements are designed with improved load transfer technology.

Figure 1 Flexible vs. Rigid Pavement Structure(s)



Flexible Pavement Distresses and Treatment Selection

Treatment recommendation is dependent upon the condition of the road section at the time of the review.

Treatment Selection – Critical Area Analysis

When using the Inventory Manual methodology all of the 'holistic' needs are considered in the recommendation. For example, a road may appear to require only a resurfacing, however, when the other critical areas are reviewed, there may be a capacity problem which would then result in a recommendation to resurface and widen (RW) that would address both the pavement condition and the need for additional lanes. Another example would be where the pavement is exhibiting some type of

distress but there is also poor drainage. The recommendation would then be to reconstruct (REC if rural, RSS if urban).

Treatment Selection for Non-Structural Rehabilitation

Resurfacing recommendations are predicated upon the type and extent of distress noted. For example, all pavements will develop thermal/transverse cracking as they age. As the age of the pavement increases, the frequency of the cracking increases. If the spacing of he cracks is still greater than 10m, then the R1 – resurface with one lift of asphalt – treatment will typically be sufficient to restore the road as the treatment provides for overlay and base asphalt repair. However, if the frequency of transverse cracking , which may have become transverse alligator cracking if left unattended too long, then the recommendation will be more extensive, such as a PR2- Pulverize and resurface with 2 lifts of asphalt. The following illustrates transverse cracking.

Transverse /Thermal cracking

Treatment Selection for Structural Rehabilitation

Road sections exhibiting structural failure such as fatigue cracking require a more extensive rehabilitation to restore the performance of the road section. In simple terms, placing a single lift of asphalt over structurally failed asphalt will guarantee the same failure in a very short time period. Unless the single lift overlay is placed knowingly as a holding strategy, it should be avoided on structurally deficient pavements. For pavements that have failed structurally or have too much transverse cracking, the recommendation is typically PR2 as a minimum provided the drainage is adequate or requires only minor improvement.

Reflective Cracking

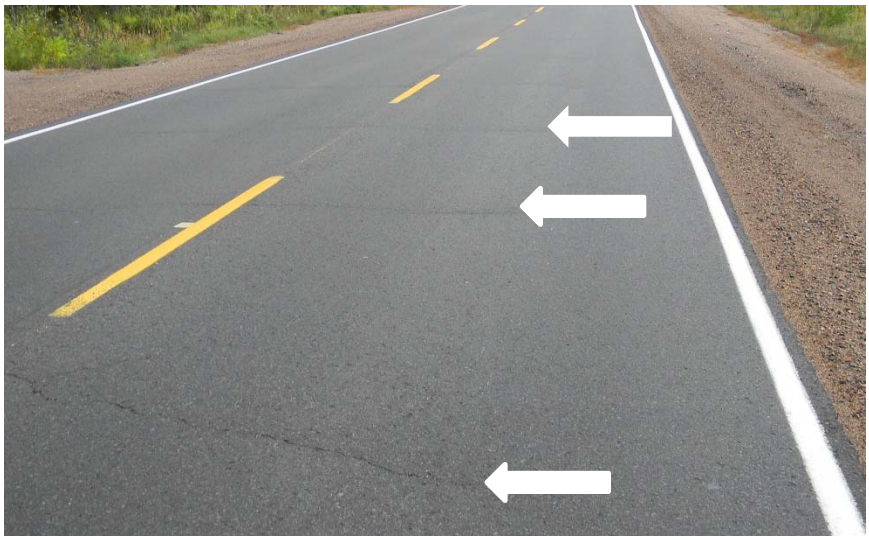
Paving over an active crack(s) will result in a crack(s) in the same location with 2 to 3 years. As a rule of thumb, the crack will migrate through at approximately 25mm per year. Therefore it would be

anticipated that if a 50mm overlay is placed, then the cracking would reappear in approximately 2 years. This is not an efficient usage of available funding.

Structurally Failed Pavement

The above figure illustrates a pavement that has failed both structurally and has very frequent severe transverse cracks. Placement of a 50mm overlay over this type of pavement condition will result in rapid failure is not recommended. The figure below illustrates a newer pavement that already have very frequent transverse cracks appearing likely the result of paving over a failed pavement. The first transverse crack generally occurs in approximately 4 to 5 years and the cracks are 40m to 50m or more apart.

Reflective Transverse Cracking on Newer Pavement



Appendix C: Deterioration Curve Detail

WorkTech Asset Classes and Deterioration Curves for Roads

Asset Classes

In order to utilize the Best Practice and Performance Modeling modules of WorkTech Asset Manager Foundation (WT), assets must be defined by an asset class. Table 1 identifies the road asset classes that have been developed for use in WT by 4 Roads Management Services Inc.

Table 1: Road Asset Classes

Asset Class	Subtype	Material	RDSE Envt	AADT Low	AADT High
A/C-R	All	A/C	R	1	100,000
A/C-S	All	A/C	S	1	100,000
A/C-U	All	A/C	U	1	100,000
CM1-R	All	C/M	R	1	3,000
CM1-S	All	C/M	S	1	3,000
CM1-U	All	C/M	U	1	3,000
CON-R	All	CON	R	1	100,000
CON-S	All	CON	S	1	100,000
CON-U	All	CON	U	1	100,000
GST1-R	All	G/S	R	1	10,000
GST1-S	All	G/S	S	1	10,000
HCB1-R	ART	HCB	R	20,000	100,000
HCB1-S	ART	HCB	S	20,000	100,000
HCB1-U	ART	HCB	U	20,000	100,000
HCB2-R	ART	HCB	R	10,000	20,000
HCB2-S	ART	HCB	S	10,000	20,000
HCB2-U	ART	HCB	U	10,000	20,000
HCB3-R	All	HCB	R	1,000	10,000
HCB3-S	All	HCB	S	1,000	10,000
HCB3-U	All	HCB	U	1,000	10,000
HCB4-R	All	HCB	R	1	1,000
HCB4-S	All	HCB	S	1	1,000
HCB4-U	All	HCB	U	1	1,000
ICB-S	All	ICB	S	1	3,000
ICB-U	All	ICB	U	1	3,000
ICB1-R	All	ICB	R	1	3,000
LCB1-R	All	LCB	R	1	2,000
LCB1-S	All	LCB	S	1	2,000
LCB1-U	All	LCB	U	1	2,000

WorkTech Asset Classes and Deterioration Curves for Roads

Conventional wisdom has been to define road assets by their functional classes such as Arterial, Collector or Local and then further differentiate by usage, such as residential or commercial. From a performance modeling perspective, using the functional classification will only work to a point, as the traffic on a functional class will vary between agencies.

4 Roads believes that the performance/deterioration of a road section is more predictable based on surface type and traffic volume rather than by functional class. Based on that philosophy, Table 1 was created identifying Road Asset Classification by Surface Type, Traffic Volume and Roadside Environment. Roadside Environment has been added to permit the calculation of different replacement costs between rural and urban cross-sections.

Deterioration Curves

When using the Inventory Manual (IM) methodology, Structural Adequacy is a measurement of the percentage of the surface of the road that is exhibiting distress. The rater will consider the type of distress as well as the other critical areas (surface width, capacity, geometry, drainage and surface width) in order to provide a recommendation for an improvement. In the IM, any, or multiple of the critical areas, may produce a Time of Need (TON). The overall TON of the road section is the worst of all of the TON's. For example, if five of the TON's are ADEQ, and one is NOW, the section is a NOW need.

It would be possible, but very difficult, to develop performance models around all of the critical areas. So for the purposes of the performance modeling, Structural Adequacy (distress) has been selected to be the driver in the decisions with respect to the model.

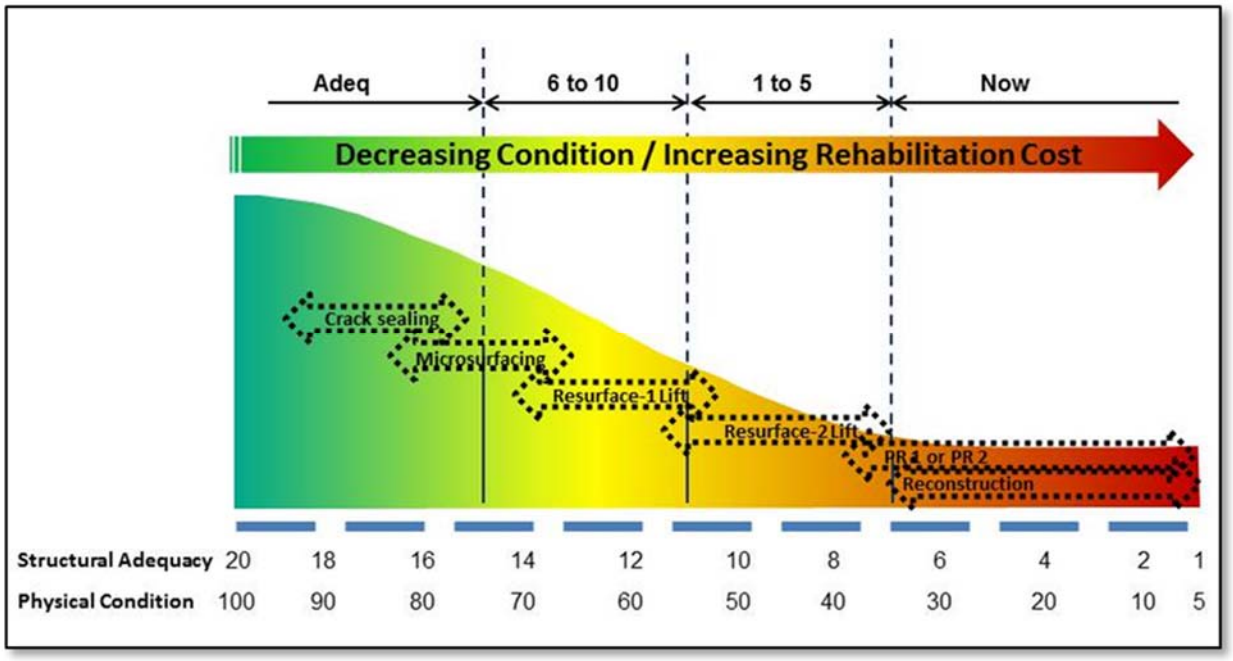
In the early years of the model, if a project is selected that has an identified improvement type, that improvement will be used for the project in the year that it is selected. In the later years, presumably after all current deficiencies have been corrected the model will revert to the assigned asset class for deterioration and project selection based on estimated condition.

