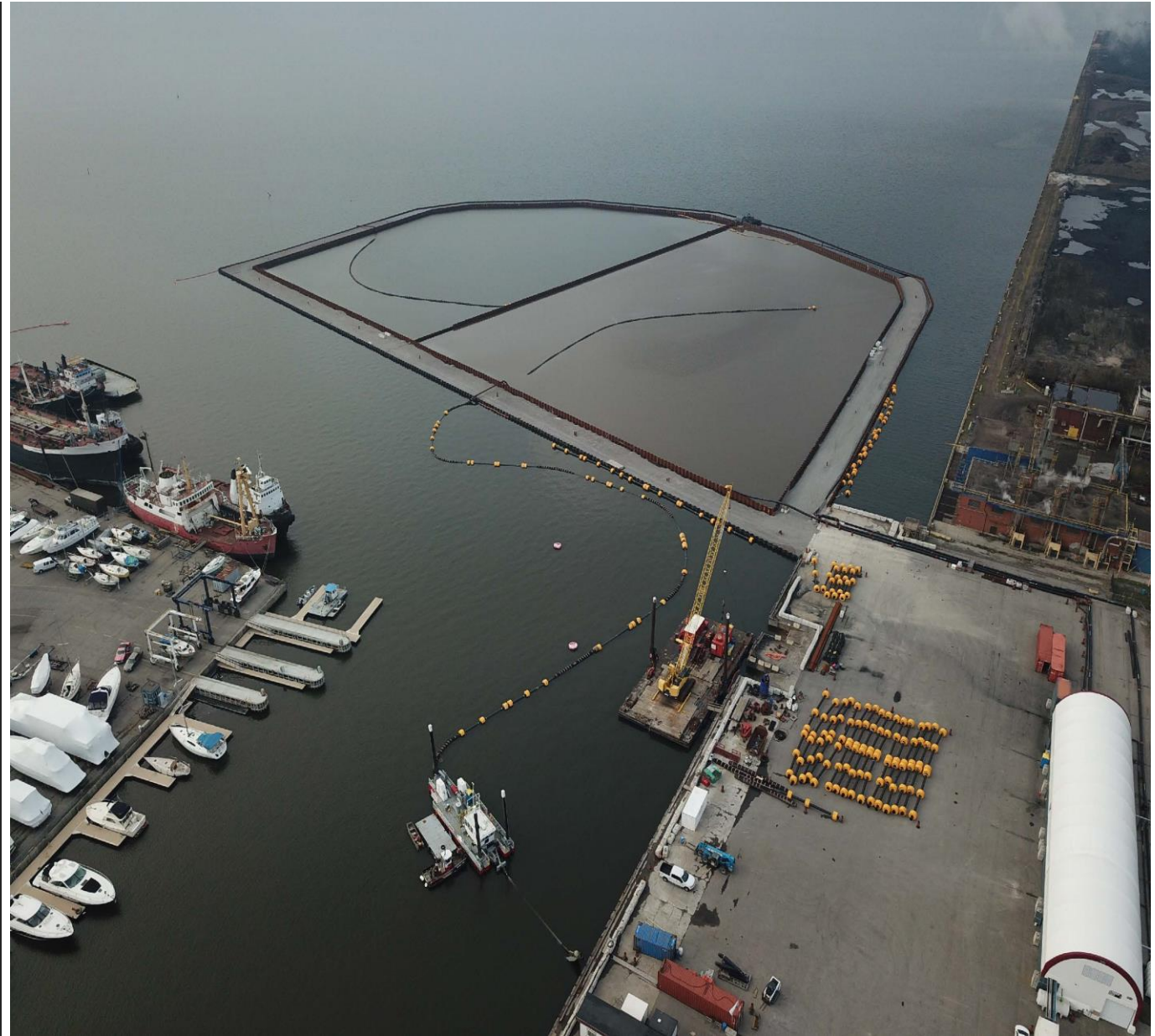


# Methodologies Utilized for Contaminated Sediment Dredging, Thin Layer Capping, Isolation Capping, and Water Treatment

Randle Reef Sediment  
Remediation Project  
Stage 2



# The Randle Reef clean-up is funded by:



Environment and  
Climate Change Canada

Environnement et  
Changement climatique Canada



Hamilton

**HOPA**  
PORTS





# Randle Reef Sediment Remediation Project Hamilton Harbour, Lake Ontario



## Randle Reef Site Specifics



- Impacted by historic operation of coal gasification plant and steel operations;
- Approximately 615,000 m<sup>3</sup> of contaminated sediment (PAHs & metals); and
- Average total PAH concentration near 5,000 ppm with peaks over 73,000 ppm.
- **Site Area:** ~60 ha (148 acres)
- **Depth of Water:** Ranges from ~4 m to 12 m
- **Sediment Depth:** Ranges from ~0.1 m to >3 m

