

# CHANGING CLIMATE CHANGING RISKS

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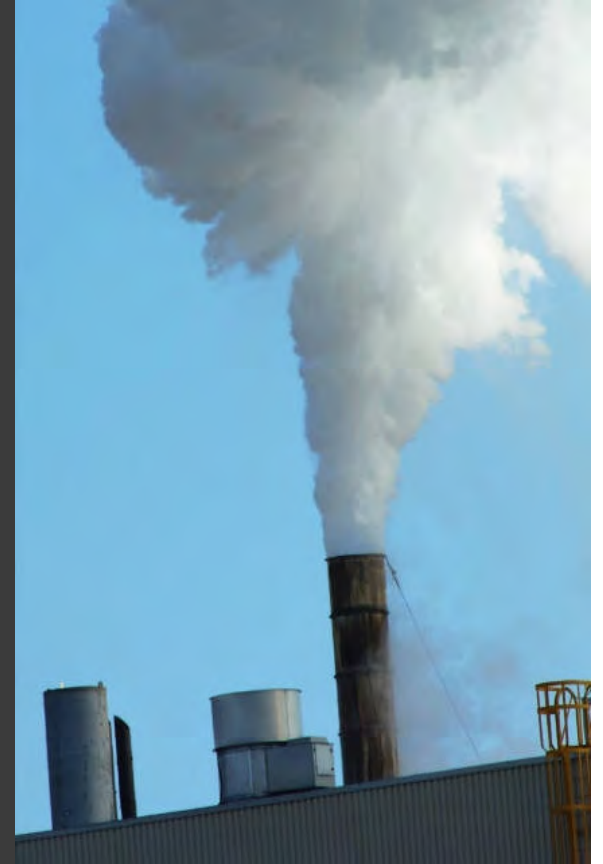
*Alberta*  Transportation

# Climate and Due Diligence

- current infrastructure was built based on design values calculated from the climate data record
- the accepted practice has been to use climate data as the best estimate of conditions to be expected during the future lifespan of structures

# Climate and Due Diligence

- ① the increasing concentration of greenhouse gases (GHG) in the atmosphere is changing the climate
- ① growing concern that the recent past climate is not a sufficiently reliable indicator of future climate





# Changing Climate

The way we operated before may not be adequate.

**What's the alternative?**

Better understand the risks and options to reduce the impact of changing climate on transportation



# Climate Change Risk Assessment and Adaptation

ICF Marbek, Ottawa, and  
Summit Enterprises International Inc.  
May 2012

Available at: [www.transportation.alberta.ca](http://www.transportation.alberta.ca)



# Purpose of the Risk Assessment

- identify and prioritize the potential climate change risks to Alberta's Provincial Highway Network (roads and bridges) over the next 40 to 50 years

# Vulnerability to Climate Change

Article in Jan-Feb 2013 TR News described the arctic and northern latitudes as the **climate change classroom** for the continent

- ⦿ experiencing temperature and precipitation extremes
- ⦿ facing significant challenges due to permafrost melting







# Vulnerability to Climate Change

Depends on three factors:

- **Exposure**
- **Sensitivity**
- **Adaptive capacity**

# Vulnerability Factor 1

- **Exposure**

- the magnitude of change in temperature, precipitation and other changes such as melting of permafrost

# Vulnerability Factor 2

- **Sensitivity**

- the effect of exposure to climate on the system or component;



# Vulnerability Factor 3

- **Adaptive capacity**
- the potential to reduce the vulnerability to climate events through; available technology, resources, human capital, institutional and decision making capacity

# Climate Change Projections (1 of 2)

Are based on the following factors:

- ⦿ Observed climate data and trends
- ⦿ Expected climate trends using General Circulation (climate) Models
- ⦿ Short-term variations around the long-term trends (El Nino, etc.)

