PROVIDING MORE EPCOR

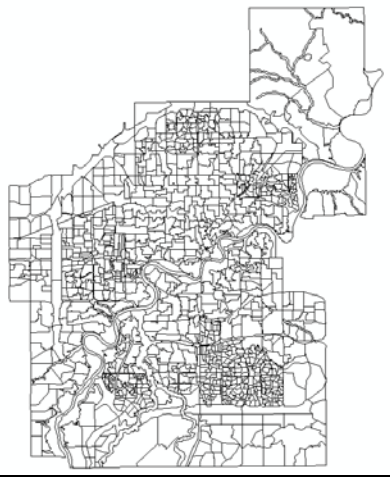
Stormwater Integrated Resource Plan (SIRP) – Developing the Risk Framework

Recommendation:
Utility Committee receive this report for information

Background:
This report provides a progress update on the development of the Risk Ranking Framework for the Stormwater Integrated Resource Plan. In our report to Utility Committee on February 23rd, EPCOR proposed a Risk methodology aligned with the vulnerability risk analysis underway through the City of Edmonton's Climate Change Resiliency and Adaptation initiative being led by the City Environmental Strategies group.

The Climate Change Adaptation project is assessing the City of Edmonton from an overall perspective. The vulnerability analysis will provide an overall risk assessment for the region. EPCOR in parallel to the City wide assessment has been developing as part of the SIRP a more granular assessment of the risks and vulnerabilities at the stormwater sub-basin level.

The following figure shows the stormwater sub-basins that have been identified along with a more detail view of how a stormwater sub-basin has been defined through a review of pipe catchment areas. There are approximately 1200 stormwater sub-basins that cover the City.

Stormwater Sub-basins	Detail of a particular Sub-basin
	

EPCOR as part of the SIRP is developing a risk framework that allows each sub-basin to be risk ranked from three perspectives for both the Urban Flooding and River Flooding Climate hazard perspective:

- Capacity
- Condition (including Environmental objectives)
- Social Impacts

This report provides an update on the information we have been able to collect to date for each of these three perspectives and where additional analysis or monitoring will be required to fully assess the risks within a particular sub-basin.

EPCOR will return to Utility committee in October 2018 with the results of the risk analysis with a range of scenarios showing different weightings between the risk factors to support Utility committee direction on the recommended priorities to develop the capital and operational expenditures to improve the overall resiliency of the stormwater network.

It is recognized that in some cases some of the desired data for a particular stormwater sub-basin may not be available to fully define the risks and proposed capital investment by April 2019, in these cases surrogate indicators for the specific information component will be proposed. For example, for the stormwater sub-basins currently without model generated data for capacity, EPCOR will set the risk based on the design standard in place at the time the sub-basin was developed. This approach of surrogate indicators is consistent with the approach being taken in other communities, such as Ottawa and Saskatoon.

The Stormwater Integrated Resource Planning (SIRP) process is a dynamic process that is expected to adapt over time as additional information is collected. EPCOR will continue to update the SIRP and the risk framework in future years as additional information about particular sub-basins are collected and will reflect the enhanced information in the utility rates filings and annual capital budget updates.

Risk Grid Consequence Levels

EPCOR has also been reviewing different risk grid models used by different communities as well as the vulnerability risk assessment work being completed through the Climate Change Adaptation project and recommends that the risks for each sub-basin should be considered through the following four perspectives.

- **Health and Safety**
- **Environment**
- **Financial or Economic Impact**
- **Social or Service Level Impact**

EPCOR will be leveraging the public engagement approach described in the February 23rd Utility committee meeting to obtain the public input on how to rank the consequences from these varying perspectives. The following table provides some example statements that will be considered in the development of the final risk grid.

Potential Risk Grid Framework – to be confirmed through Conjoint analysis **Examples of the type of risk statement to be considered in each category – these statements are from the Climate Change Adaptation project City Wide risk framework**				
Risk Consequence Score	**Health and Safety**	**Environment**	**Social**	**Financial**
5 – Extreme	Fatalities or Severe Injuries Risk or severe vector borne disease risk	Permanent loss of local eco-system or species	Inability to access a social service facility for greater than 6 months	TBD
4 – Major	Severe Injuries or major vector borne disease risk	Major damage of local ecosystem or species or impairment of more than 2% of the resource	Inability to access an social service facility for 1 to 6 months	TBD
3 – Moderate	Moderate Injuries or moderate vector borne disease risk	Moderate damage or impairment of more than 0.2% local ecosystem or species	Inability to access a social service facility from 1 to 4 weeks	TBD
2 – Minor	Minor injuries or minor vector borne disease risk	Minor damage or impairment of more than .02% of local ecosystem or species	Inability to access an essential service between 12-24 hours	TBD

1 –Negligible	Minor injuries	Negligible damage with 0.002% of impact on local ecosystem or species	Inability to access an essential service between 0-12 hours	TBD
0 – No Impact	No impact	No Impact	No Impact	No Impact

Additional analysis of the property and infrastructure financial values within each stormwater sub-basin needs to be completed to determine the dollar values to align with the City wide financial impacts being assessed in the Climate Change Adaptation project.