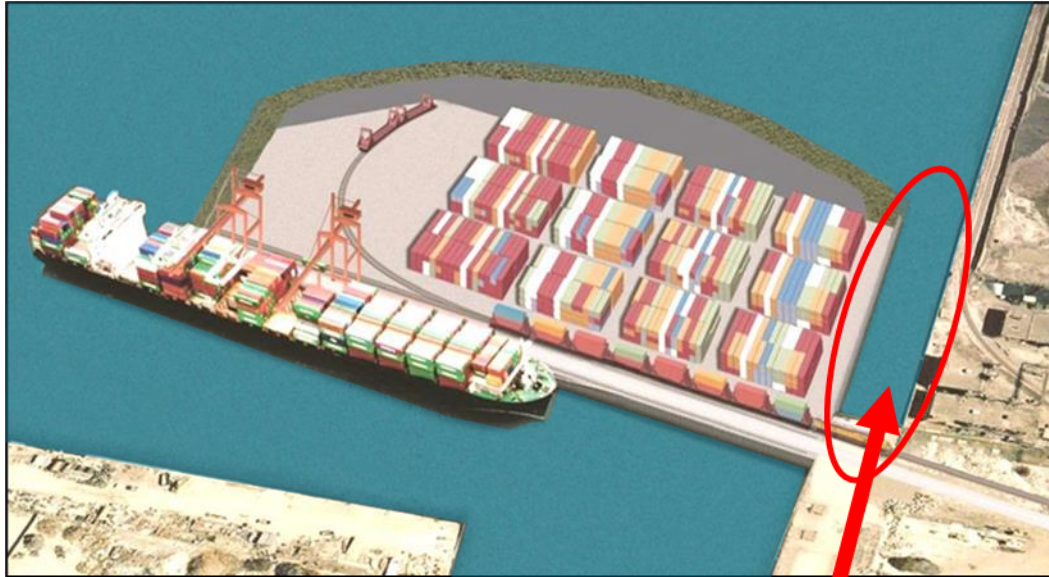


Environment and  
Climate Change Canada

Environnement et  
Changement climatique Canada

Canada



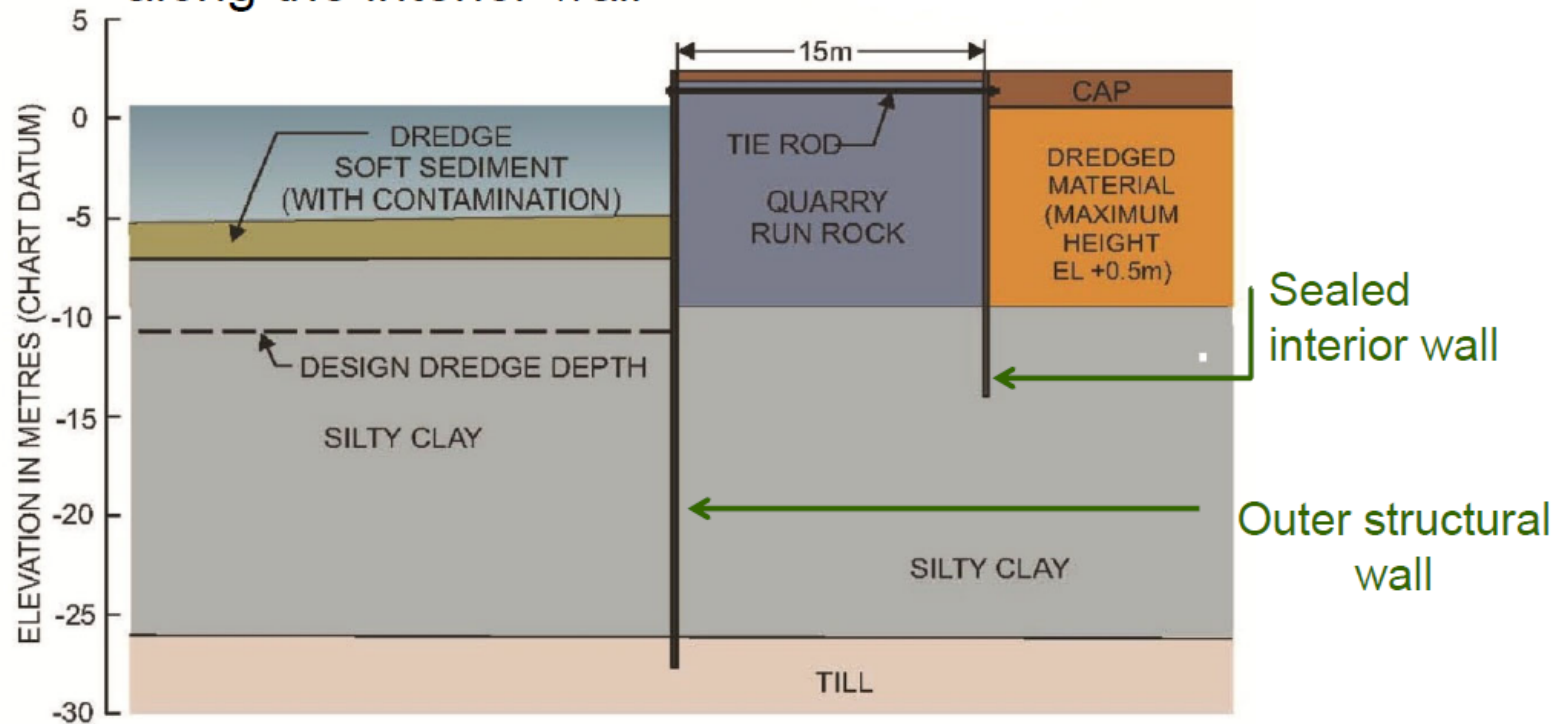


Stelco Channel

- Construct a 6.2 hectare Engineered Containment Facility (ECF) over the most highly contaminated sediment (~140,000 m<sup>3</sup> *in-situ*);
- Using a combination of hydraulic and mechanical dredging, remove ~450,000 m<sup>3</sup> and place within ECF;
- Thin Layer Capping of ~20,000 m<sup>3</sup> of marginally contaminated sediment
- Cap Stelco Intake/Outfall Channel sediments ~5,000 m<sup>3</sup>
- Cap ECF and construct a port facility.
- Total sediment management of ~615,000 m<sup>3</sup>

# Isolation Structure

A double steel sheetpile wall with sealed interlocks along the interior wall



Environment and  
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Changement climatique Canada

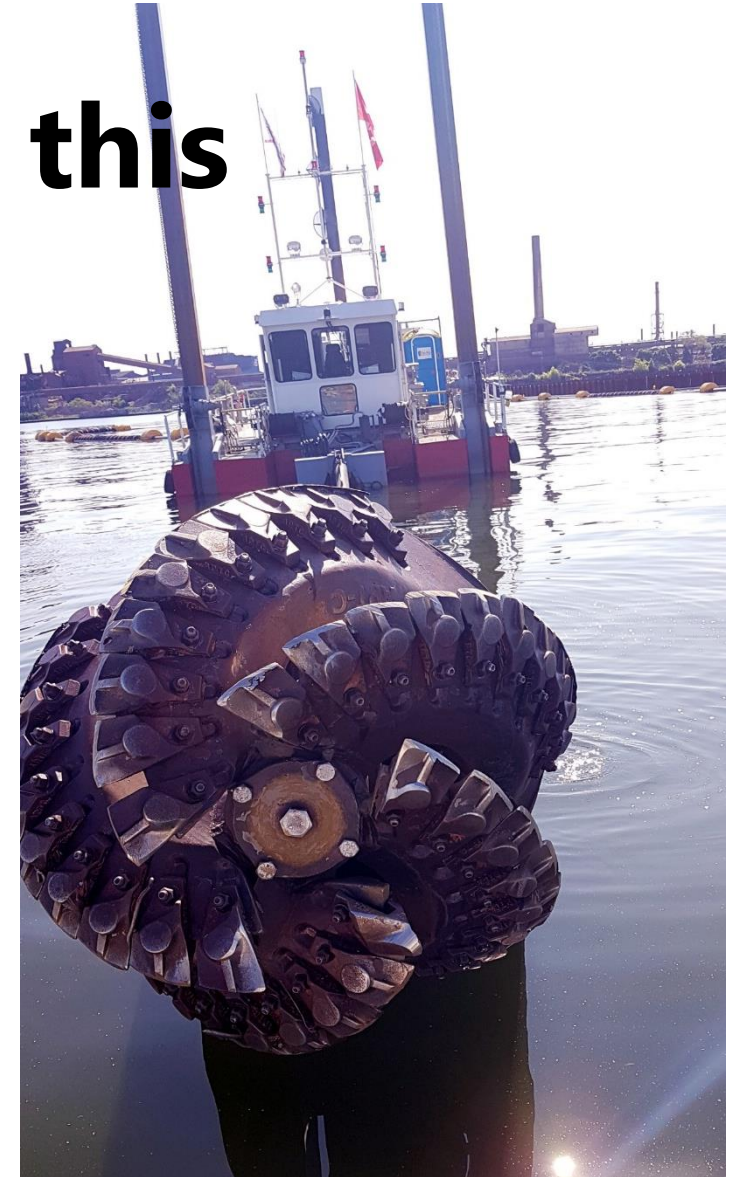
Canada

# Cutter Suction Dredge: Lt. General John Simcoe

- Designed specifically for this project

Built & Assembled in Hamilton.

