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Merging Flood Protection with Brownfield Redevelopment

Toronto Case Studies

Flood Risks in Toronto

Flood Protection Needs

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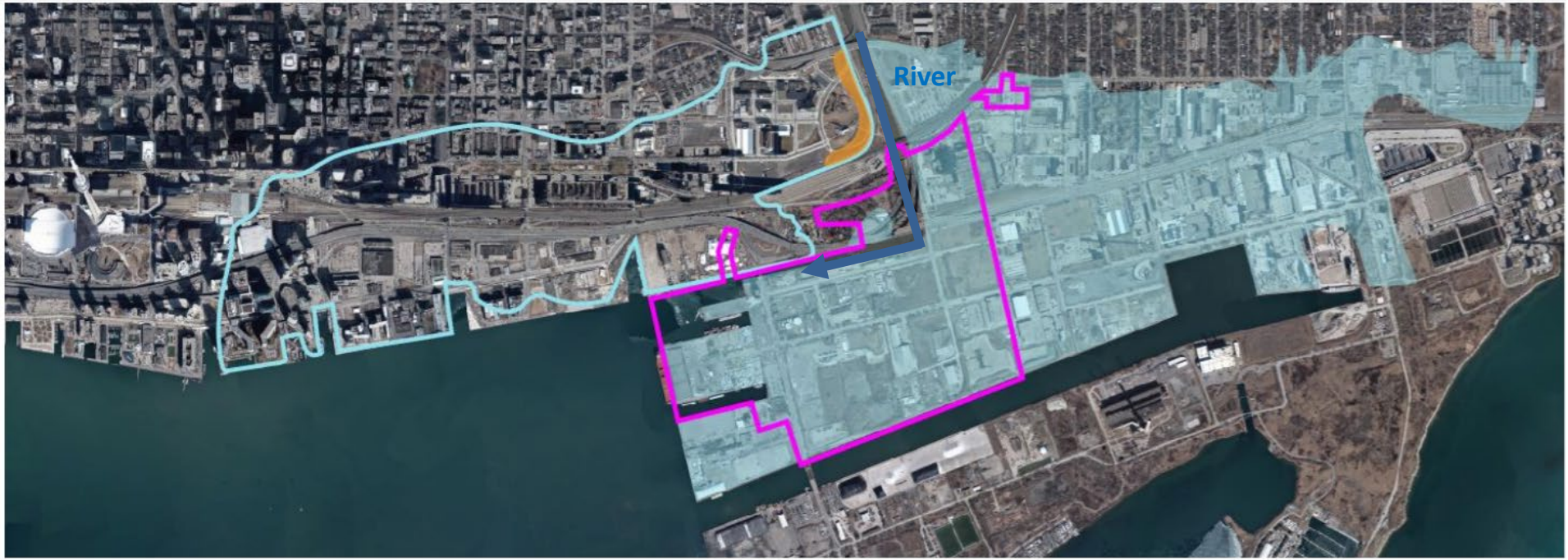

Case Study: West Don Lands Redevelopment

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- 6,000 new residential units, 20% affordable housing
- Abundant employment and commercial space
- 9.3 hectares of parks
- Space for elementary school and child-care, college residence, YMCA, indigenous health care centre
- Preservation of heritage buildings
- Build out 2011 to 2025

Where's the Money?

- Toronto awarded Pan Am/Parapan Am Games in 2009 giving the project a Firm Deadline
- Land owned by the Province to be used for the Athlete's Village
- Three levels of gov't: $135M for public realm, infrastructure and flood protection
- Province: $550M for Athlete's Village
- Public-Private Partnership

Environmental Work

- $10M environmental consulting services
  - 8 Risk Assessments
  - Remediation on 6 properties
  - 11 Environmental Land Permits
- Land Use Controls throughout
- Ongoing Long Term Environmental Oversite