All deterioration curves relate to the 'Physical Condition' data field in WorkTech. Physical Condition is the Structural Adequacy multiplied by 5 to produce a score from 5 to 100. The Physical Condition deterioration curve is specific to the Inventory Manual and therefore the trigger points and definition of the curve will be different than other methodologies. It should be noted that different evaluation methodologies will produce varying deterioration curves and trigger points. Familiarity with the rating system being utilized is essential.

The deterioration curves are the same for each asset class regardless of roadside environment. For urban sections, the improvement is RSS- Reconstruction with Storm Sewers, rather than REC- Reconstruction Rural.

WorkTech Asset Classes and Deterioration Curves for Roads

Figure 1: Physical Condition versus Improvement Selection



Where the MTO PCI / Inventory Manual Condition Rating format is being used, the PCI data is entered to produce a PCI score from different formulas that represent the defects and weightings by surface type. The PCI score is then used to approximate a Structural Adequacy score (and a Physical Condition). Table 2 identifies the approximations to convert PCI to Structural Adequacy and a Time of Need.

Table 2: PCI to Structural Adequacy Approximations

Time of Need	ASTM 6344	Structural Adequacy	Physical Condition	MTO PCI	Surface Condition	Description	Approximation PCI to SA
NOW	1-39	1 to 7	1 to 35	1 to 55	Now Needs – Reconstruction or Major Rehabilitation	Poor to Very Poor to Failed	IF PCI <=55 then, PCI / 8 = SA
1 to 5	40-55	8 to 11	36 to 55	56 to 75	1 to 5 year Needs – R2 /more extensive rehabilitation	Fair / Passable	IF PCI >55<=75 then, PCI / 7 =SA
6 to 10	55-70	12 to 14	56to 70	76 to 85	6 to 10 year Needs – R1 Resurfacing	Good	IF PCI >75<=85 then, PCI / 6 =SA
ADEQ	71-100	15 to 20	75 to 100	86 to 100	Adequate – Maintenance and Preservation	Satisfactory/ Good/ Excellent	If PCI >85 then, PCI /5.4 =SA

Once a Structural Adequacy Score has been determined, the TON is also calculated. What this achieves is the detail of PCI data collection and the strength of the holistic evaluation of the Inventory Manual.

Improvement Types- Effect on the Asset

Appendix A of this report includes a summary of the improvement types that are included in the inventory Manual. In WorkTech there is no restriction on what may be developed as an improvement type for a road agency. However, regardless of the improvement types that are used the effect that the improvement has on the asset has to be understood in order to use performance modeling.

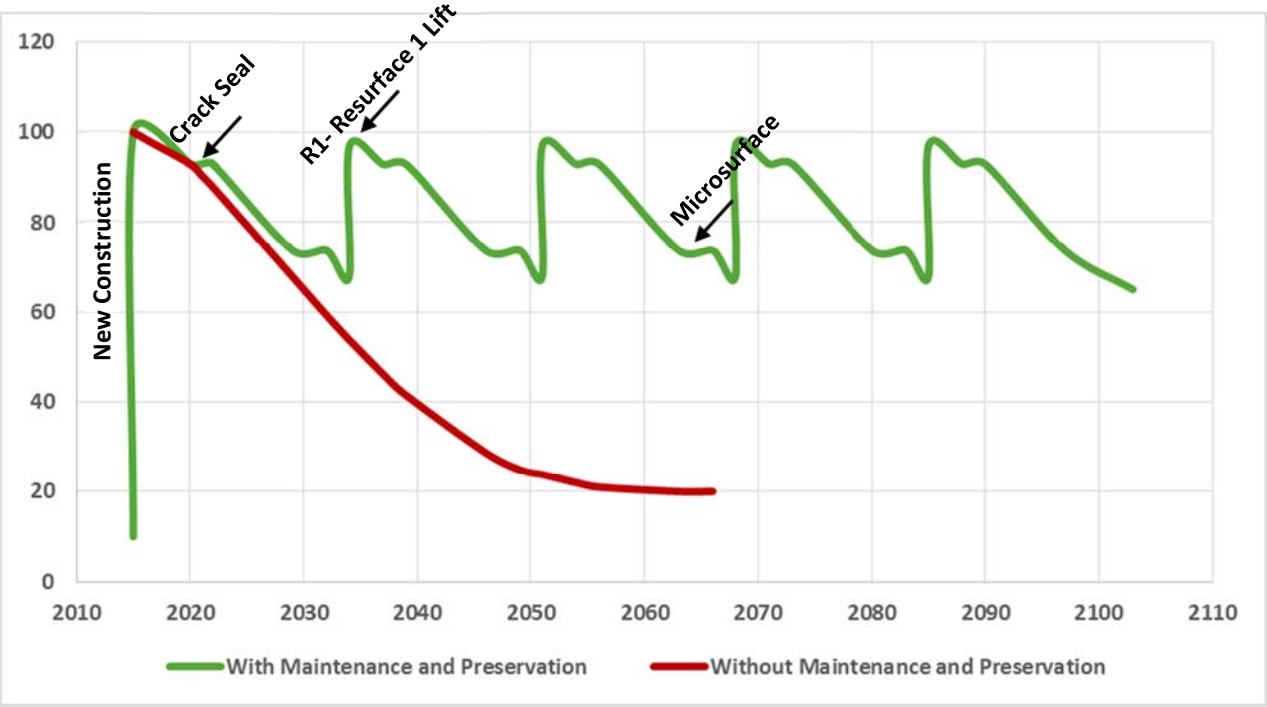
The following table identifies a number of improvement types and further identifies the effect that they have on a road asset. A similar approach may be taken with other assets.

Code	Description	Effect on the Asset
R1	Basic Resurfacing – Single Lift	Increase Physical Condition to 97
R2	Basic Resurfacing – Double Lift	Increase Physical Condition to 100
RM	Major Resurfacing	Increase Physical Condition to 100
PR1	Pulverizing and Resurfacing – Single Lift	Increase Physical Condition to 95
PR2	Pulverizing and Resurfacing – Double Lift	Increase Physical Condition to 100
BS	Base and Surface Tolerable – Tolerable standard for lower volume roads – Rural and Semi-Urban Cross sections only	Increase Physical Condition to 95
RW	Resurface and Widen	Increase Physical Condition to 97
REC	Reconstruction	Increase Physical Condition to 100
RNS	Reconstruction Nominal Storm Sewers (Urban: no new sewer, adjust manholes, catch basins, add sub-drain, remove and replace curb and gutter, granular, and hot mix)	Increase Physical Condition to 100
RSS	Reconstruction including Installation of Storm Sewers (New storm sewers and manholes in addition to the above)	Increase Physical Condition to 100
NC	Proposed Road Construction	Increase Physical Condition to 100
SRR	Storm Sewer Installation and Road Reinstatement	No effect
CRK	Crack Sealing	Hold Physical Condition for 2 Years
MICRO	Microsurfacing	Hold Physical Condition for 3 years
GRR	Gravel Road Resurfacing – add 75mm	Hold Physical Condition for 3 years
GRR2	Gravel Road Resurfacing - Add 150mm	Increase Physical Condition by 20

The effect that a treatment has on an asset is critical to the analysis. Inaccurate determination of the effect of a treatment on an asset will produce an inaccurate – and indefensible- result. The following chart is a comparison of the deterioration of a road section without any treatment applied versus a road section that has appropriate treatment at the optimal condition, producing a more cost effective life cycle.

Figure 2, shown below, illustrates several different aspects of performance model output including the effect of a treatment on an asset and the effect of multiple treatments undertaken at the optimal asset condition to produce a cost effective management strategy.

Figure 2: Performance Model – Effect of Treatment on Asset



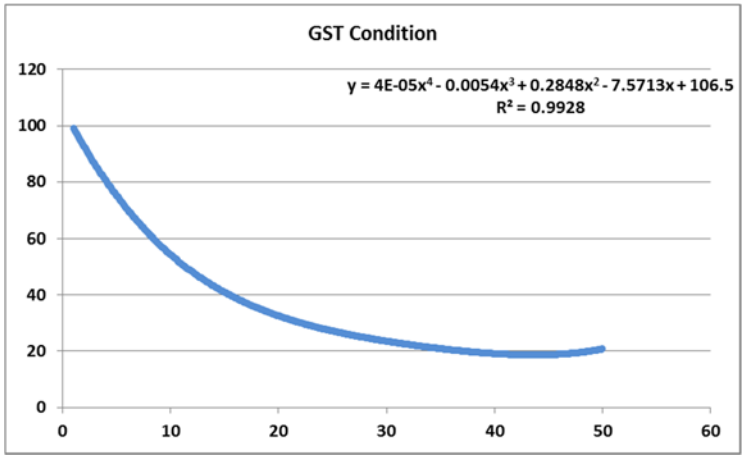
Deterioration Curves by Surface Type and Traffic Volume

The following pages includes tables and graphs indicating the anticipated performance of an appropriately constructed road asset and the condition triggers for treatments. The deterioration curves by asset class used in concert with the table indicating the treatment effect on the asset, and the agency's unit costs, will produce a performance model that demonstrates the effect on the system at various budget levels and produce a program based on input parameters.

