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# RANDLE REEF SEDIMENT REMEDIATION: CURRENT STATUS OF CONSTRUCTION AND NEXT STEPS

## ABSTRACT

Along the shores of Lake Ontario, Randle Reef at Hamilton Harbour, Canada, is a listed Area of Concern (AOC) under the Great Lakes Water Quality Agreement (GLWQA). In fact, with a sediment volume of 695,000 cubic metres, it is the largest site contaminated with Polycyclic Aromatic Hydrocarbon (PAH) on the Canadian side of the Great Lakes and in the entire country. The remediation project involves the completion of three stages of construction to manage PAH and heavy metal-contaminated sediments. The project is being led by Environment and Climate Change Canada and is jointly funded by Canada, Ontario, the City of Hamilton, the Hamilton Port Authority (HPA), U.S. Steel Canada, the City of Burlington and the Regional Municipality of Halton.

The project's first stage involves constructing a 6.2 hectare Engineered Containment Facility (ECF) around the most severely contaminated sediments. Stage 2 comprises the hydraulic dredging of surrounding contaminated sediments and placement of the dredged sediment within the ECF. Thin layer backfill will be used to manage residuals generated during dredging. A thin layer cap and an isolation cap will be used to manage undredged contaminated sediments. Stage 3

involves capping of the ECF and consolidation of the dredged sediment contained within. The completion of all three stages of the project is anticipated to take eight years.

Public Works and Government Services Canada awarded the Stage 1 contract for the construction of the ECF in 2015 and work is underway. The project includes the reconstruction of the adjacent Pier 15 wall led by HPA to permit future environmental dredging, and started in September of 2015, the project is now complete. Fabrication of the steel pilings for the ECF and mobilisation to the project staging area was undertaken in the fall 2015 to start ECF construction in 2016. This article will present an overview of the Randle Reef Sediment Remediation Project, the design of the ECF, as well as showcase the completed Pier 15 rehabilitation and ECF steel sheet pile installation (Figure 1).

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Above: Randle Reef at Lake Ontario's Hamilton Harbour was listed as an Area of Concern in 1985 under the Great Lakes Water Quality Agreement. Photo McNally Construction Inc.

## INTRODUCTION

Located within Lake Ontario's Hamilton Harbour, Canada, Randle Reef swells with 695,000 cubic metres of Polycyclic Aromatic Hydrocarbon (PAH) contaminated sediment, making it the largest contaminated sediment site in Canada. As the country's largest port on the Great Lakes, Hamilton Harbour has a long history of industrial activity, especially steel-making. In 1985 the port was designated as an Area of Concern (AOC) under the Great Lakes Water Quality Agreement (GLWQA) between the United States and Canada, with the environmental effects of the contaminated sediment serving a key reason for this designation. As part of its obligations under the GLWQA to address AOC issues, the Government of Canada works with its partners to achieve the required remediation goals.

The Randle Reef Sediment Remediation project is led by Environment and Climate Change Canada and is jointly funded by Canada, Ontario, the City of Hamilton, the Hamilton Port Authority (HPA), U.S. Steel Canada, the City of Burlington and the Regional Municipality of Halton. The Randle Reef site itself is a water lot owned by the HPA, a crown corporation affiliated with the Government of Canada.



Figure 1. Installation of the face wall sheet pile at Pier 15 East (Heddle Marine) on 7 October 2015. Photo Riggs Engineering Ltd.

**STATUS UPDATE:** *Dated 15 June 2016, the following paper represents an overview and current status of the Randle Reef Sediment Remediation Project. As the paper was produced in 2016, it is now out of date in terms of the current status of the project. The project is currently in its second year of Stage 1, the construction of the 6.2 hectare Engineered Containment Facility and has an expected completion date of December 2017. All the sheet piles that comprise the facility have now been installed and driven to grade and mechanical dredging has started to remove contaminated sediments from between the walls. Stage 2, hydraulic dredging of the contaminated sediments surrounding the facility, was successfully tendered and awarded to the joint venture of Milestone Environmental Contracting Inc. and Fraser River Pile and Dredge (GP) Inc. in June 2017. Stage 2 is expected to start in May 2018 and be complete by December 2019.*

### SITE CHARACTERISATION

Sediment-related investigations, assessments and remediation plans for the Randle Reef site date back to the 1970s. After four decades of sampling work, nearly 700 sediment samples have been collected from the site alongside on-going efforts to continually optimise the project design. Delineation of the site has shifted significantly over the years. The site itself is located within an active working harbour. The various historical inputs and activities within the area have made the sediment composition quite heterogeneous. Early delineation of the contamination problem focused on the by-product of nearby steel mills. The initial focus was on an area nicknamed the ‘whale tail’ named for its form. However as further sampling was conducted and the understanding of the issue increased so did the boundary of the area.

