1 City of Portage la Prairie – Water Resources Infrastructure Assessment

1.1 Background

The Public Infrastructure Engineering Vulnerability Committee (PIEVC) has identified water resources infrastructure vulnerability as one of four priority areas for review within the first national engineering assessment of Canadian public infrastructure vulnerability to changing climatic conditions. The City of Portage la Prairie water works system and the drinking water treatment plant served as:

- a case study to apply PIEVC's Process and Engineering Protocol to water resources infrastructure; and
- pilot study to refine the parameters of the PIEVC's Process and Engineering Protocol.

PIEVC contracted Genivar and TetrES Consultants to lead a study team and to conduct the step-by-step vulnerability assessment based on PIEVC's Process and Engineering Protocol. OURANOS, a Montreal-based consortium, developed regional climate information and scenarios for the case study. (Historic incident data compiled by the City of Portage La Prairie were also used.)

1.2 Where, What and How

This case study focuses on the water works system and the drinking water treatment plant in the City of Portage la Prairie. The community of 13,000, located 100 kilometres west of Winnipeg, Manitoba, draws raw water from the Shellmouth Reservoir located Assiniboine River. The river is subject to large annual and seasonal variations in flow and turbidity, and can be vulnerable to drought. The Assiniboine is linked to water-control infrastructure to lessen flooding between Portage la Prairie and Winnipeg. Portage la Prairie experiences wide seasonal temperature extremes (sometime below -40ºC n winter and close to +40ºC in summer).

Figure A-1 Location of Portage La Prairie

In addition to the City of Portage la Prairie, the water works system with its capacity of 34 million litres a day, also serves as a regional water system for residents in the rural municipalities of Portage la Prairie and Grey. Two large potato-processing plants use more than half of the water treated by the plant. Originally built in the 1970s, the Portage la Prairie water treatment facilities underwent major upgrades in 2004. The standard life span of a treatment facility is 30 years, while the distribution and larger controls structures have anticipated time frames of 80 to100 years.

A total of 25 PIEVC and affiliated stakeholders participated in a workshop and plant tour to review and provide input on applying the Protocol to the Portage la Prairie infrastructure.
The PIEVC Protocol was used to assess the degree to which the Portage la Prairie water and related infrastructure are vulnerable to climate-change-related events. That included identifying anticipated adverse climatic effects and then assigning probabilities of their anticipated severity (from negligible or not applicable, to certain/highly probable) on specific aspects of the water resources infrastructure. Numerical values assigned based on the severity of the impact, allowed prioritizing of the recommendations according to whether:

- remedial action is required to upgrade the infrastructure;
- management action is required to account for changes in the infrastructure;
- no further action is required; and
- additional data and study are required.

1.3 Technical Summary

This case study used the following probability scale (Method A in the PIEVC Protocol) when assessing the vulnerability or likelihood of an effect on infrastructure components due to climate change.

Scale	Probability
0	**Negligible or not applicable**
1	**Improbable/highly unlikely**
2	**Remote**
3	**Occasional**
4	**Moderate/possible**
5	**Often**
6	**Probable**
7	**Certain/highly probable**

The PIECV Protocol and climatic data were applied to the following Portage la Prairie infrastructure components: personnel, facilities/equipment; Shellmouth Dam/Reservoir;
the Assiniboine River system; pre-treatment; softening; storage; valves/pipelines (water treatment plant site); pump stations; pipelines and valves; substations/transformers; standby generation; vehicles; maintenance facilities; supplies; roadway infrastructure; telephones and telemetry. Individual infrastructure components were matched to the following climatic variables: floods; ice jamming, ice build-up; ice storms, high temperatures, drought; intense wind/tornadoes and hail.
Consideration of the infrastructure components in combination with the climatic variables
and the assigned numerical values allow decisions on whether:

Figure A- 2 Shellmouth Dam

- vulnerability exists – when total load exceeds the infrastructure's total capacity; and
- adaptive capacity exists – when total load is less than the infrastructure's total capacity.

None of the assessments of infrastructure components or climatic variables resulted in a probability rating greater than 3 (occasional). Using Step 4 (Qualitative Evaluation) of the PIEVC Protocol, led to recommendations for:

- Remedial action
- Management action
- No further action
- Additional study required

(See Policy Makers Executive Summary for more details on the recommendations.)

1.4 Policy Makers' Executive Summary

The case study points out factors that leave components of Portage la Prairie's water infrastructure potentially sensitive to climate change. Where climate change places demands in excess of infrastructure capacity, the system is vulnerable and action is required. Where climate-changes result in loads upon infrastructure that are less than capacity, adaptive capacity exists in the system and action is not required.

These principles are applied in the key PIEVC findings and professional judgement, as well as the recommendations relating to aspects of Portage la Prairie's water infrastructure summarized below.