Last Ten Years of Development

Brownie Awards

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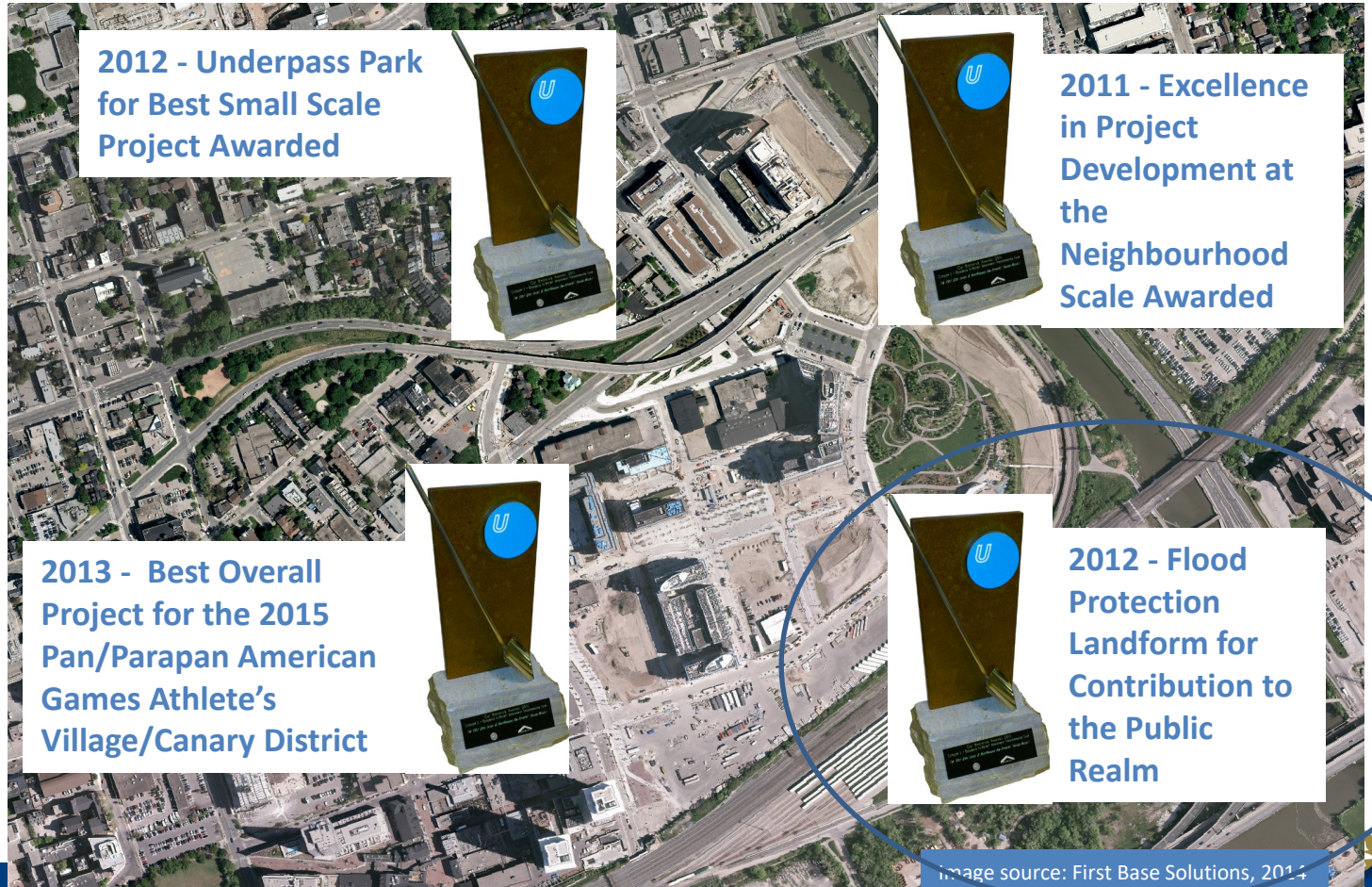

