

Windsor, Ontario

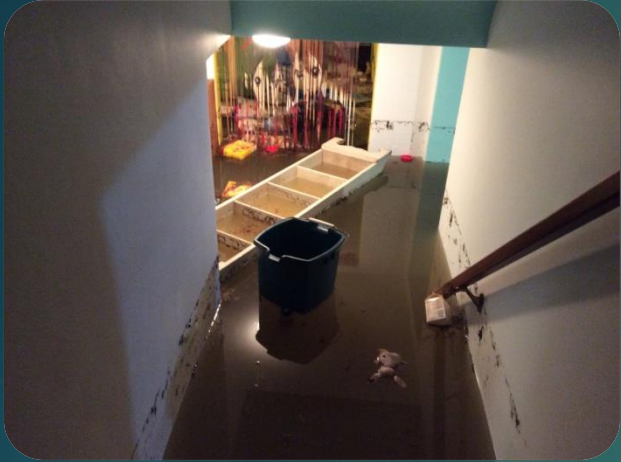
Pop approx. 217,000
\$6.1B in reported assets (2019)
Located just south of Detroit,
Michigan



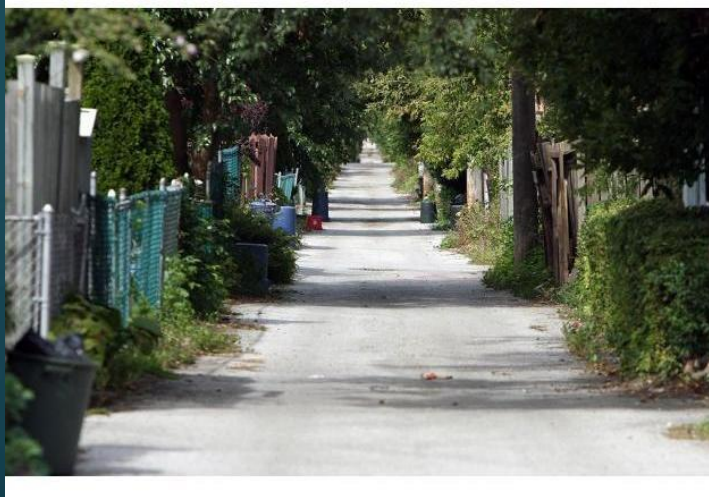
AGENDA

- ▶ What is an acceptable level of risk?
- ▶ What is risk assessment?
 - ▶ What are the chances this will really happen?
 - ▶ If it happens, how bad will it be?
- ▶ Windsor's Risk Matrix
- ▶ How Windsor applied it for Asset Management

WHAT IS AN ACCEPTABLE LEVEL OF RISK?



DIFFERENT ASSETS – DIFFERENT RISK



Challenge...

- ▶ Creating a way to consistently evaluate risk for all assets

What is risk assessment?

- ▶ Identification
 - ▶ What would prevent you from achieving your objectives, service levels and or projects?
- ▶ Analysis
 - ▶ How do you measure risk?
- ▶ Evaluation
 - ▶ What is the corporate tolerance for risk?
- ▶ Treatment
 - ▶ Based on the results what next steps do you take, including a potential next step of 'tolerating' the risk

What is risk assessment?

- ▶ Identification
 - ▶ Impact on City of failed assets as a result of age or condition
- ▶ Analysis
 - ▶ Creating a Probability and Consequence risk matrix for a risk score
- ▶ Evaluation
 - ▶ Defining the numerical threshold for risk scores
- ▶ Treatment
 - ▶ How results inform asset management for Windsor

Risk Analysis

Risk = Probability of Failure x Consequence of Failure

In other words...

What are the chances this will really happen?
And if it does happen, how bad will it be?

What are the chances this will really happen?



Source Calgary.ca



Source cbc



What are the chances this will really happen?

