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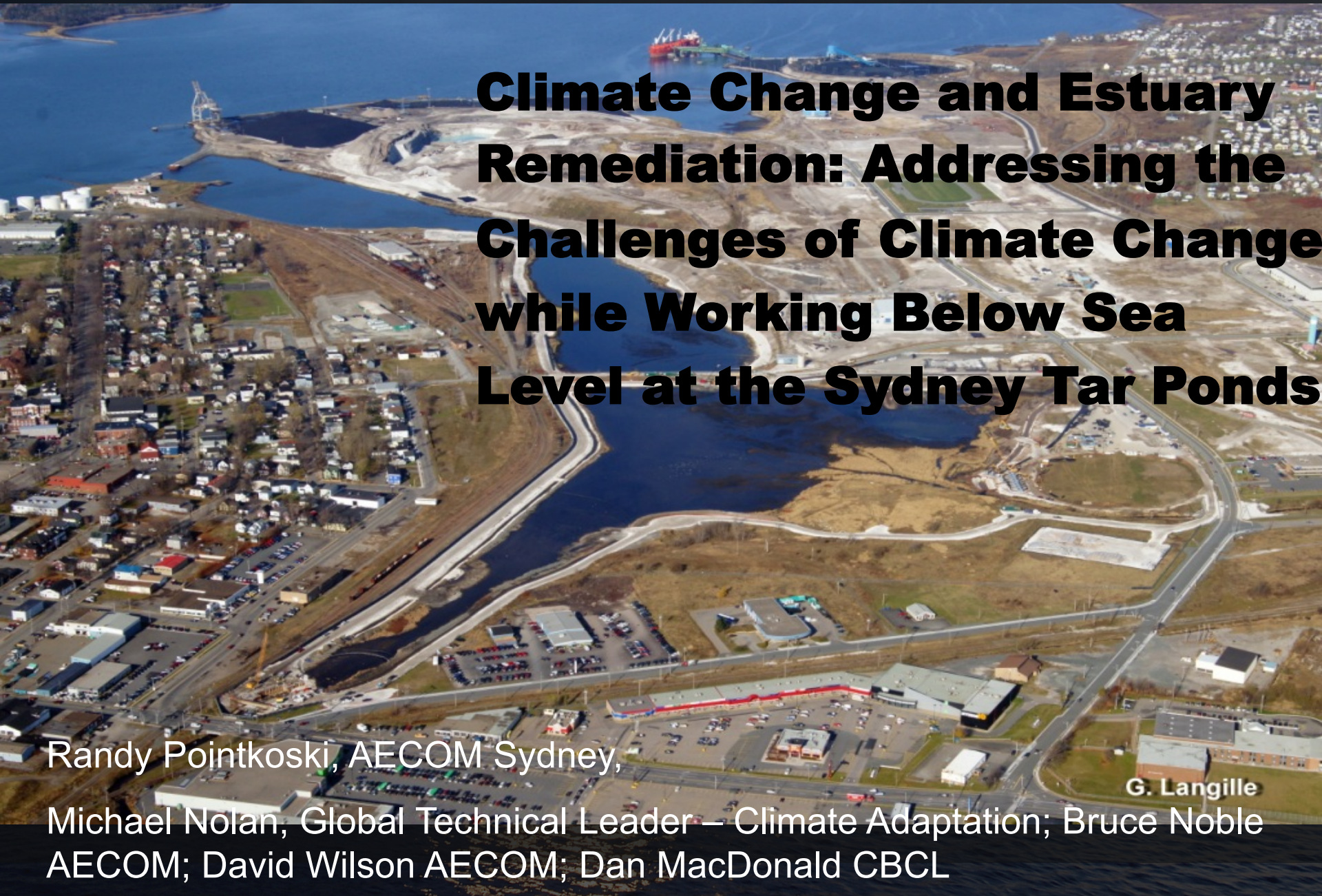
Climate Change and Estuary Remediation: Addressing the Challenges of Climate Change while Working Below Sea Level at the Sydney Tar Ponds



Randy Pointkoski, AECOM Sydney,

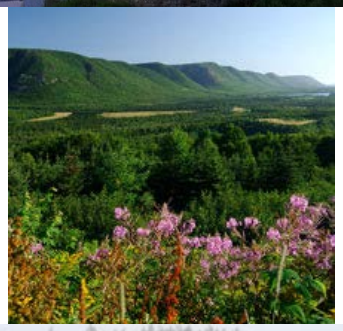
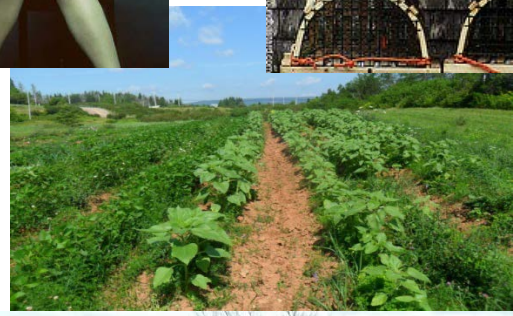
Michael Nolan, Global Technical Leader – Climate Adaptation; Bruce Noble AECOM; David Wilson AECOM; Dan MacDonald CBCL

Safety Stewardship – Why I work Safe?