# Climate Change Projections (2 of 2)

- climate projections in a highly summarized, easy to use format
- *Adapting to Climate Change: A Risk-based Guide for the Government of Alberta* developed by Alberta Environment and Sustainable Resource Development



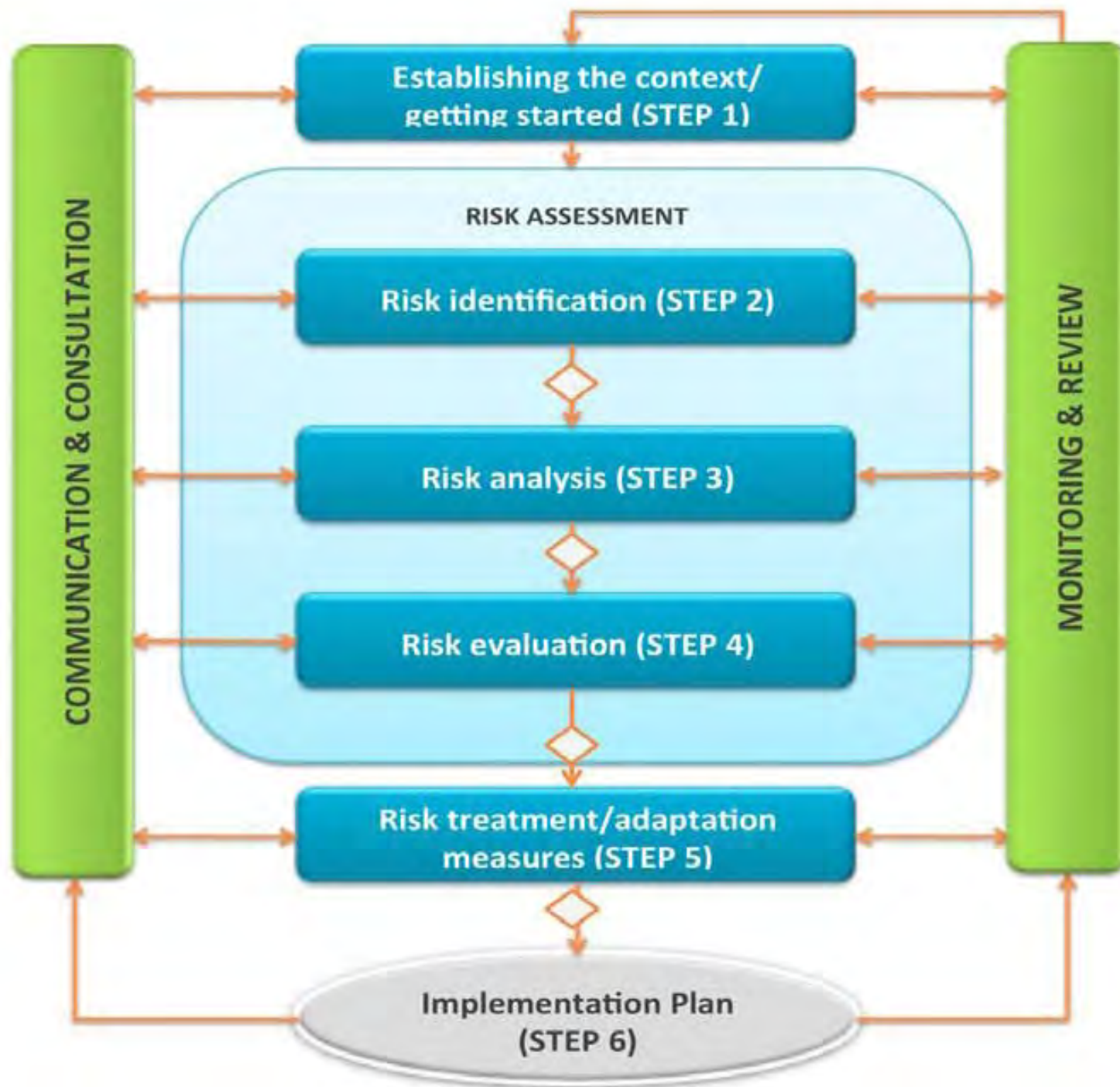
# Risk Management Process

- **Selecting the best course of action** by helping to **identify, understand, analyze** and **treat risks** and to **communicate** to others about them
- A guidebook was developed for this process (*Adapting to Climate Change: A Risk-based Guide for the Government of Alberta*)