Current Condition Rating Categories		
Category	Definition	Numeric Rating
		From To
Adequate Roads: Greater than 10 Years	Roads which will need repair in a greater than 10 year timeframe. Roads that are in adequate pavement condition.	1 4
6-10 Year Deficient	Roads that will need repair in 6 to 10 years. Generally, selective crack sealing should be done if funding is made available. Isolated base repairs and mill & pave may also be performed.	5 9
1-5 Year Deficient	Roads that will need repair within 1 to 5 years. Typically a mill and pave should be completed.	10 19
NOW Deficient Roads	Roads that are in the worst pavement condition and need immediate repair. Typically roads in the "Now Deficient" category are not good candidates for mill and pave rehabilitation and therefore require full reconstruction.	20 100

Asset Design Life	Current Age	Estimated Remaining Life
20 years	12 years	8 years



What are the chances this will really happen?

Rating	Probability	Criteria
Almost Certain (5)	>90%	Very high likelihood of occurrence (almost inevitable) over the next 36 months - occurrence is expected.
Likely (4)	60% - 90%	High likelihood of occurrence over the next 36 months - occurrence is probable.
Possible (3)	40% - 60%	Moderate likelihood of occurrence over the next 36 months - occurrence is occasional.
Unlikely (2)	10% - 40%	Low likelihood of occurrence over the next 36 months - occurrence is unusual and not expected.
Remote (1)	<10%	Very low likelihood of occurrence over the next 36 months - occurrence is unprecedented.

Description	Probability	Possible impacts		
		Delay (days)	Costs	Quality
None	0	0	0	None
V.Low	10^{-5} - 10^{-4}	<0.1	<100	Failure to meet a minor specification
Low	10^{-4} - 10^{-3}	0.1-1	100-1K	Failure to meet >1 minor specifications
Medium	10^{-3} - 10^{-2}	1-10	1K-10K	Failure to meet a important specification
High	10^{-2} - 10^{-1}	10-100	10-100K	Failure to meet >1 important specifications
V.High	10^{-1} - 10^0	>100	>100K	Failure to meet acceptance criteria

IPCC quantitative descriptors	
Probability range	Descriptive term
< 1%	Extremely unlikely
1-10%	Very unlikely
10-33%	Unlikely
33-66%	Medium likelihood
66-90%	Likely
90-99%	Very likely
> 99%	Virtually certain

If it happens, how bad will it be?

- ▶ SARS (2003) W.H.O. stats
 - ▶ Cases 8,437
 - ▶ Deaths 813
- ▶ EBOLA (2014-2016) CDC stats
 - ▶ Cases 28,652
 - ▶ Deaths 11,325
- ▶ COVID 19 (2019 to Sept 14, 2020) W.H.O. stats
 - ▶ Cases 28,918,900
 - ▶ Deaths 922,252
 - ▶ Economic implications
 - ▶ New legislations
 - ▶ Massive number of people out work
 - ▶ Overwhelmed health care industries
 - ▶ Global news coverage on daily basis
 - ▶ Shut down of major industries
 - ▶ And many more impacts

If it happens, how bad will it be?

- ▶ What types of consequences are important?
 - ▶ Health and Safety
 - ▶ Damages and Liabilities
 - ▶ Operational Impacts
 - ▶ Regulation and Reputation
 - ▶ Strategy
 - ▶ Legal

If it happens, how bad will it be?

Impact range to consider

- ▶ Minor to Major
- ▶ Insignificant to Critical
- ▶ Insignificant to Severe
- ▶ Low to Catastrophic

Assign each impact range a score, usually 1 to 5 or 1 to 4

If it happens, how bad will it be?

Create definitions and criteria for each risk range for each category

- ▶ Will someone die or only need a band-aide?
- ▶ Will it cost \$5M or \$500 to fix it?
- ▶ Will it adversely impact our environment?
- ▶ Will it impact one small area or the whole City?
- ▶ Will it mean new legislation might result from this?
- ▶ Will it be a small article in the local paper or a global new item?