Image source: First Base Solutions, 201

Case Study: Villiers Island Precinct

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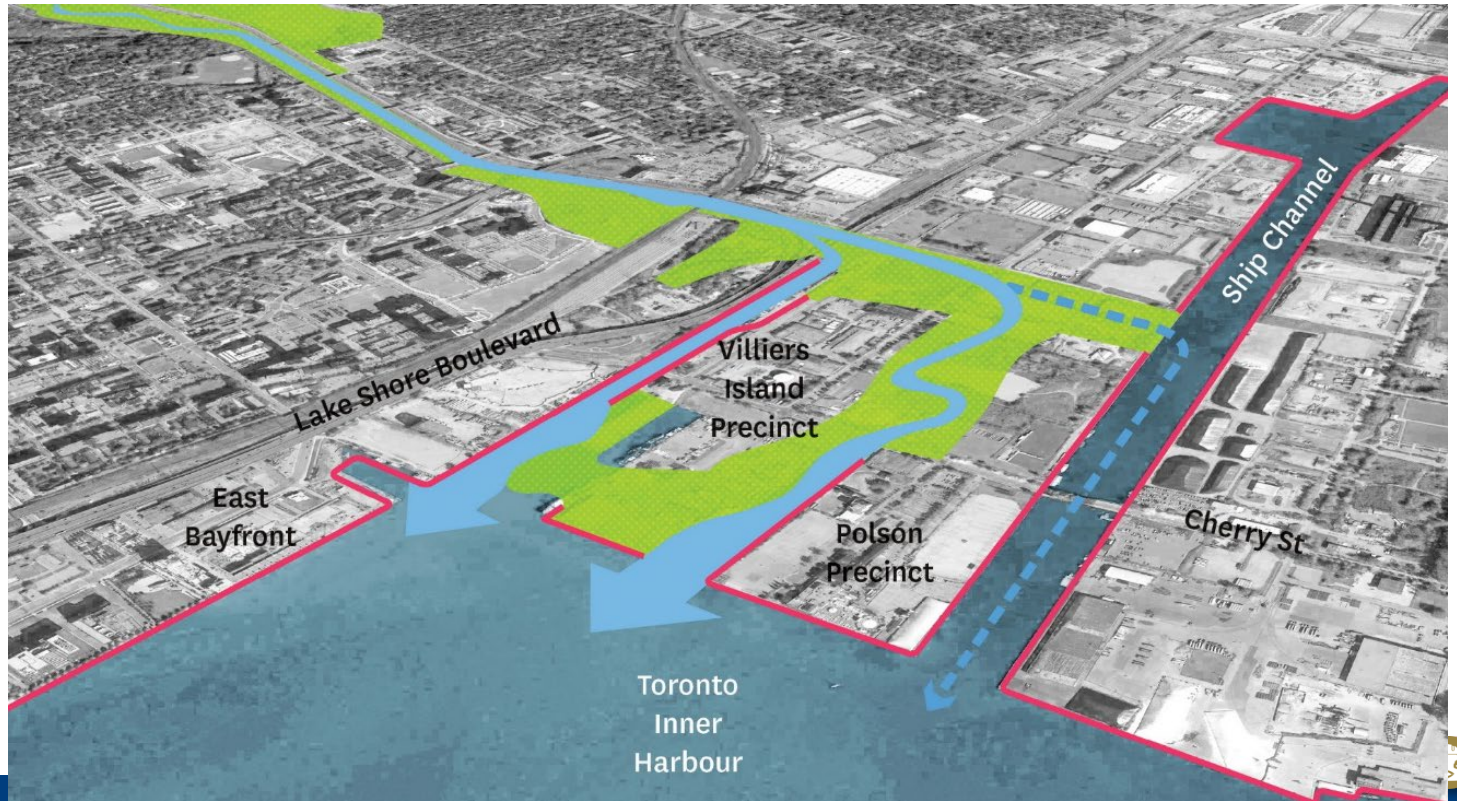