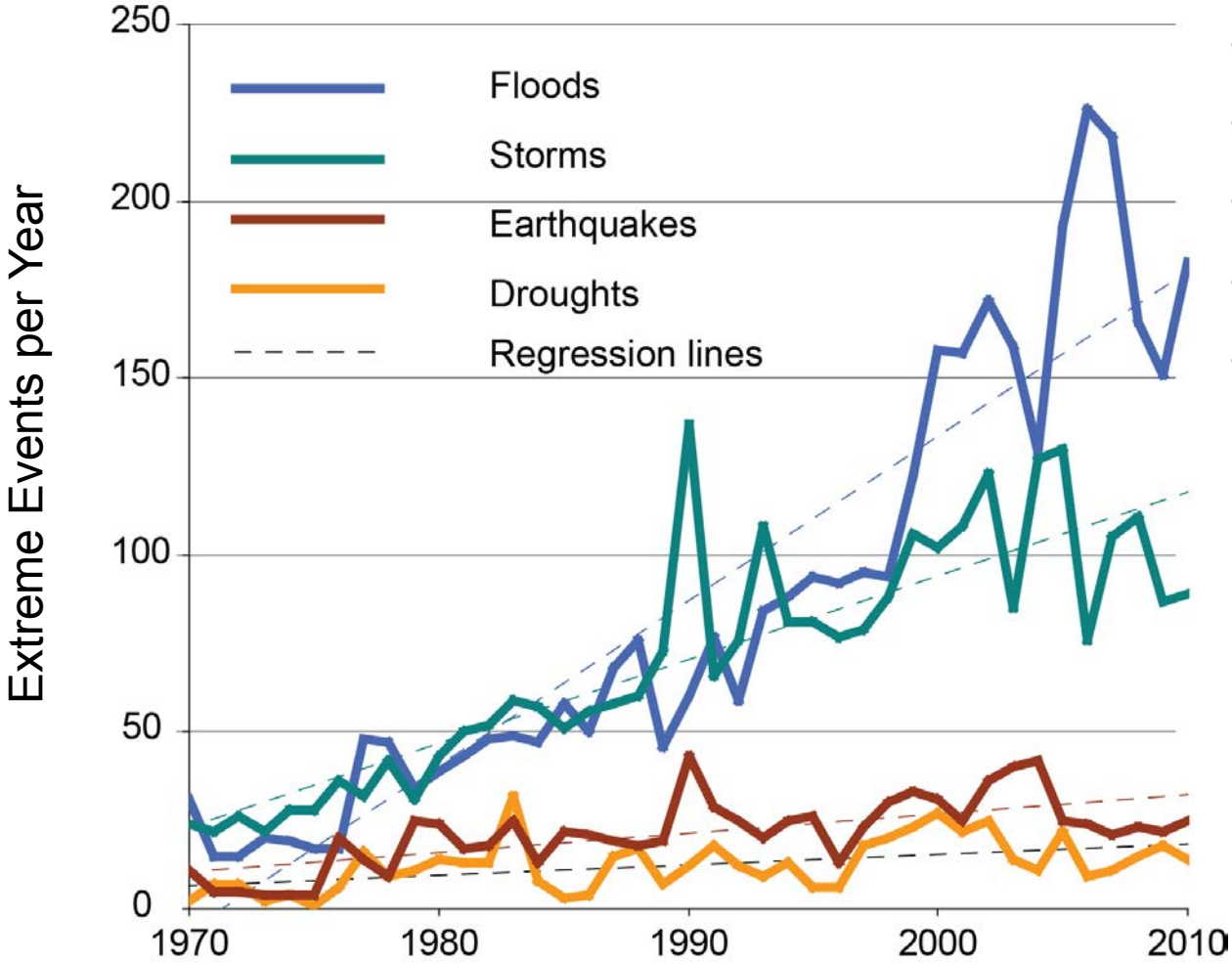





I WORK SAFE so I can go home and enjoy my Cape Breton Country home with Body, Mind and Spirit in tact!!!!