Consequence	Critical Success Factors							
	Safety	Quality of Services	Reputation	Environment	Cost	Legal/Contractual		
Severe	Would cause loss of life.	Severe impact on the quality of services provided by the Council resulting in a significant increase in complaints from the community (increase of 50% or more).	External Reputation irrevocably destroyed or damaged. Severe impact on staff turnover (increase of >20% above average levels)	Would cause catastrophic environmental damage leading to fines against the Council and significant resources to rectify.	>2.5M	Legal. Numerous Major Litigations. Contract. Termination of Contract for default.		
Major	Would cause serious casualties resulting in the long-term physical impairment of personnel.	Considerable impact on the quality of services provided by the Council resulting in a marked increase in complaints from the community (increase of 25-50%).	External Reputation severely damaged: considerable effort and expense required to recover. Major impact on staff turnover (increase of 10-20% above average levels)	Would cause extensive environmental damage requiring significant resources to rectify.	\$1M-2.5M	Legal. Single Major litigation or numerous Moderate Litigations. Contract. Receive written notice from the contractor threatening termination if not rectified.		
Moderate	Would cause several casualties that require hospitalisation with no long-term effects.	Some impact on the quality of services provided by the Council resulting in an increase in complaints from the community (10-25%).	External Reputation damaged: some effort and expense required to recover. Moderate impact on staff turnover (increase of 10-20% above average levels)	Would cause some environmental damage requiring the allocation of some resources to rectify.	\$500k-1M	Legal. Single Moderate litigation or Numerous Minor Litigations. Contract. Receive verbal advice that, if breaches continue, a default notice may be issued.		
Minor	Would cause several minor casualties that require medical attention off-site with no long-term effects.	Minor impact on the quality of services provided by the Council resulting in an increase in complaints from the community (<10%).	External Reputation minimally affected. Little effort or expense required to recover. Minor impact on staff turnover (increase of 5-10% above average levels)	Minor environmental damage. Risk Rating 5 occurs from existing bu	Economic Cost to the organisation greater than \$1 Million	Environmental Irreparable damage to the environment and the permanent loss of species or fauna	Social Single or multiple fatalities	Reputation Multiple stories and media both nationally and internationally
Insignificant	Would cause minor injuries that are able to be treated at the site with no long-term effects.	No impact on the quality of services delivered by Council.	External Reputation not affected. No effort or expense required to recover. No impact on staff turnover	No environmental damage. Risk Rating 4	Cost to the organisation of \$1 Million	Greater than 1 year to repair the damage, major litigation impact	Multiple hospitalisations of personnel or public, and/or multiple loss of permanent employment	State and national multiple stories in papers and media

3	Cost to the organisation \$500,000	1 year to repair the damage, major litigation impact	Single hospitalisation of personnel or public, and/or a single loss of permanent employment	State and national media enquiries
2	Cost to the organisation \$100,000	4 weeks to repair the damage, minor litigation impact	Major medical treatment required of personnel or public, and/or a temporary loss of permanent employment	Local and state media attention, multiple stories in papers
1	Cost to the organisation \$10,000	1 week to repair the damage, no litigation impact	Minor medical treatment required for personnel or public, and/or no loss of permanent employment	Local media exposure
0	Cost to the organisation less than \$10,000	Nil damage to the environment	Nil medical or employment impact	Nil media enquiries

Risk Evaluation

Overall Risk Score (out of 25)

Low	0 to 3.75
Moderate	3.76 to 9
Significant	9.1 to 16
Critical	16.1 to 25

Probability of Failure	P10	Certain	Green	Green	Yellow	Red	Red
	P7	Almost Certain or Very Likely	Blue	Green	Yellow	Yellow	Red
	P4	Likely	Blue	Green	Green	Yellow	Yellow
	P2	Possible	White	Blue	Green	Green	Green
	P1	Rare	White	White	Blue	Blue	Green

Risk Matrix

Likelihood	Consequence				
	1 INSIGNIFICANT	2 MINOR	3 MODERATE	4 MAJOR	5 CATASTROPHIC
A CERTAIN	High	High	Extreme	Extreme	Extreme
B LIKELY	Medium	Medium	High	Extreme	Extreme
C POSSIBLE	Low	Medium	High	Extreme	Extreme
D UNLIKELY	Low	Low	Medium	High	Extreme
E RARE	Low	Low	Medium	High	High

Insignificant	Minor	Moderate	Major	Catastrophic
C1	C2	C4	C7	C10
Consequence of Failure				

City of Windsor's Risk Matrix

What are the chances this will really happen?

Measurement Criteria for the Risk Assessment Tool

Probability					
Rating - Descriptor	1 - Rare	2 - Unlikely	3 - Possible	4 - Likely	5 - Almost Certain
Description - Frequency or approximate probability	May only occur in certain conditions. Every 10 + years or 0% to 10%	Could occur some time. Every 5 to 10 years or 10% to 40%	Might occur at some time. Every 3 to 5 years or 40% to 60%	Will probably occur in most circumstances. Every 2 to 3 years or 60% to 90%	Almost certain to occur. Annually or more frequently or 90% to 100%

If it happens, how bad will it be?

