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Success of an Adaptive Management Program for Large Infrastructure Projects: A Case Study

Boyne Trunk Sanitary Sewer

Civil Engineering Award, Regional Municipality of Halton

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Environmental Scientist

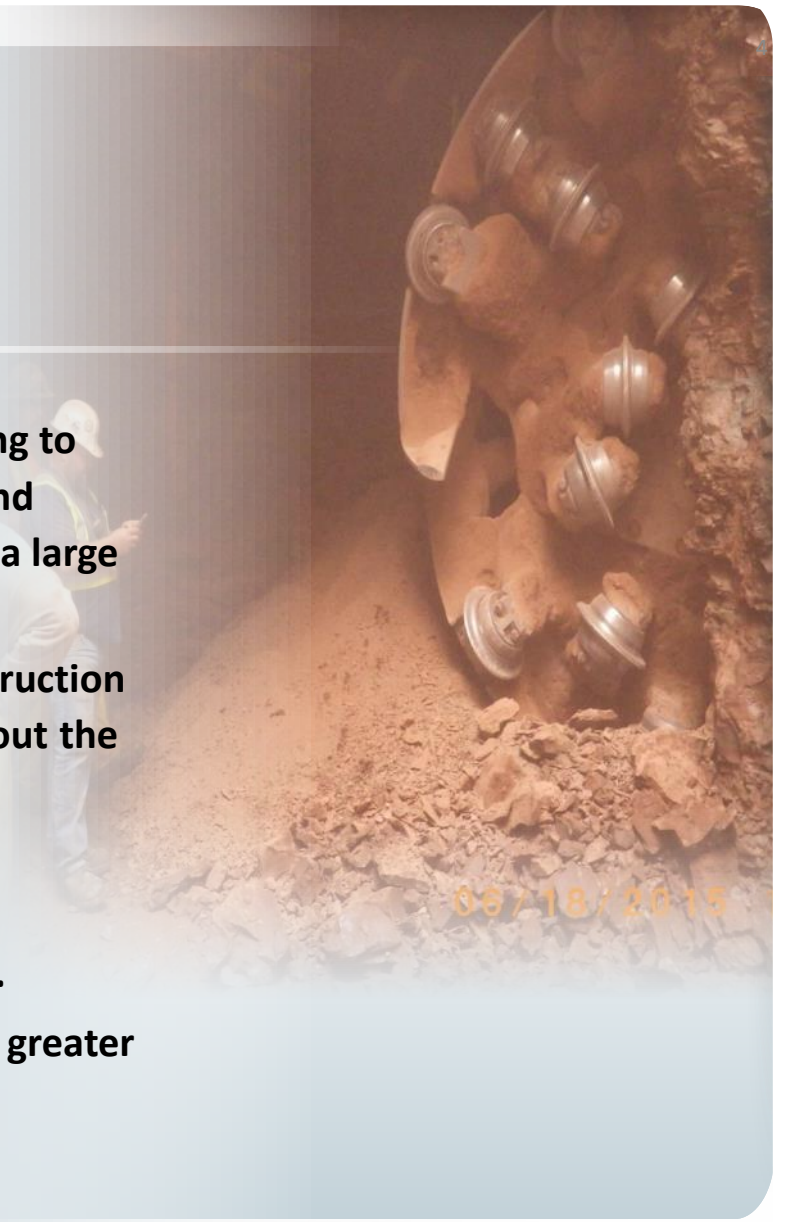
March 22, 2017

What is "Adaptive Environmental Management"?

Ref: Public Domain

The Project

- In 2008, Halton Region retained Dillon Consulting to complete the environmental assessment (EA) and subsequent design and construction phases for a large diameter (up to 2400mm) gravity sewer.
- Approximately 8km of mining and trench construction with various water discharge locations throughout the alignment.
- This project was recognized with a 2016 Civil - Infrastructure Project of the Year Award by the Hamilton/Halton Engineering Week Committee.
- OPWA Project of the Year Award (Environment, greater than $50 Million Category).