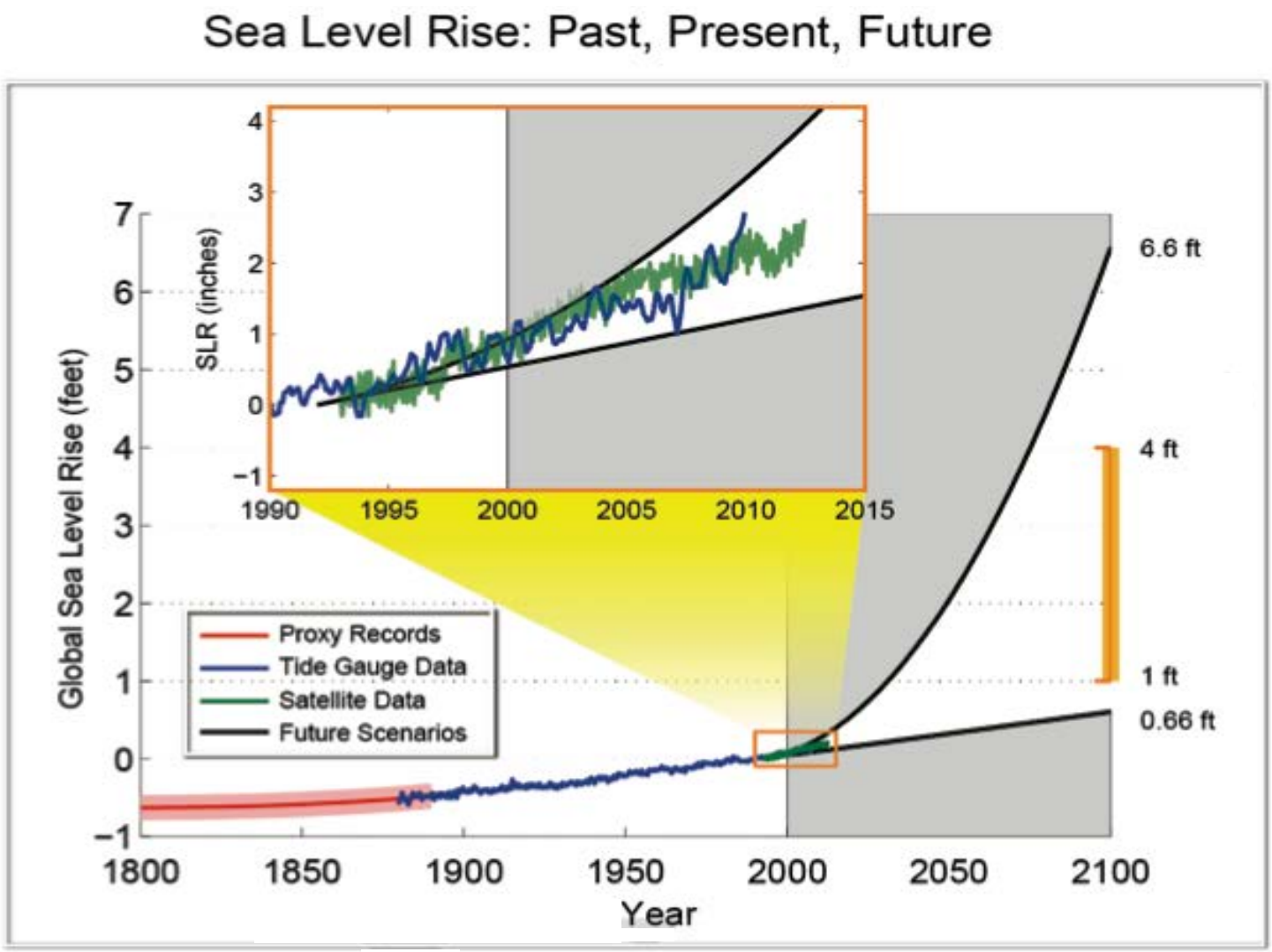
The climate is changing



- Extreme Events
- Degradation of Materials
- Resource Demand
- Health Impacts
- Long Term Impacts

Data Source: United Nations Office for Disaster Risk Reduction;
EM-DAT – HPPT://www.emdat.be/
Note: Earthquake trend not tied to climate change and could be due to better reporting