- ▶ Windsor's consequence factors
 - ▶ Health and Safety
 - ▶ Damages and Liabilities
 - ▶ Liability cost
 - ▶ Cost to replace / repair
 - ▶ Environmental impact
 - ▶ Operational Impacts
 - ▶ Disruption of services
 - ▶ Cost overruns
 - ▶ Loss of other funding sources
 - ▶ Regulation and Reputation
 - ▶ Public trust and media attention
 - ▶ Number of people impacted
 - ▶ Governance oversight
 - ▶ Legislation or regulation violations

If it happens, how bad will it be?

- ▶ Range of how bad will it be for the City
- ▶ 5 levels of impact from Insignificant to Severe
- ▶ Examples of the ranges we used:
 - ▶ Damages and Liabilities
 - ▶ Liability cost
 - ▶ Insignificant – less than \$25K
 - ▶ Severe - \$3M or more
 - ▶ Cost to replace / repair
 - ▶ Insignificant - less than \$25K
 - ▶ Severe - \$3M or more
 - ▶ Environmental impact
 - ▶ Insignificant – minimal, no clean up not long lasting
 - ▶ Severe – permanent impacting requiring clean up

If it happens, how bad will it be?

- ▶ How do you gage how bad the result is for each impact?
 - ▶ Regulation and Reputation
 - ▶ Public trust and media attention
 - ▶ Insignificant – less than \$25k
 - ▶ Severe – \$3m or more
 - ▶ Number of people impacted
 - ▶ Insignificant – little or no media and attention no impact to public confidence
 - ▶ Severe – Significant national or provincial coverage resulting in loss of confidence in City Administration
 - ▶ Number of people impacted
 - ▶ Insignificant – under 1% of customers
 - ▶ Severe – 100% of customers and for a sustained period of time
 - ▶ Governance oversight
 - ▶ Insignificant – some unfavourable comments by local governance
 - ▶ Severe – Senior governing bodies imposing temporary leadership
 - ▶ Legislation or regulation violations
 - ▶ Insignificant – infraction with limited penalties (less than \$25K)
 - ▶ Severe – multiple major violations with significant penalties (over \$3m)

Rating - Descriptor	Consequence					
	1 - Insignificant	2 - Minor	3 - Moderate	4 - Major	5 - Severe	
H&S Health & Safety - <i>injuries to staff, public or stakeholders</i>	No treatment required	Minor injury or illness requiring medical treatment	Serious injury or illness requiring medical treatment	Permanent disability or widespread illness	Death	
Damages & Liability	Legal Liability - <i>incur \$ (claims, lawsuits, etc.)</i>	< \$25K	\$25K-250K	\$250K-500K	\$500K-3M	> \$3M
	Physical Assets - <i>replacement of</i>	Replaceable worth < \$25k	Replaceable worth \$25k-250k	Replaceable worth \$250k-500k	Replaceable worth \$500k-3M	Replaceable worth over \$3M or significant asset is irreplaceable
	Environment - <i>damage to</i>	Negligible event, non-permanent impact requiring no clean-up measures @ (\$0-25K)	Minor event, non-permanent impact requiring very little clean up effort @ (\$25-250k)	Major event, some permanent impact requiring moderate clean-up effort @ (\$250k-500k)	Major event, some permanent impact requiring extensive clean-up effort @ (\$500k-3M)	Severe event, permanent impact requiring significant clean-up @ (> \$3M)
Operational Impact	Quality - <i>impact or disruption to overall quality of service delivered</i>	Limited impact to overall quality of discretionary service	Moderate or localized impact to overall quality of discretionary service OR Limited impact to overall quality of <u>essential</u> service or major project	Serious or widespread disruption to overall quality of discretionary service OR Moderate or localized impact to overall quality of <u>essential</u> service or major project	Inability to provide an <u>discretionary</u> service OR Significant sustained impact to overall quality of <u>essential</u> service or major project	Inability to provide an <u>essential</u> service
	Budget - <i>cost overruns or reallocation of funds for service or project</i>	< \$25K	\$25K-250K	\$250K-500K	\$500K-3M	> \$3M
	Funding - <i>loss of external funding or revenue (e.g. grants, leasing revenue, user fees)</i>	< \$25K	\$25K-250K	\$250K-500K	\$500K-3M	> \$3M
Regulation & Reputational Impacts	Public Trust / Media Attention - <i>negative attention</i>	Limited attention by media, limited impact on public confidence	Local media coverage, department official fielding media questions,	Regional media coverage, significant impact on public confidence that damages City's image	National or Provincial media coverage, external agency inquiry, major impact on public confidence that is difficult to regain	Significant National or Provincial media coverage, external agency criminal investigation, sustained serious loss of confidence in management of City
	Impacted Customers	Under 1% of customers	2% - 25% of customers	26% - 50% of customers	51% - 100% of customers	100% of customers for sustained period of time
	Governance - <i>management oversight (e.g. Min. of Labour, TSSA)</i>	Some unfavourable comments by governing body (i.e. Management or Council)	Criticism by governing body (i.e. Management or Council)	Request for change recommendations by governing body (i.e. Management or Council)	Senior governing body demanding immediate changes to status quo (i.e. Federal or Provincial)	Senior governing body imposing temporary leadership (i.e. Federal or Provincial)
	Legislative - <i>violation of legislation</i>	Infraction of legislation with limited penalties (under \$25k)	Minor infraction of legislation with penalties (\$25k-\$250k)	Moderate infraction of legislation with penalties (\$250k-\$500k)	Major violation of legislation with significant penalties (\$500k-\$3M), high profile trial	Multiple major violations of legislation with significant penalties (over \$3M), public inquiry & high profile trial