WorkTech Asset Classes and Deterioration Curves for Roads

Gravel Roads- All Roadsides, all AADT

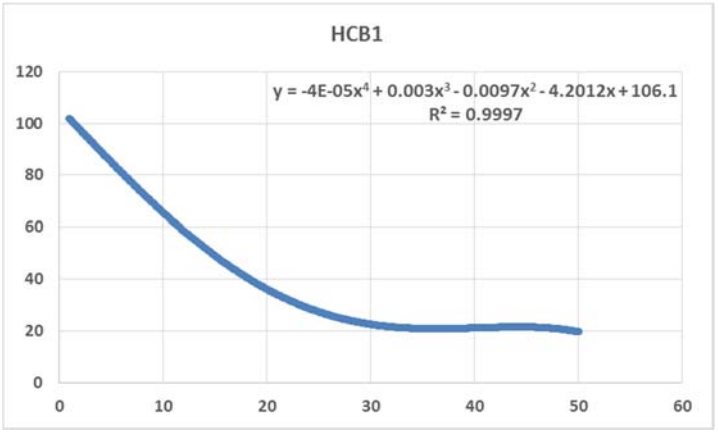
Year	Condition	Imp Typet	Description
1	100	NONE	No Improvement Required
2	92.45	NONE	No Improvement Required
3	86.21	GRR	75mm of Granular A
4	80.43	GRR	75mm of Granular A
5	75.11	GRR	75mm of Granular A
6	70.21	GRR	75mm of Granular A
7	65.7	GRR2	150mm of additional Gravel
8	61.55	GRR2	150mm of additional Gravel
9	57.75	GRR2	150mm of additional Gravel
10	54.27	GRR2	150mm of additional Gravel
11	51.07	GRR2	150mm of additional Gravel
12	48.15	GRR2	150mm of additional Gravel
13	45.48	GRR2	150mm of additional Gravel
14	43.04	GRR2	150mm of additional Gravel
15	40.81	GRR2	150mm of additional Gravel
16	38.77	GRR2	150mm of additional Gravel
17	36.9	GRR2	150mm of additional Gravel
18	35.2	GRR2	150mm of additional Gravel
19	33.63	REC	Reconstruction - Rural
20	32.19	REC	Reconstruction - Rural
21	30.86	REC	Reconstruction - Rural
22	29.64	REC	Reconstruction - Rural
23	28.51	REC	Reconstruction - Rural
24	27.45	REC	Reconstruction - Rural
25	26.47	REC	Reconstruction - Rural
30	22.28	REC	Reconstruction - Rural
35	18.88	REC	Reconstruction - Rural
40	20	REC	Reconstruction - Rural
45	20	REC	Reconstruction - Rural
50	20	REC	Reconstruction - Rural



WorkTech Asset Classes and Deterioration Curves for Roads

HCB1 All Roadsides- AADT > 20,000, assumes 10% Commercial

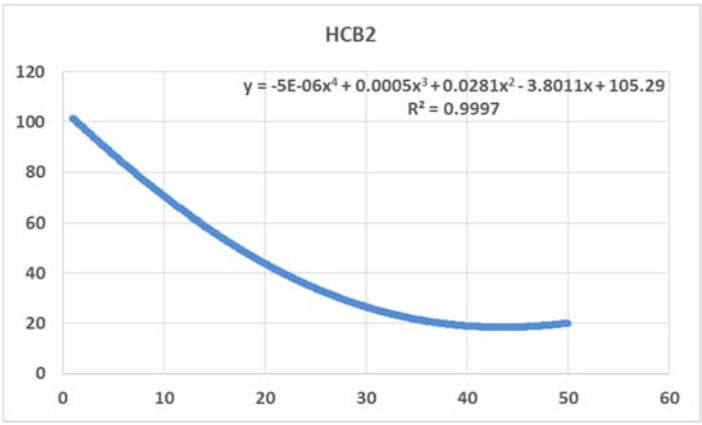
>Year	Condition	Imp. Type	Description
1	100	NONE	No Improvement Required
2	98.61	NONE	No Improvement Required
3	94.19	NONE	No Improvement Required
4	89.83	CRK	Crack Sealing
5	85.55	CRK	Crack Sealing
6	81.36	CRK	Crack Sealing
7	77.26	MICRO	Microsurfacing -Pavement Preservation
8	73.28	MICRO	Microsurfacing -Pavement Preservation
9	69.4	R1	Basic Resurfacing 1 - 50mm
10	65.65	R1	Basic Resurfacing 1 - 50mm
11	62.02	R1	Basic Resurfacing 1 - 50mm
12	58.54	R1	Basic Resurfacing 1 - 50mm
13	55.19	R2	Basic Resurfacing 2 - 100mm
14	52	R2	Basic Resurfacing 2 - 100mm
15	48.96	R2	Basic Resurfacing 2 - 100mm
16	46.08	R2	Basic Resurfacing 2 - 100mm
17	43.36	R2	Basic Resurfacing 2 - 100mm
18	40.81	R2	Basic Resurfacing 2 - 100mm
19	38.41	R2	Basic Resurfacing 2 - 100mm
20	36.19	REC	Reconstruction - Rural
22	32.24	REC	Reconstruction - Rural
23	30.51	REC	Reconstruction - Rural
24	28.95	REC	Reconstruction - Rural
25	27.55	REC	Reconstruction - Rural
26	26.3	REC	Reconstruction - Rural
27	25.21	REC	Reconstruction - Rural
28	24.27	REC	Reconstruction - Rural
29	23.47	REC	Reconstruction - Rural
30	22.82	REC	Reconstruction - Rural
35	21.31	REC	Reconstruction - Rural
40	20	REC	Reconstruction - Rural
50	20	REC	Reconstruction - Rural



WorkTech Asset Classes and Deterioration Curves for Roads

HCB 2 All Roadsides- AADT >10,000 <20,000, Assumes 10% Commercial

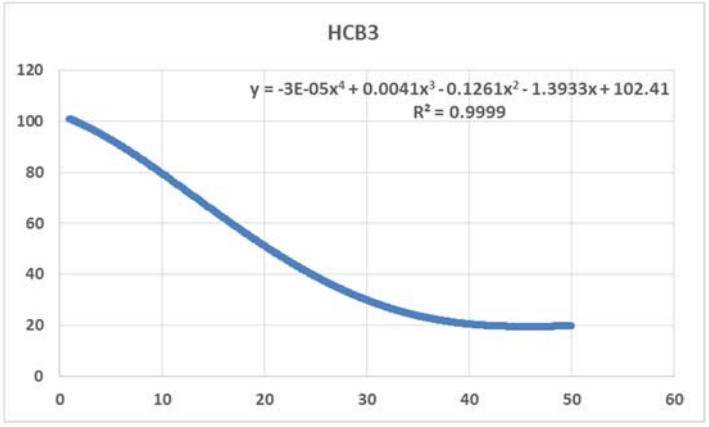
>Year	Condition	Imp. Type	Description
1	100	NONE	No Improvement Required
2	98.79	NONE	No Improvement Required
3	94.85	NONE	No Improvement Required
4	91.01	CRK	Crack Sealing
5	87.29	CRK	Crack Sealing
6	83.68	CRK	Crack Sealing
7	80.18	CRK2	Crack Sealing
8	76.79	MICRO	Microsurfacing -Pavement Preservation
9	73.51	MICRO	Microsurfacing -Pavement Preservation
10	70.33	R1	Basic Resurfacing 1 - 50mm
11	67.26	R1	Basic Resurfacing 1 - 50mm
12	64.28	R1	Basic Resurfacing 1 - 50mm
13	61.41	R1	Basic Resurfacing 1 - 50mm
14	58.63	R1	Basic Resurfacing 1 - 50mm
15	55.95	R2	Basic Resurfacing 2 - 100mm
16	53.38	R2	Basic Resurfacing 2 - 100mm
17	50.89	R2	Basic Resurfacing 2 - 100mm
18	48.5	R2	Basic Resurfacing 2 - 100mm
19	46.2	R2	Basic Resurfacing 2 - 100mm
20	43.99	R2	Basic Resurfacing 2 - 100mm
21	41.87	R2	Basic Resurfacing 2 - 100mm
22	39.84	R2	Basic Resurfacing 2 - 100mm
23	37.89	R2	Basic Resurfacing 2 - 100mm
24	36.03	R2	Basic Resurfacing 2 - 100mm
25	34.26	REC	Reconstruction - Rural
26	32.56	REC	Reconstruction - Rural
27	30.95	REC	Reconstruction - Rural
28	29.42	REC	Reconstruction - Rural
29	27.97	REC	Reconstruction - Rural
30	26.59	REC	Reconstruction - Rural
35	20.86	REC	Reconstruction - Rural
40	20	REC	Reconstruction - Rural
50	20	REC	Reconstruction - Rural



