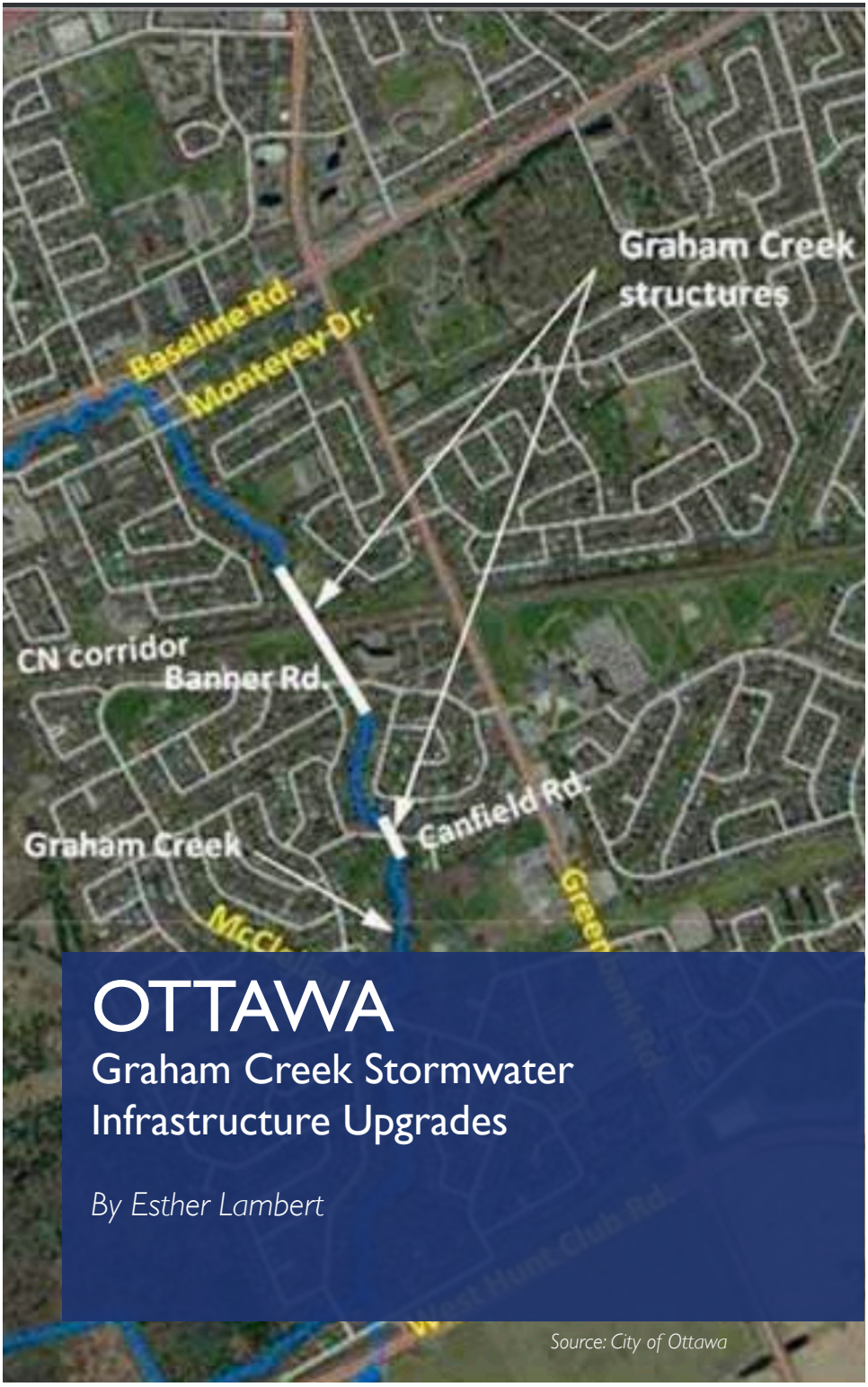

OTTAWA

Graham Creek Stormwater Infrastructure Upgrades

By Esther Lambert

Source: City of Ottawa

THE SCIENCE

Stormwater infrastructure, such as culverts and storm sewer structures, slow the flow of water to reduce the risk of flooding during extreme rain events and act as a purification system to prevent contaminated water from entering waterways. Investing in upgrades to individual municipal infrastructure, especially aging ones, is important to ensure long-term performance. Also important is the value in understanding infrastructure vulnerability of multiple assets simultaneously and acting with entire systems in mind. Vulnerability assessment tools such as the PIEVC protocol, while they can be used to assess the climate vulnerability of individual types of infrastructure, can also be used to achieve a system-wide approach to asset management that requires multiple other actions alongside the protocol. The Graham Creek stormwater infrastructure upgrades were pursued within this systems-focused approach.