Risk Evaluation

Overall Risk Score (out of 25)

Low	0 to 3.75
Moderate	3.76 to 9
Significant	9.1 to 16
Critical	16.1 to 25



How does Windsor use their risk matrix for asset management?

Probability - Roads

Rating - Descriptor	1 - Improbable to Rare	2 - Unlikely	3 - Possible	4 - Likely	5 - Certain
Description - Frequency or approximate probability	May only occur in certain conditions. Every 10 + years or 0% to 10%	Could occur some time. Every 5 to 10 years or 10% to 40%	Might occur at some time. Every 3 to 5 years or 40% to 60%	Will probably occur in most circumstances. Every 2 to 3 years or 60% to 90%	Almost certain to occur. Annually or more frequently or 90% to 100%
PCI Score: Expressway, Arterial, Collector	0 to 4	5 to 9	10 to 14	15 to 19	20 or higher
PCI Score: Local, Scenic	0 to 9	10 to 19	20 to 29	30 to 39	40 or higher

Measurement Criteria for the Risk Assessment Tool - Roads

Asset Renewal Decision Making Risk		Relevant LOS: Condition - Staff concerned about roads deteriorating at faster than expected rate. This would be accounted for in PoF score (condition). - Re-classification of some roads may be required (eg. a road defined as a Collector but really playing the role of an Arterial) - Railway crossings are separate assets in Hansen and should also have their own risk score (CoF scores were			
		Expressway	Arterial - Class 1 & 2, including Riverside	Local	
	PoF	Condition	Condition Score	Condition Score	Condition Score
	Probability / Likelihood of Failure	Failed Condition Score Benchmark / At what score is asset 'almost certain' to fail? [refer to mapping in table (Cell E40)]:	Higher than 20	Higher than 20	Higher than 40
	H & S	Health & Safety - injuries to staff, public or vendors	5 - Severe: Death	4 - Major: Permanent disability or widespread illness	3 - Moderate: Serious injury requiring medical treatment
	Damages & Liability	Liability - incur \$	4 - Major: \$500K-3M	4 - Major: \$500K-3M	2 - Minor: \$25K-250K
		Information Exposure - exposure of sensitive information			
		Physical Assets - loss of	5 - Severe: Replaceable worth over \$3M or significant asset is irreplaceable	4 - Major: Replaceable worth \$500k-3M	3 - Moderate: Replaceable worth \$250k-500k
		Environment - damage	2 - Minor: Minor event, non-permanent impact requiring very little clean up effort @ \$250k	2 - Minor: Minor event, non-permanent impact requiring very little clean up effort @ \$250k	1 - Insignificant: Negligible event, non-permanent impact requiring no clean-up measures