Registered in Canada meets Floating Plant Clause.

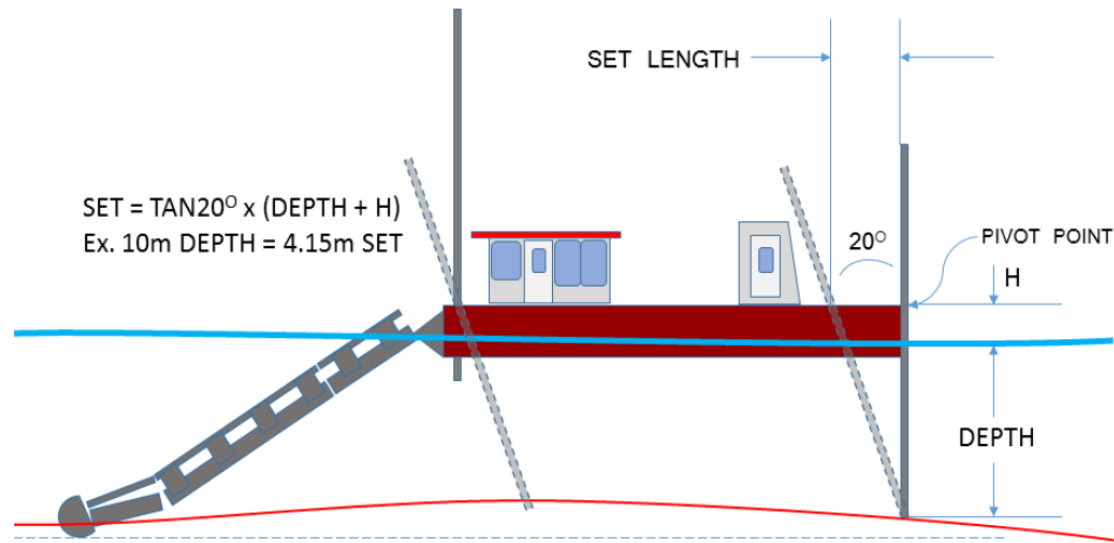




# Cutter Suction Dredge



- 1.1m cutterhead diameter
- 14 x 16 inch Pump
- 13.5 metre dredge depth
- 0.95 meter draft
- Sophisticated DGPS RTK Positioning system

