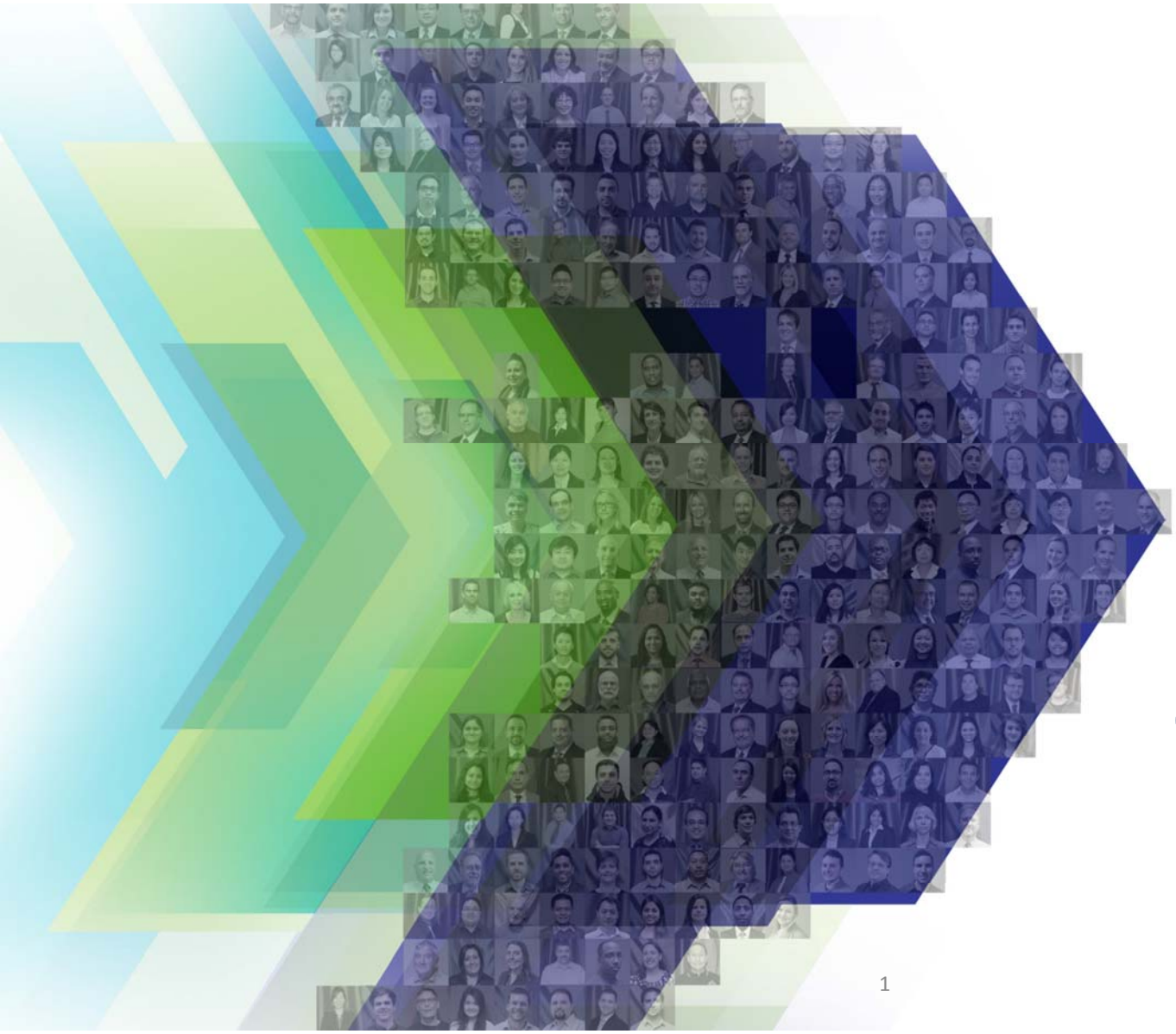


Presentation to SERO Annual General Meeting

September 30, 2016

Mark Bassingthwaite, P.Eng.