	Operational Impact	Objectives Achievement - Service disruptions OR project** under-achievements			
		Quality - Disruptions in services, projects**, or processes	5 - Severe: Inability to provide an essential service or complete a major project.	4 - Major: Inability to provide an discretionary service OR Significant, sustained impact to quality of essential service or a major project	2 - Minor: Moderate or localized impact to quality of discretionary service OR Limited impact to quality of essential service or a major project
		Budget - cost overruns for service or project	3 - Moderate: \$250K-500K	3 - Moderate: \$250K-500K	2 - Minor: \$25K-250K
		Funding - loss of external funding	1 - Insignificant: < \$25K	1 - Insignificant: < \$25K	1 - Insignificant: < \$25K
	Regulation & Reputational Impacts	Public Trust / Media Attention - negative attention	3 - Moderate: Regional media coverage, significant impact on public confidence that damages City's image	3 - Moderate: Regional media coverage, significant impact on public confidence that damages City's image	2 - Minor: Local media coverage, department official fielding media questions
		Impacted Customers - number of people impacted by service failure	4 - Major: 51%-100% of customers	4 - Major: 51%-100% of customers	2 - Minor: 2%-25% of customers
		Governance - management oversight	2 - Minor: Criticism by governing body (I.e. Management or Council)	1 - Insignificant: Some unfavourable comments by governing body (I.e. Management or Council)	1 - Insignificant: Some unfavourable comments by governing body (I.e. Management or Council)
		Legislative - violation of legislation	1 - Insignificant: Infraction of legislation with limited penalties (under \$25k)	1 - Insignificant: Infraction of legislation with limited penalties (under \$25k)	1 - Insignificant: Infraction of legislation with limited penalties (under \$25k)
			35	31	20
		Total Risk Score	3.181818182	2.818181818	1.818181818

Road Risk Results for Windsor

▶ Probability (by road classification)

▶ Expressway, Arterial & Collector

- ▶ Improbable 0 - 4
- ▶ Unlikely 5 - 9
- ▶ Possible - 10 - 14
- ▶ Likely - 15 - 19
- ▶ Certain - 20+

▶ Local, Paved Alley and Scenic

- ▶ Improbable 0 - 9
- ▶ Unlikely 10 - 19
- ▶ Possible - 20 - 29
- ▶ Likely - 30 - 39
- ▶ Certain - 40+

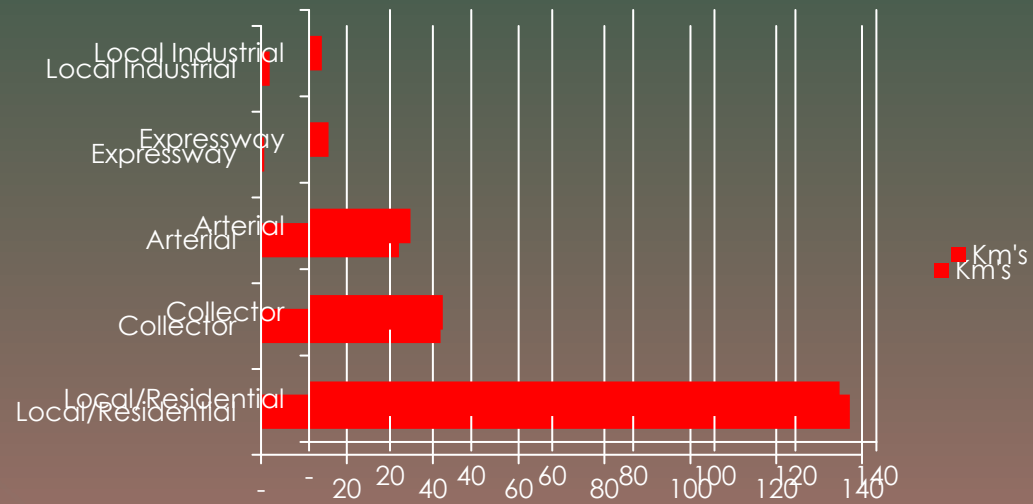
▶ Consequence (by road classification)