WorkTech Asset Classes and Deterioration Curves for Roads

HCB 3 All Roadsides – AADT 1,000 < 10,000, Assumes 10% Commercial

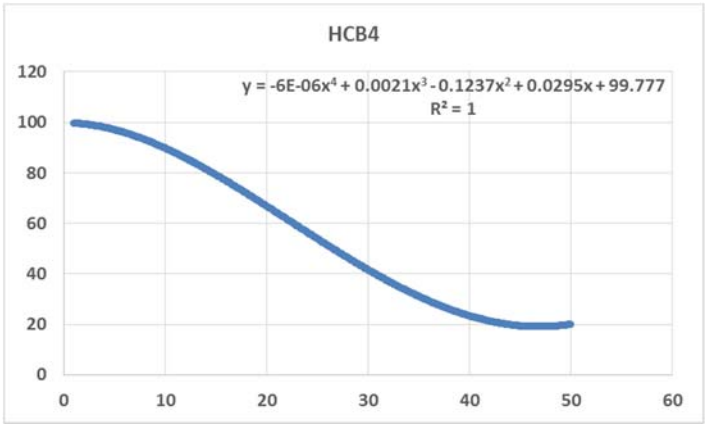
>Year	Condition	Imp. Type	Description
1	100	NONE	No Improvement Required
2	99.44	NONE	No Improvement Required
3	97.46	NONE	No Improvement Required
4	95.29	NONE	No Improvement Required
5	92.95	CRK	Crack Sealing
6	90.48	CRK	Crack Sealing
7	87.88	CRK2	Crack Sealing
8	85.18	CRK2	Crack Sealing
9	82.4	CRK2	Crack Sealing
10	79.56	MICRO	Microsurfacing -Pavement Preservation
11	76.67	MICRO	Microsurfacing -Pavement Preservation
12	73.76	MICRO	Microsurfacing -Pavement Preservation
13	70.83	R1	Basic Resurfacing 1 - 50mm
14	67.91	R1	Basic Resurfacing 1 - 50mm
15	65.01	R1	Basic Resurfacing 1 - 50mm
16	62.14	R1	Basic Resurfacing 1 - 50mm
17	59.31	R1	Basic Resurfacing 1 - 50mm
18	56.54	R1	Basic Resurfacing 1 - 50mm
19	53.83	R2	Basic Resurfacing 2 - 100mm
20	51.19	R2	Basic Resurfacing 2 - 100mm
21	48.63	R2	Basic Resurfacing 2 - 100mm
22	46.17	R2	Basic Resurfacing 2 - 100mm
23	43.8	R2	Basic Resurfacing 2 - 100mm
24	41.53	R2	Basic Resurfacing 2 - 100mm
25	39.37	R2	Basic Resurfacing 2 - 100mm
26	37.31	R2	Basic Resurfacing 2 - 100mm
27	35.37	R2	Basic Resurfacing 2 - 100mm
28	33.54	REC	Reconstruction - Rural
29	31.82	REC	Reconstruction - Rural
30	30.22	REC	Reconstruction - Rural
35	23.83	REC	Reconstruction - Rural
40	20	REC	Reconstruction - Rural
45	20	REC	Reconstruction - Rural
50	20	REC	Reconstruction - Rural



WorkTech Asset Classes and Deterioration Curves for Roads

HCB 4 All Roadsides- AADT <1,000, Assumes 5% Commercial

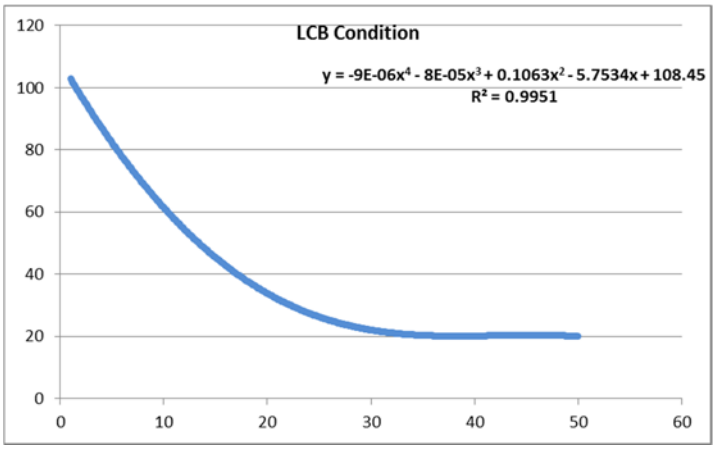
>Year	Condition	Imp. Type	Description
1	100	NONE	No Improvement Required
2	99.44	NONE	No Improvement Required
3	97.46	NONE	No Improvement Required
4	95.29	NONE	No Improvement Required
5	92.95	CRK	Crack Sealing
6	90.48	CRK	Crack Sealing
7	87.88	CRK2	Crack Sealing
8	85.18	CRK2	Crack Sealing
9	82.4	CRK2	Crack Sealing
10	79.56	MICRO	Microsurfacing -Pavement Preservation
11	76.67	MICRO	Microsurfacing -Pavement Preservation
12	73.76	MICRO	Microsurfacing -Pavement Preservation
13	70.83	R1	Basic Resurfacing 1 - 50mm
14	67.91	R1	Basic Resurfacing 1 - 50mm
15	65.01	R1	Basic Resurfacing 1 - 50mm
16	62.14	R1	Basic Resurfacing 1 - 50mm
17	59.31	R1	Basic Resurfacing 1 - 50mm
18	56.54	R1	Basic Resurfacing 1 - 50mm
19	53.83	R2	Basic Resurfacing 2 - 100mm
20	51.19	R2	Basic Resurfacing 2 - 100mm
21	48.63	R2	Basic Resurfacing 2 - 100mm
22	46.17	R2	Basic Resurfacing 2 - 100mm
23	43.8	R2	Basic Resurfacing 2 - 100mm
24	41.53	R2	Basic Resurfacing 2 - 100mm
25	39.37	R2	Basic Resurfacing 2 - 100mm
26	37.31	R2	Basic Resurfacing 2 - 100mm
27	35.37	R2	Basic Resurfacing 2 - 100mm
28	33.54	REC	Reconstruction - Rural
29	31.82	REC	Reconstruction - Rural
30	30.22	REC	Reconstruction - Rural
40	20	REC	Reconstruction - Rural
45	20	REC	Reconstruction - Rural
50	20	REC	Reconstruction - Rural



WorkTech Asset Classes and Deterioration Curves for Roads

LCB All roadsides – All AADT's

Year	Condition	Imp. Type	Description
1	100	NONE	No Improvement Required
2	98.61	NONE	No Improvement Required
3	94.19	NONE	No Improvement Required
4	89.84	NONE	No Improvement Required
5	85.56	NONE	No Improvement Required
6	81.36	NONE	No Improvement Required
7	77.26	SST	Single Surface Treatment
8	73.28	SST	Single Surface Treatment
9	69.4	SST	Single Surface Treatment
10	65.65	SST	Single Surface Treatment
11	62.02	SST	Single Surface Treatment
12	58.54	SST	Single Surface Treatment
13	55.19	SST	Single Surface Treatment
14	52	SSTplus	SST plus Padding / geometric correction
15	48.96	SSTplus	SST plus Padding / geometric correction
16	46.08	SSTplus	SST plus Padding / geometric correction
17	43.36	SSTplus	SST plus Padding / geometric correction
18	40.81	SSTplus	SST plus Padding / geometric correction
19	38.41	SSTplus	SST plus Padding / geometric correction
20	36.19	REC	Reconstruction - Rural
21	34.13	REC	Reconstruction - Rural
22	32.24	REC	Reconstruction - Rural
23	30.51	REC	Reconstruction - Rural
24	28.95	REC	Reconstruction - Rural
25	27.55	REC	Reconstruction - Rural
30	22.82	REC	Reconstruction - Rural
35	21.31	REC	Reconstruction - Rural
40	21.92	REC	Reconstruction - Rural
45	20	REC	Reconstruction - Rural
50	20	REC	Reconstruction - Rural



