GMF number	15504
Name of the lead applicant (municipality or other partner)	Toronto Waterfront Revitalization Corporation
Name, title, full address, phone, fax, e-mail of lead technical contact for this Pilot Project	Meggen Janes, Director, Soil and Water Management
Date of the Report	December 2020

1. Introduction

The Port Land Flood Protection (PLFP) Project Treatment Technology Evaluation Program was led by staff from Waterfront Toronto, with input from numerous consultants, the City of Toronto, and the Toronto and Region Conservation Authority.

2. The Pilot Project

The PLFP project is one of the most significant active brownfield redevelopment projects in Canada. The overall goal is to transform 356 hectares of flood-prone, under-utilized commercial/industrial land into a vibrant mixed-use community. The overall scope of the project involves the construction of a new, naturalized mouth for the Don River, along with associated flood-protection infrastructure to allow for redevelopment of the study area. Current (2019) estimates include 1,494,000 m^3 of excavation, and 1,068,000 m^3 of fill placement.

To minimize the environmental and social impacts of the PLFP project, innovative technologies were considered to minimize the volumes of soil exported from the site because of chemical contamination and/or geotechnical properties. In addition, potential technologies for the treatment of dewatering effluent were also considered. The first part of the project included bench scale tests of eleven technologies with limited quantities of soil, groundwater, and hydrocarbon products from the site. Each of the project teams was required to produce documentation of the methodology for their technology along with verification of the results through laboratory testing of soil and water chemistry and/or geotechnical properties of the final products.

Following the bench-scale testing program, Waterfront Toronto considered the bench scale test results along with an evaluation of the probability of success within the site-specific technical, schedule, and budgetary constraints of the PLFP Project. The following six technologies were selected for pilot scale testing:

1. Chemical Soil Stabilization
2. Block and Adsorb
3. Surfactant and Oxidant Treatment
4. STAR® (in-situ thermal treatment)
5. STARx® (ex-situ thermal treatment)
6. Biodegradation

a) Did the pilot project include a methodology or approach for verifying or testing the performance of the technology or solution? Please respond Yes or No.

Yes [X] No [ ]

Over a dozen environmental consultants and independent testing laboratories were utilized to evaluate the performance of the technologies.

3. Pilot Project Results:

The following technologies are being implemented for the full scale remedial treatment of soil (and groundwater where required):

- STARx for highly impacted soils;
- Enhanced bio-remediation for treatment of lightly impacted soils, and/or soils subject to higher criteria thresholds; and
- Use of activated carbon as a pervious reactive layer. Although this was not specifically tested, activated carbon was shown to be effective as part of the Block and Absorb testing process.

a) Please complete the following table that was part of your pilot project application with the actual results from your pilot project. Please also provide the page numbers where the environmental results of the pilot project can be found in the final report.

Environmental results table

A	B	C	D	E	F	G
Project defined parameter	**Units relevant to performance of parameter**	**Baseline performance before project**	**Anticipated performance after project completion**	**Revised Baseline Performance before Project**	**Revised Anticipated Performance after Project Completion**	**Actual Performance of the Project**
Land made available for re-use	ha	0	0	0	0	0
Soil, Surface Water and Groundwater Remediated or Risk Managed	m^3	0	100	100	100	863
Waste Diverted from Landfill (weight)	tonnes	0	200	200	200	176*

* Based on STARx and Bioremediation pilot tests only. Other pilot tests are completed in-situ.

Utilization of one or more technologies from this evaluation program will reduce the number of off-site truck trips by approximately 25,000 one-way trips of a period of three years. This will have a significant positive impact on local traffic, and significantly reduce the carbon emissions associated with the project. There will be a carbon cost for the treatment, regardless of the process(es) utilized at full scale, but this will be much less than the impacts from trucking. The net carbon savings will be assessed as the full-scale project proceeds.

Through remediation and risk management, vast amount of land will be made available for use. Villiers Island will include 35.5 acres of development land with 5.6 million sf of development density, including

4.5 million sf of residential (4,820 units) and 1.1 million sf of non-residential density. 29 hectares of naturalized area will be created in the new river valley, and an additional 16 hectares of parkland is intended in Villiers Island and to the south of the new river channel.

Soil, surface water or groundwater remediated or risk managed to complete the project will affect the 29 hectares of the new river valley (wetland habitat and aquatic habitat) and 16 hectares of parkland in Villiers Island and to the south of the new river channel as well as new risk managed road of Cherry, Commissioners and Villiers Streets. Approximately 1.4 million m3 of soil will be excavated to create the new river channel; within the excavation footprint deeper contaminants over 200,000 m2 area (or 400,000 m3 volume of material) will likely be risk managed in place. It is estimated that 80% of the excavated soil can be treated for reuse within the Project. Outside of the river channel, 16 hectares of parkland will be risk managed (assuming a contaminated depth of 5 m, the parkland volume of soil risk managed is 800,000m3). The total soil and groundwater remediated or risk managed is approximately 2.16 million m3.

As for the amount of waste diverted from landfill, of the excavated soil from the new river valley, up to 700,000 m3 can be diverted from landfilling by using pre-excavation and post-excavation remediation approaches and reused within the Project. Also, another aspect of the Project includes the land creation used to provide flood protection relief along the existing Keating Channel. The land creation is expected to require 320,000 m3 of fill which will be imported to the site and potentially diverted from landfills or other distant filling locations. Providing an option for fill placement closer to sources of the fill provides immediate benefit of reducing longer distance truck routing and GHG emissions with longer haul. The total waste diverted from landfill is approximately 1,020,000 m3 or 2,040,000 tonnes.