# ISO 31000

## Risk Management Standard

- The Guide follows the risk management framework described in the International Standards Organization's *ISO 31000 Risk management – Principles and guidelines* (2009)
- The process is shown in the following figure:





# Multi-Step Process (1 of 2)






- ① identified the climate elements to which transportation infrastructure is sensitive or vulnerable
- ② assessed the potential risks to Alberta's provincial highway network

# Multi-Step Process (2 of 2)

- Held a risk assessment workshop with technical staff responsible
- Considered both likelihood and consequences
- Results are summarized in the next figure considering **Likelihood** and **Consequence**

Consequences	Very High					
	High					
	Moderate			<ul style="list-style-type: none"> <li>• Road washouts and blockages from more frequent high-intensity, low duration rain events, causing overwhelmed culverts and drainage systems, and landslides</li> </ul>	<ul style="list-style-type: none"> <li>• Road traffic disruptions and increased accidents from more frequent winter rain, freezing rain, and wet snow</li> </ul>	
	Low	<ul style="list-style-type: none"> <li>• Increasing damage to transportation infrastructure (roads, bridges, overpasses) due to increased freeze/thaw cycles</li> <li>• Damage to water management infrastructure due to ice jams caused by increased freeze/thaw cycles</li> <li>• Softening and distortion of road pavement due to increased likelihood of hot days</li> <li>• Shorter duration of winter-weight on highway network</li> <li>• Longer exposure of vulnerable road users (pedestrians, cyclists, etc.) due to longer summer</li> <li>• Just-in-time delivery threatened by road closures related to weather events</li> </ul>	<ul style="list-style-type: none"> <li>• Loss of ice roads/bridges due to warmer and shorter winters</li> <li>• Inadequate capacity of water management infrastructure to deal with extreme rainfall and rain on snow melt events, leading to flooding</li> <li>• Road closure and hazards due to severe wind storms and blizzards</li> <li>• Damage to signage due to extreme high winds and blockage of roads due to fallen trees, power lines, etc.</li> </ul>	<ul style="list-style-type: none"> <li>• Reduced visibility and traffic disruptions due to increased wildfires and smoke</li> </ul>		
	Very Low					
	Very Low	Low	Moderate	High	Very High	
		Likelihood				

# Risk Assessment Categories

	Extreme Risk: Immediate controls required
	High Risk: High priority control measures required
	Moderate Risk: Some controls required to reduce risks to lower levels
	Low Risk: Controls likely not required
	Negligible Risk: Scenarios do not require further considerations



# Results of Risk Assessment

- ① identified 13 potential risks
  - 1 identified as 'high'
  - 2 'moderate' priority risks
  - 10 were 'low'

# High & Moderate Risks (3)

- ⦿ **High Risk:** road traffic disruptions and increased collisions from more frequent winter rain, freezing rain, and wet snow.
- ⦿ **Moderate Risk:** road washouts and blockages from more frequent high-intensity, low duration rain events, causing overwhelmed culverts and drainage systems, and landslides.
- ⦿ **Moderate Risk:** reduced visibility and traffic disruptions due to increased wildfires and smoke