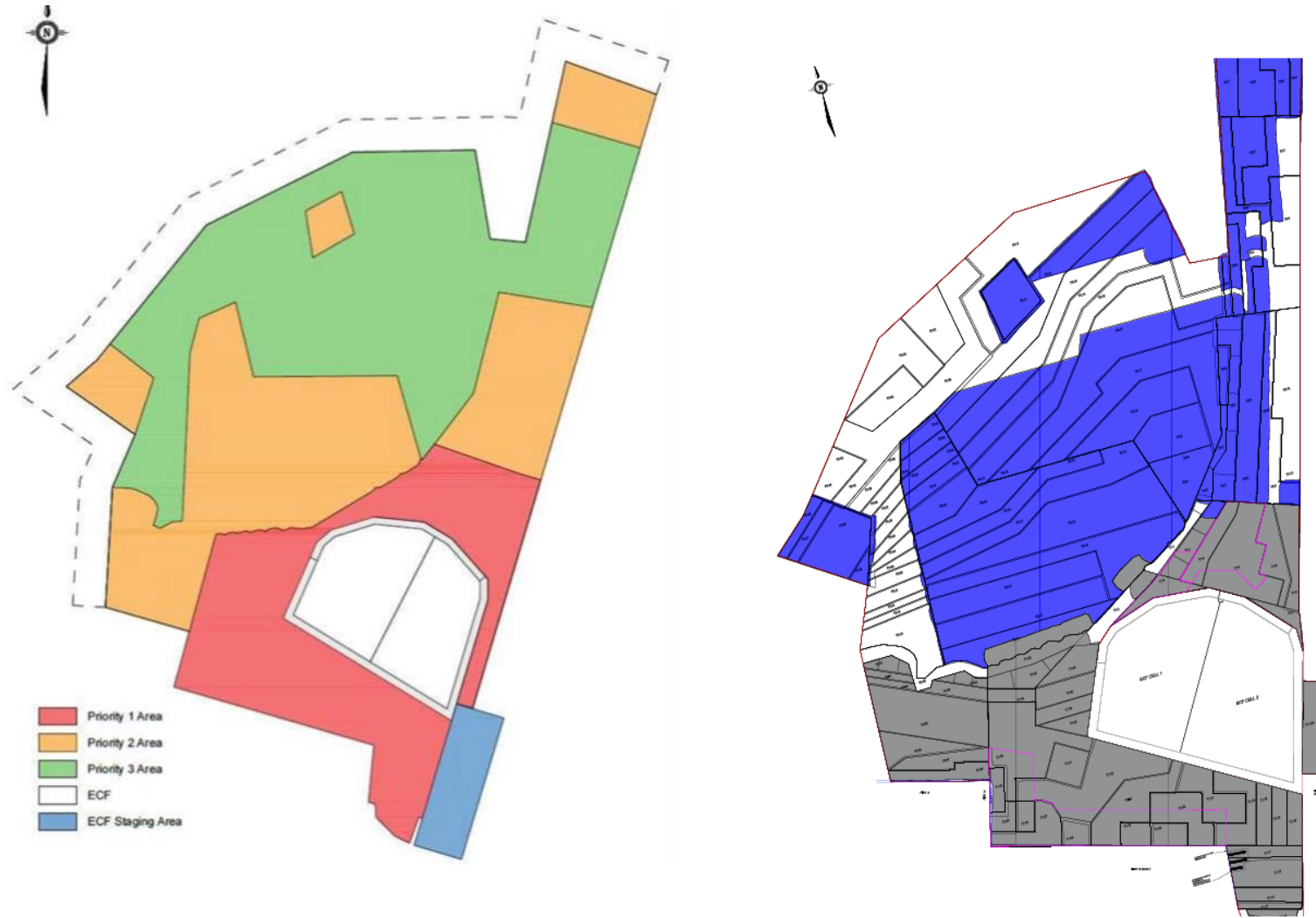




# Dewatering and water treatment

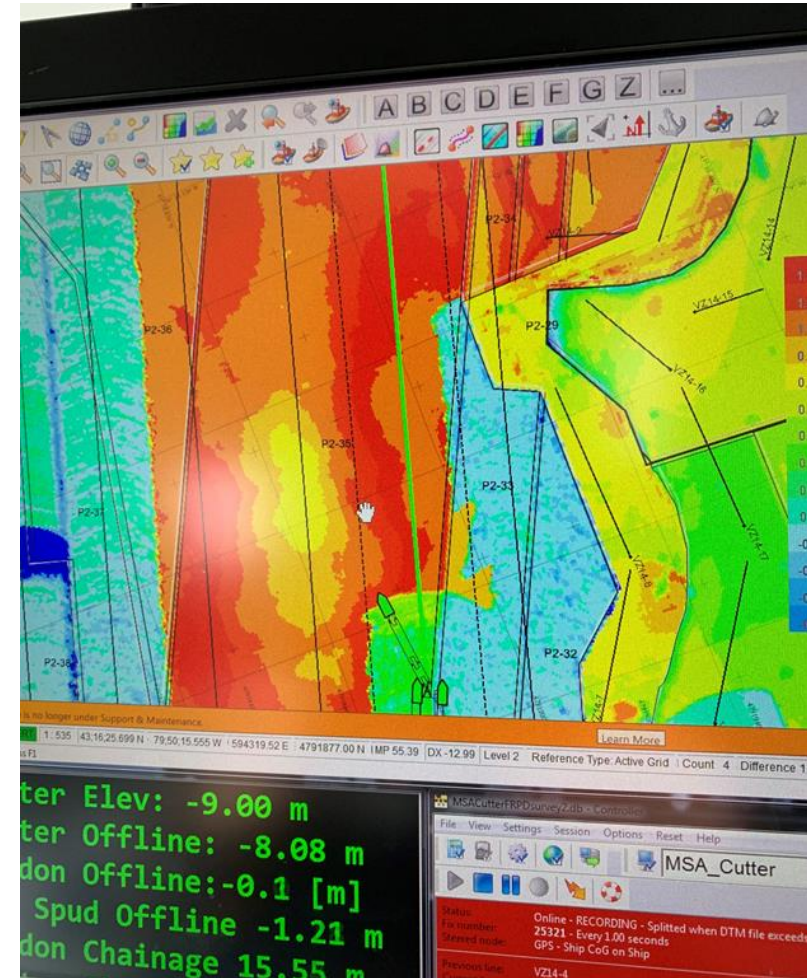
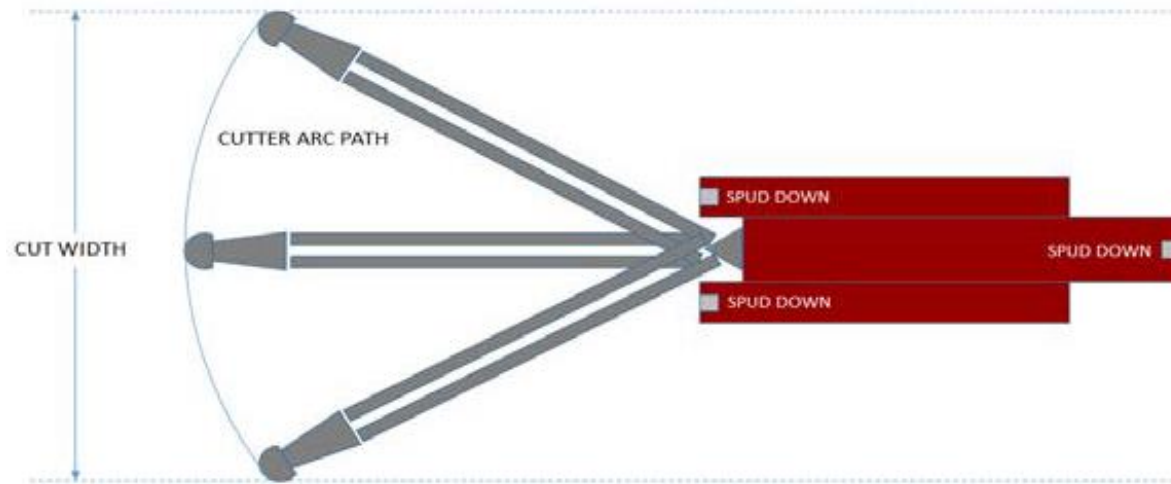