Figure 1 – Economic benefits

A	B	C
Economic benefit	**As described in your GMF application**	**Anticipated economic benefits of the pilot project at full scale based on pilot experience.** If the result is different than what was expected in the application form, please indicate **why**.
Increased return on investment		
Deferred or avoided capital expenditures	Cost savings from soil reuse.	Cost savings from soil reuse. Up to 700,000 m3 can be diverted from landfilling by using pre-excavation and post-excavation remediation approaches and reused within the Project.
Decrease in facility operating or maintenance costs		
Extended lifespan for facility		
Increased municipal revenue streams (e.g. property tax, user fees, etc.)		
Lower taxes		

Stimulus for local economy (use of local business, capacity for local business development)		Implementation of remediation and soil reuse will provide significant revenue to local businesses, both contractors and professional consultants.
Increased employment options or job retention		
Increased transit ridership		
Attraction of new businesses		
Other (please specify)		

Figure 2- Social benefits

A	B	C
Social benefits	**As described in your GMF application**	**Anticipated social benefits of the pilot project at full scale implementation based on pilot experience** If the result is different than what was expected in the application form, please indicate **why.**
Improvements to public health		
Improvements to public safety		
Improvements to community quality of life		
Increased opportunities for community engagement		
Increased public education or awareness		
Community revitalization	Villiers Island Precinct Plan presentation showing community revitalization. New river construction, flood protection creates Villiers Island.	New river construction, flood protection will create Villiers Island, which will unlock about 300 ha of underutilized real estate currently within the floodplain of the Don River
New housing and infrastructure	Villiers Island Precinct Plan presentation showing new housing and infrastructure. New river construction, flood protection creates Villiers Island.	Creation of Villiers Island will unlock 290 ha of land, a large portion of which will include residential, retail and commercial development.
New or enhanced public space or public facilities	Villiers Island Precinct Plan presentation showing new public spaces. New river construction, flood protection creates Villiers Island.	As part of the PLFP project, three new public parklands and water access facilities will be developed for increased recreational opportunities.
Improved access to recreation and physical activities		As part of the PLFP project, three new public parklands and water access facilities will be developed for increased recreational opportunities.
Reduced urban sprawl		Future land development for unlocked floodplain includes high density towers, increasing urban density and reducing need for urban sprawl.
Increased civic pride, ownership and participation		
Improved quality and efficiency of service provision to residents		
Reduced opportunities for crime		
Other (please specify)		

4. Lead Applicant's Next Steps

Waterfront Toronto is proceeding with the PLFP project and is implementing one or more of the remedial technologies assessed through the pilot program such that impacted soils can be reused within the project area.

5. Lessons Learned

Waterfront Toronto began this project to facilitate consideration of innovative remedial strategies that might not have been considered otherwise. The key lesson learned is that innovative technologies have the potential to offer unexpected cost and environmental benefits. At full scale, it is challenging to take risks with innovative approaches. Smaller scale testing can provide valuable insights earlier in the process. It is also important to balance innovation and practicality, even at the pilot scale. Key questions proponents should consider are:

1. Degree of innovation – Is this technology already proven; do we need to test it?
2. Potential for implementation – Is this a technology too far out along the innovation spectrum?
3. Requirements for site-specific data – Even if the technology is proven, are site-specific data required to implement it at full-scale? (i.e. physical stabilization – optimal mixtures)

With multiple pilot tests being completed at the same time, it is important to have consistent methodology throughout, spatial separation, and open communication among the different parties involved. Waterfront Toronto and all pilot test vendors had regular coordination meeting throughout the duration of the pilot test and through these meetings, issues or concerns were resolved promptly.

We would advise others undertake these pilot studies earlier in the site redevelopment process because some technologies may be constrained by other tasks in the overall project plan. For example, the project team became aware that the STAR thermal process requires a soil or other form of cap to be in place, and the PLFP schedule included an early shallow excavation program for the river valley. This early excavation work precluded implementation of this technology.

The main barriers and challenges with the execution of this pilot project were with the schedule. Because the bench and pilot scale testing project was not part of the initial overall project plan, there was insufficient time to properly schedule the work (i.e., slow bioremediation during a cold Canadian winter, and freezing of air lines in the STAR pilot). It was not possible to solve all of the weather issues, but the knowledge gained can be transferred to the full scale implementation work (i.e., no bioremediation scheduled in the winter, insulation of air lines, etc.)

6. Knowledge Sharing

Waterfront Toronto plans to share the results of this pilot study on the PLFP website and with its key partners – the City of Toronto and the Toronto and Region Conservation Authority. By publishing the final report on the project website, the knowledge can be shared with the wider brownfield redevelopment community.
The results of the pilot test projects have been shared with different parties and at a number of different conferences by Waterfront Toronto and the pilot test vendors, including:

- City of Richmond, BC
- Dutch civil-engineering press
- The Arizona State University

- 2018 Remtech Conference
- 2018 RPIC
- 2018 SMART Remediation
- 2019 Society of Environmental Toxicology and Chemistry (SETAC) Conference
- MECP Standard Development Branch Training Day
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Several site tours were completed during the pilot test phase and representatives from Environment Canada, Ministry of the Environment, City of Toronto, and Toronto and Region Conservation Authority were in attendance. Pilot test results were also shared through guest lectures to university students at Ryerson and University of Toronto. Students at Guelph University completed a Capstone Project on full scale application of the some of the pilot test programs using the pilot test results. There are also plans to publish papers in scientific journals and two papers have been accepted to date

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