Capacity Risk Indicators

The stormwater sub-basin capacity risks are being assessed from two perspectives; the potential for basement flooding and the potential for overland flooding. Data sources include historical engineering analysis reports completed for the Drainage utility, records of past flooding locations, overland flood models available from the Province of Alberta and the Insurance industry.

Insurance Bureau of Canada Flood mapping update

Subsequent to the April 23rd Utility Committee meeting, EPCOR was able to obtain additional information on the Overland flooding maps being shared by the Insurance Bureau of Canada. These maps developed in conjunction with JBA Risk Management provide the insurance industry with information on the depth of overland flooding predicted for different storm intensities. These maps are based on the topography of the region and global climate models. The maps do not consider the capacity of the pipe network that supports the reduction of the flooding risk. EPCOR will be working with IBC and JBA Risk management to pilot an approach to provide the additional utility level information to accompany these maps to better inform the risk assessment of the areas shown at risk of flooding.

Capacity Data sources

The following tables describe the information that has been collected for the different types of flooding and the extent of coverage for the particular factor.

Sanitary Surcharge Modelling	
Basement flooding can occur during when there is a sanitary surcharge event where the sanitary or combined sewer system surcharges to an elevation above the floor level of the basement, typically 2.5 meters below the ground elevation. For purposes of the capacity risk assessment for basement flooding EPCOR has compiled data through a review of the historical engineering analysis models. This information provides an initial indication of stormwater sub-basins where the water levels are predicted to be in excess of 2.5 meters below ground elevation. Since these engineering studies cover a number of years, EPCOR is currently confirming the predicted risk levels considering the capital construction that has occurred from the time the initial study was completed.	Depth Ranges for Sanitary Surcharge • More than 2.5meters underground • Between 2.5 and 1.5 underground • Between 1.5 and ground elevation

Surface Flooding Modelling	
Surface or Overland flooding occurs when the piped network is overwhelmed due to flows in excess of what can be transported or accepted into the system through the catch basins. For purposes of the capacity risk assessment for overland flooding EPCOR has compiled data through a review of the historical engineering analysis models. This information provides an initial indication of stormwater sub-basins where the water levels are predicted to be above the ground elevation. Since these engineering studies cover a number of years, EPCOR is currently confirming the predicted risk levels considering the capital construction that has occurred from the time the initial study was completed.	<u>Depth Ranges for Overland Flooding</u> • Between below ground elevation and 0.35 meters above ground • Between 0.35 meters and 0.5 meters above ground • Between 0.5 meters and 0.75 meters above ground • Over 0.75 meters above ground Consideration in the risk scoring will also be given of the additional health risks for overland flooding of the combined sewer systems

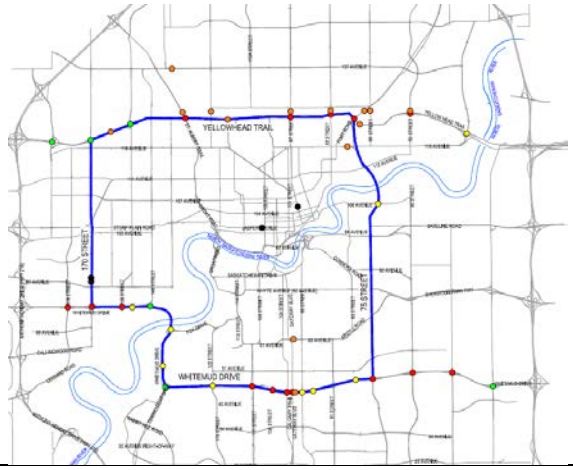
Basement Flooding - historical records	
To supplement the modelled information, EPCOR is also leveraging the Drainage utility records on known basement flooding events. The data set includes records starting in 2003. The records only reflect calls that were made to the Drainage Control center to report the flooding. It is known that not all customers report flooding events when they occur so this data is only being used to validate information being assembled from the modelling data.	The basement flooding information does not distinguish between the different causes of the flooding incident. Potential causes of flooding include: • Intense rain storms • Intense Hail events clogging systems • Sewer main blockages – both on the public and private systems • Water main failures – main breaks or utility strikes • Overland flow due to snow or ice blocking catch basins • Leaking water hoses next to homes • Poor grading around homes leading the rain to open basement windows

Underpass Modelling

In 2017, the Drainage utility completed an engineering study to assess the risk of flooding of underpasses within Edmonton.