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The Two Focal Discharge Zones

North Discharge Location:

South Discharge Location:

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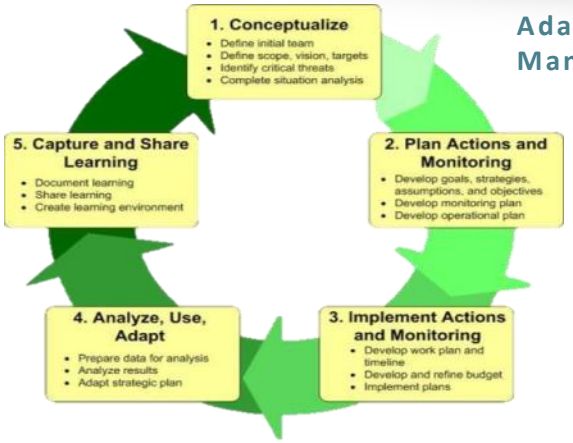
Step 1: Conceptualize the program



- Soil type = red clay/shale.
- Fine particles require longer residence time to settle out.
- Industrial product may be present.
- Understand contractor's design for treatment and discharge waters.

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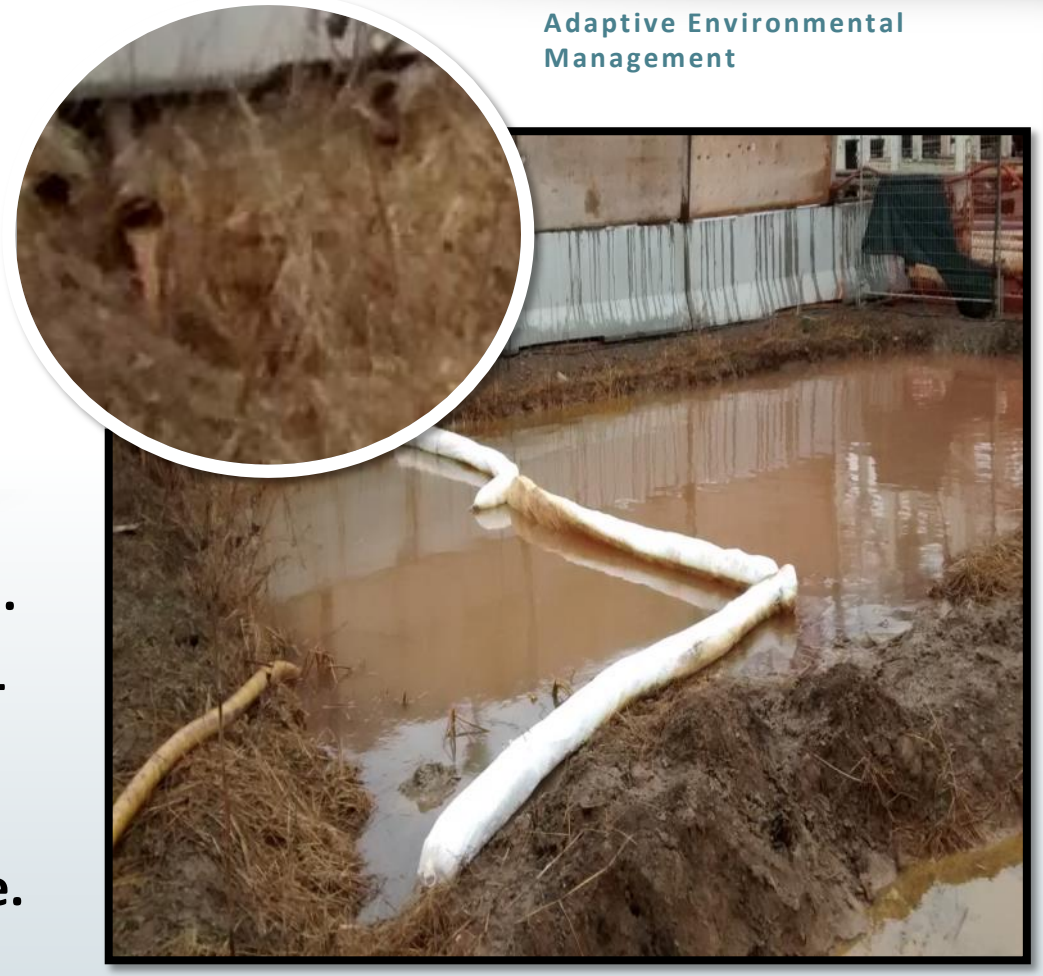
Step 2: Plan Actions and Monitoring



