## Remedial Excavation of Metals-Contaminated Sediment and Creek Restoration



Melissa Hamilton, P.Eng.

RemTech 2011 Friday, October 21, 2011



## Outline

- Introduction
- Remediation Program
  - Preliminary Excavation
  - Follow-Up Sampling (post-flood)
  - Delineation of Metals-Impacts On and Off-Site
  - Secondary Excavation and Restoration Work
- Results
- Conclusions and On-Going Investigation





#### Introduction

- Site Location and Description
  - Industrial right-of-way adjacent to a creek in Saskatchewan
  - Agricultural land (grazing cattle) on adjacent third-party owned property
- Battery Debris On-Site



- Preliminary Sampling Program
  - Another consultant collected soil and sediment samples in May 2009
  - Metals impacts identified adjacent to and downstream of the battery pile



## Introduction

- Regulatory Framework
  - CCME Canadian Environmental Quality Guidelines (CEQG) for soil and sediment
  - Soil guidelines for agricultural land use  $\rightarrow$  soil and food ingestion pathway for livestock
  - Sediment guidelines for the protection of freshwater aquatic life
  - Selection of remediation criteria to consider 3 elements of risk: receptor, pathway, contaminant of concern (CoC)









## **Preliminary Excavation**

- Corrective Action Plan submitted to Saskatchewan MOE in July 2009 to remove battery pile on-site
- Regulatory applications for the protection of aquatic habitat:
  - Saskatchewan Ministry of Environment (MOE)
  - Fisheries and Oceans Canada (DFO)
- Remedial excavation of battery pile on-site in August 2009







## **Preliminary Excavation**



After the excavation in 2009, Dillon planned to return to the site in 2010 after the spring freshet to sample the creek sediment for concentrations of metals



- In June 2010 there was a major flood event in southern Saskatchewan
- Peak flow in Maple Creek in June 2010 was a 1-in-3,700 year event
- Flood water volumes were at 1-in-250 year quantities
- Overland flooding in the area of the site and creek flows ~10x greater



Photograph by: Troy Fleece, Leader-Post files



Photograph from CBC News Online http://www.cbc.ca/gfx/images/news/photos/2010/09/22/sk-highway-flood-2010.jpg



- On-site in July 2010 for follow-up sediment sampling
- Flooding and subsequent erosion in the creek exposed additional battery debris and impacted sediment



• Additional batteries on south bank of the creek (unearthed and deposited during flooding)





- Concentrations of some metals were higher than previously identified during initial sampling program in 2009
- Concentrations of Cu and Zn in sediment samples collected from the creek downstream of the battery pile:

	Units	CCME CEQG Soil and Sediment Guidelines		Initial Compliant Event		Deet Fleed Fellow Up	
Parameters		Livestock Soil and Food Ingestion	Freshwater Aquatic Life	Prior to Excavation (May 2009)		Sampling (July 2010)	
Copper	mg/kg	300	35.7	<u>826</u>	18.6	<u>34,000</u>	<u>3,700</u>
Zinc	mg/kg	640	123	<u>6,680</u>	74.6	<u>3,600</u>	<u>8,400</u>







#### EM survey results:







- Collected soil and sediment samples on a 10x10 metre grid on-site
- XRF Analyzer dried sediment samples on-site
- Soil impacts above CCME guidelines for livestock "soil and food ingestion" limited to a 10 metre section along the north bank
- Sediment impacts above CCME guidelines for aquatic life from former battery pile downstream to property boundary









• One objective of the delineation sampling program was to assess the precision of the XRF analyzer so that it could be used accurately on-site during the remedial excavation

Zinc (mg/kg)						
XRF	Lab	Relative Percent Difference				
18	29	47%				
53	52	2%				
3386	4100	19%				
280	410	38%				
45	40	1%				
44	47	6%				
483	510	5%				
90	100	11%				
26	40	42%				
227	97	80%				
129	94	31%				
96	100	4%				
60	78	25%				
28	43	41%				
51	41	21%				
34	49	35%				
24	20	18%				
Average	25%					





Permits again! Permits were more challenging since creek would be isolated for approximately 1 week (in 2009 the creek was only isolated for 12 hours)

Restoration plan to protect right-of-way (bank stabilization design work) since the remedial plan included the excavation of the full length of the north bank from each fence line

River flow nearly 10 times greater than year before – required greater pump capacity, also pumps needed to run 24 hours/day for the full length of the project

Winter conditions – ice, snow and cold temperatures

Due to recent storm events in the fall of 2010, the water table was very high and gravel was required to stabilize the access road



- Minimal disturbance to aquatic life and adjacent pasture land
- Preparation for creek isolation, including access to the site, backfill materials, placing pumps, etc.









Installing rig mats for pump outlet



- Objective of remediation to excavate battery debris and contaminated soil and sediment
- XRF sampling while on-site to guide excavation (>10% of samples submitted for lab analysis)
- Excavated approximately 550 tonnes of material (batteries, soil and sediment)









Ice forming at pump outlet

Temporary crossing for fuelling pumps

# DILLON



- Hydrological and hydraulics analysis to estimate the design flood levels for bank protection
  - The objectives of the restoration plan were to protect the bank from further erosion and to maintain fluvial and ecological processes





#### Results



- Excavation of battery debris and contaminated soil and sediment on-site
- Creek bed and banks restored with approximately 1' of rock and 6" of small gravel to eliminate risk to aquatic life and prevent further erosion





#### **Conclusions and On-Going Investigation**

- Multi-disciplinary remediation project completed and met the project objectives:
  - Remedial excavation to meet CCME CEQG
  - Maintain bank stabilization & prevent further erosion
  - Minimal disturbance to adjacent pasture
  - Minimal disturbance to ecological habitat & aquatic life
- Ecological risk assessment to be conducted for residual impacts off-site downstream of the industrial property
- Continual coordination with adjacent landowner
- On-going monitoring of bank protection measures and ecological habitat re-growth