- ▶ Expressway - 3.18
- ▶ Arterial - 2.8
- ▶ Collector - 2.17
- ▶ Local - 1.82
- ▶ Paved Alley - 1.36
- ▶ Gravel Alley - 1.27

Overall Risk Score (out of 25)

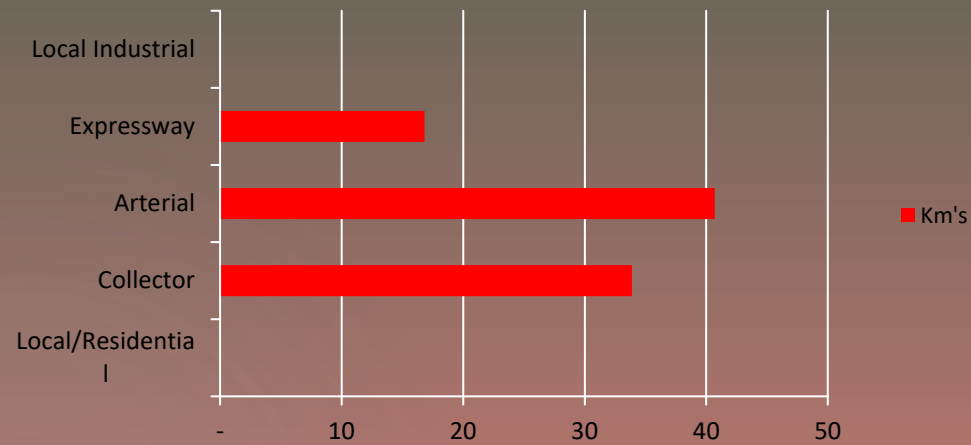
Low	0 to 3.75
Moderate	3.76 to 9
Significant	9.1 to 16
Critical	16.1 to 25

2015 Roads in Poor/Very Poor Condition



2015 Roads in Poor/Very Poor Condition			
	Total Kms	Poor / Very Poor	% of Road Class
Local Industrial			
Local Expressway	653.6	134.03	21%
Collector Arterial	167.31	32.98	20%
Arterial Collector	150.61	25.03	17%
Expressway	56.3	4.78	8%
Local/Residential			

2015 Roads @ Significant Risk Level



	Km's at Significant risk	% of Total Road Network
Expressway	16.83	2%
Arterial	32.98	3%
Collector	40.13	4%
Local	0	

Risk Results	Consequence	Probability	Maximum Risk Score	Maximum Risk %	Maximum Risk Rating
Road Classification					
Expressway	3.18	5	15.9	64%	Significant
Arterial (inc scenic)	2.82	5	14.1	56%	Significant
Collector	2.18	5	10.9	44%	Significant
Local	1.81	5	9.05	36%	Moderate
Bridge Classification					
Bridge/Subway/Culvert	3.73	5	18.65	75%	Critical
Pedestrian Bridge	2.36	5	11.8	47%	Significant
Facilities					
Roof (leak)	1.64	5	8.2	33%	Moderate
Roof (structural)	3.55	5	17.75	71%	Critical
Heating	1.45	5	7.25	29%	Moderate
Cooling	1.45	5	7.25	29%	Moderate
Air Handling	1.45	5	7.25	29%	Moderate
Air Handling (huron lodge)	1.82	5	9.1	36%	Moderate
Elevators	1.36	5	6.8	27%	Moderate
Plumbing	1.18	5	5.9	24%	Moderate
Main Electrical	1.73	5	8.65	35%	Moderate
Building Auto. Systems	1.18	5	5.9	24%	Moderate
Fire Suppression	2.36	5	11.8	47%	Significant
Flooring/Stairs	1.45	5	7.25	29%	Moderate
Fuel Storage	1.64	5	8.2	33%	Moderate
Sidewalks	1.45	5	7.25	29%	Moderate



Do's
&
Don'ts



- ▶ Do – leverage tools already out there
- ▶ Do – Engage various groups in your organization
- ▶ Do - Develop descriptions which are generic to allow for flexibility with all assets

- ▶ Don't – assume the someone else's tool can't be changed, or shouldn't be changed to fit your needs.
- ▶ Don't - try to over complicate things too soon
- ▶ Don't – build it in a vacuum