# Dredge Priority Areas and Verification Zones





# CUT LINES AND RTK GPS POSITIONING

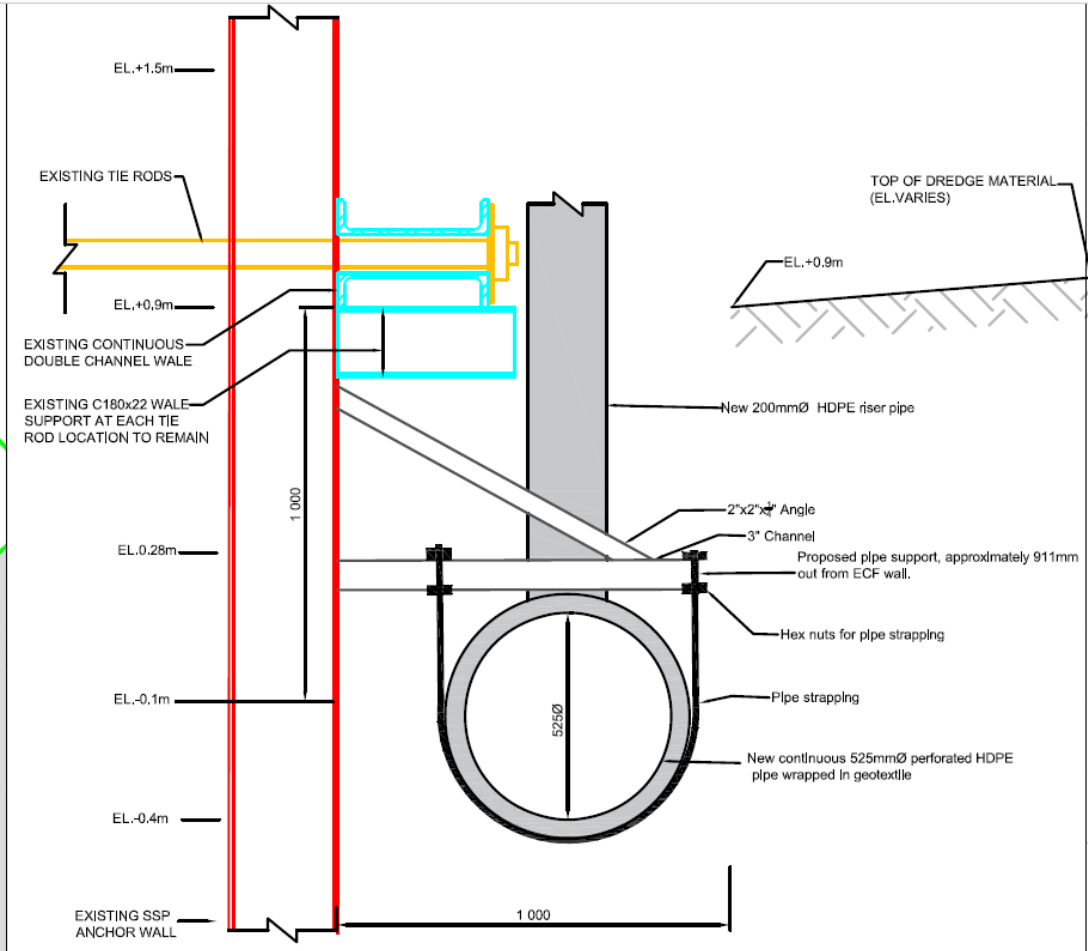




# DEBRIS MANAGEMENT – Large debris removed pre-dredging, debris removed from cutter during dredging



# ECF - Perimeter Underliner Drainage Pipe



Cross Section of Proposed Underliner Drainage Pipe





Isolation Capping  
of Stelco  
Intake/outfall  
channel  
sediments

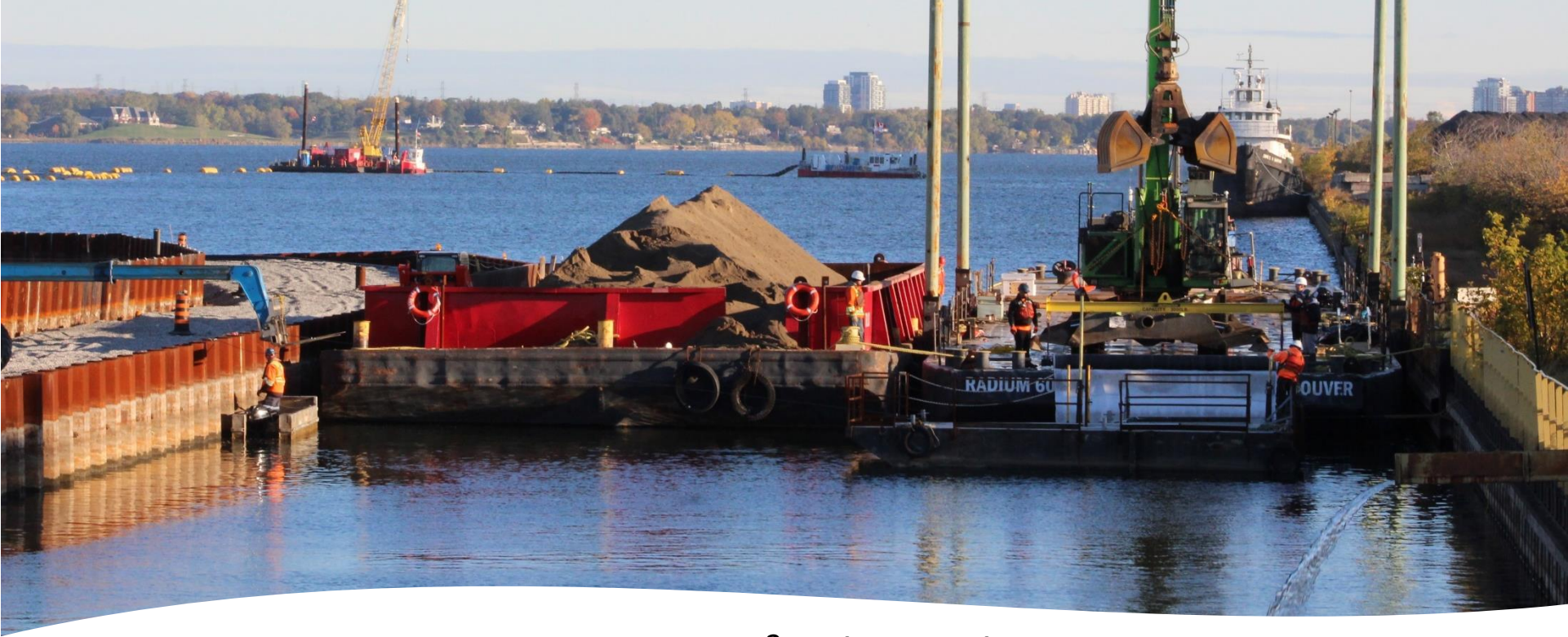
Thin Layer  
Capping of  
marginally  
contaminated  
sediment





# ISOLATION CAPPING – STELCO CHANNEL





## ENGINEERED ISOLATION CAP

## ACTIVE CAP

- 1,270 m<sup>2</sup> Tektoseal Active OC geocomposite
- 700 mm thick sand cap mixture containing 3% Total Organic Carbon
- Upper Geotextile Type 2
- 200mm thick layer of 50mm armouring stone

# ISOLATION CAPPING – OC PLACEMENT

- Water depth of 7 to 8 metres
- Spreader bar connected to material handler positioned on barge
- Second smaller barge used for positioning, braces to corners of fabric connected to secured anchor points
- All combined with GPS positioning, allowed for greater placement control and security of material



