Manitoba Hydro

Marketing & Customer Service
Engineering and Construction Division
Gas Engineering & Construction Dept.

REPORT ON:

Pipeline Risk Assessment – 2017 Results
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Executive Summary

This report provides an analysis and evaluation of the current risk profile of Manitoba Hydro's natural gas pipeline system.

The methodology includes separating the pipeline network into approximately 40,000 segments sharing similar attributes (pipe material, internal pressure, cathodic protection, etc.) and into two asset groupings: Distribution (≤ 1900 kPa) or transmission (>1900 kPa).

The likelihood of an incident (unintentional release of gas below grade) occurring is calculated using historical incident data as well as industry recognized risk determiners and expressed as a Frequency Score (incidents / 1000kmyr) for each pipe segment and each hazard category. The total Frequency Score for the pipe segment is determined by summing the individual Frequency scores for each hazard category.

Hazard Categories are as defined by the Canadian Gas Association (CGA) Asset and Integrity Management task force and are:

- External human interference (e.g. third party hits)
- Corrosion / degradation (age related failures)
- Natural Forces (e.g. slope failures)
- Material, manufacturing or construction defects
- Incorrect operation
- Other / Unable to Classify

The impact of an incident is calculated using industry recognized risk determiners such as the impact radius and building density of the pipe segment and expressed as a Consequence Score (units / incident) for each pipe segment. See Table 2: Consequence Score Characteristics.

The results of the total risk evaluation are plotted on the Risk Matrices and summarized in the legend. The results for individual hazards are available within the report.

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Total Risk Matrix (Distribution)

Consequence	Very Rare	Rare	Unlikely	Posible	Likely	Almost Certain
High			68	3		
Medium			707	320		
Low			27898	5377	43	
	Frequency					

Total Risk Matrix (Transmission)

Consequence	Very Rare	Rare	Unlikely	Posible	Likely	Almost Certain
High	16	78				
Medium	200	248				
Low	912	790				
	Frequency					

Legend:

Colour:	Risk Evaluation:	Distribution		Transmission		
		Total	%	Total	%	Action
Red	Significant	71	0.2%			Refine analysis, evaluate options, and implement action.
Yellow	Less Significant	1070	3.1%	94	4.2%	Refine analysis, consider options.
Green	Not Significant	33275	96.7%	2150	95.8%	Monitor

The results of the risk evaluation can be visually represented on a thematic map of the pipeline system. See Figure 1: Distribution - Thematic Map and Figure 2: Transmission - Thematic Map.

The vast majority of the distribution system (96.7%) was determined to be of "not significant" risk. A small percentage (3.1%) of pipelines in the city of Brandon, Winnipeg and Selkirk were evaluated as having "less significant" risk and an even smaller percentage (0.2%) as having "significant" risk. They are:

- Portions of high pressure pipelines in the city of Brandon
- Portions of high pressure pipelines in the city of Winnipeg
- Portions of high pressure pipelines in the city of Selkirk
- Portions of distribution pressure pipelines in D2701 (e.g. Knox Street, Hamilton Ave, Buchanon Blvd, Risbey Cr)

- Portions of distribution pressure pipelines in D2704 (e.g. William Ave W, Elgin Ave W, Ross Ave W, Roy Ave, Pacific Avenue W, Alexander Ave, Logan Ave)
- Portions of distribution pressure pipelines in D3002 (e.g. Brownell bay, Hammond Road, Sandham Cr, O'Brien Cr, Rannock Ave, Cullen Dr, Lismer Cr, Fitzgerald Cr)
- The majority of distribution pressure pipelines in D3007 (e.g. West End, Daniel McIntyre Wolseley, St. Mathews)
- The majority of the distribution pressure pipelines in D3008 (e.g. Downtown, Exchange District, South Point Douglas, South Portage, Colony, Broadway Assiniboine, Armstrong Point)
- Portion of the high pressure pipeline in D3101 (Bishop Grandin Blvd)
- Portions of distribution pressure in D3202 (e.g. Van Hull Way)
- Portions of distribution pressure in D3203 (e.g.Tascona Rd, Bonaventure Drive)
- Portions of distribution pressure in D3205 (e.g. Ottawa Ave, Washington Ave, Jamison Ave, Bowman Ave, Larsen Ave, Harbison Ave W, Martin Ave W, Union, Chalmers Ave, Johnson Ave W, Poplar Ave)

The vast majority of the transmission system (95.8%) was determined to be of "not significant" risk. A small percentage (4.2%) of pipelines near Dauphin, Brandon, Winnipeg and Selkirk were evaluated as having "less significant" risk (See Figure 13, Figure 14 and Figure 15).

The objective of the Pipeline Risk Assessment is to inform management and pipeline integrity activity owners of pipeline segments with significant risk from a failure incident. A failure incident is defined in this report as an unintentional release of gas below grade.

The results of the Pipeline Risk Assessment are a potentially valuable tool for:

- Making effective choices among risk control measures.
- Supporting specific operating and maintenance practices for pipelines subject to integrity hazards;
- Assigning priorities among inspection, monitoring, and maintenance activities; and
- Supporting decisions associated with modifications to pipelines, such as rehabilitation or changes in service.

Further information such presentations, assistance with implementing risk control options, and pipe segment location data is available from the author by request.

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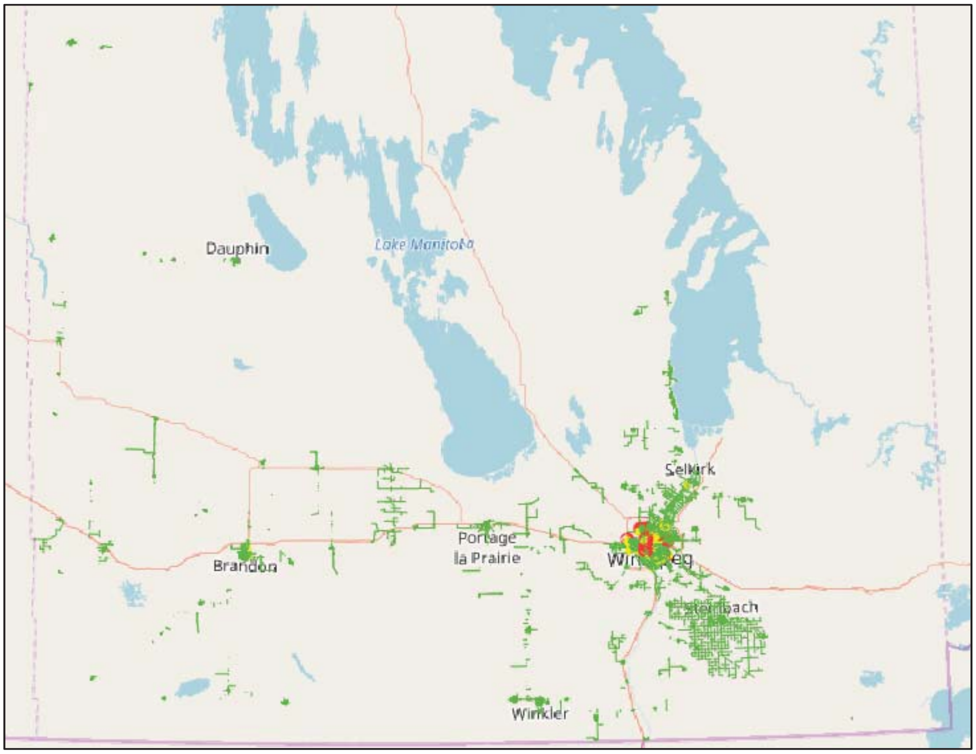