Appendix D: 10 year Program Details

10 Year Capital and Maintenance Plan From Performance Model

W/ Committed Projects - rev 20150927

Year	Asset ID	Street Name	Description	Imp. Type	Cost	Start Cond	End Cond	Yrs Hold	Length (km)
2016	830	Joe St	(to) Maude St-to-Tom St	CRK	$ 192	95	95	2	0.096
2016	854	Maude St	(to) Annie St-to-Petrolia Line	CRK	$ 226	95	95	2	0.113
2016	855	Maude St	(to) Lorne Ave-to-Jennie St	CRK	$ 222	95	95	2	0.111
2016	926	Tank St	(to) Petrolia Line-to-End of Curb and Gutter	CRK	$ 692	85	85	2	0.346
2016	786	First Ave	(to) Garden-to-150m East of Garden Crescent (West Leg)	CRK	$ 1,396	85	85	2	0.698
2016	907	Queen St	(to) Petrolia Line-to-Lorne Ave	CRK	$ 444	95	95	2	0.222
2016	802	Garfield Ave	(to) Parkside Ct-to-Golden Gate Cl	CRK	$ 184	90	90	2	0.092
2016	803	Garfield Ave	(to) Golden Gate Cl-to-Applewood Dr	CRK	$ 202	90	90	2	0.101
2016	857	Maude St	(to) Dufferin Ave-to-Joe St	CRK	$ 1,048	80	80	2	0.524
2016	786B	First Ave	(to) 120m West of Garden Crescent (West Leg)-to-Glenview Rd	CRK	$ 730	95	95	2	0.365
2016	970A	Lane Behind Church	(to) King St-to-West End Cul De Sac	CRK	$ 140	85	85	2	0.07
2016	805	Glenview Rd	(to) Dufferin Ave-to-Wellington St	CRK	$ 620	85	85	2	0.31
2016	3582	Oozloffsky St N	(to) 365m South of Petrolia Line-to-Petrolia Line	CRK	$ 632	85	85	2	0.316
2016	3639	Annie St	(to) Huggard St-to-Maude St	CRK	$ 200	85	85	2	0.1
2016	3641	Jennie St	(to) Huggard St-to-Maude St	CRK	$ 204	85	85	2	0.102
2016	716	Albany St	(to) Dufferin Ave-to-Walnut St E	CRK	$ 420	85	85	2	0.21
2016	747	Country View Dr	(to) Henderson Dr-to-NW Corner	CRK	$ 232	85	85	2	0.116
2016	812	Grove St	(to) Princess St-to-Glenview Rd	CRK	$ 562	85	85	2	0.281
2016	826	Jacs Ct	(to) Gables Ave-to-North End Cul De Sac	CRK	$ 88	85	85	2	0.044
2016	843	Kerr St	(to) Princess St-to-Glenview Rd	CRK	$ 560	85	85	2	0.28
2016	875	Parkside Ct	(to) Rosemount Dr-to-North End Cul De Sac	CRK	$ 110	85	85	2	0.055
2016	876	Parkside Dr	(to) Parkside Pl-to-Rosemount Dr	CRK	$ 516	85	85	2	0.258
2016	943	Walnut St E	(to) Greenfield St-to-Oil St	CRK	$ 340	85	85	2	0.17
2016	807A	Glenview Rd	(to) Petrolia South Limits-to-330m North of South Limits	CRK	$ 660	85	85	2	0.33
2016	831	Joe St	(to) Tom St-to-Valentina St S	CRK	$ 336	85	85	2	0.168
2016	820	Huggard St	(to) Petrolia Line-to-Annie St	CRK	$ 228	80	80	2	0.114
2016	821	Huggard St	(to) Annie St-to-Jennie St	CRK	$ 222	80	80	2	0.111
2016	806	Glenview Rd	(to) Wellington St-to-Kerr St	CRK	$ 252	80	80	2	0.126
2016	766	Egan Ave	(to) Florence Ave-to-Sanway Ct	CRK	$ 214	80	80	2	0.107
2016	815	Henderson Dr	(to) Country View Dr-to-Valentina St N.	CRK	$ 394	80	80	2	0.197
2016	904	Princess St	(to) Wellington St-to-Grove St	CRK	$ 252	80	80	2	0.126
2016	905	Princess St	(to) Grove St-to-Kerr St	CRK	$ 220	80	80	2	0.11
2016	914	Rosemount Dr	(to) Parkside Ct-to-Redwood Ct	CRK	$ 184	80	80	2	0.092
2016	945	Wellington St	(to) Princess St-to-Glenview Rd	CRK	$ 766	80	80	2	0.383
2016	800	Garfield Ave	(to) Maple St-to-Mulberry Pl	CRK	$ 182	80	80	2	0.091
2016	282	Catherine St	(to) Garfield Ave-to-Pine Cr	CRK	$ 214	95	95	2	0.107
2016	3592	Oozlofsky St Extention	(to) Ignatiefna St-to-365m South of Petrolia Line	CRK	$ 610	95	95	2	0.305
2016	728	Bluebird St	(to) Country View Dr-to-Joe St	CRK	$ 198	95	95	2	0.099
2016	737	Centre St	(to) Andrew St-to-James St	CRK	$ 172	95	95	2	0.086

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Year	Asset ID	Street Name	Description	Imp. Type	Cost	Start Cond	End Cond	Yrs Hold	Length (km)
2016	746	Country View Dr	(to) NW Corner-to-Bluebird St	CRK	$ 136	95	95	2	0.068
2016	808	Golden Gate Cl	(to) West End Cul De Sac-to-Garfield Ave	CRK	$ 258	95	95	2	0.129
2016	866	Oil St	(to) Walnut St E-to-Petrolia Line	CRK	$ 216	95	95	2	0.108
2016	938	Valentina St S.	(to) Hunter-to-Country View	CRK	$ 358	95	95	2	0.179
2016	906	Progress Dr	(to) West End-to-Oil Heritage Rd	CRK	$ 978	85	85	2	0.489
2016	738	Centre St	(to) James St-to-200m North of Portland	CRK	$ 570	90	90	2	0.285
2016	717	Albany St	(to) Walnut St W-to-Petrolia Line	CRK	$ 278	90	90	2	0.139
2016	745	Country View Dr	(to) Bluebird St-to-East End Cul De Sac	CRK	$ 106	90	90	2	0.053
2016	794	Gables Ave	(to) Eureka St-to-Jacs Ct	CRK	$ 174	90	90	2	0.087
2016	804	Gem Ave	(to) Petrolia Line-to-North End Cul De Sac	CRK	$ 750	90	90	2	0.375
2016	824	Hunter Ct	(to) West End Cul De Sac-to-Valentina St S.	CRK	$ 194	90	90	2	0.097
2016	850	Lorne Ave	(to) Maude St-to-Midblock	CRK	$ 130	90	90	2	0.065
2016	877	Parkside Dr	(to) Parkside Pl-to-Garfield Ave	CRK	$ 370	90	90	2	0.185
2016	878	Parkside Pl	(to) South End Cul De Sac-to-Parkside Pl	CRK	$ 120	90	90	2	0.06
2016	937	Valentina St S.	(to) Henderson Dr-to-Hunter Ct	CRK	$ 306	90	90	2	0.153
2016	845	King Well Lane/Gemfield	(to) Kerby St-to-Eureka St	CRK	$ 190	80	80	2	0.095
2016	777	Eureka St	(to) Catherine St-to-Ernest St	MICRO	$ 4,764	75	75	3	0.164
2016	848	Lancey St	(to) Warren Ave-to-Emmeline St	MICRO	$ 686	80	80	3	0.028
2016	929	Third St	(to) First Ave-to-Fourth St	R2	$ 113,389	30	100		0.244
2016	807	Glenview Rd	(to) 330m North of South Limits-to-Kerr St	R2	$ 130,170	40	100		0.318
2016	814	Hawthorne Pl	(to) West End Cul De Sac-to-Sycamore Dr	R2	$ 33,514	40	100		0.076
2016	735	Petrolia Line Storm Sewer	Petrolia Line	SRR	$ 1,296,453	80	100		
2016	735	Petrolia Line Watermain	Petrolia Line	Water	$ 1,059,098				
					$ 2,658,272				

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Year	Asset ID	Street Name	Description	Imp. Type	Cost	Start Cond	End Cond	Yrs Hold	Length (km)
2017	752	Discovery Line	(to) Stanley Ave-to-Eureka St	CRK	$ 449	83.76	83.76	2	0.449
2017	739	Centre St	(to) 200m North of Portland-to-020-108 (333 Centre)	CRK	$ 1,170	89.73	89.73	2	0.585
2017	740	Centre St	(to) 020-108 (333 Centre)-to-Discovery Line	CRK	$ 472	89.73	89.73	2	0.236
2017	754A	Discovery Line	(to) Former Railway Crossing-to-Tank St	CRK	$ 328	94.55	94.55	2	0.164
2017	847	King Well Lane/Gemfield	(to) Centre St-to-Fletcher St	CRK	$ 272	74.49	74.49	2	0.136
2017	776	Eureka St	(to) Maple St-to-Catherine St	MICRO	$ 7,902	73.76	73.76	3	0.272
2017	767	Ella St	(to) Emma St-to-Warren Ave	MICRO	$ 3,847	79.27	79.27	3	0.157
2017	732	Catherine St	(to) Pine Cr-to-Juniper Cr	R2	$ 38,365	39.27	100		0.087
2017	896	Pine Cr	(to) Catherine St-to-West corner	R2	$ 45,421	39.27	100		0.103
2017	897	Pine Cr	(to) West Corner-to-East Corner	R2	$ 56,886	39.27	100		0.129
2017	898	Pine Cr	(to) East Corner-to-Catherine St	R2	$ 42,775	39.27	100		0.097
2017	765	Egan Ave	(to) Petrolia Line-to-Florence Ave	RSS	$ 123,932	28.95	28.95		0.158
2017	788	Florence Ave	(to) Garfield Ave-to-Egan Ave	RSS	$ 170,406	24.05	24.05		0.22
2017	789	Florence Ave	(to) Egan Ave-to-Kerby St	RSS	$ 162,661	20	20		0.208
2017	841	Kerby St	(to) Petrolia Line-to-Florence Ave	RSS	$ 123,932	39.27	39.27		0.16
2017	765-788-789-841	Florence Egan Kirby	Florence Egan Kirby	Sanitary	$ 119,070				
2017	765-788-789-841	Florence Egan Kirby	Florence Egan Kirby	Storm	$ 119,070				
2017	765-788-789-841	Florence Egan Kirby	Florence Egan Kirby	Water	$ 90,000				
					$ 1,106,958				