Overview

- This presentation will cover some lessons learned through several watercourse restoration projects that involved modifications to floodplains in conjunction with watercourse realignment or restoration due to erosion

The History

- Until the advent of modern environmental planning, development continually encroached on watercourses
- Watercourses were historically realigned, channelized, confined, hardened and often piped to facilitate development
- These encroachments have often caused increased flood hazards, erosion risks and impairments/losses in ecological function

Fitting with Waterfront Restoration?

- At first glance, watercourse restoration may not fit in with the theme of this meeting – “Urban Waterfront Restoration”
- However, watercourse restorations and floodplain/valley enhancements support coastal restoration by:
  - Reducing sediment loads in watercourses
  - Reducing flood flows to the coastal areas
  - Providing better connectivity for wildlife

Floodplain Modification

- Today, we will review several examples of watercourse restoration and floodplain modification through three of our recent projects
- Not all projects include expansion of floodplains

Pomona Mills Creek

- Tributary of Don River
- Located south of Highway 407, east of Yonge
- Area developed in 1950's

Pomona Mills Creek

- Pomona Mills Creek had numerous steel sheet pile grade control weirs. The weirs present issues with fish passage when functioning, and eventually become outflanked when not functioning.

Pomona Mills Creek

- Cobbled together triple culvert (1.8 m, 1.2 m, 0.9 m diameters) crossing of Pomona Mills Creek in Thornhill, owned by City of Markham

- Culverts were rusting out, and erosion was present both upstream and downstream of culvert

Pomona Mills Creek

- The City desired to remove the culvert and weirs, and replace with a more natural channel system with a pedestrian bridge
- Design in 2010-2011, Tender and Construction 2012-2013
- Constraints on design included hydro poles, Region owned sanitary sewer parallel to Creek, City owned watermain crossing Creek
- Significant grading constraints based on valley slopes, and adjacent trail connections
- Construction required helical piles for bridge abutments and significant wing walls to meet grades and maintain trails
- Worksite was on a flashy urban system, presenting construction challenges

Pomona Mills Creek

- Culverts were replaced by a 16 m long, 3 m wide pedestrian bridge

Pomona Mills Creek

- The Creek was opened up through the new bridge as much as possible, reducing erosive forces
- Photo is after July 8, 2013 event

Pomona Mills Creek

- Sheet steel weirs were pulled or cut off at grade and banks cut back to reconnect watercourse with floodplain. Pool/riffle sequences constructed to maintain grade control

Pomona Mills Creek

- Bridge and removal of 2 weirs completed in early 2013
- A total of 9 more weirs were removed in late 2013 and 2014
- Improved fish passage and vegetation
- Mitigated erosion, protecting path
- After construction of one of the weirs, erosion occurred immediately upstream.
- **Lessons learned: Hard grade controls can be avoided when banks are cut back to reconnect to floodplain. Always extend erosion treatment well beyond work area**

Fairy Lake Garden Pond

- Fairy Lake Garden Pond was an on-line pond centrally located in downtown Newmarket. The Pond was viewed by the public as a park-feature although it was located on private property owned by York Region Housing.

IMAGE FROM GOOGLE 2011

Fairy Lake Garden Pond

- The Pond required maintenance dredging as the accumulation of sediment had significantly reduced the aesthetic appeal, volume and function of the pond. The pond did not provide stormwater management to current standards.
- After completion of an alternative assessment, Cole Engineering designed a channel to convey sediment laden surface runoff downstream to Fairy Lake to minimize future maintenance needs, including intermittent scour and transport of any sediment within the channel to Fairy Lake.

Fairy Lake Garden Pond

Fairy Lake Garden Pond

- After completion of an alternative assessment, agency coordination and public consultation, Cole Engineering designed a channel to convey sediment laden surface runoff downstream to Fairy Lake to minimize future maintenance needs, including intermittent scour and transport of any sediment within the channel to Fairy Lake.

Fairy Lake Garden Pond Design

- During the design process comments were received from the public. One comment was that the public did not want the channel to look ‘dark, wild and overgrown’ like a channel that was recently constructed across the road from the site. This comment was incorporated into the design, and a wider channel with more open water, a clear vista and better view from the road was provided. The constructed channel has the park-like feel which was desired.
- A Public Information Centre was held at the senior’s residence prior to construction (Fig. 11). Digital renderings of the design (Fig. 9) were displayed to allow residents to see how the channel should look. Questions about the design and construction were answered.