In addition to the mills’ outflows, other long-

ceased industrial activities impacted sediment quality. A tributary adjacent to the harbour and Randle Reef site, Sherman inlet, was once lined with facilities such as tanneries and oil refineries. Combined sewers and other former industrial operations, including a coal gasification plant, discharged into the inlet. Large portions of Hamilton Harbour were infilled, often using slag as the primary material, in order to expand industrial lands. Bulk-storage of coal and coke used for steel production is still prevalent within the harbour’s confines.

Randle Reef area is a sheltered embayment within the harbour which for the most part has contained the most severe contamination and limited mitigation to a slow outward spread over many years. Within the site itself, activities over the past 150 years such as dredging, deposition of dredge spoils, anchor drag and vessel scour resulted in high



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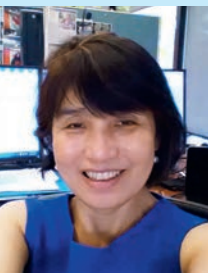
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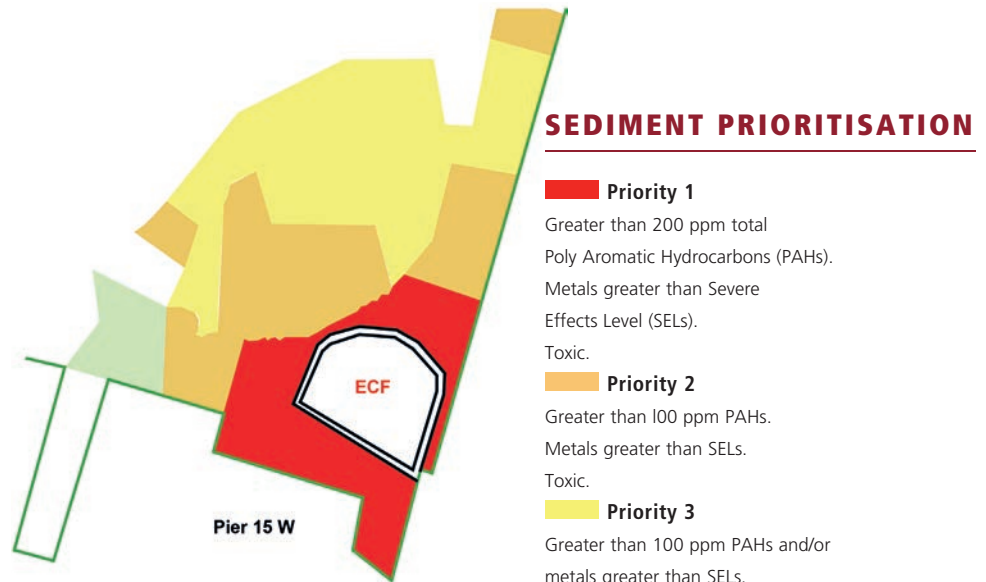


Figure 2. Four areas of prioritisation were identified for the Randle Reef Sediment Management project.

**SEDIMENT PRIORITISATION**

- Priority 1**  
Greater than 200 ppm total Poly Aromatic Hydrocarbons (PAHs).  
Metals greater than Severe Effects Level (SELS).  
Toxic.
- Priority 2**  
Greater than 100 ppm PAHs.  
Metals greater than SELs.  
Toxic.
- Priority 3**  
Greater than 100 ppm PAHs and/or metals greater than SELs.  
Not toxic.
- Priority 4**  
Less than 100 ppm PAHs.  
Metals less than SELs.  
Toxicity not attributed to specific contaminant.

variability in sediment quality from one sampling location to another. Due to coal tar being a large source of contamination in pockets throughout this area, the pollutant also adds to the variability between sampling locations. Despite all of these challenges, a successful delineation and prioritisation of Randle Reef sediments for remediation was established utilising a combination of sediment sampling and toxicity tests (Milani, 2006a, 2006b).

**SITE PRIORITISATION**

Management of the Randle Reef sediment involves the use of blended sediment management remedies and is based upon this prioritisation. All Priority 1 and 2 sediments are to be placed within an Engineered Containment Facility (ECF). Priority 3 sediments are to be placed into the ECF depending on remaining capacity. Priority 3 sediment not placed in the ECF will be managed by Thin Layer Capping. Priority 4 areas have toxicity less than the clean-up threshold criteria and will be left to recover naturally (see Figure 1).