Brownfield Redevelopment

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4,865 units

8,200-10,700 people

2,900 jobs

340-415 people+jobs/ha

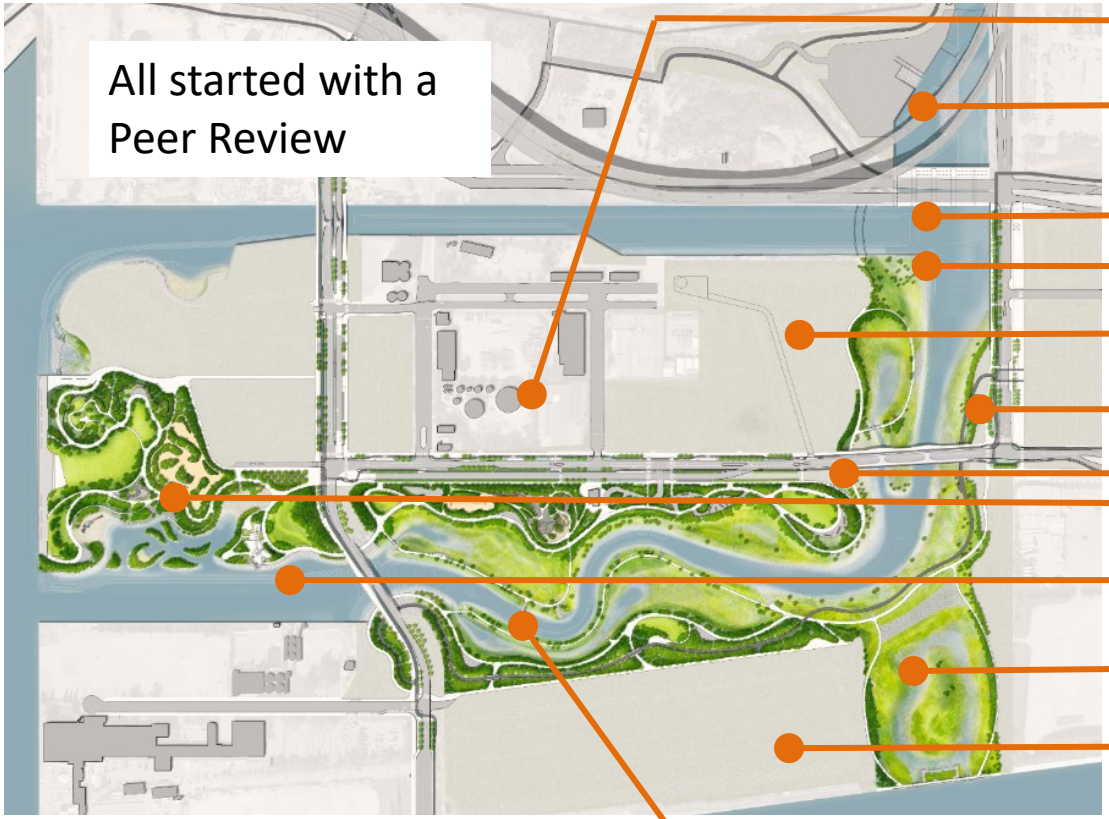
3km of waterfront access

11.2 ha of parkland

More Money?

- Flood protection driver
- $1.25B - funded by three levels of government. Flood protection only.
- Land owned by the City, Waterfront Toronto and private
- Argued Rate of Return justified expenditure:
  - Positive return on investment
  - construction and future development in the region will add $5.1 billion to the Canadian economy
  - $1.9 billion in government revenues (taxes)

Geosyntec Scope



- Site wide Groundwater Model
- Dredging and RMM design
- River Enviro Long Term Plan
- Plug design
- Interim Fill design
- Flood Protection Landform design
- Cutoff Wall design
- Parkland geotechnical design
- Lake RMM Design
- River RMM Design
- Bioremediation Peer Review
- Dewatering Estimation

Risk Management Measures/Land Use Controls

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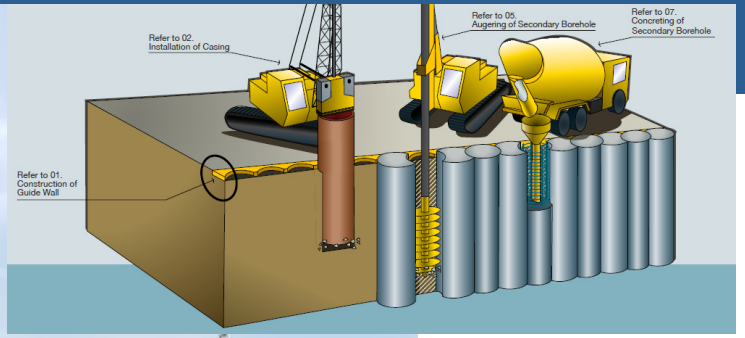
Major design challenge:

1) **limit the amount of groundwater and surface water infiltration into construction space**
2) **provide construction support for deep river valley excavation**
3) **facilitate placement of river finishes in dry condition**
4) **provide long term vertical RMM to prevent recontamination of the newly constructed river valley and prevent contaminant migration back into new river valley**

Secant pile walls were constructed along 1,100 m river valley to provide interim hydraulic controls for construction and a long-term vertical barrier for contaminants left in place