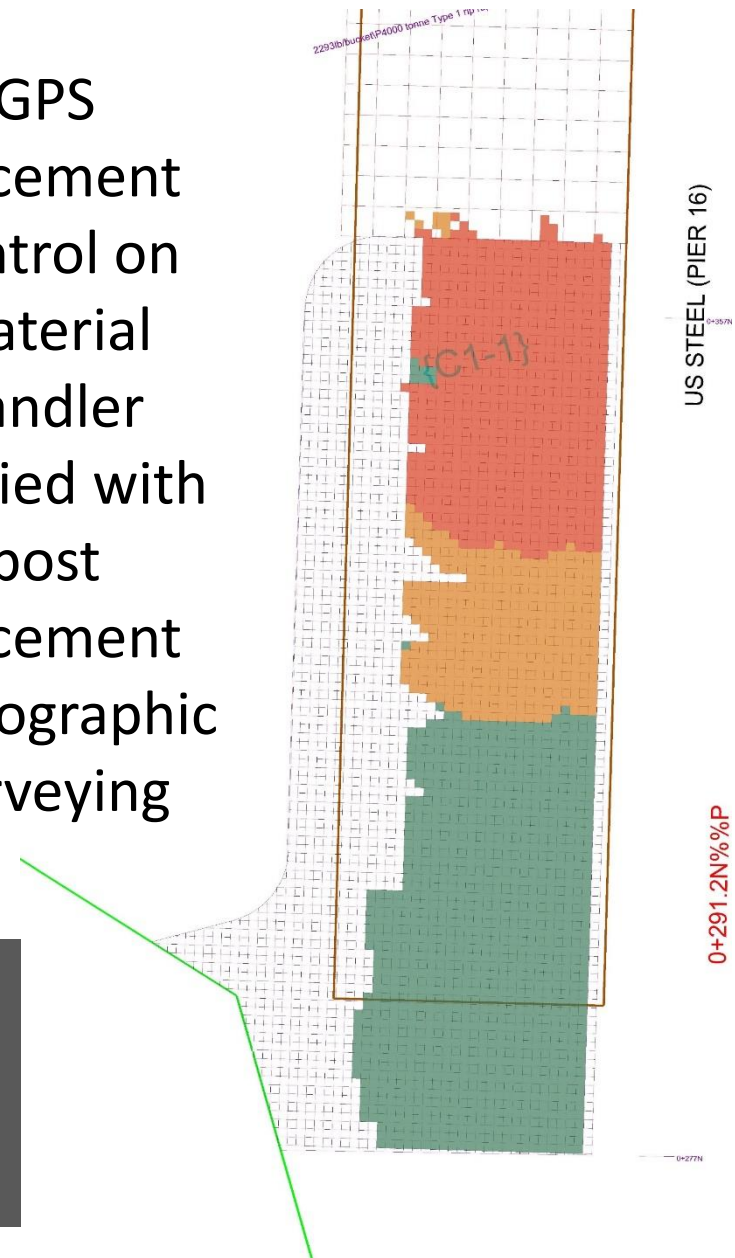




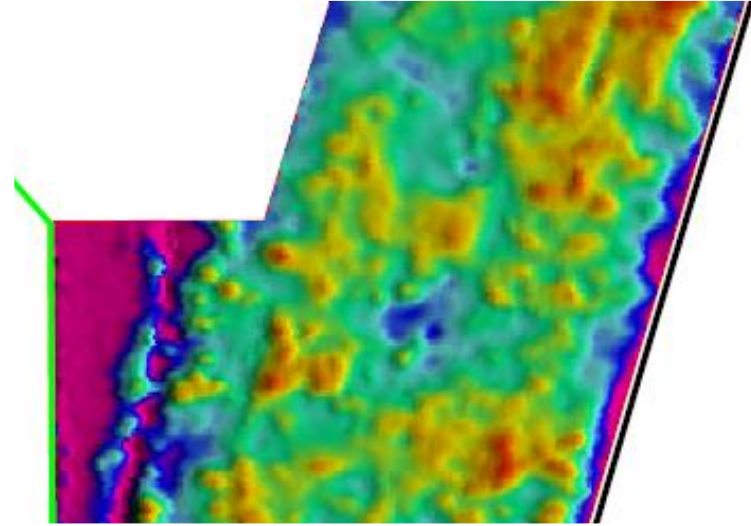
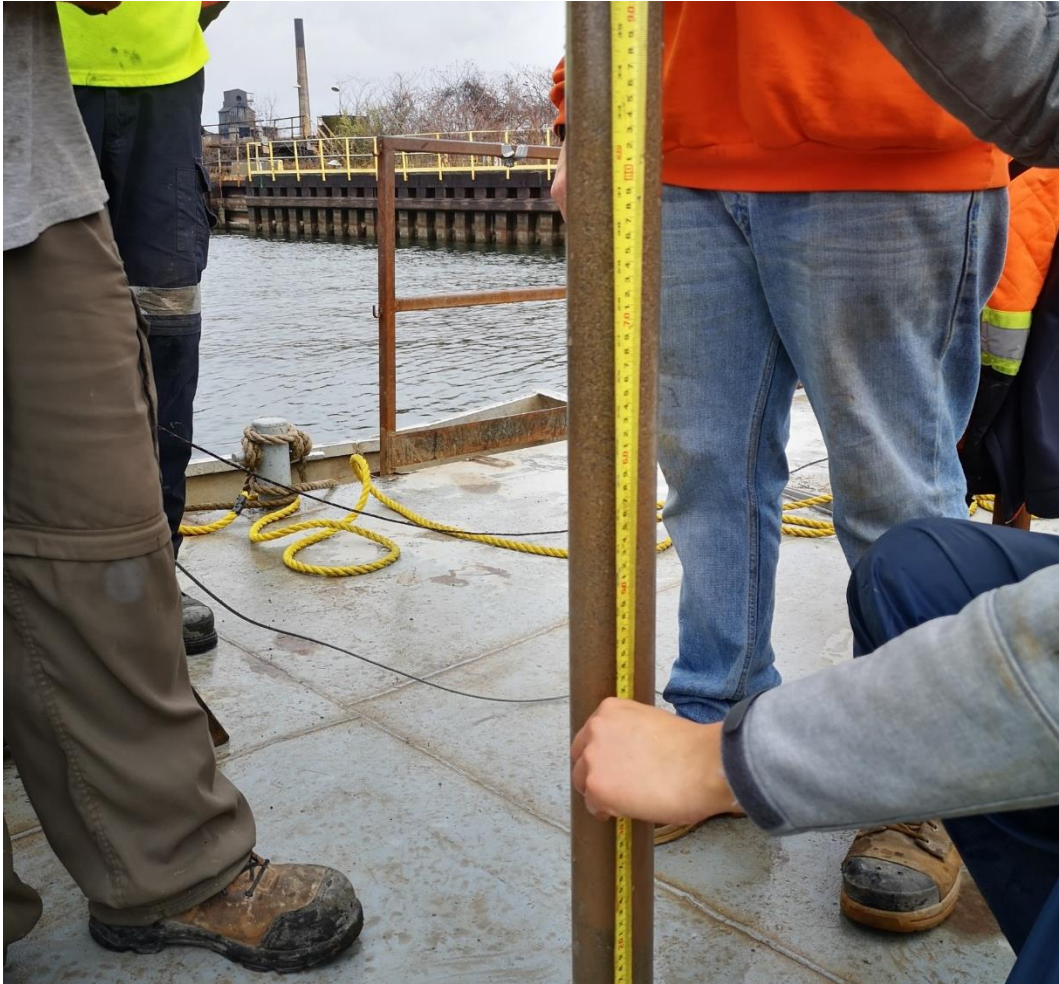
GPS  
Placement  
Control on  
material  
handler  
verified with  
post  
placement  
Hydrographic  
Surveying

### ARMOURING STONE:

- Rip Rap placed at mouth of channel for scour protection
  - Layer of Geotextile Type 2
  - Rip Rap Type 1 (250mm to 600mm size stone), over,
  - Rip Rap Type 2 (100mm to 200 mm size stone)



# SAND CAPPING THICKNESS VERIFICATION



- CORE SAMPLING OF INSTALLED CAP
- HYDROGRAPHIC SURVEY PLOTS
- GPS POSITIONING



# WATER TREATMENT PLANT: Design Build and Operation by Veolia Water Technologies Canada

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# Our Solution



# Actiflo® Technology

## High Rate Clarification Process

- Ballast Flocculation Technology
- Ballast Material : Microsand
- Enhanced Lamella Settling
- Short Hydraulic Retention Times