**PROJECT OVERVIEW**

The primary remedial approach – an on-site ECF – for the Randle Reef Sediment

Remediation Project was first detailed in a 2006 Basis of Design report (Blasland, Bouck and Lee, 2006). To manage PAH and heavy metal-contaminated sediments, the remediation project involves the completion of the three stages.

The three stages are being led and managed by the Government of Canada with Environment and Climate Change Canada as the project leader and Public Works and Government Services Canada as Project Manager. Public Works and Government Services Canada will take temporary possession of the project site from the HPA to undertake this work. To permit dredging of the contaminated sediments near Pier 15, the project also includes an HPA-led project to reconstruct the adjacent Pier 15 wall.

**Stage 1**

A 6.2 hectare ECF will be constructed around the most severely contaminated Priority 1 sediments within a double-walled sheet piling structure (see Figure 4). A sealed inner wall will isolate the contaminants from the sides. This sealed environmental wall is driven into the underlying silty clay which isolates the contaminants from below. Mechanical dredging will be utilised to move contaminated sediment



Figure 3. Mechanical dredging moves contaminated sediment from between the double walls of the ECF into the ECF containment cell. Photo McNally Construction Inc.

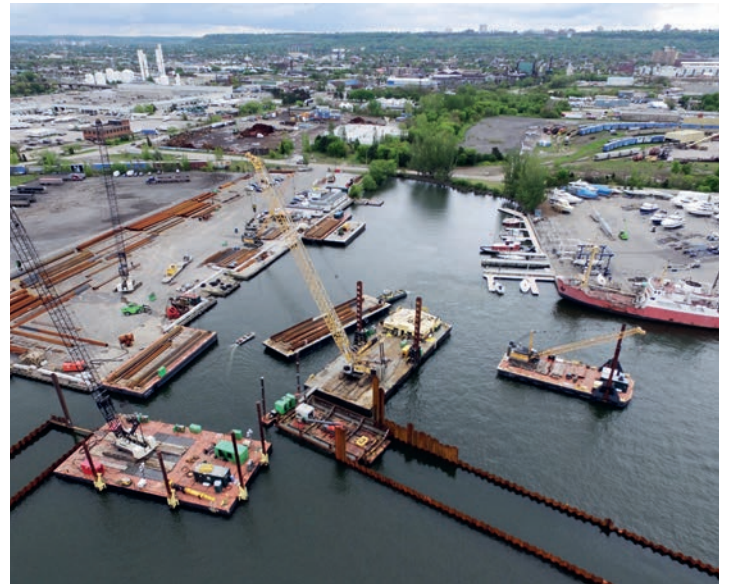


Figure 4. The hydraulic dredging of sediments from the surrounding Priority 1, 2 and 3 will be completed to established dredge design elevations. Photo McNally Construction Inc.

from between the double walls of the ECF into the ECF containment cell (Riggs Engineering Ltd., 2014).

For the successful execution of Stage 1, the sealed inner wall is the critical element necessary to isolate the contaminated sediment from the ecosystem (see Figure 2). The inner wall serves as an ‘anchor wall’ for the outer ‘face wall’. The face wall protects the ECF’s containment cell and will eventually form the working dock’s wall.

### Stage 2

The hydraulic dredging of sediments from the surrounding Priority 1, 2 and 3 will be completed to established dredge design



Figure 5. Construction of the 6.2 hectare Engineered Containment Facility. Photo McNally Construction Inc.

elevations (see Figure 3). Bathymetric surveys will be used to confirm the successful completion. Verification sampling will also be used to ensure the completion of the hydraulic dredging has successfully removed the contaminated sediment. If residual contaminated sediment remains in place, second pass dredging and/or thin layer back-filling will be conducted. A focus will be placed on the need to minimise the disturbance and re-suspension of the contaminated sediment. The oversight of turbidity will play a key role in monitoring the re-suspension of sediment within the work zone.

A thin layer cap will be applied to undredged Priority 3 sediment and an isolation cap will be used to manage undredged contaminated Priority 1 sediments within the channel located between the ECF and the US Steel Canada dock wall.

Effective dewatering of sediments placed within the ECF and the associated treatment of the water and effluent coming out of the ECF will be a key factor during Stage 2. As the ECF fills and the ‘holding capacity’ for water within the main ECF cell is reduced, the water treatment system will be faced with an influent with higher Total Suspended Solids (TSS).