Fairy Lake Garden Pond Design

- A Public Information Centre was held at the senior's residence prior to construction. Digital renderings of the design were displayed to allow residents to see how the channel would look. Questions about the design and construction were answered.

Fairy Lake Garden Pond Construction

- An experienced contractor, R&M Construction, was retained to complete the work.
- Geogrid and granular material was used to cap the sediment to minimize exported material.

Fairy Lake Garden Pond Construction

- The end result was a channel, including a “no-mow” zone that has vegetated well post-construction.
- Underlying river stone has not displaced, but sediment from upstream areas flows through the site as intended.

Fairy Lake Garden Pond

Pre-construction (2009)

Post-construction (2016)

Fairy Lake Garden Pond Construction

- Lessons Learned:
  - Work with a good contractor
  - Consider both floodplain hydraulics (big flows) and sediment transport (smaller flows) when modifying floodplains and watercourses

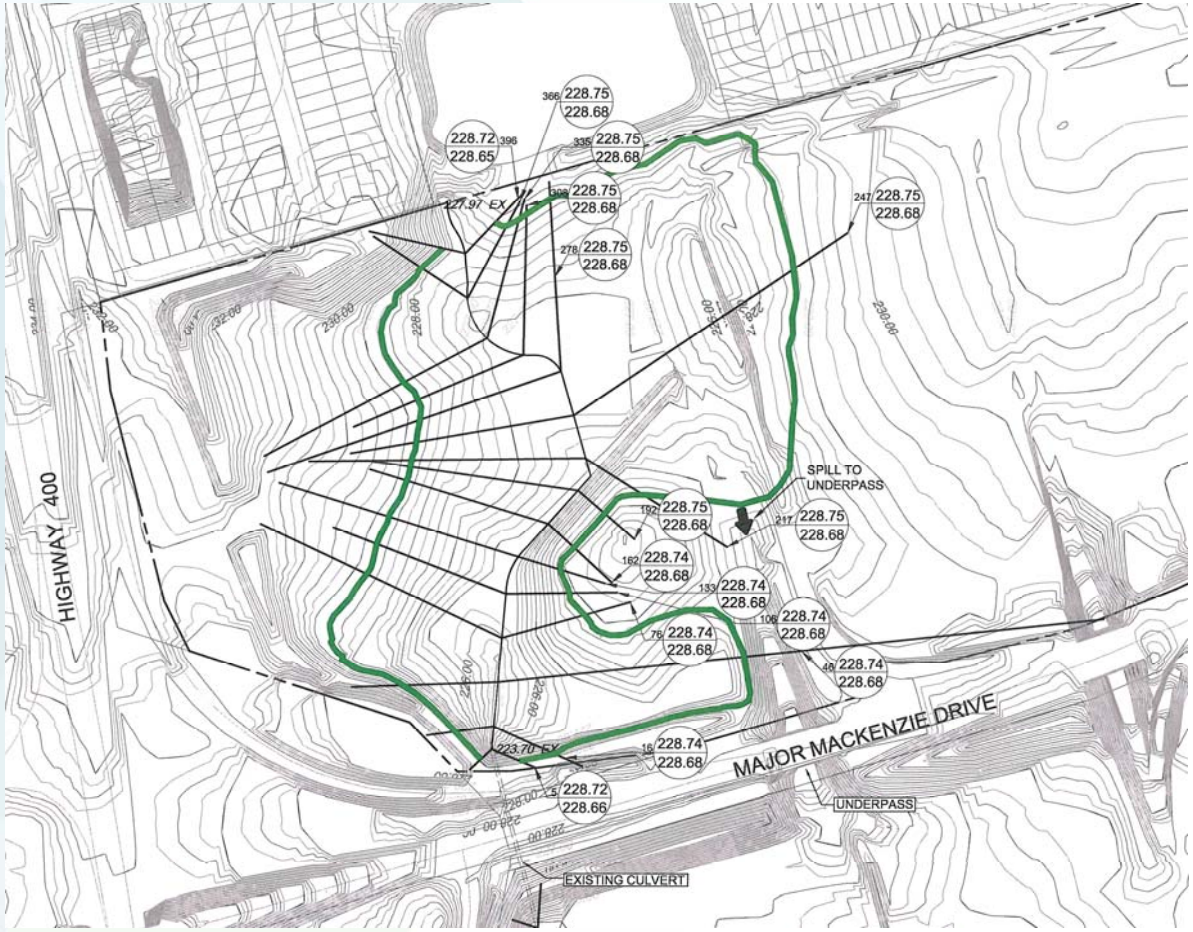
Vaughan Healthcare Precinct

- Adjacent to the site of the new Vaughan Hospital, north of Canada's Wonderland, one of the headwaters of the Don River conveys flow from an upstream area of approximately 170 ha and approximately 30 ha of the Vaughan Healthcare Precinct
- The highly altered (ditched) watercourse flows from the subdivision to the north to Major Mackenzie Drive to the south, and then flows through Canada's Wonderland.
- Floodplain mapping indicated that the culvert under Major Mackenzie Drive had insufficient capacity to convey regulatory flows, resulting in a large un-natural floodplain and spill to the adjacent underpass.

Vaughan Healthcare Precinct Site

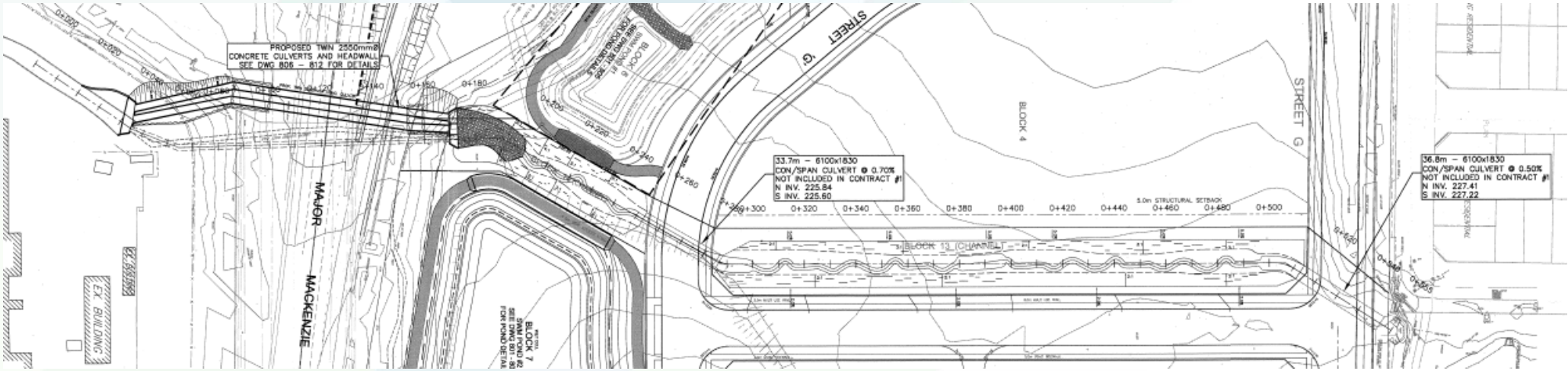
Vaughan Healthcare Precinct Floodplain

- Floodplain mapping indicated that the culvert under Major Mackenzie Drive had insufficient capacity to convey regulatory flows, resulting in a large un-natural floodplain and spill to the adjacent underpass.