## Compact Footprint Technology

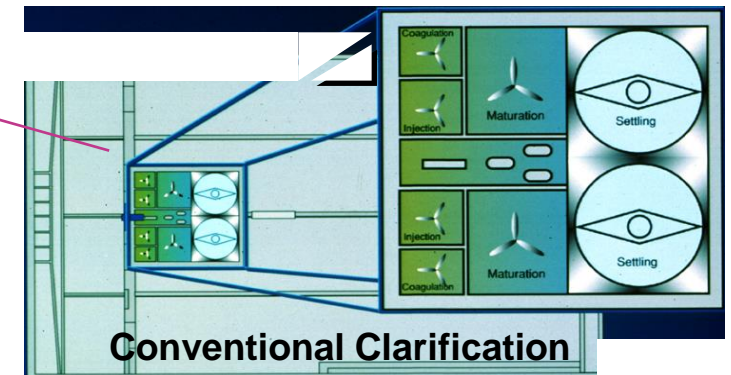
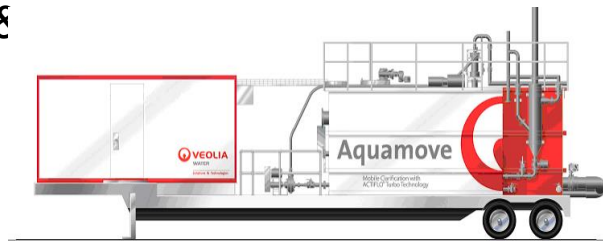
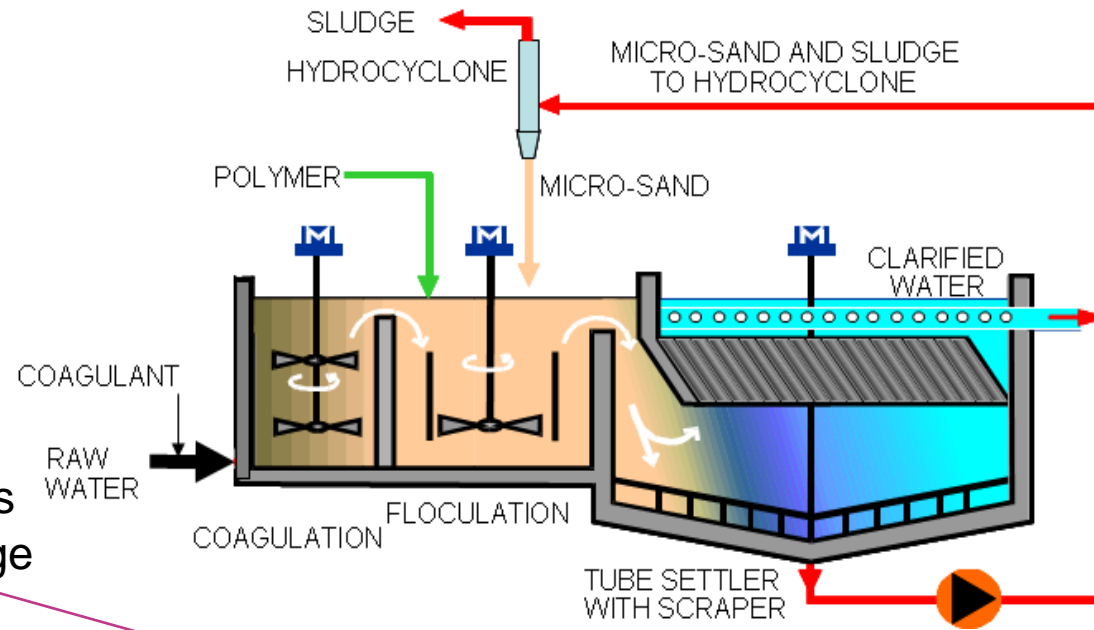
- Rise rate : 40m/h-100 m/h
- 20 times smaller than Conv. Process
- Often allows shop fabricated package

## Ability to Handle Variations

- Turbidity : 5 to 2500 NTU
- Faster Response to variation &

## High Quality Effluent

- Capture of very fine particles
- Low level metals precipitation



Conventional Clarification

295,000 m<sup>3</sup>/d 5% to do same flow

# Process

- Removal of TSS and metals using ACTIFLO
  - *pH control and addition of a coagulant*
- Removal of PAHs and organics using ACTICARB
  - *Addition of powdered activated carbon (PAC) and another coagulant*
- Selection of coagulants was tricky because criteria for both aluminium and iron
- Spent PAC and TSS returned to the ECF
- Effluent was recycled back to the ECF during commissioning, and any periods of non-compliance





# Water Treatment Plant: Design Build Operate Veolia Water Technologies



## **Applications:**

- Removal of TSS and PAH from dredging water
- Chemical Supply
- Operation

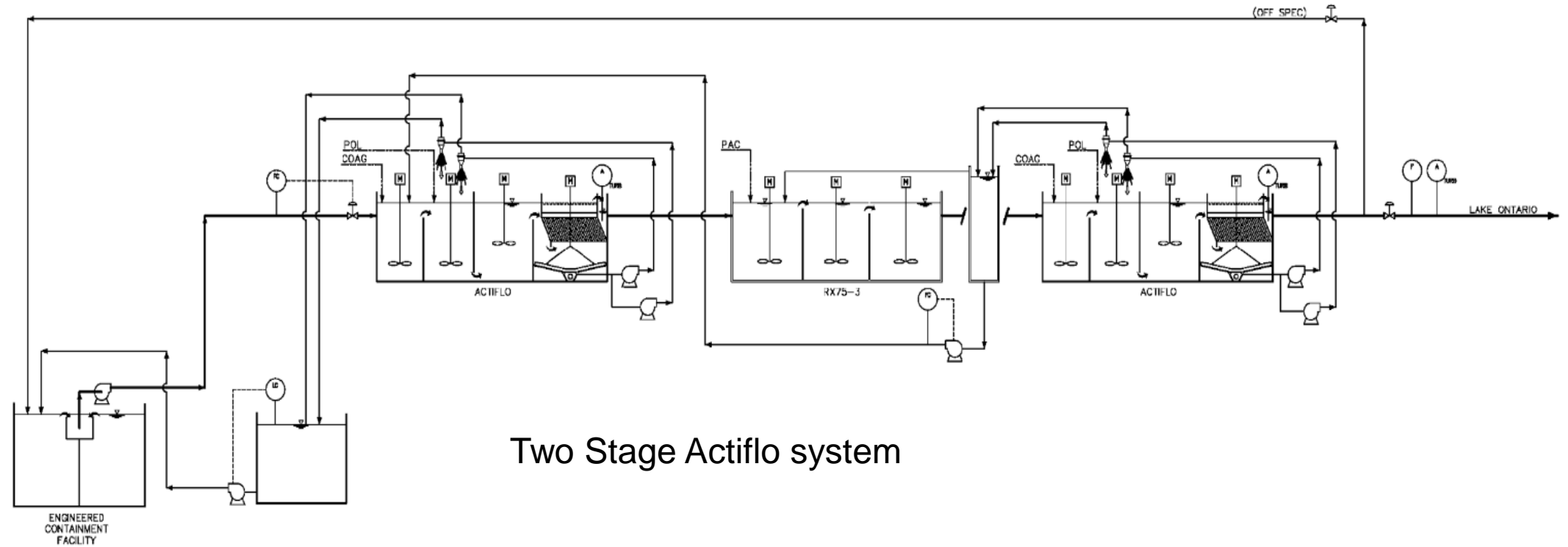
## **Technologies:**

- Actiflo for TSS removal
- Acticarb for PAH (Polycyclic Aromatic Hydrocarbons)