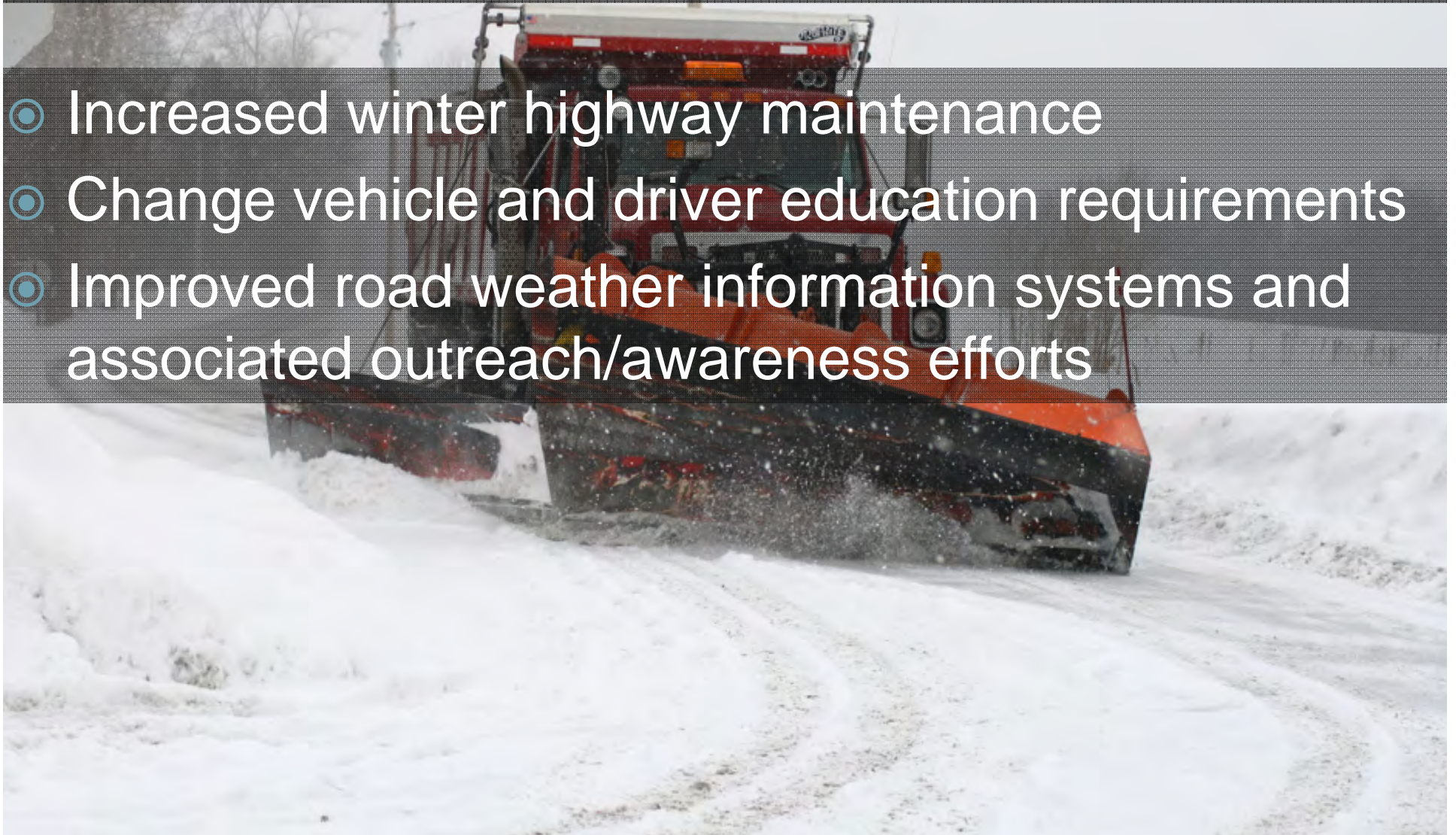
# Adaptation Measures

- For each of these priority risks, adaptation measures were developed through a second workshop with participants from the core responsibility groups of the department.
- Focused on those that could become critical within a decade.



# High Risk – Road Traffic Disruption Adaptation Options (1 of 2)

- ⦿ Increased winter highway maintenance
- ⦿ Change vehicle and driver education requirements
- ⦿ Improved road weather information systems and associated outreach/awareness efforts





# High Risk – Road Traffic Disruption Adaptation Options (2 of 2)

- Change the geometry of road design
- Increase monitoring of road traffic disruptions and increased collisions
- Identify alternate transportation modes

# Moderate Risk – Road Washout, Adaptation Options

- Change design standards
- Survey existing infrastructure to determine "at-risk" installations
- Accelerate retrofitting of at-risk sites
- Review/update emergency management plans

# Moderate Risk – Reduced Visibility Adaptation Options

- Improve travel advisory systems



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Alberta's Official Road Reports

Call 511 ▶ [511.alberta.ca](http://511.alberta.ca) ▶  ▶  @511Alberta

Alberta  
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# 10 Low Risk Events (1 of 4)

- ⦿ Inadequate capacity of water management infrastructure to deal with extreme rain fall and rain on snow melt events, leading to flooding
- ⦿ Road closures and hazards due to severe wind storms and blizzards