Cutoff Wall

- Secant Piles on either side of the central river – approx. 1 km
- Concrete Secant Pile walls with over 800 overlapping piles drilled into bedrock (20 to 40 metres deep)
- A few sections will be left exposed as park features; the remainder will be buried under layers of aggregate, planting soil, wetland material



Slurry Wall

- Bentonite slurry wall on either side of the east and north portion of river
- Approximate 2 km of wall

Horizontal Barrier

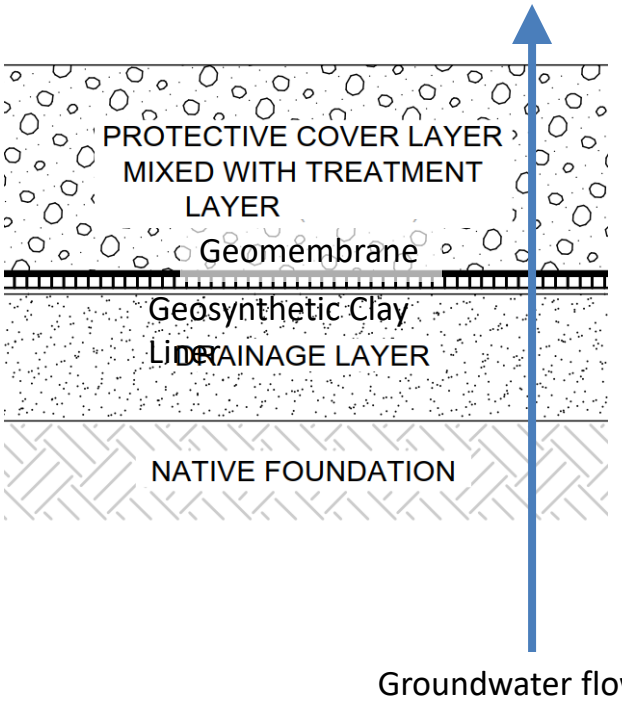
Barriers (vert/horiz) serves two functions: environmental protection and enabling dry excavation.

The horizontal barrier lines the river valley to contain impacted soil and groundwater.

Designed with Capsim/ Pollute Model for 100 year lifespan

Multi-composite system comprised of:

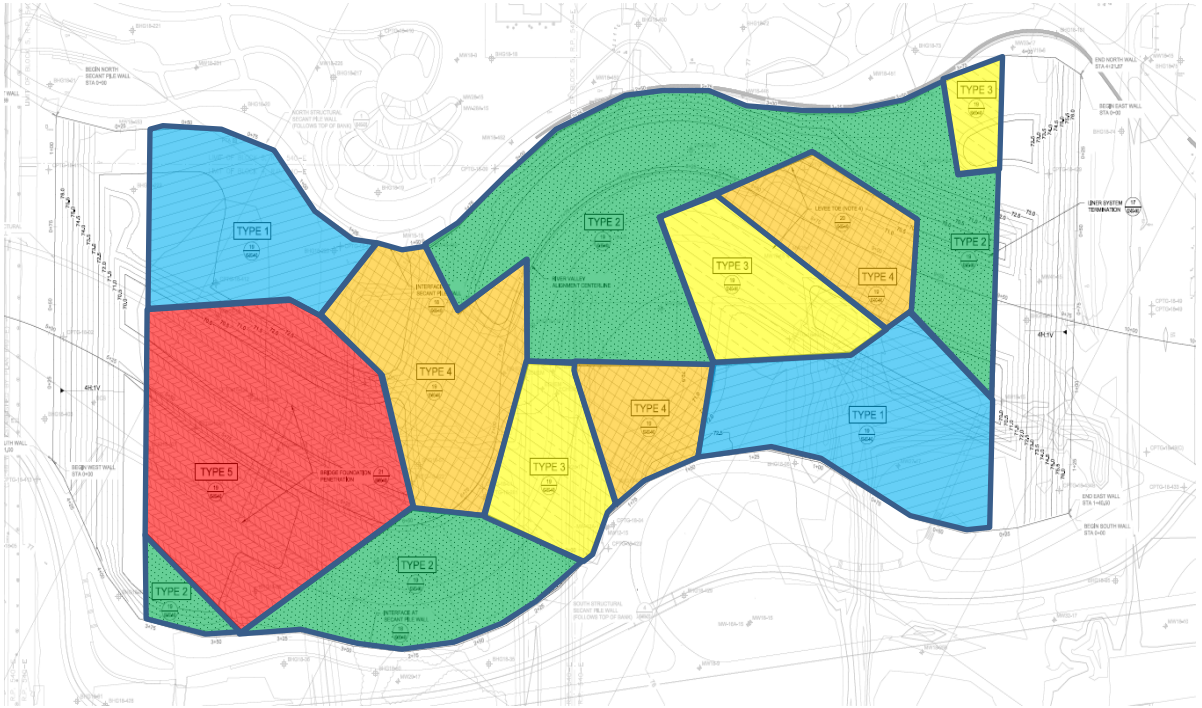
- Drainage Layer
- Impermeable Barrier
- Reactive Treatment Layer (GAC)