**Capacity:** 16 300 m<sup>3</sup>/d

## **Particularities:**

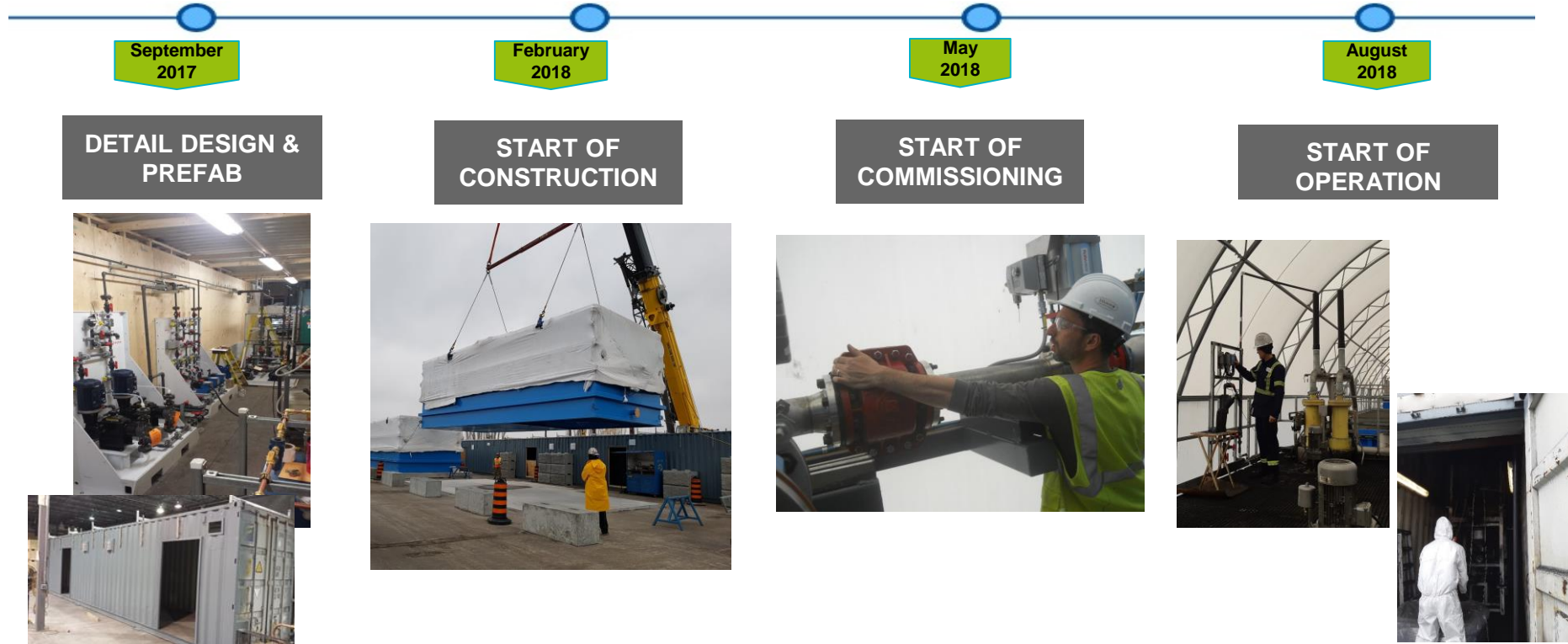
- Rehabilitation of the highly contaminated Hamilton Harbour
- Temporary installation (3 years)
- Turn-key project, from construction through demobilis



Two Stage Actiflo system



# Agressive Construction Schedule



# Construction

- Treatment plant designed to be for easy shut down and dismantled easily once treatment is completed
- Plant is not operated in winter
  - *No dredging once ice is present*





# Results

# Metals Removal Results

- Meeting both iron and aluminium was tricky
  - *We need a coagulant!*

Analyte	Units	Discharge limit	Detection limit	Raw Water		Effluent	
				Average	98th percentile	Average	98th percentile
pH	pH units		0,1	7,98	8,17	7,56	7,85
Total Suspended Solids	mg/L	15	2	26,74	86,97	2,45	4,58
Turbidity	NTU		0,1	24,02	55,79	1,17	2,31
Aluminum (Al)-Total	mg/L	0,0750	0,005	0,3473	0,7994	0,0119	0,0241
Cadmium (Cd)-Total	mg/L	0,00030	0,000005	0,00016	0,00045	0,00000	0,00001
Cobalt (Co)-Total	mg/L	0,00090	0,0001	0,00038	0,00099	0,00043	0,00059
Copper (Cu)-Total	mg/L	0,0050	0,001	0,0025	0,0059	0,0005	0,0013
Iron (Fe)-Total	mg/L	0,3000	0,01	1,07	3,21	0,18	0,28
Lead (Pb)-Total	mg/L	0,0250	0,00005	0,0149	0,0577	0,0001	0,0002
Silver (Ag)-Total	mg/L	0,00010	0,00005	0,00005	0,00016	0,00003	0,00003
Zinc (Zn)-Total	mg/L	0,0300	0,003	0,077	0,298	0,003	0,008



# PAH Results

- 99.7% compliance over the life of the project

Analyte	Units	Discharge limit	Detection limit	Raw Water		Effluent	
				Average	98th percentile	Average	98th percentile
Anthracene	ug/L	0,05	0,012	0,261	1,007	0,006	0,006
Benzo(a)anthracene	ug/L	0,05	0,018	0,200	0,748	0,010	0,009
Benzo(a)pyrene	ug/L	0,015	0,005	0,107	0,491	0,003	0,003
Benzo(g,h,i)perylene	ug/L	0,05	0,02	0,044	0,186	0,010	0,010
Benzo(k)fluoranthene	ug/L	0,05	0,02	0,058	0,230	0,010	0,010
Chrysene	ug/L	0,05	0,02	0,136	0,499	0,010	0,010
Fluoranthene	ug/L	0,05	0,02	0,840	2,585	0,012	0,010
Fluorene	ug/L	0,2	0,02	0,893	3,215	0,011	0,010
1-Methylnaphthalene	ug/L	2	0,02	0,457	2,788	0,012	0,023
2-Methylnaphthalene	ug/L	2	0,02	0,875	5,243	0,013	0,035
Naphthalene	ug/L	7	0,05	32,895	234,680	0,345	4,570
Perylene	ug/L	0,05	0,02	0,030	0,138	0,010	0,010
Phenanthrene	ug/L	0,03	0,02	0,922	3,033	0,011	0,010
Pyrene	ug/L	0,05	0,02	0,609	1,996	0,011	0,010

# Conclusions



## Why did this work so well?

- Client did his homework and came up with a good project definition
- The team of Milestone and FRDP were extremely supportive during execution and operations
- The technology is robust and well proven
- Process turnkey with risk sharing allowed us to control costs across the project
- Good collaboration at the site from all parties involved



# QUESTIONS?





**David Oliphant**  
**Vice President-Heavy Industry**



**Wayne Harris**  
**Senior Project Manager**