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Year	Asset ID	Street Name	Description	Imp. Type	Cost	Start Cond	End Cond	Yrs Hold	Length (km)
2018	801	Garfield Ave	(to) Mulberry Pl-to-Parkside Ct	CRK	$ 262	92.95	92.95	2	0.131
2018	798	Garfield Ave	(to) Petrolia Line-to-Florence Ave	CRK	$ 316	92.95	92.95	2	0.158
2018	816	Henry Ave	(to) Oil St-to-Warren Ave	CRK	$ 128	89.73	89.73	2	0.064
2018	751	Discovery Line	(to) West town limit-to-Stanley	CRK	$ 300	83.76	83.76	2	0.3
2018	743	Chestnut St	(to) Walnut St E-to-School St	CRK	$ 212	94.55	94.55	2	0.106
2018	779	Evergreen Trail	(to) Applewood Dr-to-Rosemount	CRK	$ 186	94.55	94.55	2	0.093
2018	780	Evergreen Trail	(to) Rosemount Dr-to-North End Cul De Sac	CRK	$ 106	94.55	94.55	2	0.053
2018	793	Fourth St	(to) Sixth St-to-South End	CRK	$ 106	94.55	94.55	2	0.053
2018	795	Gables Ave	(to) Jacs Ct-to-East End	CRK	$ 214	94.55	94.55	2	0.107
2018	911	Redwood Ct	(to) Rosemount Dr-to-North End Cul De Sac	CRK	$ 118	94.55	94.55	2	0.059
2018	920	Sixth St	(to) First Ave-to-Fourth St	CRK	$ 482	94.55	94.55	2	0.241
2018	940	Victoria Ave	(to) Princess St-to-Queen St	CRK	$ 288	94.55	94.55	2	0.144
2018	754	Discovery Line	(to) Centre St-to-Former Railway Crossing	CRK	$ 164	89.73	89.73	2	0.164
2018	757B	Discovery Line	(to) 400m West of Oil Heritage Rd-to-Oil Heritage Rd	CRK	$ 800	89.73	89.73	2	0.4
2018	939	Vanderwal Dr	(to) Discovery Line-to-North End Cul De Sac	CRK	$ 384	94.55	94.55	2	0.192
2018	768	Emma St	(to) Ella St-to-Emmeline St	MICRO	$ 1,405	76.91	76.91	3	0.055
2018	769	Emma St	(to) Emmeline St-to-East End	MICRO	$ 2,018	76.91	76.91	3	0.079
2018	758	Dufferin Ave	(to) Huggard St-to-Maude St	R1	$ 30,273	59.32	97		0.102
2018	835	Juniper Cr	(to) Juniper North-to-Sycamore Dr	R2	$ 95,252	37.07	100		0.216
2018	925	Sycamore Dr	(to) Maple St-to-North End Cul De Sac	R2	$ 59,091	37.07	100		0.134
2018	765	Egan Ave	(to) Petrolia Line-to-Florence Ave	RSS	$ 134,598	28.95	100		0.158
2018	788	Florence Ave	(to) Garfield Ave-to-Egan Ave	RSS	$ 185,073	24.05	100		0.22
2018	789	Florence Ave	(to) Egan Ave-to-Kerby St	RSS	$ 176,660	20	100		0.208
2018	841	Kerby St	(to) Petrolia Line-to-Florence Ave	RSS	$ 134,598	39.27	100		0.16
2018	765-788-789-841	Florence Egan Kirby	Florence Egan Kirby	Sanitary	$ 119,070				
2018	753	Discovery Line	(to) Eureka St-to-Centre St	SST	$ 3,186	77.27	90		0.284
2018	765-788-789-841	Florence Egan Kirby	Florence Egan Kirby	Storm	$ 119,070				
2018	765-788-789-841	Florence Egan Kirby	Florence Egan Kirby	Water	$ 90,000				
					$ 1,154,360				

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Year	Asset ID	Street Name	Description	Imp. Type	Cost	Start Cond	End Cond	Yrs Hold	Length (km)
2019	813	Hartford St	(to) Petrolia Line-to-North St	CRK	$ 180	90	90	2	0.09
2019	839	Kentail St	(to) Petrolia Line-to-North St	CRK	$ 190	90	90	2	0.095
2019	862	North St	(to) Hartford St-to-Kentail St	CRK	$ 396	90	90	2	0.198
2019	863	North St	(to) Kentail St-to-Wood St	CRK	$ 340	90	90	2	0.17
2019	864	North St	(to) Wood St-to-Oil Heritage Rd	CRK	$ 724	90	90	2	0.362
2019	950	Wood St	(to) Petrolia Line-to-North St	CRK	$ 192	90	90	2	0.096
2019	849	Lancey St	(to) Emmeline St-to-East End Cul De Sac	R1	$ 58,687	59.1	97		0.208
2019	834	Juniper Cr	(to) Catherine St-to-Juniper Cr South	R2	$ 97,897	39.27	100		0.222
2019	775	Eureka St	(to) Petrolia Line-to-Maple St	R2	$ 160,918	43.8	100		0.375
2019	879	Pearl St	(to) England Ave-to-First Ave	R1	$ 40,448	59.1	97		0.133
2019	731	Catherine St	(to) Pine Cr-to-Pine Cr	R2	$ 37,924	43.91	100		0.086
2019	759	Dufferin Ave	(to) Maude St-to-Princess St	R2	$ 69,641	35.37	100		0.129
2019	772	England Ave	(to) Pearl St-to-South End	R1	$ 30,519	59.1	97		0.094
					$ 498,056				

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Year	Asset ID	Street Name	Description	Imp. Type	Cost	Start Cond	End Cond	Yrs Hold	Length (km)
2020	772	England Ave	(to) Pearl St-to-South End	CRK	$ 188	97	97	2	0.094
2020	849	Lancey St	(to) Emmeline St-to-East End Cul De Sac	CRK	$ 416	97	97	2	0.208
2020	879	Pearl St	(to) England Ave-to-First Ave	CRK	$ 266	97	97	2	0.133
2020	757A	Discovery Line	(to) Bridge-to-400m West of Oil Heritage Rd	SST	$ 5,082	77.27	90		0.22
2020	757	Discovery Line	(to) East Limit Petrolia Discovery Centre-to-Bridge	SST	$ 15,154	77.26	90		0.656
2020	756	Discovery Line	(to) Tank St-to-Petrolia Discovery East Limit	SST	$ 7,588	77.26	90		0.328
2020	797	Garden Cr	(to) First Ave-to-Heritage Heights Ln	R1	$ 82,609	56.5	97		0.249
2020	936	Valentina St S.	(to) Charlie St-to-Henderson Dr	R1	$ 34,959	56.5	97		0.105
2020	916	Sanway Ct	(to) West End Cul De Sac-to-Eagan Ave	R1	$ 39,093	56.5	97		0.117
2020	733	Catherine St	(to) Juniper-to-70m East of Juniper	R2	$ 29,987	46.33	100		0.068
2020	770	Emmeline St	(to) Emma St-to-Lancey St	MICRO	$ 3,347	72	72	3	0.131
2020	948	Wingfield St	(to) Petrolia Line-to-Walnut St E	Storm	$ 138,915				
2020	949	Wingfield St	(to) Walnut St E-to-Dufferin Ave	Water	$ 100,000				
2020	948	Wingfield St	(to) Petrolia Line-to-Walnut St E	RSS	$ 352,000	22.73	100		0.135
2020	949	Wingfield St	(to) Walnut St E-to-Dufferin Ave	RSS	$ 528,000	22.73	100		0.208
					$ 1,337,604				

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Year	Asset ID	Street Name	Description	Imp. Type	Cost	Start Cond	End Cond	Yrs Hold	Length (km)
2021	735	Centre St	(to) Petrolia Line-to-Robert St	CRK	$ 176	92.95	92.95	2	0.088
2021	736	Centre St	(to) Robert St-to-Andrew St	CRK	$ 168	92.95	92.95	2	0.084
2021	908	Queen St	(to) Lorne Ave-to-Dufferin Ave	CRK	$ 250	92.95	92.95	2	0.125
2021	3607	Nelson St	(to) Princess St-to-Dufferin Ave	CRK	$ 736	92.95	92.95	2	0.368
2021	758	Dufferin Ave	(to) Huggard St-to-Maude St	CRK	$ 204	92.95	92.95	2	0.102
2021	799	Garfield Ave	(to) Florence Ave-to-Maple St	CRK	$ 428	92.95	92.95	2	0.214
2021	814	Hawthorne Pl	(to) West End Cul De Sac-to-Sycamore Dr	CRK	$ 152	97	97	2	0.076
2021	851	Lorne Ave	(to) Princess St-to-Queen St	CRK	$ 284	97	97	2	0.142
2021	900	Princess St	(to) Lorne Ave-to-Petrolia Line	CRK	$ 448	97	97	2	0.224
2021	901	Princess St	(to) Lorne Ave-to-Dufferin Ave	CRK	$ 248	97	97	2	0.124
2021	902	Princess St	(to) Nelson St-to-Dufferin Ave	CRK	$ 622	97	97	2	0.311
2021	915	Rosemount Dr	(to) Redwood Ct-to-Evergreen Trail	CRK	$ 176	97	97	2	0.088
2021	916	Sanway Ct	(to) West End Cul De Sac-to-Eagan Ave	CRK	$ 234	97	97	2	0.117
2021	929	Third St	(to) First Ave-to-Fourth St	CRK	$ 488	97	97	2	0.244
2021	936	Valentina St S.	(to) Charlie St-to-Henderson Dr	CRK	$ 210	97	97	2	0.105
2021	3605	Princess St	(to) Wellington St-to-Nelson St	CRK	$ 330	97	97	2	0.165
2021	3642	Jennie St	(to) West St-to-Egan Ave	CRK	$ 190	97	97	2	0.095
2021	3656	West St	(to) Annie St-to-Petrolia Line	CRK	$ 226	97	97	2	0.113
2021	3657	West St	(to) Jennie St-to-Annie St	CRK	$ 226	97	97	2	0.113
2021	722	Applewood Dr	(to) Parkside Ct-to-Evergreen Trail	CRK	$ 310	97	97	2	0.155
2021	723	Applewood Dr	(to) Evergreen Trail-to-Garfield Ave	CRK	$ 182	97	97	2	0.091
2021	748	Country View Dr	(to) Henderson Dr-to-Valentina St N.	CRK	$ 486	97	97	2	0.243
2021	748A	Country View Dr	(to) Englehart Dr-to-Valentina St N.	CRK	$ 260	97	97	2	0.13
2021	748B	Englehart Drive	(to) Country View Dr-to-East End Cul De Sac	CRK	$ 500	97	97	2	0.25
2021	785A	Fairway Court	(to) West End Cul De Sac-to-First Ave	CRK	$ 390	97	97	2	0.195
2021	790	Fourth St	(to) Petrolia Line-to-Third St	CRK	$ 234	97	97	2	0.117
2021	791	Fourth St	(to) Third St-to-Fifth Ave	CRK	$ 214	97	97	2	0.107
2021	792	Fourth St	(to) Fifth Ave-to-Sixth St	CRK	$ 208	97	97	2	0.104
2021	797	Garden Cr	(to) First Ave-to-Heritage Heights Ln	CRK	$ 498	97	97	2	0.249
2021	807	Glenview Rd	(to) 330m North of South Limits-to-Kerr St	CRK	$ 636	97	97	2	0.318
2021	942	Walnut St W	(to) Wingfield St-to-Greenfield St	CRK	$ 138	97	97	2	0.069
2021	941	Walnut St W	(to) Albany St-to-Wingfield St	CRK	$ 170	97	97	2	0.085
2021	853	Maple St	(to) Sycamore Dr-to-Eureka St	R2	$ 97,371	43.8	100		0.222
2021	763	Dufferin Ave	(to) Blanche St-to-Greenfield St	R2	$ 66,942	35.37	100		0.124
2021	771	England Ave	(to) Petrolia Line-to-Pearl St	R2	$ 43,542	43.91	100		0.097
2021	912	Robert St	(to) Eureka St-to-Centre St	R1	$ 97,686	59.1	97		0.3
2021	818	Hickory St	(to) School St-to-Walnut St E	PR2	$ 19,795	21.51	100		0.107
2021	935	Valentina St S.	(to) Joe St-to-Charlie St	R1	$ 31,963	59.1	97		0.096
2021	3640	Annie St	(to) West St-to-Huggard St	R1	$ 34,121	59.1	97		0.1