Figure 1: Distribution - Thematic Map

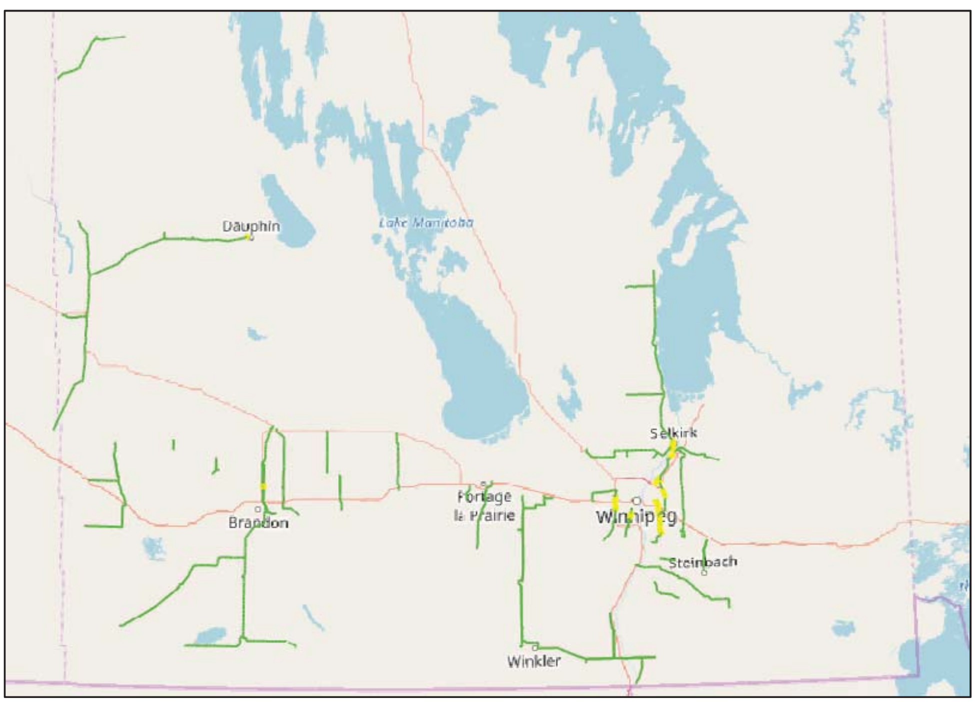

Figure 2: Transmission - Thematic Map

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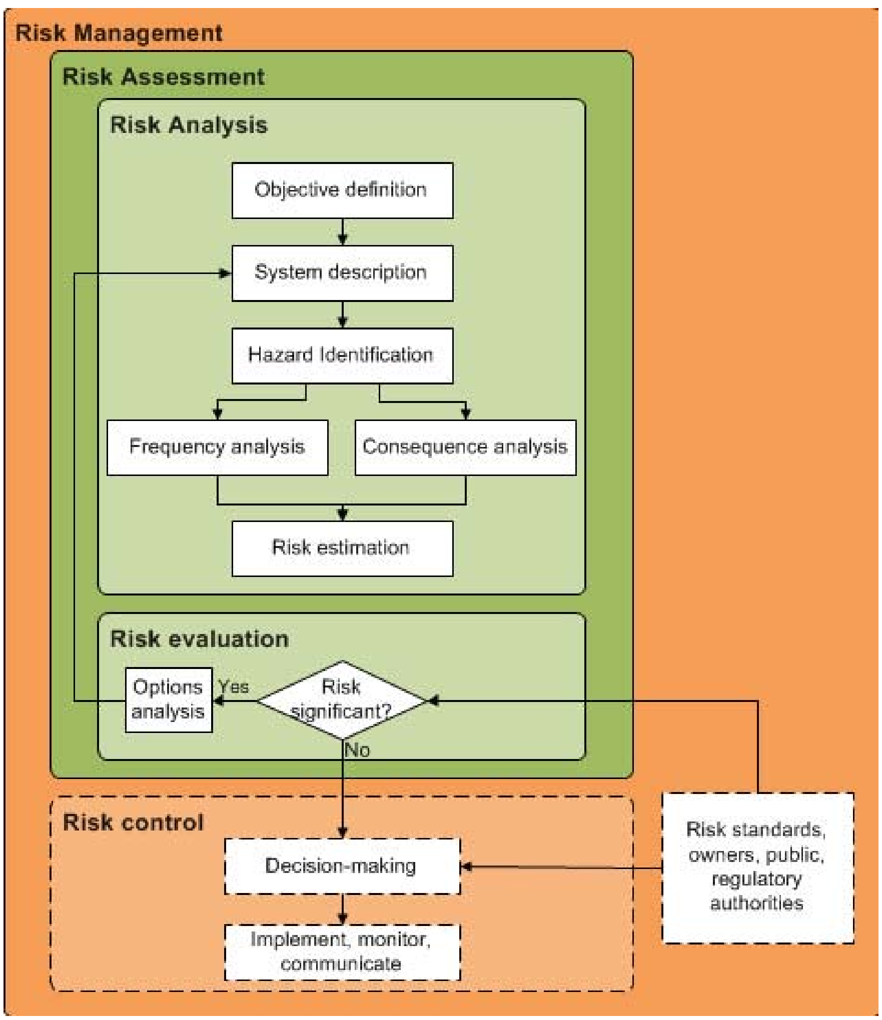
1. Introduction

This report is a snapshot in time of Manitoba Hydro's pipeline risk profile. It is the result of applying the Pipeline Risk Methodology (Gigian. 2017) to current pipeline assets.

Risk management is a consistent and rational method of reducing overall risk to the pipeline system by identifying and focusing resources on pipe segments with the highest risk factors (figure 1).

The results of the risk assessment are used to inform management and pipeline integrity activity owners so that appropriate risk control measures can be implemented. The goal is to improve the overall integrity of pipelines while reducing the frequency and consequence of incidents.

Figure 3: CSA Z662 Risk Management Process



3. Objectives and Scope

The objective of the Pipeline Risk Assessment is to inform management and pipeline integrity activity owners of pipeline segments with significant risk from a failure incident. A failure incident is defined in this report as an unintentional release of gas below grade.

The results of the Pipeline Risk Assessment are a potentially valuable tool for:

- Making effective choices among risk control measures.
- Supporting specific operating and maintenance practices for pipelines subject to integrity hazards;
- Assigning priorities among inspection, monitoring, and maintenance activities; and
- Supporting decisions associated with modifications to pipelines, such as rehabilitation or changes in service.

The scope of the Pipeline Risk Assessment is all distribution and transmission pressure pipe below grade. Pipe or assets associated with stations or services are not included.

4. Network Description

4.1. Maximum Operating Pressure

The pipeline network is separated into two asset groupings by their Maximum Operating Pressure (MOP). They are:

- Distribution - Medium and High Pressure (≤ 1900 kPa)
- Transmission Pressure (>1900 kPa)

Manitoba Hydro's defines transmission pipelines as any pipeline with an MOP greater than 1900 kPa. The MOP is always greater than or equal to the actual operating pressure which is determined by customer demand, flow requirements for odourant, etc. The Canadian Standards Association Oil and Gas Pipeline Systems Standard (CSA Z662) defines distribution pipelines as pipelines operating at less than 30% of their specified minimum yield strength. Manitoba Hydro's definition is always more conservative.

The network consists of approximately 10,200km of pipeline in total of which 1,900km is transmission pressure and 8,300km is high pressure and distribution pressure (Figure 4). Of the 1,900 km of transmission pressure mains as defined by Manitoba Hydro, only 1,200 km of mains have an MOP over 30% of specified minimum yield strength.