Administration / Operations

City Personnel

Although possibly vulnerable to floods, ice-related jams and backups, and storms, city staff can adapt without further action. Review of emergency preparedness for intense wind and tornadoes is recommended.

Facilities / Equipment

High temperatures; floods; ice-related jams, backups and storms; intense winds and tornadoes could impact water treatment and equipment. However, based on climate projection to 2080, which is beyond the current equipment's projected life (30 years), no action is required to deal with high temperatures.

Management action is suggested to review the City's protection response to floods, ice jams and build-up, coupled with remedial action, as required. Similar readiness recommendations apply to windstorms and tornadoes, and ice storms – including installing full standby/backup power.

Source Water

Shellmouth Dam/Reservoir

Based on engineering judgement, The Shellmouth Dam/Reservoir is assumed to be a critical point requiring further study. The Assiniboine River presents vulnerabilities due to drought as well as flooding and ice build-up. Cooperation with the province is urged to assess vulnerability relating to the Assiniboine and Portage Rivers.

Control Dam Structure

The control dam serving the water infrastructure should be reviewed in terms of flooding and any further needed actions taken.

Intake Wells and Pumps

The dam's intake wells and pumps are also vulnerable and action plans are needed to deal with flooding and to remedy ice blockages. Working with the Province of Manitoba, the City should review watershed effects, including drought, related to climate change.

Water Treatment

Pretreatment

Relative to pretreatment (Actiflo) of water, no action is recommended in response to high temperature variables or to floods, ice jams or ice-build-ups. The anticipated range of water-quality changes are within the limits of current seasonal variations. However, engineering judgement suggests the pre-treatment is very highly vulnerable in the event of drought. The City should request further study by the Province of climate-change effects on the Assiniboine watershed.

Softening/Clarification

Figure A-3 Chemical mixer

High temperatures due to variable climate are not expected to exceed seasonal spikes. No action is recommended for the existing softening/clarification equipment.

Storage

Treated-water storage may be vulnerable to drought. More study, with provincial involvement, of the watershed is suggested.

Chemical Storage/Hazardous Material

One-site chemical and hazardous material storage could become vulnerable due to floods, ice-related jams and build-ups, intense winds and tornadoes. Management action – and where the infrastructure is highly vulnerable – remedial action is suggested to protect bulk chemical and other storage, and to guard against flooding. The City should review emergency preparedness for intense winds and tornadoes.

Treatment Plan Valves/Pipelines

Based on engineering judgement, no action is suggested for valves and pipelines in response to floods, ice jams and ice build-up.

Distribution

Pumping Stations

Further study is recommended on the vulnerability of the water treatment plant's pumping stations to high temperatures, floods, ice jams and build-up, intense winds and tornadoes. This should include City review of flood protection and, where there is high vulnerability, carrying out remedial works. The City should review emergency preparedness for intense wind and tornadoes. Given projected temperature variances and the current pumping equipment's projected life, no action is needed to deal with higher temperatures associated with climate change.

Pipelines and Valves

Based on engineering judgement, it is assumed that the distribution system's pipeline and valve infrastructure has the ability withstand flooding and ice-related events.

Electrical Power

Substations/ Transformers

The water plant and pumping stations rely on substations and transformers to supply power. It is assumed that these facilities are adequately flood-proofed but this should be confirmed through added study. Remedial action is suggested for ice storms – including installing full-standby power for the treatment plant. In response to vulnerability to intense wind or tornadoes, cooperation with Manitoba Hydro is recommended to bury transmission lines.

Standby Generators

The vulnerability of existing standby generators to floods, ice jams and ice build-up is not expected to increase. This should be confirmed through additional study. No action is required on standby generators in response to high temperature climate variables.
Ice storms require more study – including their frequency and the need for standby power in such situations. Climate changes related to extreme winds and tornadoes could raise vulnerability and need for backup power. The City should review its emergency preparedness and work with Manitoba Hydro to bury power lines where possible.

Transmission Lines

Transmission lines are vulnerable to ice storms and remedial action is recommended as is a review of City preparedness in ice storms and installing full standby power at the water treatment plant.

Figure A-4 Shellmouth Dam in relation to Portage la Prairie

Transportation

Service Vehicles

Ice storms, hail, intense wind and tornadoes could impact City service vehicles. Additional study is recommended to determine the frequency of ice storms.
Review of emergency preparedness for intense winds and tornadoes is recommended to ensure vehicles are operational. Vulnerability of service vehicles due to hail is low but projections are not available regarding hail and more information is needed.

Maintenance Facilities

More information is needed on the frequency of ice storms and how they affect maintenance facilities. Management action is suggested to review emergency preparedness for intense wind and tornadoes to ensure operation and protection of infrastructure**.**

Supplies

More study is required on frequency of ice storm and impact on supplies. A City review of emergency preparedness should include needs in the event of tornadoes. Consider backup and alternative supply sources.