Coastal inundation and erosion



Source: Draft Third National Climate Assessment Report, Jan 2013

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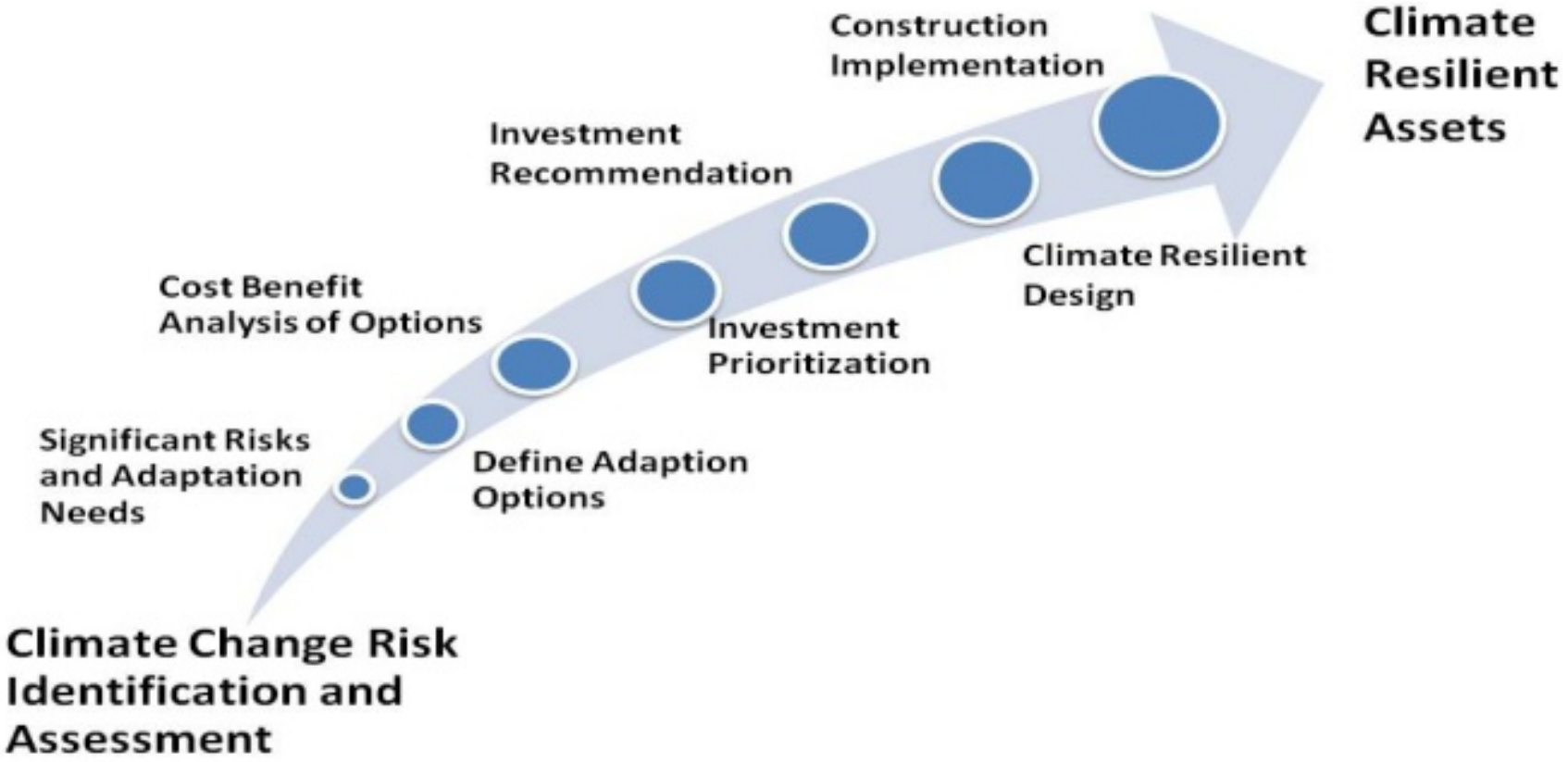
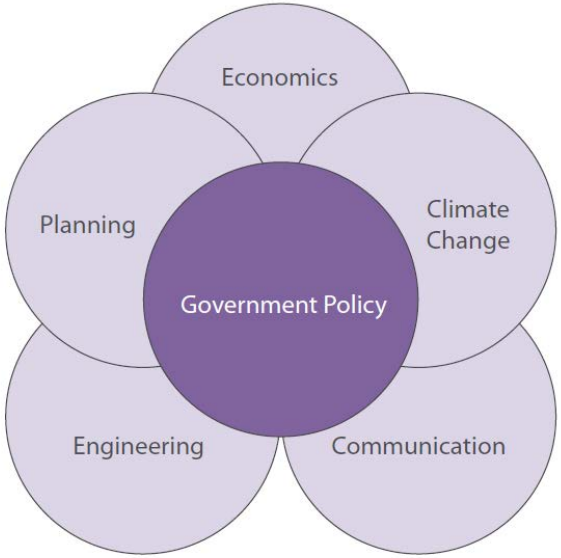
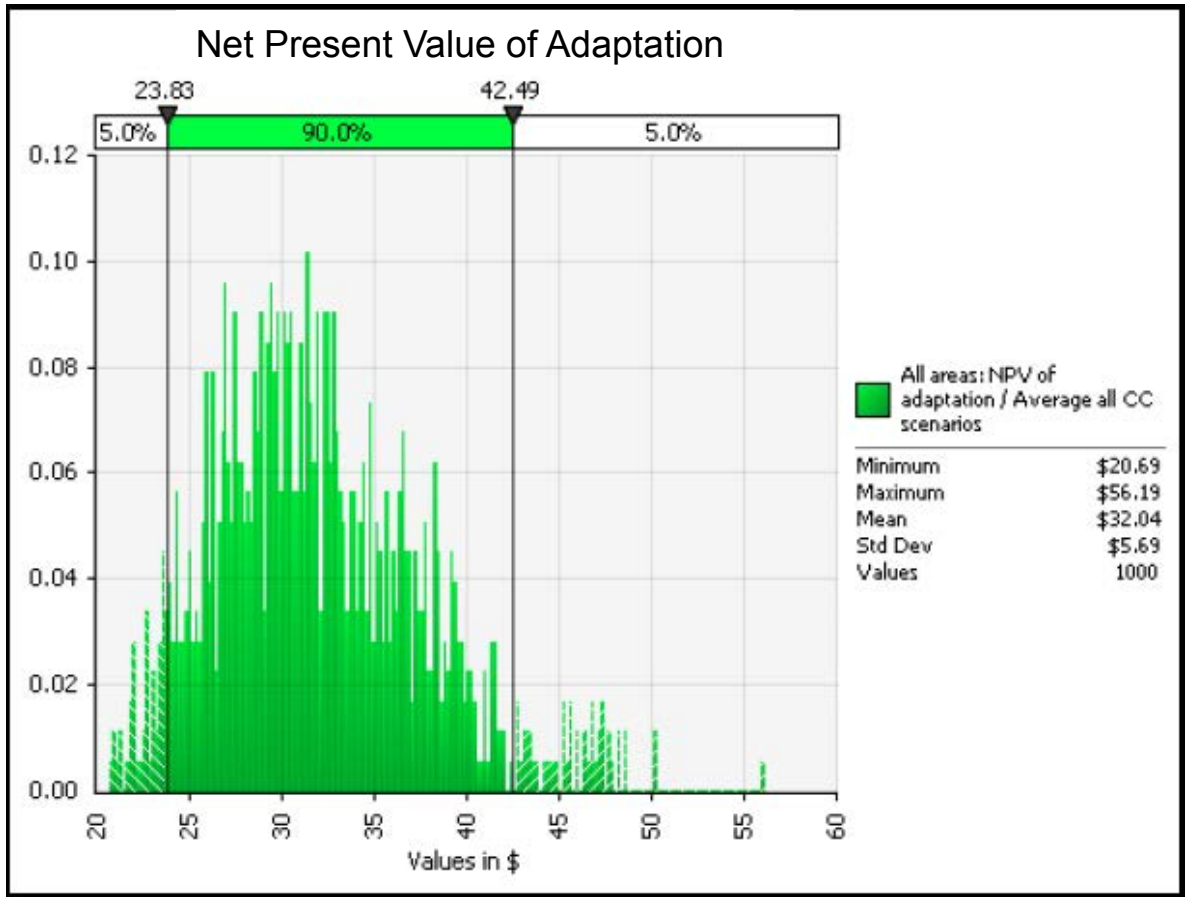
From Climate Risk to Adaptation Implementation



Economic Framework for Analysis of Climate Change Adaptation Options

- North Sydney Lagoon Municipality
- Water Supply
- Melbourne Metro Rail





Sensitivity of Materials to Climate Change Impacts

Material	CO_2	Cyclones & Storms	Sea Level Rise	Extreme Rainfall & Floods	Annual & Max Temp	UV	Bushfire	Drought
Concrete	M	H	H	M	M	L	M	L-M
Metals	L	H	H	M	M	L	H	L
Mortar	L	M	M	M	L	L	M	H
Timber	L	M	M	M-H	M	L	E	L-M
Coatings	L	M	L	M	M	H	E	L
Polymers	L	M	L	L	M	H	E	L