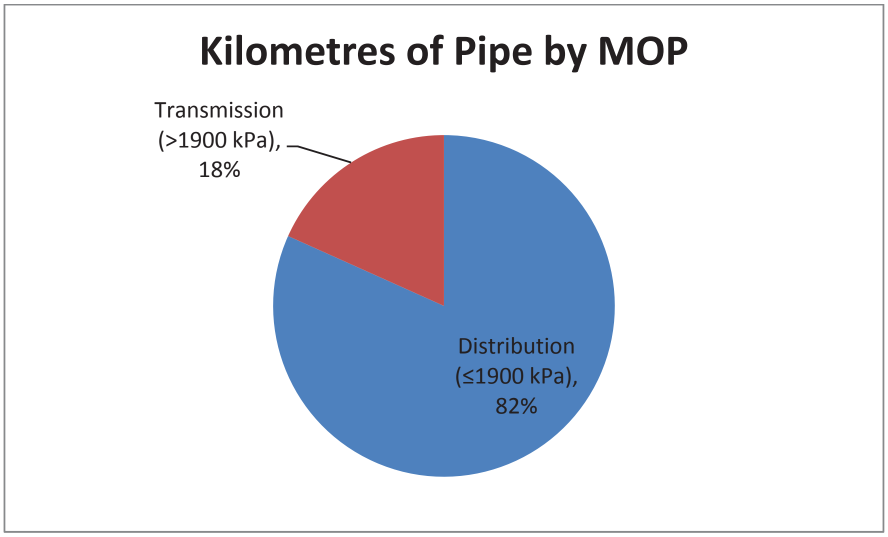


Figure 4: Kilometres of Pipe by MOP

4.2. Material Type

The transmission pipelines are made of mostly steel with a small amount of aluminum. The vintage distribution pipelines are made of steel, while most new pipelines are made of polyethylene (PE) materials (Figure 5).

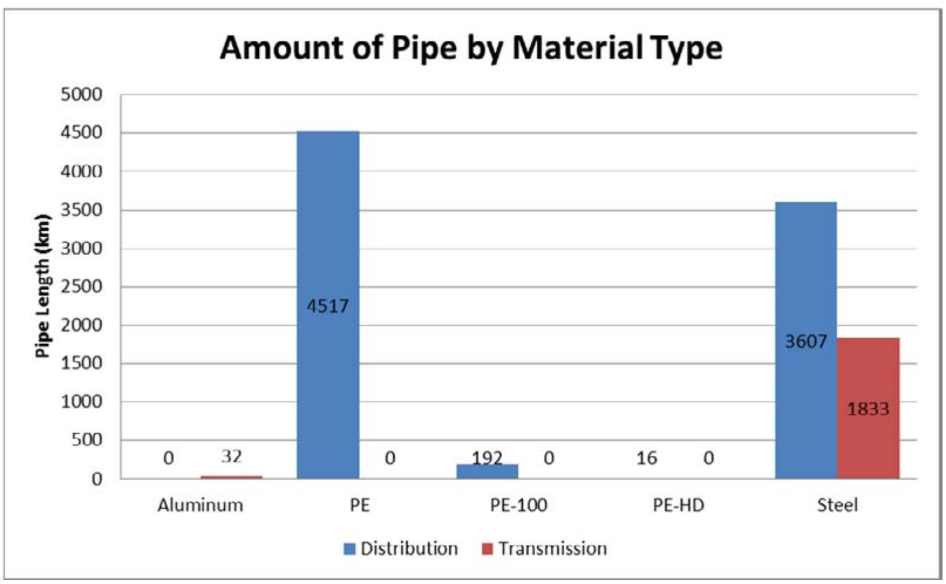


Figure 5: Amount of Pipe by Material Type

4.3. Pipe Size

Both transmission and distribution pipelines exist in a range of sizes up to and including 406.4mm (NPS 16)(Figure 6).

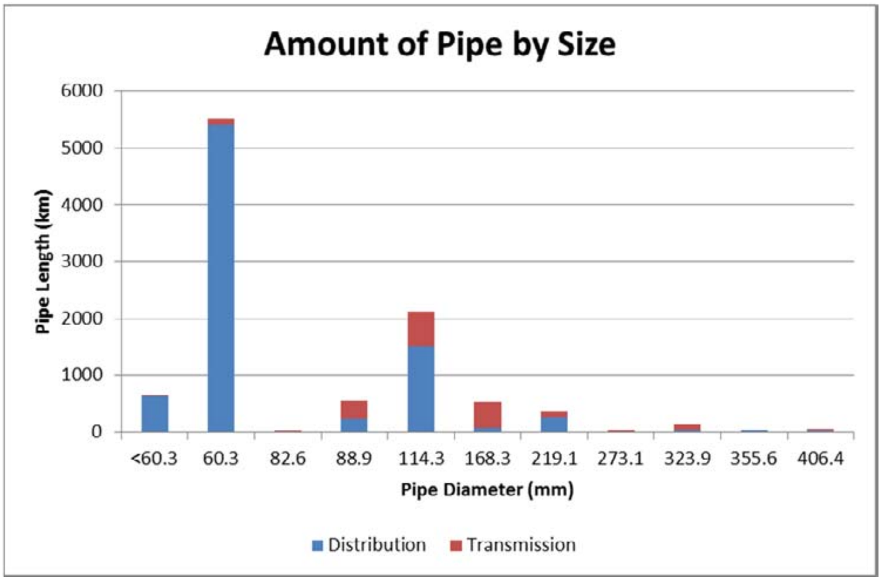


Figure 6: Amount of Pipe by Size

4.4. Age

Pipelines installed in 1990 or later have higher data quality records. For transmission pipelines without an energized year on record, a review was conducted and the field was filled in where it could be reasonably assumed. However, the large amount of distribution pipelines with an unknown energized year is representative of a lack of records for pipe installed prior to 1990 (Figure 7).

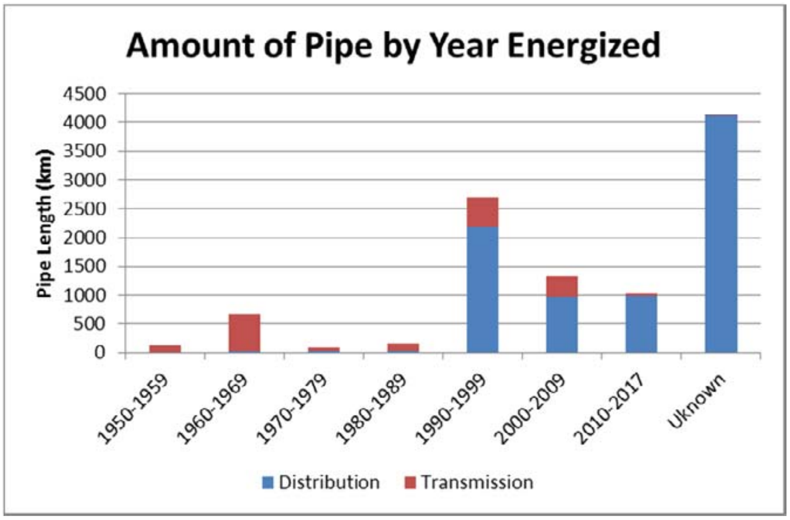


Figure 7: Amount of Pipe by Year Energized

5. Risk Methodology

The pipeline network is separated into approximately 40,000 segments sharing similar attributes (pipe material, internal pressure, cathodic protection, etc.) and into two asset groupings:

- Distribution - Medium and High Pressure (≤ 1900 kPa)
- Transmission Pressure (>1900 kPa)

The likelihood of an incident (unintentional release of gas below grade) occurring is calculated using historical incident data as well as industry recognized risk determiners and expressed as a Frequency Score (incidents / 1000kmyr) for each pipe segment and each hazard category. The total Frequency Score is determined by summing the individual Frequency scores for each hazard category. See

Table 1: Frequency Score Characteristics.