- Schedule (Mon, Wed, Fri).
- Turbidity (within 25 mg/L or 8 NTU of baseline).
- Visual indicators for industrial product release.
- Sample discharge water and compare results to PWQO and PTTW conditions.

Step 3: Implement Actions and Monitoring

- **Baseline parameters for small order streams in the area determined in field under natural conditions*:**
  - Turbidity (7 – 25 NTU)
  - Ph: 7 – 7.5

*Natural conditions were not influenced by participation or melt events.

Step 4: Analyze and Interpret

Criteria: ONTARIO PROVINCIAL WATER QUALITY OBJECTIVES (PWQO).

Ref. to MOEE Water Management document dated Feb. 1999

Note for Metal Analysis: Detection Limit was raised due to matrix interferences.

ELEMENTS BY ATOMIC SPECTROSCOPY (WATER)

ID										
Sampling Date			2014/12/08	2015/01/09	2015/03/12	2014/12/08	2014/12/22	2015/01/09	2015/02/11	2015/03/13
	Units	Criteria	CC2 (Background)			COMPOUND 7				
Metals										
Dissolved (0.2u) Aluminum (	ug/L	**15**	<5	<5	12	<5	<5	<5	<5	9
Dissolved Calcium (Ca)	mg/L	-	220	285	58.4	317	243	251	271	149
Chromium (VI)	ug/L	**1**	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Dissolved Magnesium (Mg)	mg/L	-	111	174	14.8	120	89.3	96.9	104	51.8
Total Aluminum (Al)	ug/L	-	730	930	470	110	16000	16000	1700	590
Total Antimony (Sb)	ug/L	**20**	<0.50	<5.0	<0.50	<2.5	0.98	<2.5	1.8	<0.50
Total Arsenic (As)	ug/L	**100**	<2.0 (1)	<10	<1.0	<5.0	5.1	9.6	2.3	<1.0
Total Barium (Ba)	ug/L	-	120	150	41	20	98	190	50	58
Total Beryllium (Be)	ug/L	**11**	<0.50	<5.0	<0.50	<2.5	0.75	<2.5	<0.50	<0.50
Total Bismuth (Bi)	ug/L	-	<1.0	<10	<1.0	<5.0	<1.0	<5.0	3.2	<1.0
Total Boron (B)	ug/L	**200**	120	130	23	**6300**	**7400**	**8100**	**6700**	**2900**
Total Cadmium (Cd)	ug/L	**0.2**	<0.10	<1.0	<0.10	<0.50	**0.45**	<0.50	**0.37**	0.12
Total Calcium (Ca)	ug/L	-	240000	310000	56000	290000	280000	390000	300000	160000
Total Chromium (Cr)	ug/L	-	<5.0	<50	<5.0	<25	20	<25	<5.0	<5.0
Total Cobalt (Co)	ug/L	**0.9**	0.86	<5.0	<0.50	<2.5	**8.4**	**14**	**2.4**	0.83
Total Copper (Cu)	ug/L	**5**	4.8	<10	**5.4**	<5.0	**31**	**25**	**39**	2.5
Total Iron (Fe)	ug/L	**300**	**2700**	**1500**	**530**	<500	**20000**	**22000**	**3500**	**560**
Total Lead (Pb)	ug/L	**5**	0.92	<5.0	0.89	<2.5	**14**	**30**	**7.5**	<0.50
Total Lithium (Li)	ug/L	-	37	63	<5.0	780	730	810	700	290
Total Magnesium (Mg)	ug/L	-	120000	190000	15000	120000	95000	110000	100000	58000
Total Manganese (Mn)	ug/L	-	1400	610	130	59	1400	1500	350	770
Total Molybdenum (Mo)	ug/L	**40**	0.75	<5.0	1.1	6.2	7.2	6.4	9.3	2.7
Total Nickel (Ni)	ug/L	**25**	1.5	<10	<1.0	<5.0	24	**28**	6.3	<1.0
Total Potassium (K)	ug/L	-	11000	12000	14000	37000	40000	44000	43000	19000
Total Silicon (Si)	ug/L	-	5200	6900	2500	3500	24000	29000	6000	3000
Total Selenium (Se)	ug/L	**100**	<2.0	<20	<2.0	<10	<2.0	<10	<4.0	<2.0
Total Silver (Ag)	ug/L	**0.1**	<0.10	<1.0	<0.10	<0.50	**0.24**	<0.50	<0.10	<0.10
Total Sodium (Na)	ug/L	-	750000	1100000	450000	870000	710000	770000	730000	390000
Total Strontium (Sr)	ug/L	-	2800	3900	340	12000	11000	11000	13000	5900
Total Tellurium (Te)	ug/L	-	<1.0	<10	<1.0	<5.0	<1.0	<5.0	<1.0	<1.0
Total Thallium (Tl)	ug/L	**0.3**	<0.050	<0.50	<0.050	<0.25	0.14	<0.25	0.089	<0.050
Total Tin (Sn)	ug/L	-	<1.0	<10	<1.0	<5.0	1.3	<5.0	2.1	<1.0
Total Titanium (Ti)	ug/L	-	19	<50	12	<25	370	200	22	19
Total Tungsten (W)	ug/L	**30**	<1.0	<10	<1.0	<5.0	<1.0	<5.0	<1.0	<1.0
Total Uranium (U)	ug/L	**5**	4.4	**5.4**	0.31	1.3	1.6	1.9	1.4	0.96
Total Vanadium (V)	ug/L	**6**	1.6	<5.0	1.5	<2.5	**25**	**29**	4.1	1.5
Total Zinc (Zn)	ug/L	**30**	14	<50	12	**44**	**220**	**190**	**42**	7.0
Total Zirconium (Zr)	ug/L	**4**	<1.0	<10	<1.0	<5.0	<5.0 (1)	**6.9**	1.8	<1.0