THE TRIGGER

Ottawa's Graham Creek stormwater infrastructure includes a number of stormwater management structures along Graham Creek's old alignment from West Hunt Club Road to the Ottawa River. Graham Creek traverses a mature, multi-component system through residential and specially designated areas and parks. Faced with infrastructural issues, such as the need to improve catch basins and neighbourhood drainage throughout the city, the City decided to understand asset vulnerability and to build staff capacity in implementing the PIEVC protocol within the existing asset management structure. Coincidentally, the Graham Creek Infrastructure project presented an opportunity to apply the PIEVC protocol to a specific project while applying it system-wide and taking other important actions such as developing climate projections and city-wide flood risk profiles and understanding how to implement upgrades. Approximately 530 m of culvert and other storm sewer structures were included in the Graham Creek stormwater infrastructure PIEVC assessment.

THE APPROACH

Prior to the Graham Creek PIEVC assessment and recommendations of 2017, the City of Ottawa had already implemented some of the recommended actions stated in the report. For decades, the City has been taking actions to understand its climate risk profile for buildings and sewers, so the PIEVC protocol was seen as a useful tool to add to their toolbox. The PIEVC protocol used alongside other risk analysis actions is meant to not only gain a deeper understanding of city-wide risks but to also become more proactive and adaptive in dealing with specific risks.

Some of the major PIEVC recommendations implemented for the Graham Creek stormwater infrastructure project were the installation of headwalls on the inlets of existing Graham Creek stormwater infrastructure, which are corrugated steel pipe culverts to improve their structural integrity and also minimize the risk of structural deformation and collapse while surcharged, and the installation of wingwalls at the inlets of the culverts to increase their hydraulic capacity. Trash racks were placed apart from the inlet of culverts to ensure that they do not reduce the ultimate hydraulic design capacity of the culverts. Culvert design changes considered, not only hydraulic

Figure 14: *Approximately 530 m of culvert and other storm sewer structures were included in the Graham Creek Storm Infrastructure PIEVC assessment. (Source: City of Ottawa)*

capacity, but also resiliency measures. For instance, the City based the design on "when" a design event is exceeded rather than "if" a design event is exceeded. The design capacity includes full functionality to the end of service life. Actions were also taken to consider operations and ongoing inspection and maintenance during design. Flexibility was incorporated into the design to enable upgrades before the end of service life, should the climate change assumptions and design parameters prove to be insufficient.

The City has had to make the transition from PIEVC design of standalone projects to PIEVC asset management by making some changes to the normal PIEVC matrix. It carried out hydraulic analyses, which is not strictly required by the PIEVC protocol. Multiple scenarios were simulated, which included stress tests much higher than the City's standard stress test.

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THE OUTCOME

The City is currently applying the lessons from the Graham Creek project to the current update of its sewer design guidelines, which will now include a culvert design guideline. After the Graham Creek project was completed, the City wrote up a report presenting guidance on how to apply the PIEVC protocol to entire systems. This new process includes the use of GIS and other high-level tools to screen out all culverts for various risk factors identified in the PIEVC assessment in order to create a table of risk factors. The municipality's current plans are to apply this process

city-wide. In the case of Ottawa, the use of the PIEVC will allow the City to make high-level decisions on priority infrastructure investments.

A WORD FROM OTTAWA

When asked about the usefulness of the PIEVC protocol and its ability to assist municipalities in understanding the vulnerability of their infrastructure, Hiran Sandanayake, senior engineer in the Department of Water Resources for the City of Ottawa, indicated that the PIEVC protocol can be successfully used beyond individual projects. "Applying PIEVC for a specific project at a specific time is just a piece of the bigger picture," he said. Mr. Sandanayake appealed to municipalities to incorporate the PIEVC for a long-term approach to asset management. He mentioned that in Ottawa's case, the PIEVC process is helping to corroborate and validate findings from other assessments and adaptation actions. The importance of revisiting adaptation actions as risks change and viewing the process as iterative was also highlighted. As Mr. Sandanayake continued to explain, "I will find the PIEVC process a success if, 10 years from now, I look back and see how we've been able to change and grow as new information becomes available."