Hazard Categories are as defined by the Canadian Gas Association (CGA) Asset and Integrity Management task force and are:

- External human interference (e.g. third party hits)
- Corrosion / degradation (age related failures)
- Natural Forces (e.g. slope failures)
- Material, manufacturing or construction defects
- Incorrect Operation
- Other / Unable to Classify

Table 1: Frequency Score Characteristics

Frequency Score (incidents / kmyr)	Descriptor	Characteristics
≥ 80	Almost Certain	The event will occur on an annual basis
≥ 40	Likely	The event might occur several times or more in a decade
≥ 20	Possible	The event might occur once in a decade
≥ 1	Unlikely	The event does occur somewhere from time to time.
≥ 0.5	Rare	Have heard of something like this occurring elsewhere.
< 0.5	Very Rare	Have never heard of this happening.

The impact of an incident is calculated using industry recognized risk determiners such as the impact radius and building density of the pipe segment and expressed as a Consequence Score (units / incident) for each pipe segment. See Table 2: Consequence Score Characteristics.

Table 2: Consequence Score Characteristics

Consequence Score (units/incident)	Descriptor	Characteristics
≥ 60	High	• Multiple story buildings, dense neighborhoods • Large impact zone • Poor options for reliability during an emergency (transmission only)
≥ 45	Medium	• Suburbs, single family residential areas. • Medium impact zone • Potential source of energy during an emergency outage (transmission)
< 45	Low	• Rural, farmland and low population areas. • Small impact zone • Reliable source of energy during an emergency outage (transmission only)

The Frequency and Consequence scores are used to determine the pipe segments placement on a risk matrix (Figure 8) and the risk significance (Table 3). Complete risk methodology details can be found in the Pipeline Risk Methodology (Gigian, 2017).

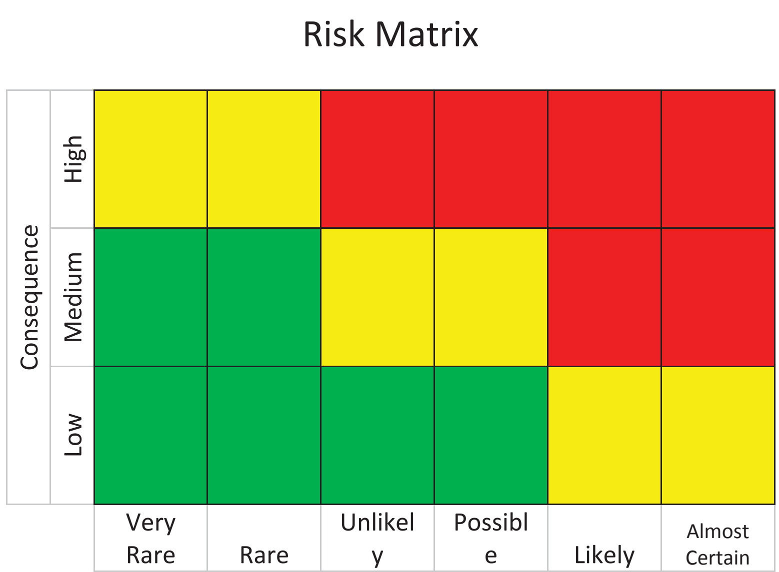


Figure 8: Risk Matrix

Table 3: Risk Evaluation and Significance

Colour:	Risk Evaluation:	Action:
Red	Significant	Refine analysis, evaluate options, and implement action.
Yellow	Less Significant	Refine analysis, consider options.
Green	Not Significant	Monitor

6. Pipeline Risk Assessment – 2017 Results

6.1. Total Risk

6.1.1. Hazard Description

The hazards considered in the 2017 Pipeline Risk Assessment are:

- External Interference (e.g. Third party hits)
- Corrosion / Degradation
- Natural Forces
- Material, Manufacturing or Construction (MMC) Defect
- Incorrect Operation
- Other / Unable to Classify

A frequency score is calculated for each of the 6 hazards using factors such as historical incident data as well as industry recognized risk determiners. The Total Risk is determined by adding the individual frequency scores together.

6.1.2. Average Frequency Score from Historical Incident Data

The Average Frequency Score represents the number of below grade leaks that have been recorded between 2011 and 2016 per 1000km of pipe installed per year.

Asset Group	Total Number of Below Grade Leaks (2011-2016)	Average Frequency Score (incidents/1000km-year)
Distribution	923	17.888
Transmission	5	0.508

6.1.3. Risk Matrices

The results of the total risk evaluation are plotted on the Risk Matrices and summarized in the legend.

Total Risk Matrix (Distribution)

Consequence \ Frequency	Very Rare	Rare	Unlikely	Posible	Likely	Almost Certain
High			68	3		
Medium			707	320		
Low			27898	5377	43	

Total Risk Matrix (Transmission)

Consequence \ Frequency	Very Rare	Rare	Unlikely	Posible	Likely	Almost Certain
High	16	78				
Medium	200	248				
Low	912	790				

Legend:

Colour:	Risk Evaluation:	Distribution		Transmission		
		Total	%	Total	%	Action
Red	Significant	71	0.2%			Refine analysis, evaluate options, and implement action.
Yellow	Less Significant	1070	3.1%	94	4.2%	Refine analysis, consider options.
Green	Not Significant	33275	96.7%	2150	95.8%	Monitor

6.1.4. Risk Results Maps

The results of the risk evaluation can be visually represented on a thematic map of the pipeline system.

The vast majority of the distribution system (96.7%) was determined to be of "not significant" risk and are coloured green on the map (Figure 9).

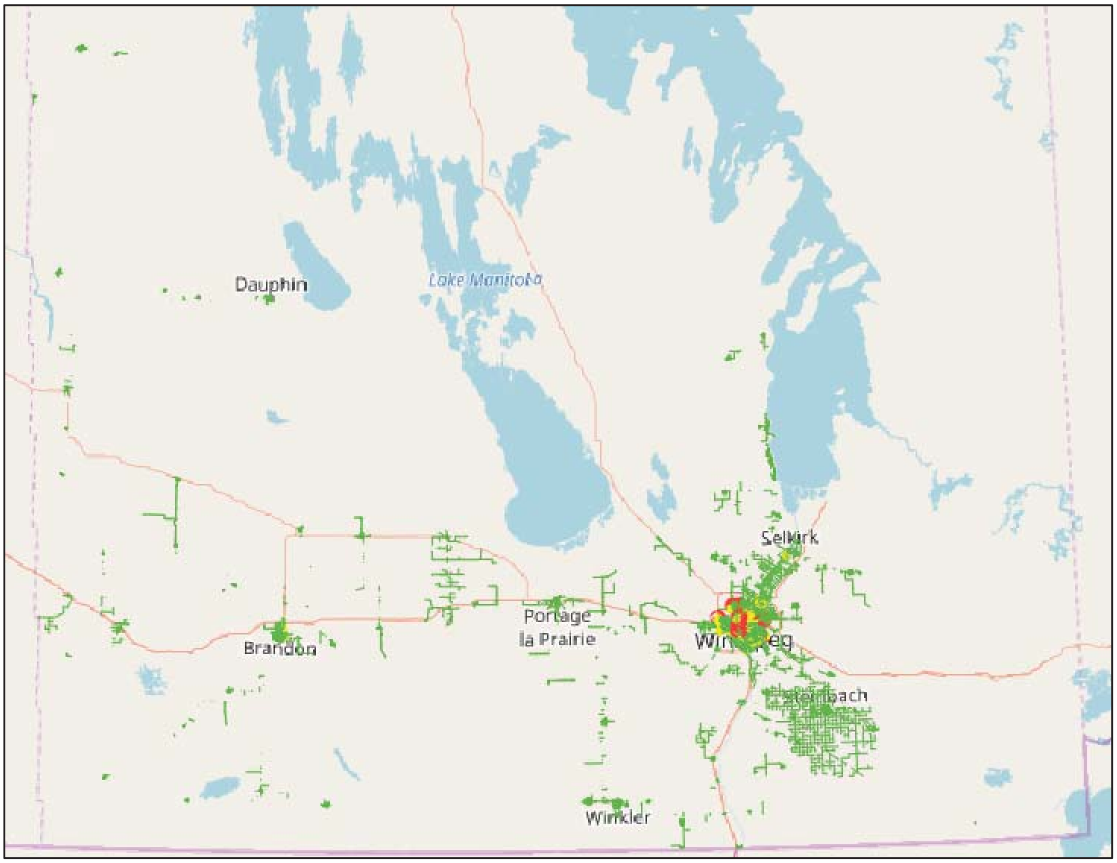


Figure 9 : Distribution Pipelines - Thematic Map of Risk Evaluation Results

A small percentage (3.1%) of pipelines in the city of Brandon, Winnipeg and Selkirk were evaluated as having "less significant" risk and an even smaller percentage (0.2%) of pipelines in the city of Winnipeg were evaluated as having "significant" risk (See Figure 10 and Figure 11). They are:

- Portions of high pressure pipelines in the City of Brandon
- Portions of high pressure pipelines in the City of Winnipeg
- Portions of high pressure pipelines in the City of Selkirk

- Portions of distribution pressure pipelines in D2701 (e.g. Knox Street, Hamilton Ave, Buchanon Blvd, Risbey Cr)
- Portions of distribution pressure pipelines in D2704 (e.g. William Ave W, Elgin Ave W, Ross Ave W, Roy Ave, Pacific Avenue W, Alexander Ave, Logan Ave)
- Portions of distribution pressure pipelines in D3002 (e.g. Brownell bay, Hammond Road, Sandham Cr, O'Brien Cr, Rannock Ave, Cullen Dr, Lismer Cres, Fitzgerald Cr)
- The majority of distribution pressure pipelines in D3007 (e.g. West End, Daniel McIntyre Wolseley, St. Mathews)
- The majority of the distribution pressure pipelines in D3008 (e.g. Downtown, Exchange District, South Point Douglas, South Portage, Colony, Broadway Assiniboine, Armstrong Point)
- Portion of the high pressure pipeline in D3101 (Bishop Grandin Blvd)
- Portions of distribution pressure in D3202 (e.g. Van Hull Way)
- Portions of distribution pressure in D3203 (e.g.Tascona Rd, Bonaventure Drive)
- Portions of distribution pressure in D3205 (e.g. Ottawa Ave, Washington Ave, Jamison Ave, Bowman Ave, Larsen Ave, Harbison Ave W, Martin Ave W, Union, Chalmers Ave, Johnson Ave W, Poplar Ave)

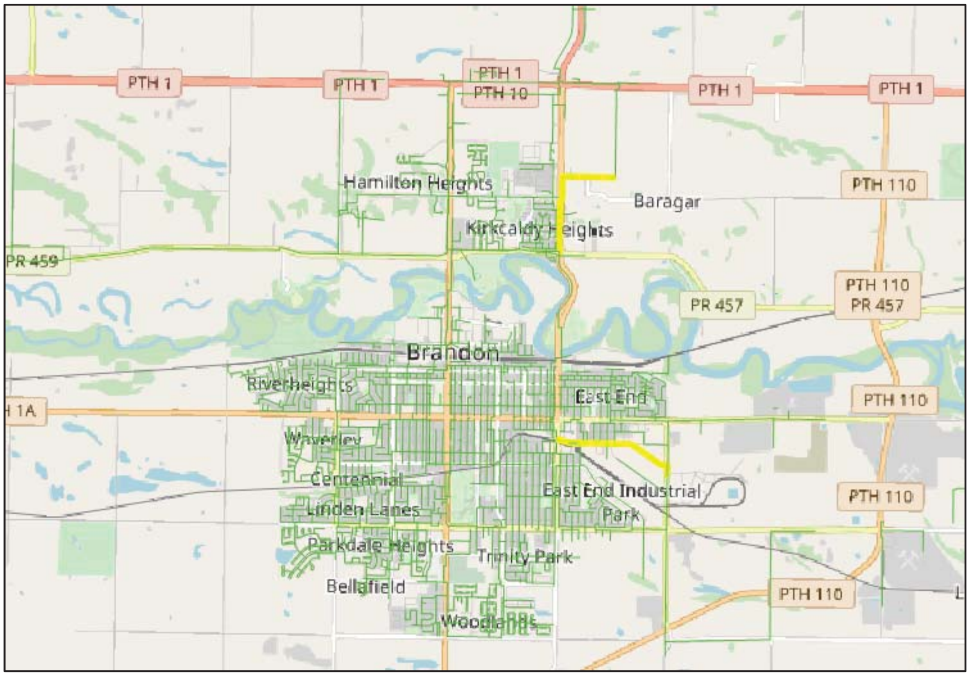


Figure 10: Distribution - City of Brandon

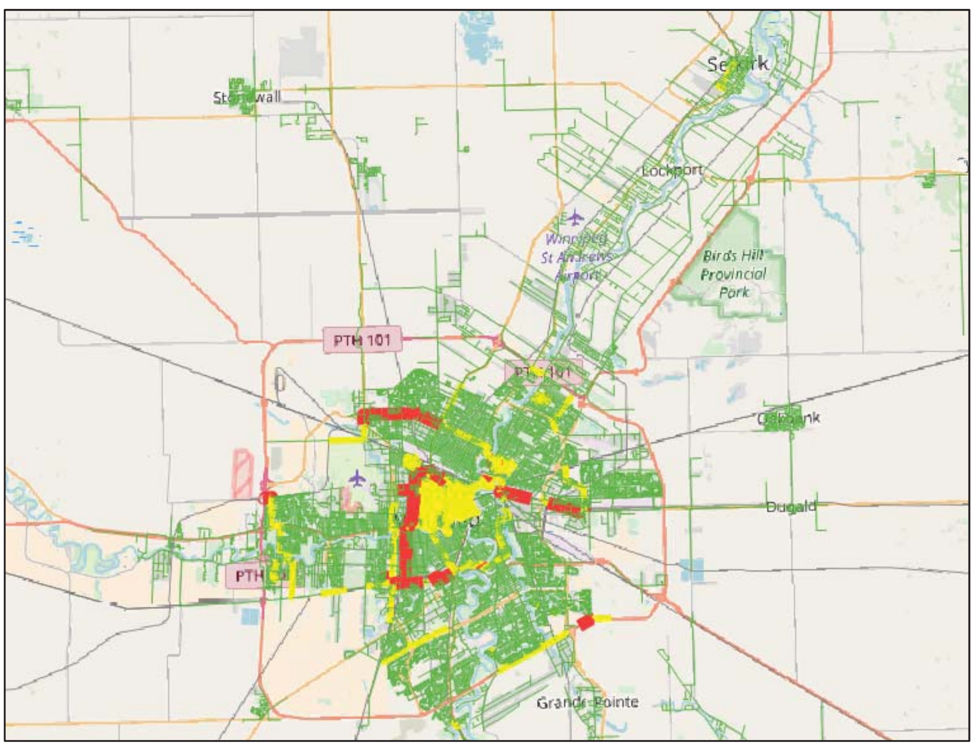


Figure 11: Distribution - City of Winnipeg and Selkirk

The vast majority of the transmission system (95.8%) was determined to be of "not significant" risk and are coloured green on the map (Figure 12).