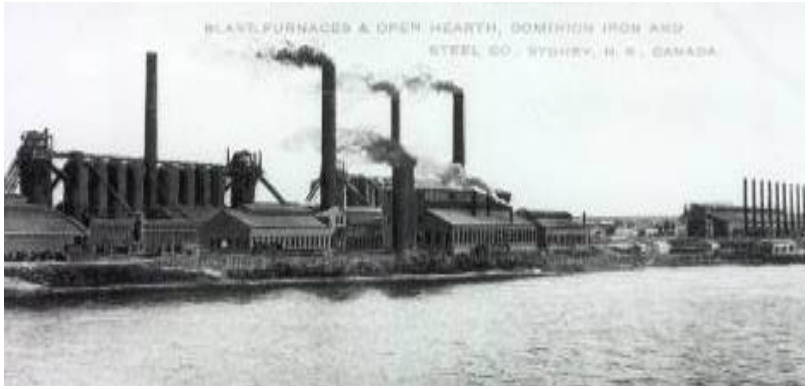
L	Low
M	Moderate
H	High
E	Extreme

Climate Risk Assessment of Remediation Sites

Impacts are a function of:

- Climate variables changing (temp, rainfall, soil moisture, sea level etc)
- Life expectancy of remediation and restoration (20 yrs versus 100 yrs)
- Location and geomorphology
- Existing degradation of natural system and vulnerability of species

An Overview of a Unique Canadian Site



- 100 years of coking operations
- Tar Ponds: 81 acres
  - 700,000 tonnes of PAH contaminated sediments
  - 45,000 tonnes of PCB contaminated sediments (> 50 PPM concentration)
  - Low Tide cover .3 m to 2.5 m
  - Thickness .5 m to >4 m
- Coke Ovens: 178 acres
  - 3,000 tonnes of PAH & VOC contaminated soil
  - 300,000 tonnes of coal tar in tar cell

History of the Site

1899 – begin construction.

1901 – largest North American steel mill begins production.

1912 – steel mill is producing half of the steel made in Canada.

Sydney Steel Plant Employed approximately 6,000 people in it's peak.

History of the Site

Coking Process Created Residual Coal Tar which was Washed down Coke Oven Brook and used as Fill Across the Site.

AECOM Role

- Design Engineer
  - Proposing and Designing Solutions
  - Permit Applications
  - Creation of Major Documents such as Environmental Protection and Management Plans, Health and Safety Plans, Quality Assurance Plans, Local Economic Benefits Plans
  - Development of Tender and Design Packages

- Construction Oversight
  - Supporting contract administration for Schedule and Budget
  - Ensuring the Contractor is in compliance with Nova Scotia Environment Construction Permit, Worker Safety and other relevant regulations
  - Ensuring Compliance with project Social Objectives
  - Managing **Design and Infrastructure Integrity** during construction to provide **Design Engineer Declaration** at project completion

AECOM: 23 Offices, 4 Countries, 350 People

Climate Risk in Remediation and Restoration Projects

Integrate into standard processes:

- Site Assessment
  - current trends
  - projected changes to climatic conditions
  - future Δ to environmental conditions
- Remediation/Restoration Design
  - designing for current & future conditions
  - options analysis
- Implementation and Monitoring
  - staged implementation
  - adaptive management

Adaptation
Australian Approach
Coconut Crab
(Birgus latro)

Adaptation and Implementation
Christmas Island NS Approach

Purpose of Project Water Management Strategy

1) To Protect Aquatic Life

2) Provide a Dewatered Area for Solidification and Stabilization

Sources of Sea Water in Estuary

- The Tide and Sydney Harbour

Sources of Fresh Water in Estuary

- Wash Brook – Urban Storm Water Collection Channel – Significant upstream urban flood risk potential

- Coke Oven Brook – Highly Varied Flows

Other Sources of Water in Estuary

- Storm Outfalls – 14 Known Outfalls into the Tar Ponds

Ground Water Infiltration

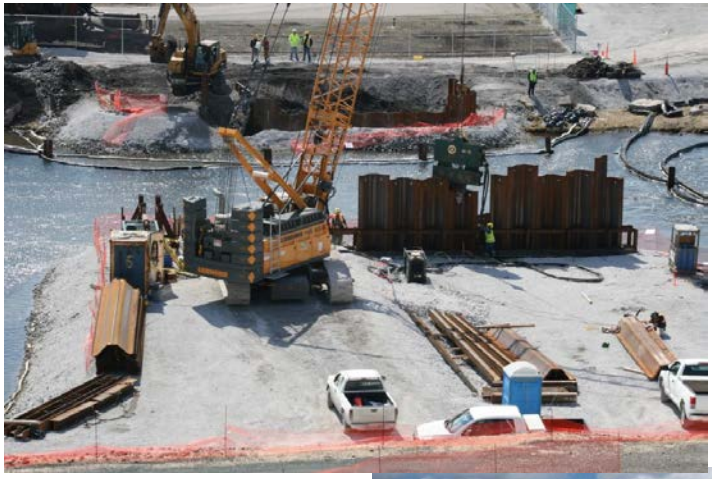
Storm Outfall Management

- Storm outfalls are temporarily directed to constructed ditches or pumped to pump around structures.
- These outfalls are directed to the newly constructed channel as part the permanent design.

Water Pumping 13.7 m^3/sec – 230,000 USGPM

Distance of Water Pump Around

- Phase 1: Approx. 550m on Coke Oven Brook
  Approx. 650m on Wash Brook
- Phase 2 - Approx. 650 m from Ferry Street to the Narrows
- Phase 3 - Approx. 650 m from the Narrows to Battery Point



TP6A Contracting Considerations

- Phased Operation – 3 Phases
- Performance Based Pumping
- Pumping Design based 1:5 year storms flows
- Critical Storm management plans
- Owner accepted risks for above 1:5 year storm contractually
- In 34 months 3 storms greater than design – no significant impacts *no harm no foul*
- One storm below 1:5 year level with flooding impacts

34 Months – 3 Phases - $34 Million

Dissipation Structures

Battery Point Discharge Halo

A MBJV **“Field Innovation”** concept by the Denis Kaufman, Battery Point Supervisor, who recommended using site materials and resources to create a solution for silt curtain and oil boom management in the harsh harbor environment.