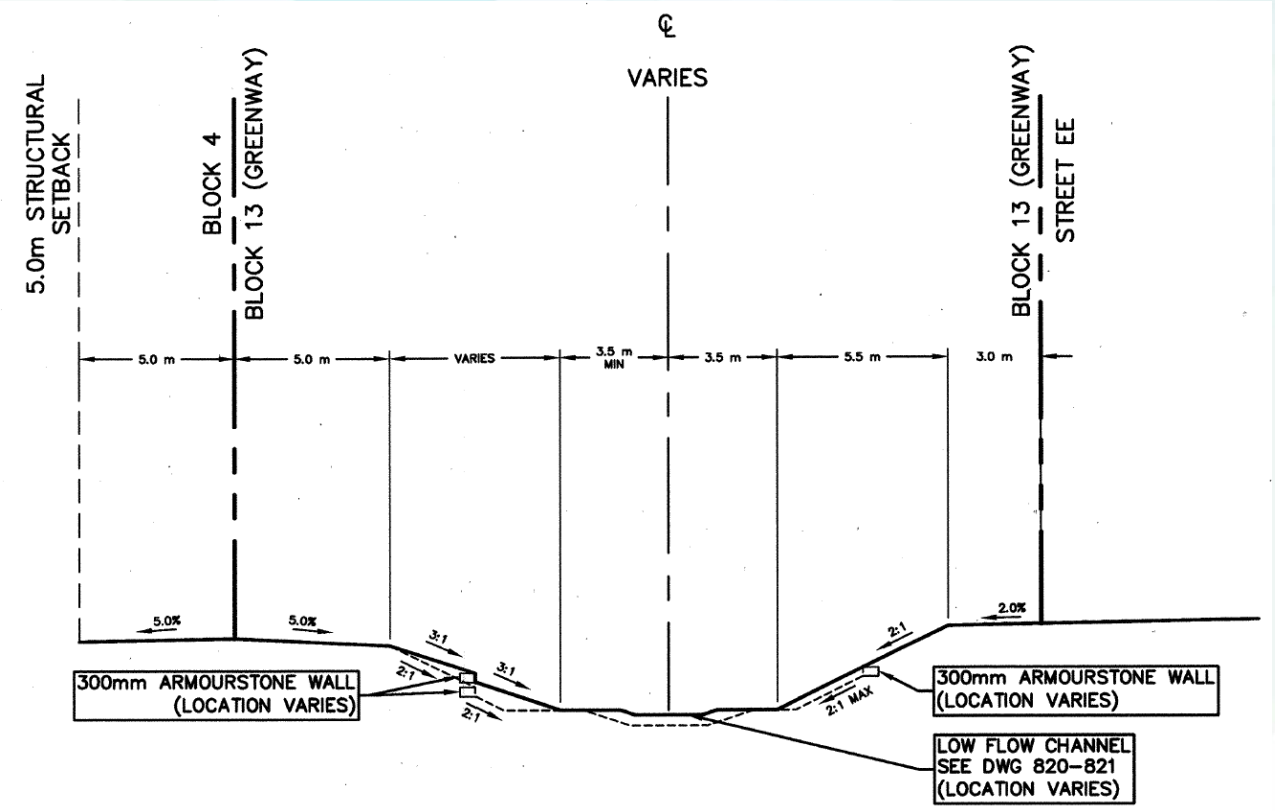


Vaughan Healthcare Precinct

- Regulation of the floodplain “as is” would have sterilized the site, as insufficient space would be available for the new hospital
- Two new 2.25 m (7.5 ft) diameter culverts were tunneled under Major Mackenzie Drive to lower the flood elevation