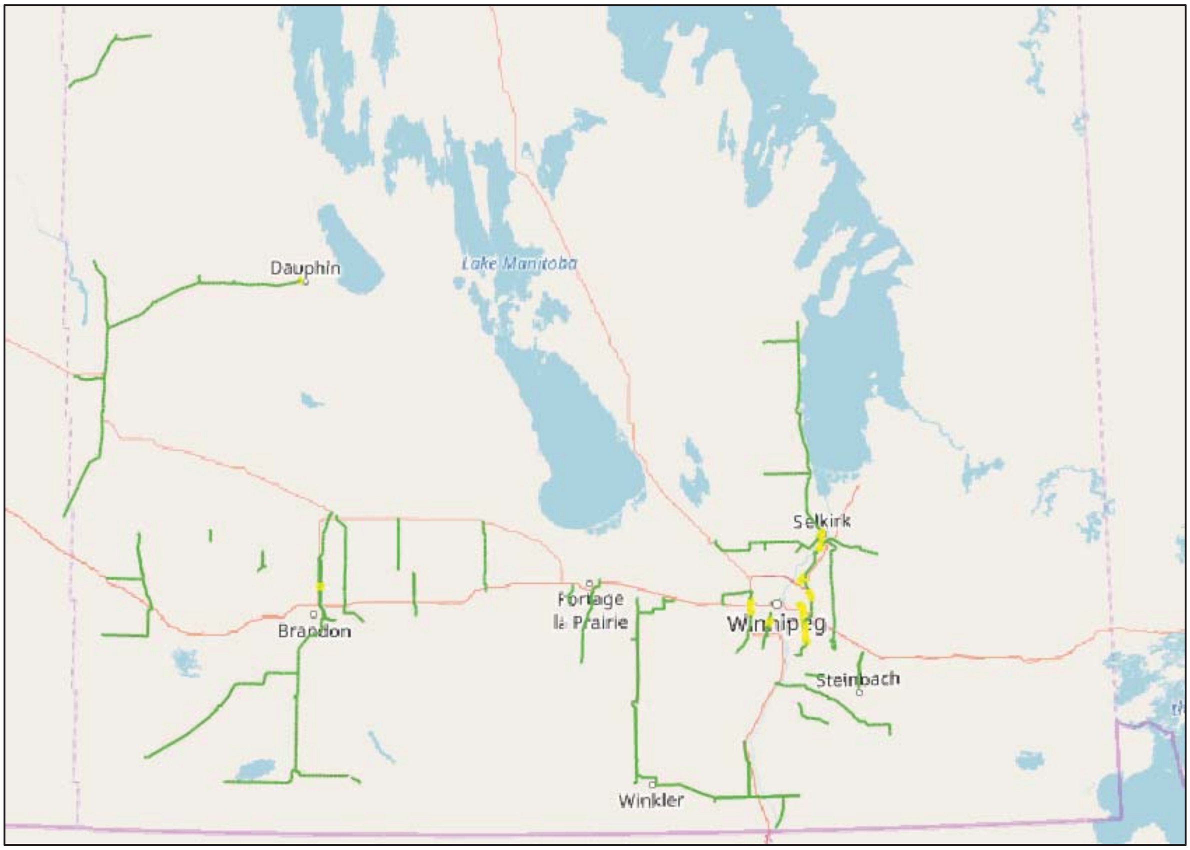


Figure 12: Transmission Pipelines - Thematic Map of Risk Evaluation Results

A small percentage (4.2%) of pipelines near Dauphin, Brandon, Winnipeg and Selkirk were evaluated as having "less significant" risk (See Figure 13, Figure 14 and Figure 15).