Step 5: Report, Share and Discuss the Findings

- Is the project site in compliance?
- If not, notify the contractor immediately and prepare a field instruction form to update the contractor of their status and obligation.
- Discharge halted at site multiple times to revise treatment to meet compliance.
- Report spill if necessary.

SOUTHERN DISCHARGE LOCATION

Step 5: Report, Share and Discuss the Findings

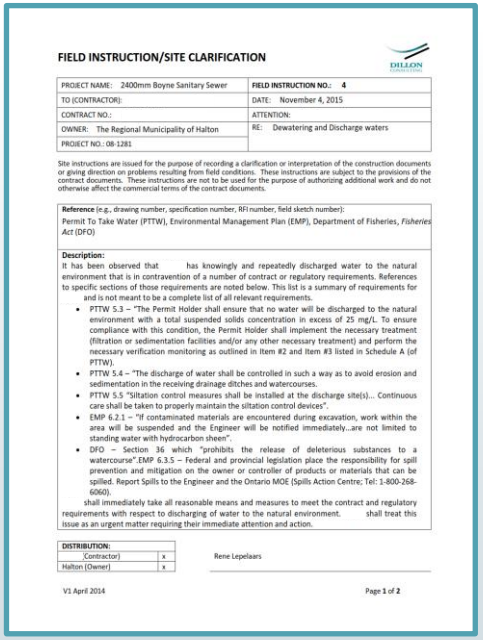
- **Is the project site in compliance?**
- **If not, notify the contractor immediately and prepare a field instruction form to update the contractor of their status and obligation.**
- **Resolve issues before continuing to discharge water.**

NORTHERN DISCHARGE LOCATION

Conceptualize the Improvements by Knowing the Technology

Non compliance parameters:

- **TSS and F3 Petroleum Hydrocarbons (PHC).**
- **Notify contractor of non-compliance and that dewatering cannot continue until efforts have been made resulting in compliance.**



FIELD INSTRUCTION/SITE CLARIFICATION

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PROJECT NAME: 2400mm Boyne Sanitary Sewer	FIELD INSTRUCTION NO.: 4
TO (CONTRACTOR):	DATE: November 4, 2015
CONTRACT NO.:	ATTENTION:
OWNER: The Regional Municipality of Halton	RE: Dewatering and Discharge waters
PROJECT NO.: 08-1281	

Site instructions are issued for the purpose of recording a clarification or interpretation of the construction documents or giving direction on problems resulting from field conditions. These instructions are subject to the provisions of the contract documents. These instructions are not to be used for the purpose of authorizing additional work and do not otherwise affect the commercial terms of the contract documents.

Reference [e.g., drawing number, specification number, RFI number, field sketch number]:
Permit To Take Water (PTTW), Environmental Management Plan (EMP), Department of Fisheries, *Fisheries Act* (DFO)

Description:
It has been observed that has knowingly and repeatedly discharged water to the natural environment that is in contravention of a number of contract or regulatory requirements. References to specific sections of those requirements are noted below. This list is a summary of requirements for and is not meant to be a complete list of all relevant requirements.

- PTTW 5.3 – "The Permit Holder shall ensure that no water will be discharged to the natural environment with a total suspended solids concentration in excess of 25 mg/L. To ensure compliance with this condition, the Permit Holder shall implement the necessary treatment (filtration or sedimentation facilities and/or any other necessary treatment) and perform the necessary verification monitoring as outlined in Item #2 and Item #3 listed in Schedule A (of PTTW).
- PTTW 5.4 – "The discharge of water shall be controlled in such a way as to avoid erosion and sedimentation in the receiving drainage ditches and watercourses.
- PTTW 5.5 "Siltation control measures shall be installed at the discharge site(s)... Continuous care shall be taken to properly maintain the siltation control devices".
- EMP 6.2.1 – "If contaminated materials are encountered during excavation, work within the area will be suspended and the Engineer will be notified immediately...are not limited to standing water with hydrocarbon sheen".
- DFO – Section 36 which "prohibits the release of deleterious substances to a watercourse".EMP 6.3.5 – Federal and provincial legislation place the responsibility for spill prevention and mitigation on the owner or controller of products or materials that can be spilled. Report Spills to the Engineer and the Ontario MOE (Spills Action Centre; Tel: 1-800-268-6060).

shall immediately take all reasonable means and measures to meet the contract and regulatory requirements with respect to discharging of water to the natural environment. shall treat this issue as an urgent matter requiring their immediate attention and action.

DISTRIBUTION:	
Contractor	x
Halton (Owner)	x

Rene Lepelaars

V1 April 2014

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Conceptualizing Improvements on North Discharge Area

- Increase residence time with ballast tanks (P1). Set up draining to geobag pond area (P2) separated by absorbents and elevated portion to allow pooling and sediment deposition (P3).
- Draining to lower pond area with coir matting , and absorbents leading to the discharge location (P4).

Continue Compliance Monitoring, Analysis and Discussion

- **Ph buffer**
  - (alkaline conditions require citric acid/ph down).
- **Strong finish for the project.**
- **Restore site conditions and rehabilitate according to restoration plans and site standards (Agricultural, Table 1).**
- **Contractor must remove contaminated soils, regrade and leave site as stated in the client agreement.**
- **Responsible Environmental Management and contractor budget.**

Critical Points of Emphasis

- Establish a regular monitoring schedule but be flexible for unannounced testing for compliance and/or emergency response.
- Debunk “Forgiveness Theory”.
- Be firm and respectful to contractors.
- Use science and regulation to monitor contractor compliance.
- Clean and restore sites to established standards.
- Take only pictures and leave only footprints.

Questions and Discussion

Thank You.

Please, consider Dillon Consulting for your Municipal infrastructure design and construction projects.

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