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Year	Asset ID	Street Name	Description	Imp. Type	Cost	Start Cond	End Cond	Yrs Hold	Length (km)
2021	926	Tank St	(to) Petrolia Line-to-End of Curb and Gutter	MICRO	$ 8,840	76.67	76.67	3	0.346
	809, 810								
2021	811	Greenfield St	(to) Petrolia Line to South End	Storm	$ 81,000				
	809, 810								
2021	811	Greenfield St	(to) Petrolia Line to South End	Sanitary	$ 81,000				
	809, 810								
2021	811	Greenfield St	(to) Petrolia Line to South End	Water	$ 100,000				
2021	809	Greenfield St	(to) Petrolia Line-to-Walnut W	RSS	$ 196,500	31.1	100		0.134
2021	810	Greenfield St	(to) Walnut W-to-Dufferin Ave	RSS	$ 317,423	22.17	100		0.208
2021	811	Greenfield St	(to) Dufferin Ave-to-South End	RSS	$ 90,692	15	100		0.058
					$ 1,276,897				

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Year	Asset ID	Street Name	Description	Imp. Type	Cost	Start Cond	End Cond	Yrs Hold	Length (km)
2022	3640	Annie St	(to) West St-to-Huggard St	CRK	$ 200	97	97	2	0.1
2022	732	Catherine St	(to) Pine Cr-to-Juniper Cr	CRK	$ 174	97	97	2	0.087
2022	896	Pine Cr	(to) Catherine St-to-West corner	CRK	$ 206	97	97	2	0.103
2022	897	Pine Cr	(to) West Corner-to-East Corner	CRK	$ 258	97	97	2	0.129
2022	898	Pine Cr	(to) East Corner-to-Catherine St	CRK	$ 194	97	97	2	0.097
2022	912	Robert St	(to) Eureka St-to-Centre St	CRK	$ 600	97	97	2	0.3
2022	935	Valentina St S.	(to) Joe St-to-Charlie St	CRK	$ 192	97	97	2	0.096
2022	850A	Lorne Ave	(to) Midblock-to-Princess St	SST	$ 1,480	77.26	90		0.065
2022	778	Eureka St	(to) Ernest St-to-Discovery Line	R1	$ 172,074	59.32	97		0.55
2022	762	Dufferin Ave	(to) Glenview Rd-to-Blanche St	R2	$ 47,507	41.54	100		0.088
2022	786A	First Ave	(to) 150m East of Garden Crescent (West Leg)-to-120m West of Gard	R2	$ 126,539	46.17	100		0.27
2022	823	Huggard St	(to) Dufferin Ave-to-Arena Lot	R1	$ 51,587	56.5	97		0.123
2022	865	Northridge Pl	(to) Petrolia Line-to-North End Cul De Sac	R1	$ 33,061	66.91	97		0.101
2022	781	Fifth Ave	(to) First Ave-to-Fourth St	R2	$ 114,354	51.35	100		0.244
2022	943	Walnut St E	(to) Greenfield St-to-Oil St	MICRO	$ 3,808	76.91	76.91	3	0.17
2022	776	Eureka St	(to) Maple St-to-Catherine St	R1	$ 85,098	67.92	97		0.272
2022	777	Eureka St	(to) Catherine St-to-Ernest St	R1	$ 51,309	67.92	97		0.164
2022	796	Garden Cr	(to) First Ave-to-Heritage Heights	R1	$ 213,986	64	97		0.645
2022	856	Maude St	(to) Dufferin Ave-to-Lorne Ave	R1	$ 43,713	64	97		0.123
2022	716	Albany St	(to) Dufferin Ave-to-Walnut St E	MICRO	$ 5,366	76.91	76.91	3	0.21
2022	944	Warren Ave	(to) Lancey St-to-Henry Ave	MICRO	$ 3,030	66.91	66.91	3	0.111
2022	786	First Ave	(to) Garden-to-150m East of Garden Crescent (West Leg)	MICRO	$ 22,720	73.76	73.76	3	0.698
2022	826	Jacs Ct	(to) Gables Ave-to-North End Cul De Sac	MICRO	$ 1,217	76.91	76.91	3	0.044
2022	734	Catherine St	(to) 70m East of Juniper-to-Eureka St	MICRO	$ 4,635	66.91	66.91	3	0.154
2022	807A	Glenview Rd	(to) Petrolia South Limits-to-330m North of South Limits	MICRO	$ 8,663	76.91	76.91	3	0.33
2022	914	Rosemount Dr	(to) Parkside Ct-to-Redwood Ct	MICRO	$ 2,769	72	72	3	0.092
2022	817	Heritage Heights Ln	(to) West End Cul De Sac-to-Garden Cr	R1	$ 25,956	66.91	97		0.197
2022	766	Egan Ave	(to) Florence Ave-to-Sanway Ct	MICRO	$ 3,296	72	72	3	0.107
2022	815	Henderson Dr	(to) Country View Dr-to-Valentina St N.	MICRO	$ 6,137	72	72	3	0.197
2022	875	Parkside Ct	(to) Rosemount Dr-to-North End Cul De Sac	MICRO	$ 1,656	76.91	76.91	3	0.055
2022	876	Parkside Dr	(to) Parkside Pl-to-Rosemount Dr	MICRO	$ 7,766	76.91	76.91	3	0.258
2022	752	Discovery Line	(to) Stanley Ave-to-Eureka St	MICRO	$ 5,343	76.91	76.91	3	0.449
2022	802	Garfield Ave	(to) Parkside Ct-to-Golden Gate Cl	MICRO	$ 3,574	79.56	79.56	3	0.092
2022	803	Garfield Ave	(to) Golden Gate Cl-to-Applewood Dr	MICRO	$ 3,924	79.56	79.56	3	0.101
2022	904	Princess St	(to) Wellington St-to-Grove St	MICRO	$ 4,035	72	72	3	0.126
2022	905	Princess St	(to) Grove St-to-Kerr St	MICRO	$ 3,523	72	72	3	0.11
2022	945	Wellington St	(to) Princess St-to-Glenview Rd	MICRO	$ 12,266	72	72	3	0.383
2022	751	Discovery Line	(to) West town limit-to-Stanley	MICRO	$ 3,570	79.27	79.27	3	0.3
2022	858	Maude St	(to) Joe St-to-South end (extension)	R2	$ 61,491	41.55	100		0.25

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Year	Asset ID	Street Name	Description	Imp. Type	Cost	Start Cond	End Cond	Yrs Hold	Length (km)
2022	800	Garfield Ave	(to) Maple St-to-Mulberry Pl	R1	$ 42,230	70.84	97		0.091
2022	3582	Oozloffsky St N	(to) 365m South of Petrolia Line-to-Petrolia Line	MICRO	$ 10,065	76.91	76.91	3	0.316
2022	3641	Jennie St	(to) Huggard St-to-Maude St	MICRO	$ 3,249	76.91	76.91	3	0.102
2022	747	Country View Dr	(to) Henderson Dr-to-NW Corner	MICRO	$ 3,695	76.91	76.91	3	0.116
2022	812	Grove St	(to) Princess St-to-Glenview Rd	MICRO	$ 8,950	76.91	76.91	3	0.281
2022	806	Glenview Rd	(to) Wellington St-to-Kerr St	MICRO	$ 4,278	72	72	3	0.126
2022	843	Kerr St	(to) Princess St-to-Glenview Rd	MICRO	$ 9,016	76.91	76.91	3	0.28
2022	3639	Annie St	(to) Huggard St-to-Maude St	MICRO	$ 3,325	76.91	76.91	3	0.1
2022	805	Glenview Rd	(to) Dufferin Ave-to-Wellington St	MICRO	$ 10,525	76.91	76.91	3	0.31
2022	970A	Lane Behind Church	(to) King St-to-West End Cul De Sac	MICRO	$ 2,426	76.91	76.91	3	0.07
2022	820	Huggard St	(to) Petrolia Line-to-Annie St	MICRO	$ 5,111	72	72	3	0.114
2022	821	Huggard St	(to) Annie St-to-Jennie St	MICRO	$ 4,977	72	72	3	0.111
2022	906	Progress Dr	(to) West End-to-Oil Heritage Rd	MICRO	$ 12,665	76.92	76.92	3	0.489
2022	847	King Well Lane/Gemfield	(to) Centre St-to-Fletcher St	R1	$ 15,595	66.91	97		0.136
2022	845	King Well Lane/Gemfield	(to) Kerby St-to-Eureka St	MICRO	$ 2,028	72	72	3	0.095
					$ 1,275,412				