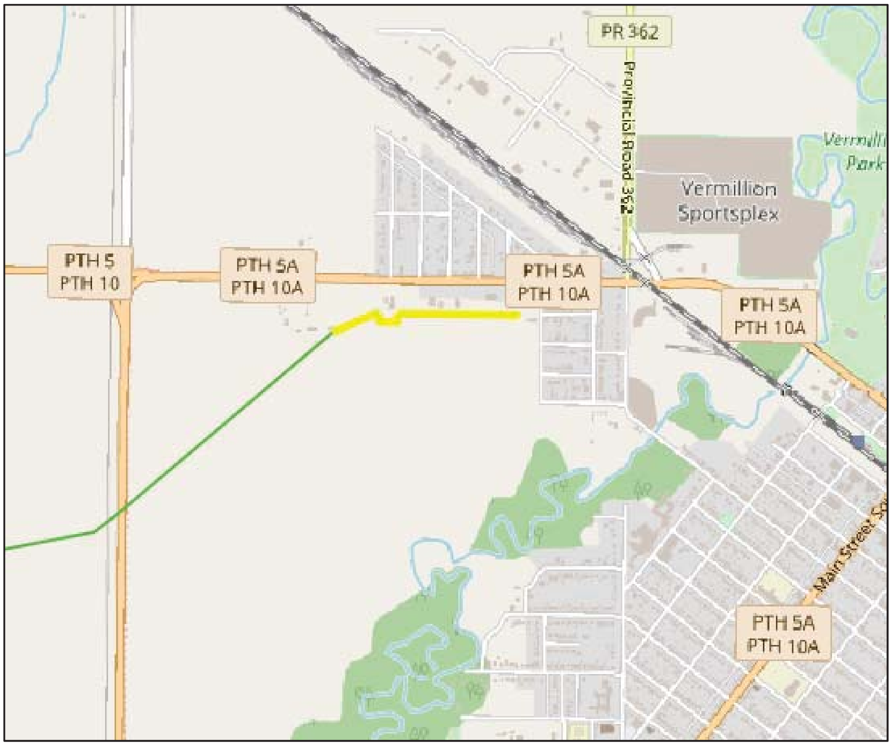


Figure 13: Transmission - Dauphin

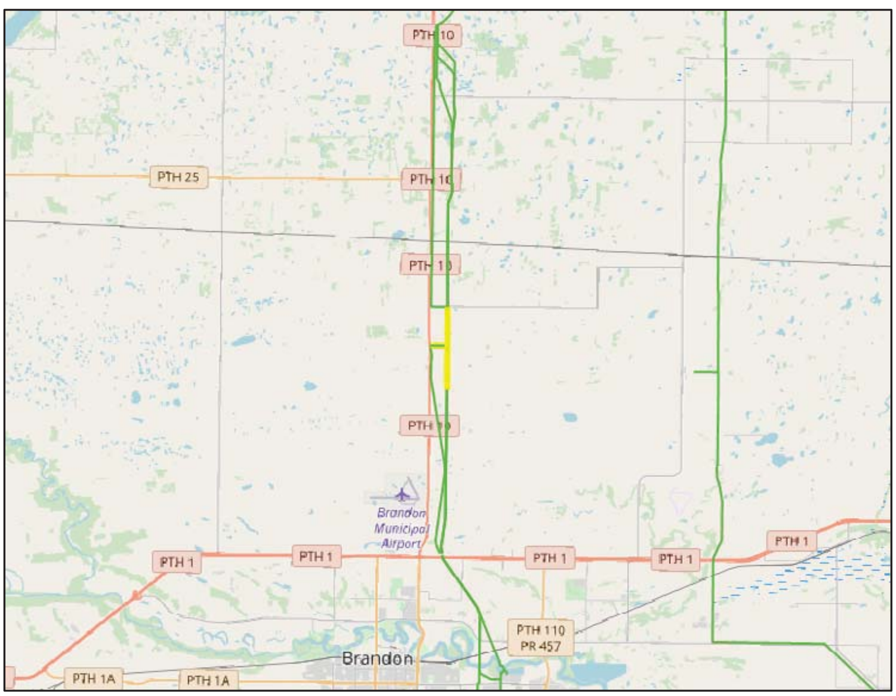


Figure 14: Transmission - Brandon

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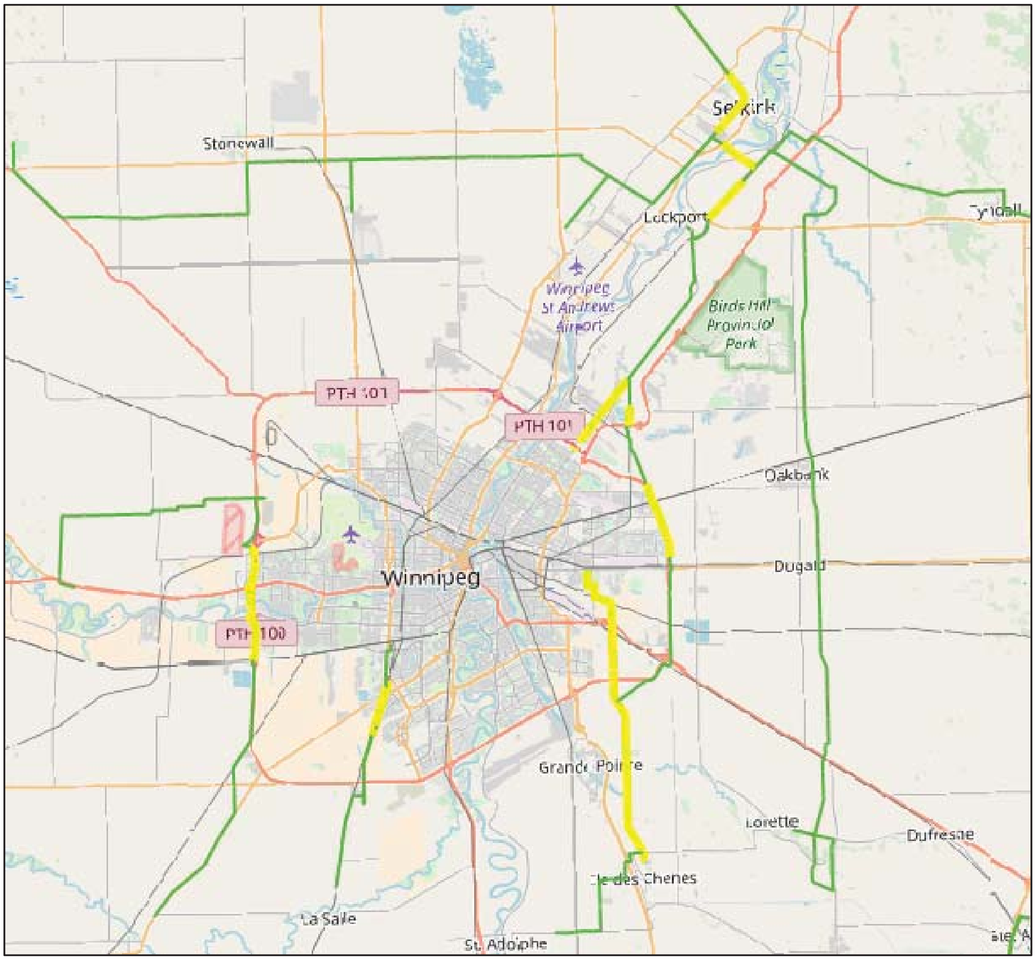


Figure 15: Transmission - Winnipeg and Selkirk

6.1.5. Risk Control Options

Pipeline Integrity Activities are summarized in the Pipeline System Integrity Management Plan (*Natural Gas Pipeline System Integrity Management Program,* 2015). Pipeline Integrity Activity owners should consider whether or not the activities they own are satisfactorily targeting the segments with the highest risk.

If the risk cannot be reduced with current Pipeline Integrity Activities, a site specific analysis may be required.

Pipeline Integrity Activities that are targeted to a specific hazard, such as corrosion, would benefit from reviewing the risk profile for that hazard. For example, the Cathodic Protection System Monitoring and Performance Evaluation activity owner should consider the pipe segments with a higher Corrosion / Degradation Risk.

6.2. External Interference Risk

6.2.1. Hazard Description

A significant hazard to the pipeline network is external interference. Incidents in this category are usually attributed to unintentional third party, company employee or company contractor damages. They may also be caused by intentional vandalism.

6.2.2. Average Frequency Score from Historical Incident Data

The Average Frequency Score represents the number of below grade leaks that have been recorded between 2011 and 2016 per 1000km of pipe installed per year.

Asset Group	External Interference Below Grade Leaks (2011-2016)	Average Frequency Score (incidents/1000km-year)
Distribution	499	9.671
Transmission	0	0.073 Note 1

Note 1: No external human interference leaks were reported on the transmission system during the study period. However, multiplying the risk model relative hazard scores by an average frequency score of 0 would show that there is no likelihood of future external human interference and therefore no risk. Of course this is unrealistic because even if an incident has not occurred in can always occur tomorrow. Additionally, a severe damage that very likely could have resulted in a leak did occur on the Altona system. For these reasons, the Average Frequency Score for External Human Interference is calculated as one incident from 2011 to present.

6.2.3. Risk Matrices

The results of the risk analysis are plotted on the Risk Matrices and summarized in the legend.

External Interference Risk Matrix (Distribution)

Consequence \ Frequency	Very Rare	Rare	Unlikely	Posible	Likely	Almost Certain
High			69	2		
Medium			1025	2		
Low			33203	115		

External Interference Risk Matrix (Transmission)

Consequence \ Frequency	Very Rare	Rare	Unlikely	Posible	Likely	Almost Certain
High	94					
Medium	448					
Low	1709					

Legend:

Colour:	Risk Evaluation:	Distribution		Transmission		
		Total	%	Total	%	Action
Red	Significant	71	0.21%			Refine analysis, evaluate options, and implement action.
Yellow	Less Significant	1027	3.0%	94	4.2%	Refine analysis, consider options.
Green	Not Significant	33318	96.8%	2157	95.8%	Monitor

6.2.4. Risk Control Options

Options that could reduce or control the risk due to External Interference include:

- Target public awareness programs to high risk areas such as new developments and densely populated areas.
- Perform depth of cover surveys and remediating insufficient covers.
- Increased signage.
- Select pipe material with better resistance properties or add barrier material (concrete slabs placed over pipeline or rock wrap).
- Reduce the percentage specified minimum yield strength (transmission).
- Relocate pipelines or widen easements in to areas with less population (transmission).
- Restrict access (fencing).

6.3. Corrosion / Degradation

6.3.1. Hazard Description

Corrosion and degradation are both time dependent hazards to the pipeline system. Corrosion has the potential to affect metal pipelines by resulting in metal loss and a reduction in wall thickness of pipe. Degradation affects some aging plastic pipelines and also includes degradation of seals when it is not preventable through regular maintenance.

6.3.2. Average Frequency Score from Historical Incident Data

The Average Frequency Score represents the number of below grade leaks that have been recorded between 2011 and 2016 per 1000km of pipe installed per year.

Asset Group	Corrosion / Degradation Below Grade Leaks (2011-2016)	Average Frequency Score (incidents/1000km-year)
Distribution	162	3.140
Transmission	1 Note 1	0.077

Note 1: The study period was extended to include the Moore Park Station leak that occurred in June 2017

The results of the risk analysis are plotted on the Risk Matrices and summarized in the legend.