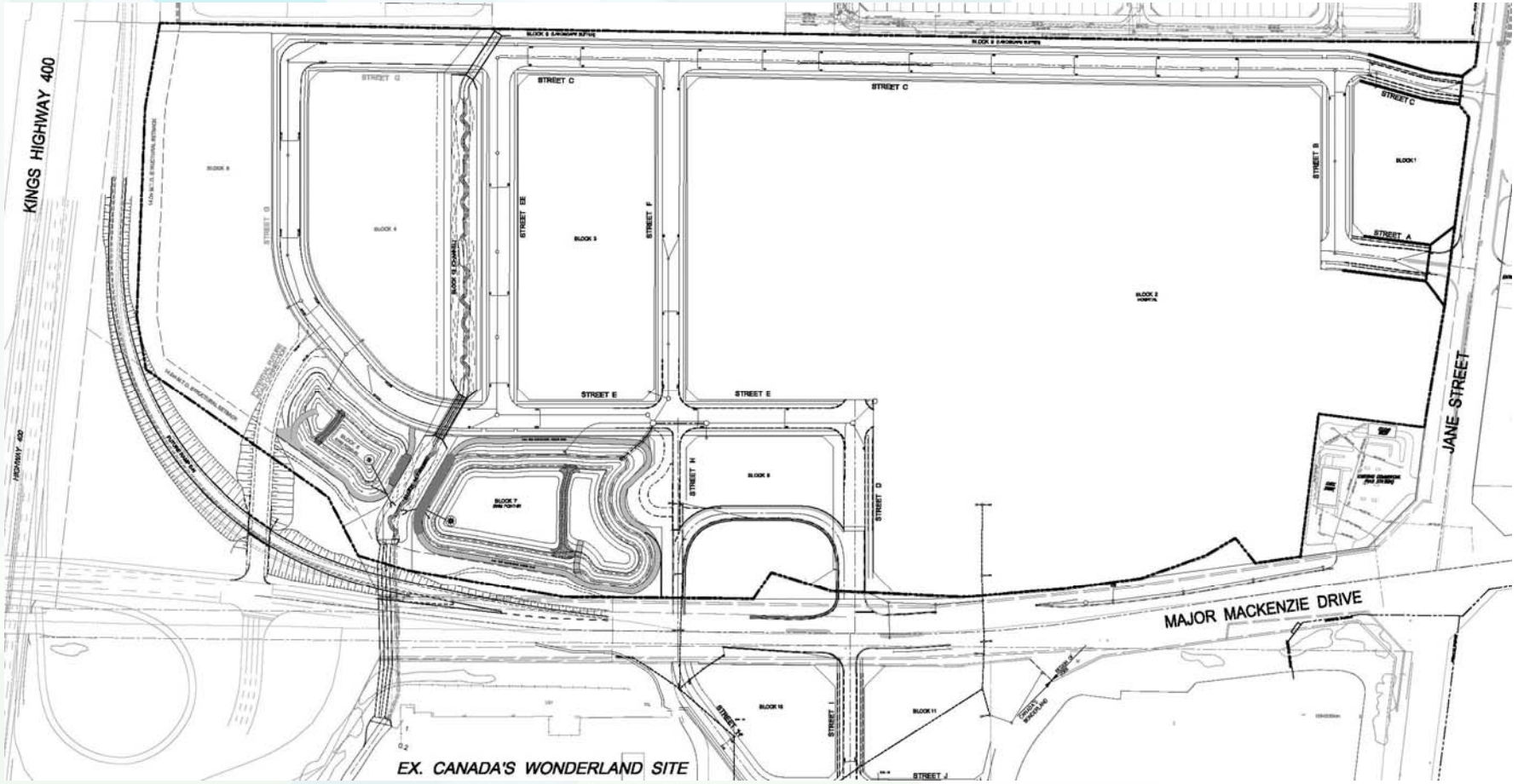


Vaughan Healthcare Precinct



- Working together with Water's Edge Environmental Solutions Team and Beacon Environmental, a realigned watercourse and "greenway" was designed, including two new open bottomed concrete arch culverts

Vaughan Healthcare Precinct



Vaughan Healthcare Precinct

- New Greenway looking downstream towards Major Mackenzie Drive (November 2014)

VHP – Culvert Installation

VHP – Culvert Installation

VHP – Greenway Video (Sept 2016)

Vaughan Healthcare Precinct

- Tunnelling new 2250 mm culverts under Major Mackenzie Drive

VHP Lessons Learned

- This project is an example of an encroachment into an un-natural floodplain, resulting in a more naturalized channel design.
- The Major Mackenzie culverts were installed in 2014, the greenway was constructed in 2014 and Con-Span culverts installed in 2016.
- All elements of the project are functioning well, and extensive monitoring will be undertaken.
- **Lesson learned: Modifications to un-natural floodplains can be successful, but require co-operation between ecologists, fluvial geomorphologists and engineers.**

Summary/Lessons Learned

- From a hydraulic, erosion and ecological standpoint, it is always preferred to avoid encroaching on floodplains
- For watercourse restorations, it is desirable to reconnect floodplains, and to remove encroachments
- However, sometimes other design constraints prevent removal of encroachments or even necessitate further encroachment
- Successful projects can be completed, but require a multi-disciplinary team of engineers, ecologists and fluvial geomorphologists