GCL/Barrier

-varying dosages of reactive carbon based on underlying nature and extent of contamination.

- Multiple interpolation tools used to assign the appropriately conservative design



Horizontal Barriers

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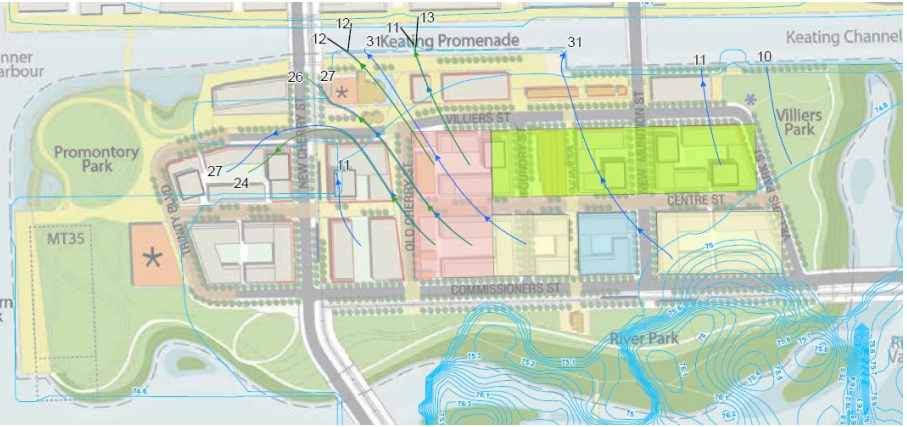
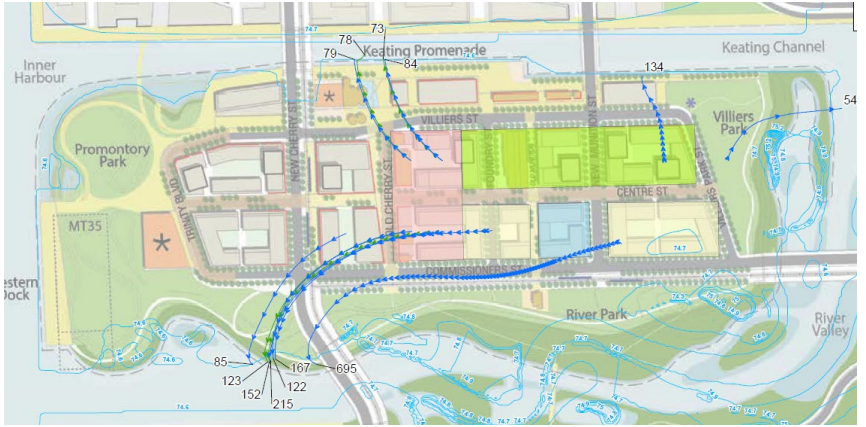
Approximately 52,000 m2 of horizontal barrier (5.2 hectares/12 acres)

Area-wide Groundwater Model



Pre-River Construction



Post-River Construction

Before and after groundwater conditions using a site wide groundwater model to demonstrate efficacy to regulators

- Demonstration of containment of groundwater and lengthening the flow paths


Baseflow

Takeaways

- **Justify Cost -** Flood Protection and Brownfield Redevelopment can be successful partners but in Canadian experience, need significant public funds
- Address flood risk land's Unique Environmental Challenges through **Integrated Engineered Solutions** that include construction and brownfield redevelopment considerations
- **Be Adaptable** and apply risk management and risk assessment tools
- Robust and rigorous design coupled with transparent and extensive consultation **Builds Trust**

Acknowledgments

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Discussion?

mjanes@geosyntec.com