Corrosion / Degradation Risk Matrix (Distribution)

Consequence	Very Rare	Rare	Unlikely	Posible	Likely	Almost Certain
High		71				
Medium		5543	369			
Low	3	28040	384	6		
	Frequency					

Corrosion / Degradation Risk Matrix (Transmission)

Consequence	Very Rare	Rare	Unlikely	Posible	Likely	Almost Certain
High	94					
Medium	448					
Low	1709					
	Frequency					

Legend:

Colour:	Risk Evaluation:	Distribution		Transmission		
		Total	%	Total	%	Action
Red	Significant					Refine analysis, evaluate options, and implement action.
Yellow	Less Significant	440	1.3%	94	4.2%	Refine analysis, consider options.
Green	Not Significant	33976	98.7%	2157	95.8%	Monitor

6.3.3. Risk Control Options

Options that could reduce or control the risk due to Corrosion or Degradation include:

- Perform below grade leak analysis to the identify root cause of failures.
- Select pipe material and coatings with better resistance properties.
- Reduce the percentage specified minimum yield strength (transmission).
- Improve maintenance practices to increase the longevity of seals (valve maintenance).
- Review the cathodic protection system for necessary improvements.
- Schedule high risk pipe segments for External Corrosion Direct Assessment or In-Line Investigation Surveys.

6.4. Natural Forces

6.4.1. Hazard Description

Failures associated with the hazard Natural Forces are either weather or geotechnical related. Causes include riverbank instability, soil erosion and frost heave.

6.4.2. Average Frequency Score from Historical Incident Data

The Average Frequency Score represents the number of below grade leaks that have been recorded between 2011 and 2016 per 1000km of pipe installed per year.

Asset Group	Natural Forces Below Grade Leaks (2011-2016)	Average Frequency Score (incidents/1000km-year)
Distribution	19	0.359
Transmission	1	0.085

6.4.3. Risk Matrices

The results of the risk analysis are plotted on the Risk Matrices and summarized in the legend.

Natural Forces Risk Matrix (Distribution)

Consequence	Very Rare	Rare	Unlikely	Posible	Likely	Almost Certain
High	66	5				
Medium	1006	21				
Low	32953	360	5			
	Frequency					

Natural Forces Risk Matrix (Transmission)

Consequence	Very Rare	Rare	Unlikely	Posible	Likely	Almost Certain
High	94					
Medium	448					
Low	1701	8				
	Frequency					

Legend:

Colour:	Risk Evaluation:	Distribution		Transmission		
		Total	%	Total	%	Action
Red	Significant					Refine analysis, evaluate options, and implement action.
Yellow	Less Significant	71	0.2%	94	4.2%	Refine analysis, consider options.
Green	Not Significant	34345	99.8%	2157	95.8%	Monitor

6.4.4. Risk Control Options

Options that could reduce or control the risk due to Natural Forces include:

- Perform depth of cover surveys and remediate insufficient covers.
- Increase monitoring through the Geotechnical Monitoring Program.
- Schedule watercourse crossing surveys.
- Install monitoring equipment such as slope inclinometers.
- Select pipe material with better resistance properties (plastic pipe will deform without failing before steel will).
- Reduce the percentage specified minimum yield strength (transmission)

6.5. Material, Manufacturing, or Construction Defect

6.5.1. Hazard Description

Material, manufacturing and construction defects are those that are created during construction or due to material defects and defective manufacturing. Examples include leaks caused by improper welds, fusions, and mechanical fittings (improper installation), not following procedures during construction, cross bores, loose cap or cracked tee caps due to over tightening.

6.5.2. Average Frequency Score from Historical Incident Data

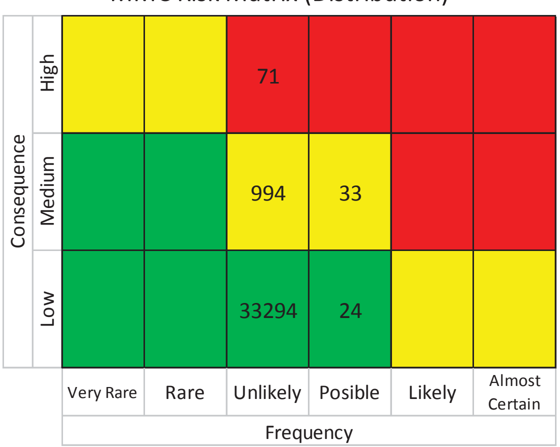
The Average Frequency Score represents the number of below grade leaks that have been recorded between 2011 and 2016 per 1000km of pipe installed per year.

Asset Group	Total Number of Below Grade Leaks (2011-2016)	Average Frequency Score (incidents/1000km-year)
Distribution	244	4.719
Transmission	3	0.254

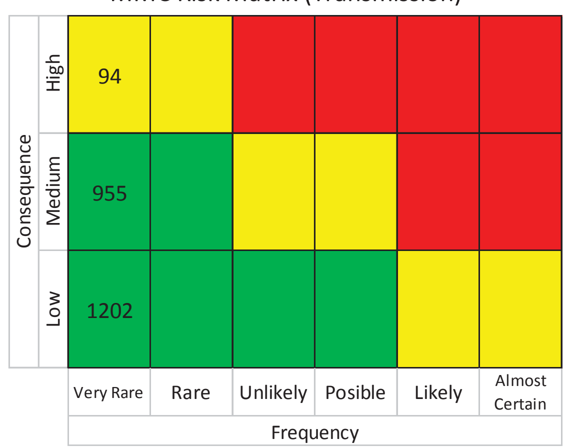
6.5.3. Risk Matrices

The results of the risk analysis are plotted on the Risk Matrices and summarized in the legend.

MMC Risk Matrix (Distribution)



MMC Risk Matrix (Transmission)



Legend:

Colour:	Risk Evaluation:	Distribution		Transmission		
		Total	%	Total	%	Action
Red	Significant	71	0.2%			Refine analysis, evaluate options, and implement action.
Yellow	Less Significant	1027	3.0%	94	4.2%	Refine analysis, consider options.
Green	Not Significant	33318	96.8%	2157	95.8%	Monitor

6.5.4. Risk Control Options

Options that could reduce or control the risk due to Material, Manufacturing or Construction Defects include:

- Investigate material with higher failure rates to determine the root cause.
- Improve quality assurance programs that review new material and manufacturers.
- Review construction procedures and implement improvements if deemed necessary.
- Reduce the percentage specified minimum yield strength (transmission).

6.6. Incorrect Operations

6.6.1. Hazard Description

The susceptibility of a failure attributed to the incorrect operation of the pipeline network post-commission is calculated in the Incorrect Operations Hazard Score. Examples include not following procedures, not having competency/training, not performing maintenance according to procedures.

Improvements in reporting methods are being undertaken to track failures resulting from incorrect operations for future reporting consideration however at this time, no leaks have been directly attributed to incorrect operations.

6.7. Other / Unable to Classify

6.7.1. Hazard Description

The Other / Unable to classify category is in place to track failures that do not fit into any of the other hazard categories and for historical leaks where the cause is unknown. Currently, when a leak is reported unable to classify, the Pipeline Integrity Technologist follows up with the operational staff to determine the correct cause and the leak record is updated.

7. Conclusion

The objective of the Pipeline Risk Assessment is to inform management and pipeline integrity activity owners of pipeline segments with significant risk from a failure incident so that appropriate risk control measures can be implemented. A failure incident is defined in this report as an unintentional release of gas below grade.

The results of the Pipeline Risk Assessment are a potentially valuable tool for:

- Making effective choices among risk control measures.
- Supporting specific operating and maintenance practices for pipelines subject to integrity hazards;
- Assigning priorities among inspection, monitoring, and maintenance activities; and
- Supporting decisions associated with modifications to pipelines, such as rehabilitation or changes in service.

Further information such presentations, assistance with implementing risk control options, and the pipe segment location data is available from the author by request.

Reference Publications

Gigian, L. (2017). *Pipeline Risk Methodology*. Winnipeg, MB: Manitoba Hydro

Manitoba Hydro (2017). *Manitoba Hydro's Natural Gas system Long-term development plan*. Winnipeg, MB: Manitoba Hydro

Manitoba Hydro (2015), *Natural Gas Pipeline System Integrity Management Program",* Winnipeg, Manitoba: Manitoba Hydro