Stabilization and Solidification

- Remedial Process can begin when the Contaminants are Relatively Dry.
- Management Site Water(e.g. Pore Water, Upwelling, Precipitation) through on-site water relocation and exfiltration galleries

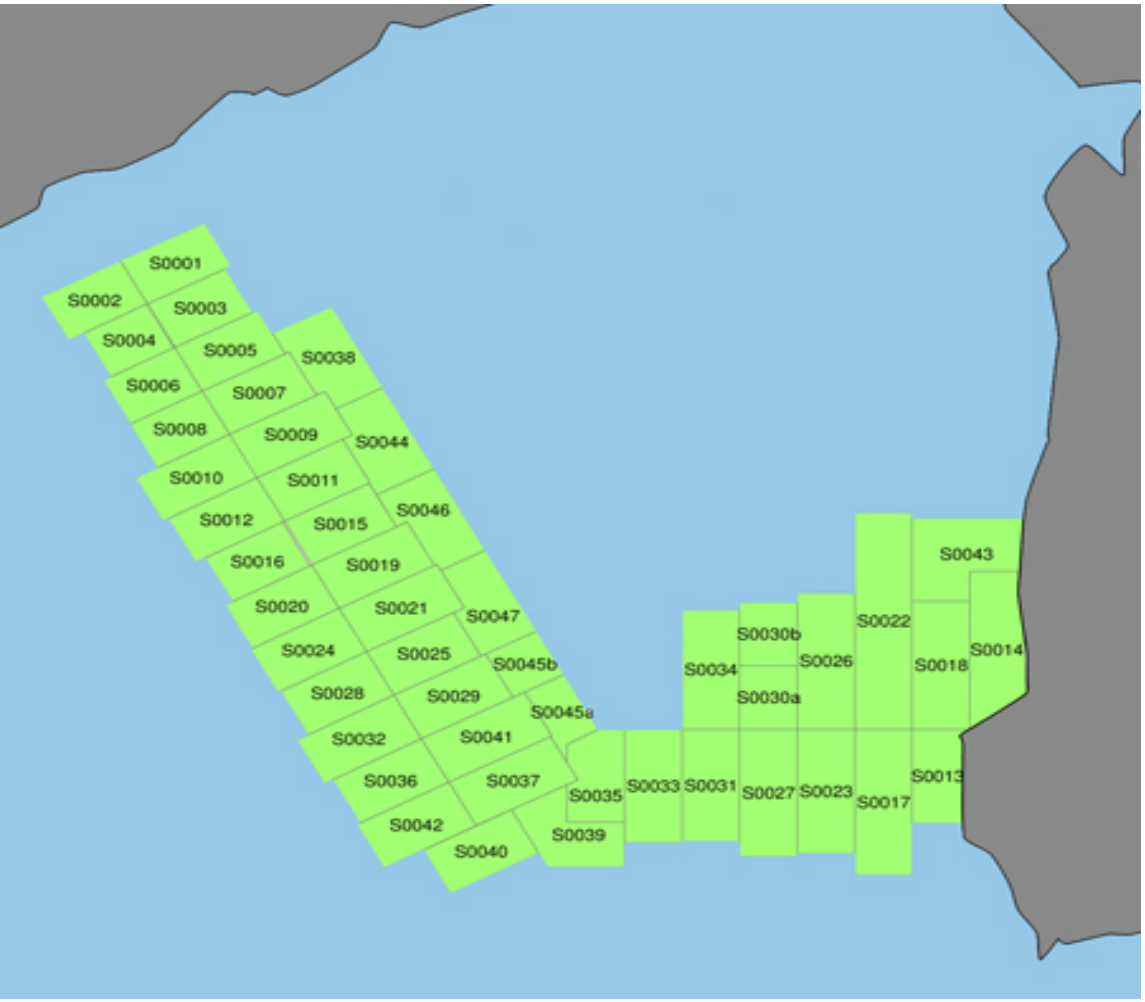
Solidification and Stabilization Process – Bucket Mixing

- Approach uses Excavators and Conveyance Boxes
- Cement Powder is placed on surface and mixed into sediments

Solidification and Stabilization Process – ALLU Mixing

- Approach uses Excavators with a Mixing head
- Cement Powder is moved from shuttle unit through mixing head to sediment
- Effective with deep cells and locations with high water infiltration

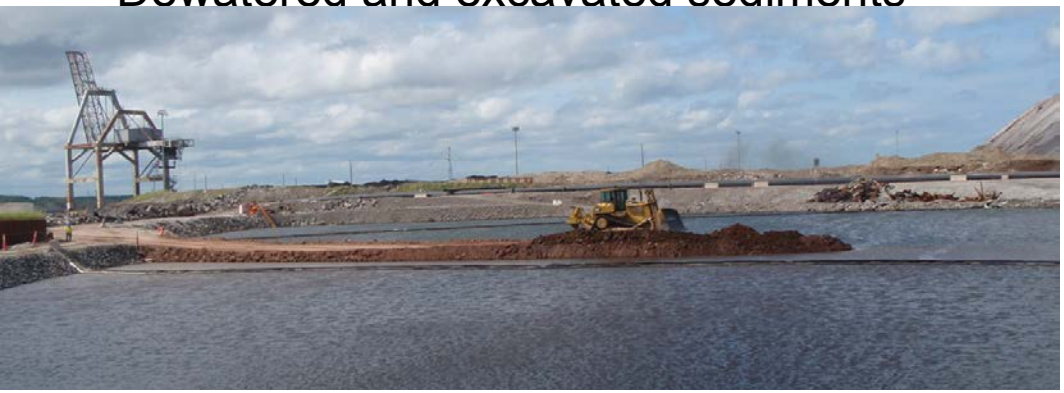
Dividing and Conquering the Tidal Water - 2009



- Imported impacted material to get above water level
- Stabilized a Cutoff wall section