# 10 Low Risk Events (2 of 4)

- ① Loss of ice roads/bridges due to warmer and shorter winters
- ② Sign damage due to extreme high winds and road blockages due to fallen trees, power lines, etc.
- ③ Shorter duration of winter weight on highway network





# 10 Low Risk Events (3 of 4)

- ① Damage to water management infrastructure due to ice jams caused by increased freeze/thaw cycles
- ② Longer exposure of vulnerable road users (pedestrians, cyclists, etc.) due to longer summer





# 10 Low Risk Events (4 of 4)

- Softening and distortion of road pavement due to increased likelihood of hot days
- Just-in-time delivery threatened by road closures related to weather events
- Increasing damage to transportation infrastructure (roads, bridges, overpasses) due to increased freeze/thaw cycles



**Slide 33**

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**G22**

There appears to be an extra space after "infrastructure" in the last bullet

GoA, 9/4/2013

# Implementation Approach

- ⦿ consider first stage actions of low or moderate cost in terms of both funding and staff resources
- ⦿ begin by responding to risk events that occur
- ⦿ consider ensuring new investments are adapted to climate risks

# Implementation Approach

- ① climate change risks are used as one input to Alberta Transportation's enterprise risk management process
- ① climate change risks are considered in relation to other risks
- ① consider the long time frame (30 to 50 yrs. out) for the climate change scenarios

# Follow-Up Options (1 of 2)

Alberta Transportation will consider:

- ⦿ reviewing the risk assessment once updated climate change scenarios are available
- ⦿ developing experience in methods for risk assessment



# Follow-Up Options (2 of 2)

Alberta Transportation will:

- identify promising technical options to reduce vulnerability and impacts of weather and changing climate
- consider climate change implications in transportation strategy being developed

# Follow Up - Project Level

- ① the screening risk assessment process for the provincial highway system identifies assets that may need more in-depth consideration
- ① may consider using procedures intended for projects such as those developed by Engineers Canada and the federal government under the **Public Infrastructure Engineering Vulnerability Committee (PIEVC)**





# Goal: Resilient Transportation System





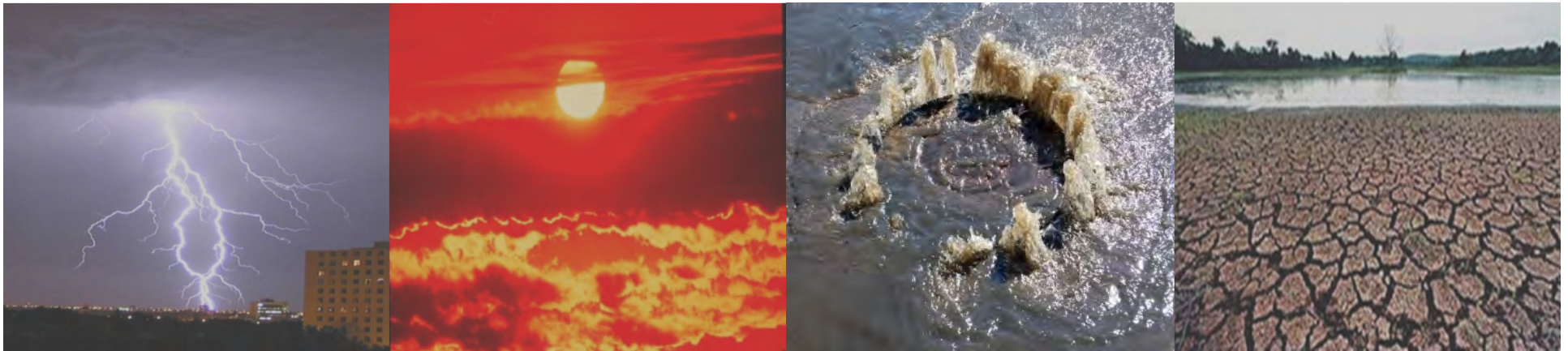


# Assessing Climate Change Risk to Stormwater & Wastewater Infrastructure

## Welland, Ontario

September 23, 2013

2013 TAC Conference & Exhibition



Marvin Ingebrigtsen, & Erik Nickel (City of Welland)