Roadway Infrastructure

Study is needed of roadway infrastructure to determine the impact of floods, ice dams and ice build-up. Based on available evidence, it is not expected that in the case of the Portage la Prairie water facilities that roadway infrastructure is more vulnerable due to climate change. However, the greater vulnerability exists due to intense winds and tornadoes. A City review of emergency preparedness should consider alternative means to access critical infrastructure.

Communications

Telephone and Telemetry

Telephones and telemetry are vulnerable to ice storms, hail, intense winds and tornadoes. More study is needed to determine ice storm frequency. More information is need on hail, although the vulnerability of telephone networks to hail is low. Climate change could cause greater vulnerability to intense wind and tornadoes. The City should review preparedness and consider burying telephone lines where possible and having back-up wireless communication.

1.5 Pilot Study Comment

Besides providing a case study of the PIEVC Protocol relative to water resources infrastructure vulnerability, the Portage la Prairie assessment also served a pilot study of the general applicability of the PIEVC's Process and the Protocol. Observations and suggestions arising from the Portage la Prairie study for fine-tuning the Process and Protocol included:

- Potential absence of necessary weather data, including about extreme weather events. Incomplete weather data may render speculative the results of assessments made using the PIEVC Protocol.
- Gathering and processing necessary weather data may take longer than anticipated.
- Recording results about infrastructure and climate events on matrices proved simpler than using the worksheets initially developed for the PIEVC Protocol.

It is important to clarify that probabilities DO NOT relate to the probability of weather events occurring but rather to the probability of weather events affecting the infrastructure.

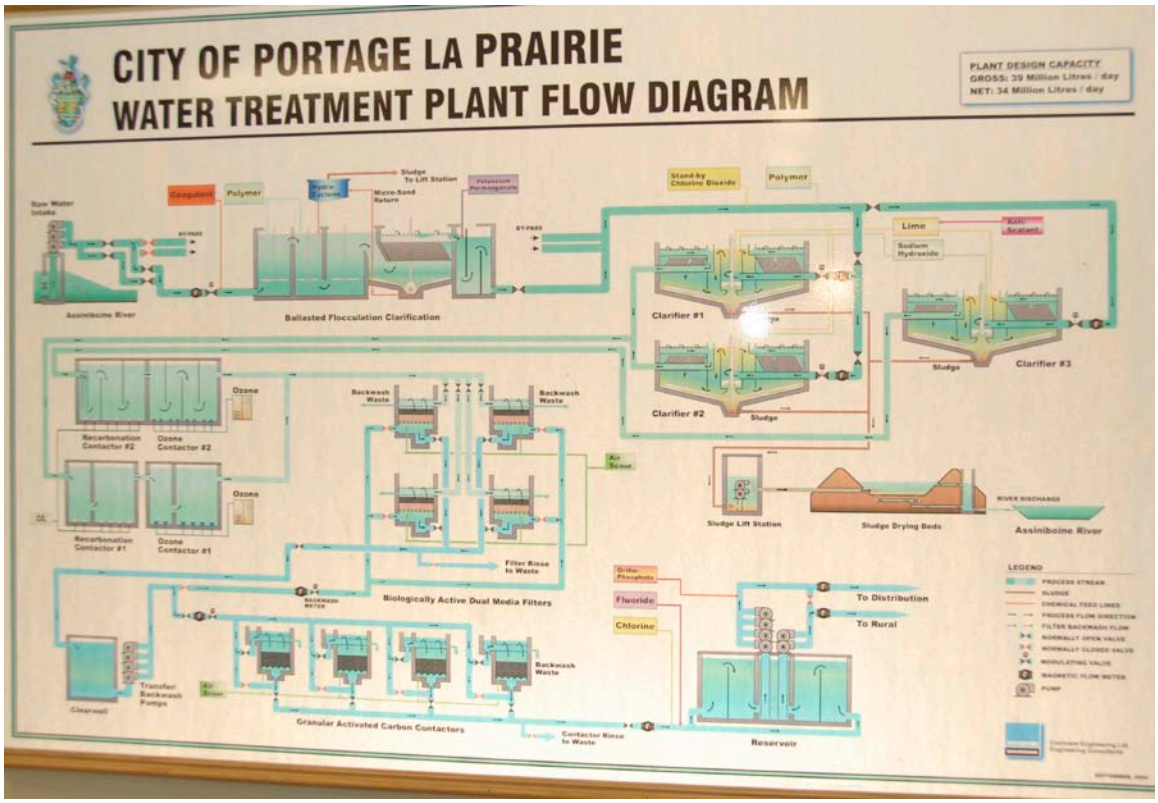

Figure A- 5 Water Treatment flow diagram