Dividing and Conquering the Water - 2012

- Imported clay to construct water management berms
- Dewatered and excavated sediments



Managing Estuary Ground Water During Construction

*Pumping and drainage

* Sheet Pile Cutoff walls

* Clay Berm cutoff walls

* Flexible Mixing Strategies

Odor Management Plan

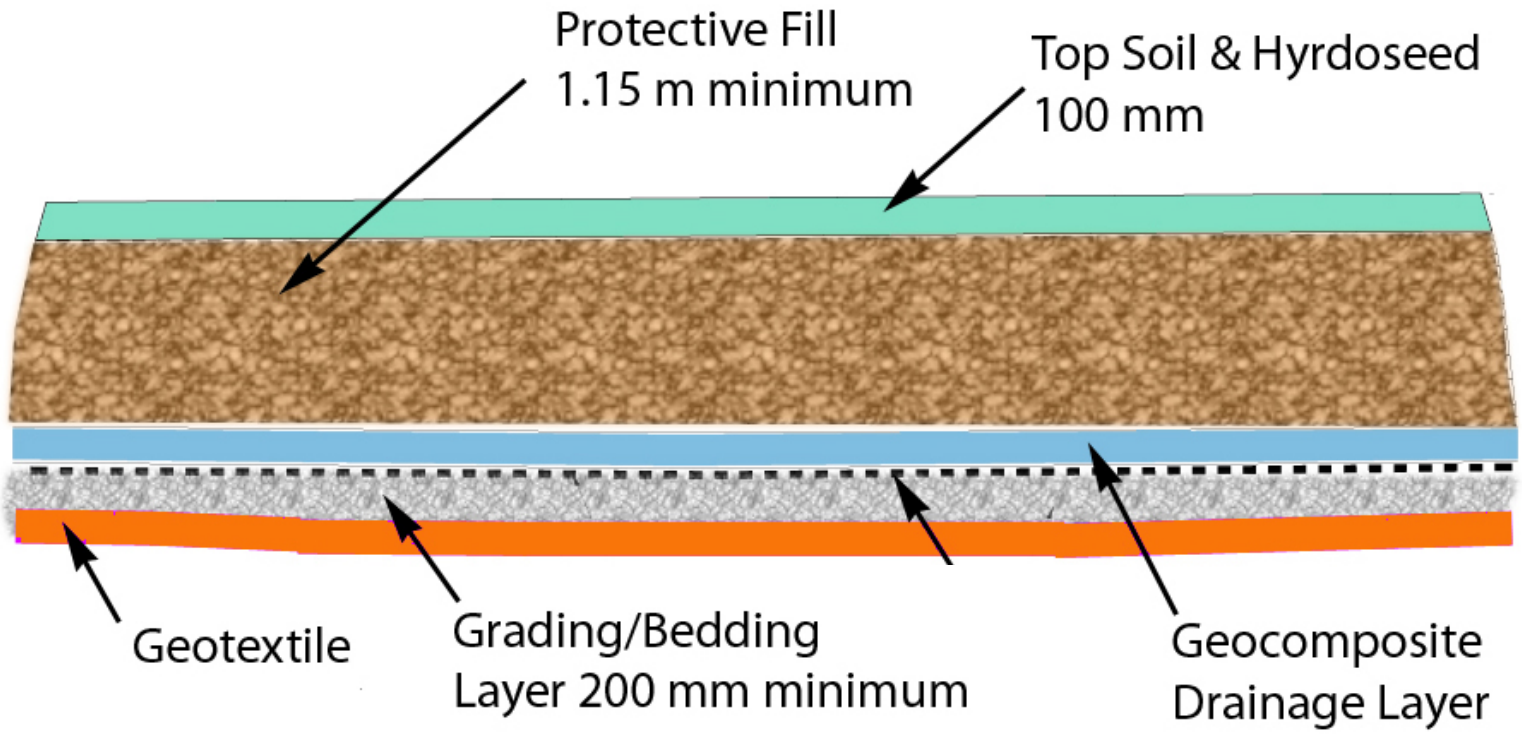
- Development of an Odor Management Plan
  - Define Roles for Contractor, Design Engineer and Client
  - Define Protocols
  - Odor Complaint Hotline

Dedicated “Odor Champion”
•Respond to Work Activities
•Ensure Adequate Supply of Odor Suppressant Products
•Odor generation is **weather dependent**

- Odor Suppressing Foams
- Concover 180
- Biosolve
- Domestic Substances List - EC
- Landfill Technology

Channel Construction

Tar Ponds Cap



- Multilayered engineered cap completes remedy after S/S
- Design criteria – 10^{-6} permeability limits & drainage features
- Cap constructed of natural & geosynthetic materials

Cap Construction

Pointkoski Ridge
The Last RFI – 1050 Documented Construction Issues – 5 Years

In Summary - Working Below Sea Level has its Challenges –

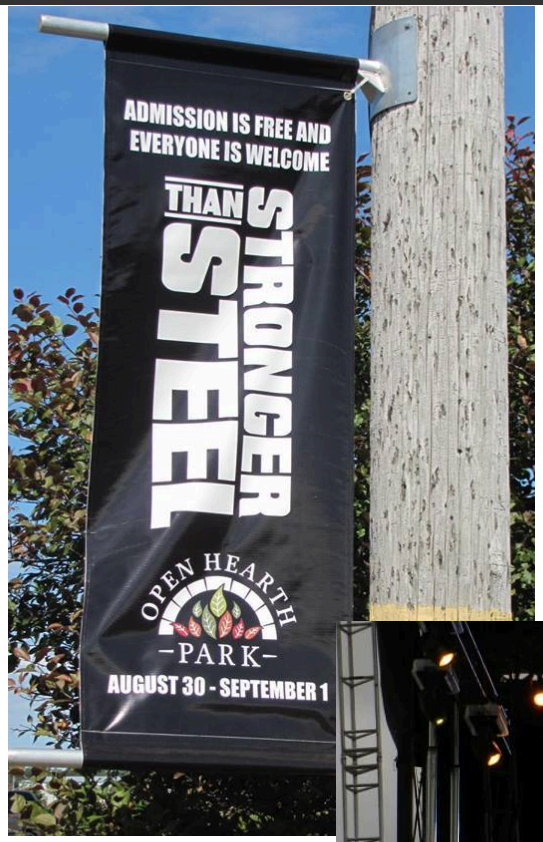
The Challenges are addressed by:

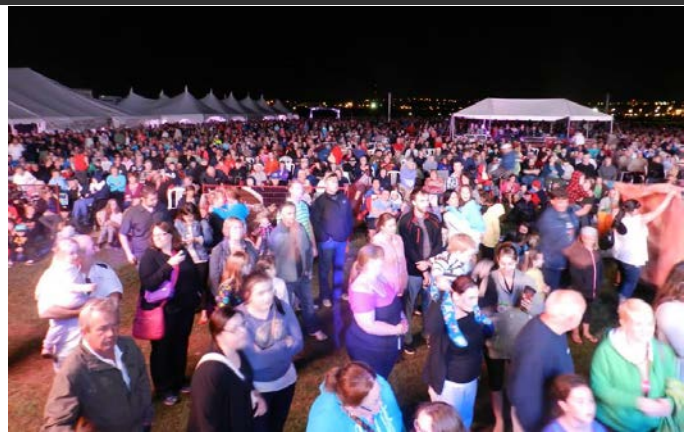
- Controlling incoming fresh water flows by diverting them from the work area using temporary pumping stations
- Control water coming from other sources using barriers of various forms
- Intercept storm water outfalls
- Create a new channel within the isolated areas
- Pumping residual water
- Complete in situ treatment of tar ponds sediments through a flexible solidification / stabilization program

Understanding and Adapting to Climate is Key

Progress to Summer 2012

Public Land Use - People and Culture





Accomplishment Through Adaptation

Various Climate Adaptation Projects in Canada for Infrastructure Systems

Climate Change Impacts on drinking water and waste water systems in the Saint-Lawrence River

- Economic assessment and benefit-cost analysis of adaptation options

Building the Case for Climate Resilience and the Electrical Distribution Sector – the case of Toronto Hydro

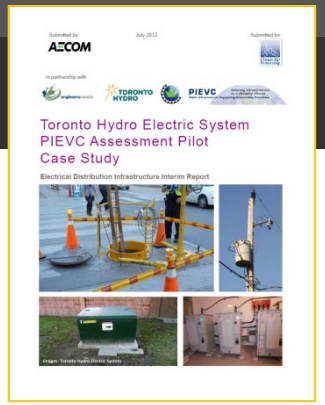
- White paper on the need for climate adaptation to support Toronto Hydro's 2015-2019 rate application

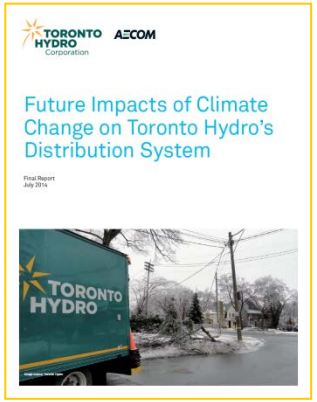
Toronto Hydro Electrical Distribution Infrastructure Climate Change Impact Assessment

- Application of Engineers Canada's risk assessment procedure to electrical infrastructure

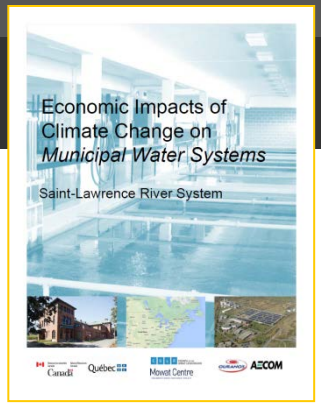
Climate Change Impacts on Storm water drainage systems

- Economic assessment and benefit–cost analysis of adaptation options



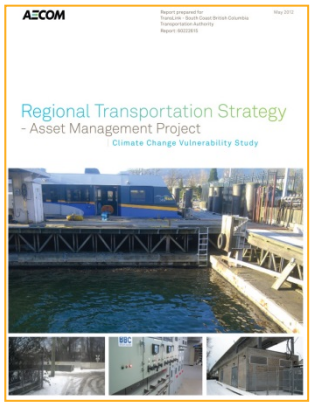


Various Climate Adaptation Projects in Canada for Infrastructure Systems cont.



Triple Bottom-Line Decision Making in the context of Adapting to Climate Change

- Development of a TBL multi-criteria method to support Engineers Canada's infrastructure risk assessment procedure

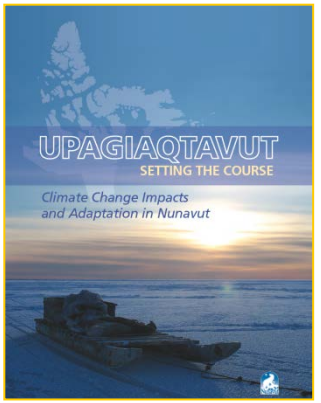


Climate Resilience Transit Asset Management Strategy

- Risk assessment of Translink's infrastructure to climate change impacts

Climate Change Related Flooding Impacts to Canadian Prairie Communities

- Economic assessment of flood impacts and benefit-cost analysis of adaptation options



Government of Nunavut Climate Adaptation Action Plan

- Development of a cross department-cross sector climate action plan for government of Nunavut

> “It is not the strongest of the species that survives, nor the most intelligent that survives. It is the one that is the most adaptable to change.”
>
> **Charles Darwin**

Questions?

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