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Year	Asset ID	Street Name	Description	Imp. Type	Cost	Start Cond	End Cond	Yrs Hold	Length (km)
2023	927	Tank St	(to) End of Curb and Gutter-to-Discovery	REC	$ 681,060	21.61	100		1.02
2023	928	Tank St	(to) Discovery-to-North Town Limit	REC	$ 454,040	15	100		0.677
					$ 1,135,100				

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Year	Asset ID	Street Name	Description	Imp. Type	Cost	Start Cond	End Cond	Yrs Hold	Length (km)
2024	759	Dufferin Ave	(to) Maude St-to-Princess St	CRK	$ 258	92.95	92.95	2	0.129
2024	775	Eureka St	(to) Petrolia Line-to-Maple St	CRK	$ 750	92.95	92.95	2	0.375
2024	823	Huggard St	(to) Dufferin Ave-to-Arena Lot	CRK	$ 246	95.86	95.86	2	0.123
2024	753	Discovery Line	(to) Eureka St-to-Centre St	SST	$ 3,186	73.27	90		0.284
2024	865	Northridge Pl	(to) Petrolia Line-to-North End Cul De Sac	CRK	$ 202	95.86	95.86	2	0.101
2024	835	Juniper Cr	(to) Juniper North-to-Sycamore Dr	CRK	$ 432	95.86	95.86	2	0.216
2024	841	Kerby St	(to) Petrolia Line-to-Florence Ave	CRK	$ 320	95.86	95.86	2	0.16
2024	925	Sycamore Dr	(to) Maple St-to-North End Cul De Sac	CRK	$ 268	95.86	95.86	2	0.134
2024	731	Catherine St	(to) Pine Cr-to-Pine Cr	CRK	$ 172	97	97	2	0.086
2024	834	Juniper Cr	(to) Catherine St-to-Juniper Cr South	CRK	$ 444	97	97	2	0.222
2024	817	Heritage Heights Ln	(to) West End Cul De Sac-to-Garden Cr	CRK	$ 394	95.86	95.86	2	0.197
2024	767	Ella St	(to) Emma St-to-Warren Ave	R1	$ 44,297	69.47	97		0.157
2024	848	Lancey St	(to) Warren Ave-to-Emmeline St	R1	$ 7,900	69.47	97		0.028
2024	768	Emma St	(to) Ella St-to-Emmeline St	R1	$ 15,908	69.47	97		0.055
2024	769	Emma St	(to) Emmeline St-to-East End	R1	$ 22,850	69.47	97		0.079
2024	770	Emmeline St	(to) Emma St-to-Lancey St	R1	$ 37,890	69.47	97		0.131
2024	786B	First Ave	(to) 120m West of Garden Crescent (West Leg)-to-Glenview Rd	MICRO	$ 11,753	79.56	79.56	3	0.365
2024	794	Gables Ave	(to) Eureka St-to-Jacs Ct	MICRO	$ 2,406	79.27	79.27	3	0.087
2024	857	Maude St	(to) Dufferin Ave-to-Joe St	R1	$ 186,223	69	97		0.524
2024	717	Albany St	(to) Walnut St W-to-Petrolia Line	MICRO	$ 4,135	79.27	79.27	3	0.139
2024	877	Parkside Dr	(to) Parkside Pl-to-Garfield Ave	MICRO	$ 5,569	79.27	79.27	3	0.185
2024	878	Parkside Pl	(to) South End Cul De Sac-to-Parkside Pl	MICRO	$ 1,806	79.27	79.27	3	0.06
2024	907	Queen St	(to) Petrolia Line-to-Lorne Ave	MICRO	$ 9,324	79.56	79.56	3	0.222
2024	745	Country View Dr	(to) Bluebird St-to-East End Cul De Sac	MICRO	$ 1,688	79.27	79.27	3	0.053
2024	804	Gem Ave	(to) Petrolia Line-to-North End Cul De Sac	MICRO	$ 11,944	79.27	79.27	3	0.375
2024	824	Hunter Ct	(to) West End Cul De Sac-to-Valentina St S.	MICRO	$ 3,089	79.27	79.27	3	0.097
2024	850	Lorne Ave	(to) Maude St-to-Midblock	MICRO	$ 2,070	79.27	79.27	3	0.065
2024	738	Centre St	(to) James St-to-200m North of Portland	MICRO	$ 9,377	79.27	79.27	3	0.285
2024	783	First Ave	(to) Third St-to-Fifth Ave	RNS	$ 117,278	20	100		0.108
2024	937	Valentina St S.	(to) Henderson Dr-to-Hunter Ct	MICRO	$ 4,900	79.27	79.27	3	0.153
2024	785	First Ave	(to) Sixth St-to-Garden Cr	RNS	$ 459,340	21.52	100		0.423
2024	932	Tom St	(to) Charlie St-to-Joe St	RNS	$ 99,904	20.85	100		0.092
2024	742	Charlie St	(to) Short St-to-Valentina St N.	RNS	$ 103,162	22.17	100		0.095
2024	899	Portland Ave	(to) West End Cul De Sac-to-Centre St	RNS	$ 120,536	22.17	100		0.111
2024	847	King Well Lane/Gemfield	(to) Centre St-to-Fletcher St	CRK	$ 272	95.86	95.86	2	0.136
2024	740	Centre St	(to) 020-108 (333 Centre)-to-Discovery Line	MICRO	$ 6,112	79.27	79.27	3	0.236
					$ 1,296,405				

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Year	Asset ID	Street Name	Description	Imp. Type	Cost	Start Cond	End Cond	Yrs Hold	Length (km)
2025	800	Garfield Ave	(to) Maple St-to-Mulberry Pl	CRK	$ 182	92.95	92.95	2	0.091
2025	776	Eureka St	(to) Maple St-to-Catherine St	CRK	$ 544	92.95	92.95	2	0.272
2025	777	Eureka St	(to) Catherine St-to-Ernest St	CRK	$ 328	92.95	92.95	2	0.164
2025	778	Eureka St	(to) Ernest St-to-Discovery Line	CRK	$ 1,100	92.95	92.95	2	0.55
2025	948	Wingfield St	(to) Petrolia Line-to-Walnut St E	CRK	$ 270	97	97	2	0.135
2025	733	Catherine St	(to) Juniper-to-70m East of Juniper	CRK	$ 136	97	97	2	0.068
2025	767	Ella St	(to) Emma St-to-Warren Ave	CRK	$ 314	97	97	2	0.157
2025	768	Emma St	(to) Ella St-to-Emmeline St	CRK	$ 110	97	97	2	0.055
2025	769	Emma St	(to) Emmeline St-to-East End	CRK	$ 158	97	97	2	0.079
2025	770	Emmeline St	(to) Emma St-to-Lancey St	CRK	$ 262	97	97	2	0.131
2025	848	Lancey St	(to) Warren Ave-to-Emmeline St	CRK	$ 56	97	97	2	0.028
2025	757A	Discovery Line	(to) Bridge-to-400m West of Oil Heritage Rd	SST	$ 5,082	77.27	90		0.22
2025	757	Discovery Line	(to) East Limit Petrolia Discovery Centre-to-Bridge	SST	$ 15,154	77.26	90		0.656
2025	756	Discovery Line	(to) Tank St-to-Petrolia Discovery East Limit	SST	$ 7,588	77.26	90		0.328
2025	765	Egan Ave	(to) Petrolia Line-to-Florence Ave	SST	$ 2,868	77.26	90		0.158
2025	788	Florence Ave	(to) Garfield Ave-to-Egan Ave	SST	$ 4,864	77.26	90		0.22
2025	789	Florence Ave	(to) Egan Ave-to-Kerby St	SST	$ 4,599	77.26	90		0.208
2025	949	Wingfield St	(to) Walnut St E-to-Dufferin Ave	CRK	$ 416	97	97	2	0.208
2025	798	Garfield Ave	(to) Petrolia Line-to-Florence Ave	MICRO	$ 4,756	79.56	79.56	3	0.158
2025	816	Henry Ave	(to) Oil St-to-Warren Ave	MICRO	$ 1,725	79.27	79.27	3	0.064
2025	801	Garfield Ave	(to) Mulberry Pl-to-Parkside Ct	MICRO	$ 5,089	79.56	79.56	3	0.131
2025	784	First Ave	(to) Fifth Ave-to-Sixth St	RNS	$ 115,107	23.06	100		0.106
2025	852	Maple St	(to) Garfield Ave-to-Sycamore Dr	RNS	$ 325,773	23.06	100		0.3
2025	741	Charlie St	(to) Tom St-to-Short St	RNS	$ 89,045	23.29	100		0.082
2025	787	Fletcher St	(to) Petrolia Line-to-Robert St	RNS	$ 99,222	20.64	100		0.084
2025	919	Short St	(to) South End Cul De Sac-to-Charlie St	RNS	$ 121,622	24.99	100		0.112
2025	782	First Ave	(to) Petrolia Line-to-Third St	RNS	$ 127,052	26.08	100		0.117
2025	744	Chestnut St	(to) School St-to-south end	RW	$ 80,691	24.99	97		0.076
2025	754	Discovery Line	(to) Centre St-to-Former Railway Crossing	MICRO	$ 2,239	79.27	79.27	3	0.164
2025	757B	Discovery Line	(to) 400m West of Oil Heritage Rd-to-Oil Heritage Rd	MICRO	$ 11,620	79.27	79.27	3	0.4
2025	739	Centre St	(to) 200m North of Portland-to-020-108 (333 Centre)	MICRO	$ 15,356	76.92	76.92	3	0.585
					$ 1,043,328				