Water and effluent treatment will take place over several steps. Initial settling will take place within the ECF itself. Effluent from the ECF will flow into a final settling cell. This cell will be located within a lined area between the ECF double walls and if required, a polymer additive will be used to enhance settling. Excess effluent discharged from the final settling cell will be pumped through a sand filter to remove any remaining TSS. The final step will be activated carbon filters to address any remaining dissolved contaminants. Treated water will be monitored at the discharge point to ensure environmental compliance before being discharged back into the harbour.

### Stage 3

Further consolidation of the dredged sediment contained within the ECF, construction of the ECF cap and surfacing of the cap for future port use of the facility takes place.

A critical environmental component, the ECF cap includes the hydraulic barrier to isolate the contaminants from above. This barrier or liner forms the final component for the isolation of the contaminated sediment. The ECF cap also includes an under liner and over liner drainage system related to this barrier.

The under liner drainage system includes wick



Figure 6. A rendering shows the ECF in its completed state. Image Environment and Climate Change Canada

drains inserted into the dredged sediment to aid in consolidation, geotextile membrane layers, horizontal drainage strips, perforated piping around the ECF perimeter and the associated riser to access the piping. As the contaminated sediment within the ECF consolidates over time, contaminated pore water will be squeezed out. The under liner drainage system directs this pore water to perimeter piping from which it will be either pumped and treated or transported to a treatment facility. The over liner drainage system is a secondary system due to the fact the ECF will be surfaced with asphalt and also have a surface water drainage system consisting of catch basins, trench drains and overland drainage across paved areas.

The over liner drainage system handles any surface water which penetrates the cap and prevents this water from sitting atop the barrier and potentially leaking through. Consolidation of the sediment within the ECF will require the use of pre-load material. A selected material will be temporarily stockpiled atop the ECF and the load will help speed up the consolidation process. This is necessary in order to achieve the loading requirements for future port use within the timeframe of the project (see Figure 5).

Upon project completion, the ECF and all project-related lands will revert back to HPA ownership. The HPA will oversee the long-term monitoring and maintenance of both the ECF and the isolation cap.

### CURRENT STATUS AND NEXT STEPS

The completion of all three stages of the project is anticipated to take eight years. Steel production, fabrication and delivery to the site

were completed in the fall/winter of 2015-16 to supply the sheet pile for both Pier 15 and ECF construction. Steel coil for the project was produced by US Steel Canada at their Nanticoke, Ontario mill. The steel coil was fabricated into anchor wall and face wall sheet pile by mills in Ontario and Mississippi, respectively. Produced by US Steel Canada at its Nanticoke, Ontario mill, steel coil was fabricated into anchor wall and face wall sheet pile by mills in Ontario and Mississippi, respectively. To be ready in time for the construction of Pier 15 and the ECF, all steel production, fabrication and delivery to the site was completed by early 2016.

The Pier 15 reconstruction was awarded by the HPA to Dean Construction in the fall of 2015 and was completed by spring 2016. In fall 2015, Public Works and Government Services Canada (PWGSC) was awarded the Stage 1 contract for the construction of the ECF to McNally International Inc. and work is currently underway. Riggs Engineering was awarded the construction engineering contract. As the project proceeds towards the completion of Stage 1, PWGSC will assess any necessary adjustments to the final design for Stage 2 before proceeding with the procurement process for the Stage 2 construction and Stage 2 and 3 engineering contracts. As Stage 2 nears completion, a similar assessment will take place for Stage 3 construction.

A 15-year-long post-construction monitoring plan is in place to demonstrate the effectiveness of the project. The plan includes biological, chemical and physical monitoring of the facility and the surrounding harbour area. The eventual use of the ECF under HPA

ownership is still unknown but the flexibility of the design will allow for a number of port-related uses. The completion of the Randle Reef Sediment Remediation Project will be one of the last major projects required for de-listing the Hamilton Harbour AOC.

## CONCLUSIONS

The approach to manage Randle Reef contaminated sediments is unique, combining a blended remediation method with a unique partnership between governments, municipalities and local industry.

Led by Environment and Climate Change Canada, the Randle Reef Sediment Remediation Project will result in the remediation of 695,000 cubic metres of PAH contaminated sediment, isolating it from the local ecosystem. Completion of the Randle Reef project will eliminate a significant source of contamination to the Great Lakes, improve the water quality and environmental health of Hamilton Harbour, ultimately setting the stage for the Government of Canada to remove Hamilton Harbour from the list of Great Lakes Areas of Concern.

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