A total of 49 underpasses were evaluated, 13 considered as high risk of flooding, 14 considered medium risk with the remainder considered low risk.

As part of the risk framework the flooding depths will be assessed against the risk impacts of public safety and vehicle property damages.

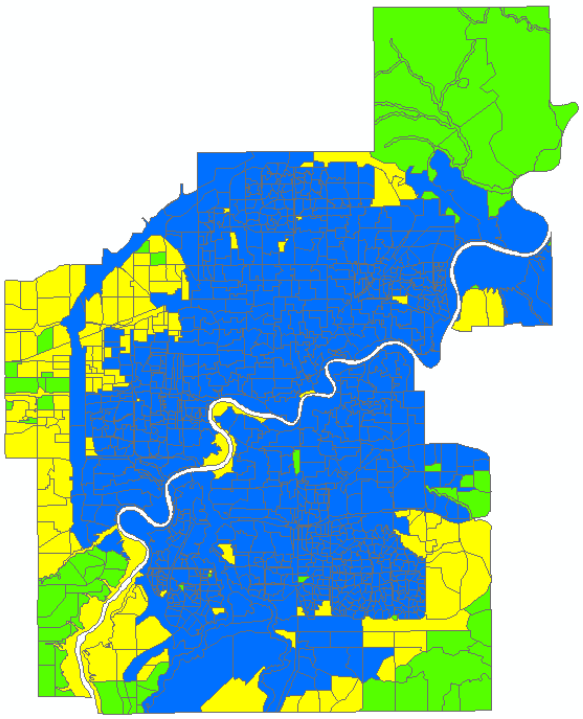


River Valley Neighbourhood Modelling

In 2017, the Drainage utility completed a river valley flooding risk analysis for the Rossdale, Cloverdale and Riverdale neighbourhoods.

EPCOR has also been evaluating the risks for treatment facilities located at Rossdale, E.L. Smith, and Gold bar.

This information is also being compared to information available from the Province of Alberta and the insurance industry overland flooding models, to further validate the findings and to inform the risk assessment for the river valley neighbourhoods not included in the 2017 Drainage study.

Stormwater Sub-basins without Modelled Capacity information	
Locations shown in Blue are the sub-basins with modelled data Locations with Piped Stormwater Network -shown in Yellow For these sub-basins the risk of flooding will be determined by the design standard in place at the time of sub-basin construction. EPCOR is also reviewing the potential to use this approach as well to incorporate the configuration of weeping tiles and roof leaders over the different generations of housing development. This approach however is limited due to the various roof leader disconnection programs that have occurred over the years. Locations without Piped Stormwater Network – shown in Green For these sub-basins the risk of flooding will be determined based on the overland flood modelling available from the Insurance industry	

Condition Risk Indicators

The condition risk ranking is being developed through the analysis of the historical inspection and operational and maintenance information available for each of the asset categories that compose the stormwater network. This includes the asset types of trunks, local pipes, manholes, catch basins, outfalls, pump stations, control gates and stormwater management facilities. The condition of each of the assets will be risk ranked based on the consequences and likelihood of the infrastructure failing within a particular stormwater basin. Risk of failure is being assessed considering both the physical condition risks and the environmental risks that could occur. It is important to note that due to the configuration of the network, some assets have the potential to impact multiple sub-basins should they not function as expected or if they are not sized for the flows expected, where this situation exists the condition risk will be incorporated into all the sub-basins impacted, not just the ones where the asset is physically located. The following table lists the assets that will be assessed from the condition perspective.

Asset Condition Information	
Stormwater and Combined Trunks	The trunk sewer network represents the larger diameter pipes that transport the large volumes of water between regions of the City towards the creeks and rivers. The different trunks are being assessed to determine the number of sub-basins they support and the impact of failure on the overall storm network. Opportunities to improve capacity will be identified for trunks that are identified as highest need for condition rehabilitation
Stormwater and Combined Local Sewers	The local sewer network consists of the pipes, manholes and catch basins located along each street or alley connected to the individual properties. Pipe upsizing or combined sewer separation will be considered to improve capacity of the network for pipes identified for rehabilitation
Stormwater Pump stations, Control Gates and Weirs	The stormwater pump stations, control gates and weirs are mechanized elements within the network that are used to direct stormwater during different flow events. Some of these are connected to the Drainage SCADA system for remote operation and others are manually operated during certain flow conditions. The impact of failure of these devices will be considered in the development of the risk ranking for the sub-basins serviced by these elements. Recommendations to improve could include replacement as well as enhanced control procedures.
Stormwater Management Facilities – Wet and Dry Ponds	The stormwater management facilities include wet ponds, dry ponds and engineered wetlands. All of these facilities contribute to the reduction of the overall flooding risk of a particular sub-basin.

Asset Condition Information	
	These facilities also provide an environmental benefit to the system and will be assessed for both their physical condition and their ability to meet this requirement. Each of these facilities will be assessed to determine the sub-basins that they benefit.
Outfalls	The stormwater and combined sewer outfalls are located along the river valley and creeks within the Edmonton area. The outfalls are being assessed for their physical condition as well as their impact to the environment. The number of sub-basins supported by a particular outfall is being considered in the risk ranking.
Neighbourhood Improvement Coordination	EPCOR Drainage supports the City of Edmonton Neighbourhood Improvement and other paving improvement initiatives through the coordination of rehabilitation work to avoid future needs to cut into new pavement. The future paving plans for the City have been reviewed and neighbourhoods also requiring pipe rehabilitation have historically been aligned with the City construction activities. Starting in 2019, EPCOR is also identifying neighbourhoods requiring a capacity upgrade to allow coordination of these elements as well. Best effort will also be made to incorporate into the 2018 construction season, however due to timelines for engineering and procurement it is recognized that some opportunities will not be possible.

An additional set of information EPCOR would like to incorporate into the risk assessment, but are still working through the data to determine if this can be mapped into each of the sub-basins relates to the frequency of operational maintenance activities by area of the City, such as catch basin clearing, root intrusion and sewer main flushing. Through the transition to EPCOR this information was migrated from the City of Edmonton SAP Work management system into EPCOR's IVARA Work management system, due to the way these work orders have been historically entered into the system, additional effort is required to confirm if the historical information on location can be extracted and mapped onto the stormwater sub-basins. A separate project is underway within EPCOR to add location to IVARA work orders in a format to facilitate mapping to be readily available for future analysis.

Social Risk Indicators

The social risk indicators are being developed to align with Climate Change Adaptation project currently underway. Through this project the City has identified the following critical building types that need to be assessed for risks due to climate change. EPCOR has mapped the locations of these building types onto the stormwater sub-basins. As the risk analysis framework is developed the sub-basins showing as higher risk for basement flooding or overland flooding will have an additional analysis to assess the impacts specifically for these individual locations within each sub-basin. This analysis will allow for the identification of various alternatives to reduce the flooding risk considering pipe infrastructure upgrades and/or flood proofing of the individual property.

Critical buildings and Facilities as defined by the Climate Change Adaptation project include:

- Hospitals
- Fire Halls, Police and Ambulance Stations
- Emergency Relief Shelters, Homeless and Addiction centers
- Seniors Homes \ Long-term Care Facilities
- Schools – Elementary through to University
- Shopping Malls
- Recreation\ Leisure Centers (also used to support emergency response)
- Transit Centers and LRT Rail corridors
- Water and Wastewater plants, reservoirs and pump stations
- Electrical Sub-stations

Next Steps

EPCOR requests feedback from Utility Committee that the components to be considered in the development of the Risk Framework tool meet their expectations, and that if there are any additional items that should be considered for this initial development that they be identified at the meeting on June 8th .

EPCOR over the next few months will be continuing to fully develop the risk framework and complete the data validation from the different sources of information that have been identified.

Public engagement to inform the risk consequence levels will be undertaken as described in the February 23rd Utility committee report following the EPCOR principles of stakeholder engagement described in a separate report presented at this Utility committee meeting.

EPCOR will return to Utility Committee in October 2018 with the Risk Framework scenarios and initial Stakeholder Engagement results to allow Utility Committee to provide direction on the relative weights for the different risk component indicators.

Following the approval of the relative weights, EPCOR will then return to Utility committee on April 2019 with recommendations on the Capital and Operational investment scenarios supporting Accelerated Flood mitigation efforts. EPCOR will also provide at the same meeting an assessment of stormwater rate approaches to support the increased investment levels.

In addition, overall progress on the SIRP will continue to be provided in the regular reporting provided with other initiatives within the Drainage utility. Active stormwater capital programs will be also be reported through the Drainage utility updates.