Associated Engineering

CANADA'S BEST MANAGED COMPANIES Platinum member



Adaptation Resilience Training

Mountains vs. Molehills: Identifying Climate Risks

Owen James, AE Practice Leader Asset Management

September 8, 2021 / March 10, 2022

“Sooner or later, everyone sits down to a banquet of consequences.”

Robert Louis Stevenson

RISK

Module Overview

Introduction

Purpose of risk identification and assessment

Topic 1: Risk and other key terms

Topic 2: What has risk got to do with climate change

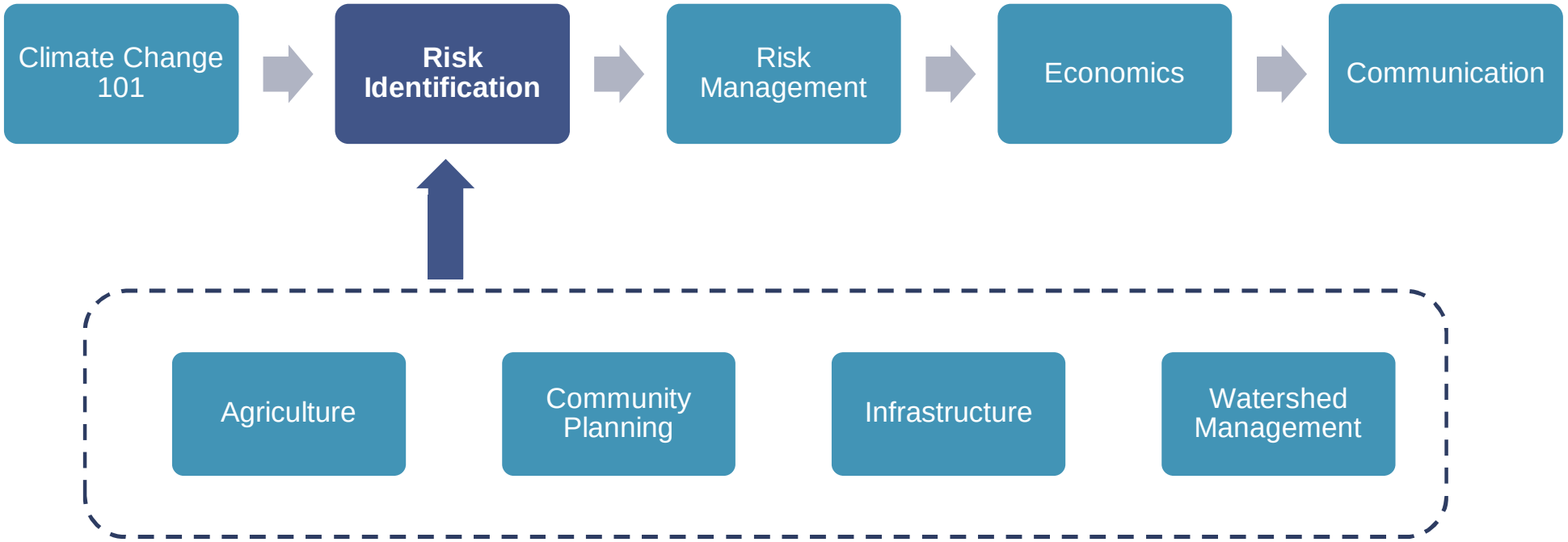
Topic 3: Identifying risks

Topic 4: Assessing and evaluating risks

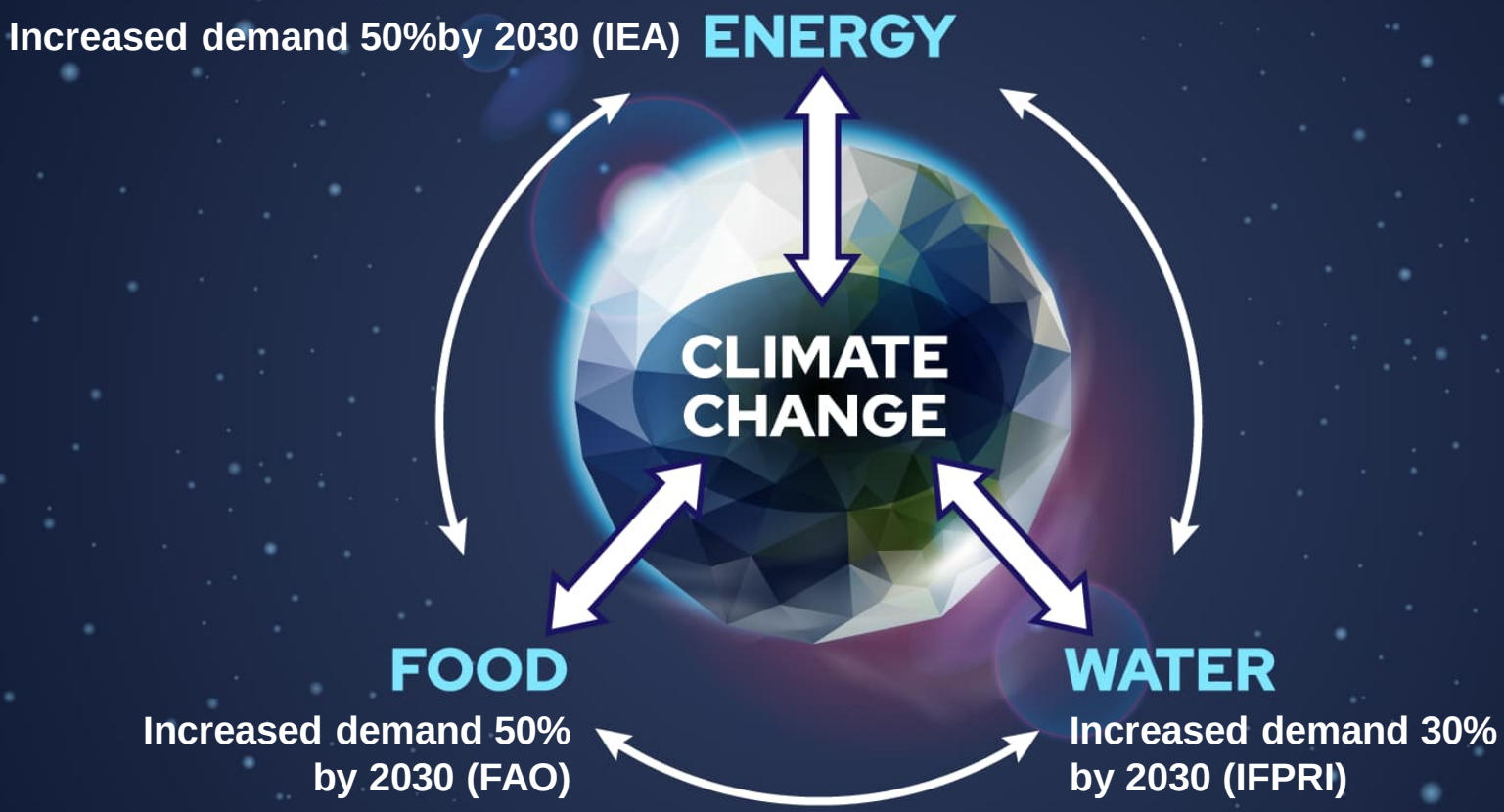
Questions and discussion

Preamble: Purpose of Risk Identification & Assessment (5 mins)

Context and relationships with other modules



The global challenge is enormous



Climate change is one of the most significant challenges

Aging Infrastructure

Community Growth

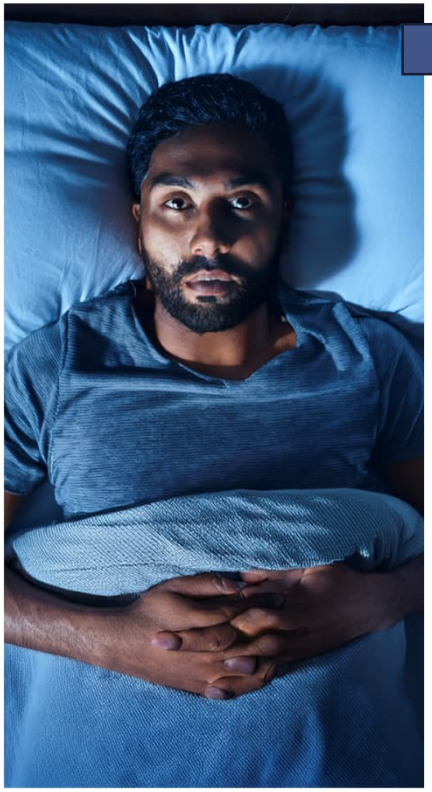
Changing Climate and Community Resilience

Service & Affordability

We live in a very complex world and face many challenges

Purpose of risk identification & assessment

Helps manage the things that keep you awake at night



- ☑ Reviewed the risks? *Flooding / fire / heat vulnerabilities*
- ☑ Identified actions? *Flood barriers/reinforcement, fire smarting*
- ☑ Actions initiated? *Yes / No / awaiting funding*
- ☑ Action status? *Complete / in progress / not started*
- ☑ Risk being managed? *Yes / No / What if investment is delayed?*

Topic 1: “Risk” and other key terms (5 mins)

Polling Question

Key Terms

- **Hazard** / threat – **A physical process or event** that can harm human health, livelihoods or natural resources

Something that could cause something bad!

- **Vulnerability** – **The degree** to which **a system** is susceptible to, and unable to cope with, the adverse effects of climate change

Something that could be negatively impacted by a hazard

- **Risk** – The **effect** of **uncertainty** on **objectives**

Possibility of something bad happening

Key Terms

- **Likelihood** / probability / uncertainty– The **chance** that something will happen
- **Consequence** / impact / severity / exposure – the (**extent of**) result or **effect of** an action or condition or event

Reflects some of the uncertainty

How big or bad (or good) is the impact going to be

What do we mean by “Risk”?

Risk: The effect of uncertainty on objectives

Effect: some sort of **consequence**

Uncertainty: probability / possibility / **likelihood**

Objectives: the things you are trying to achieve

Risk = Consequence x Likelihood

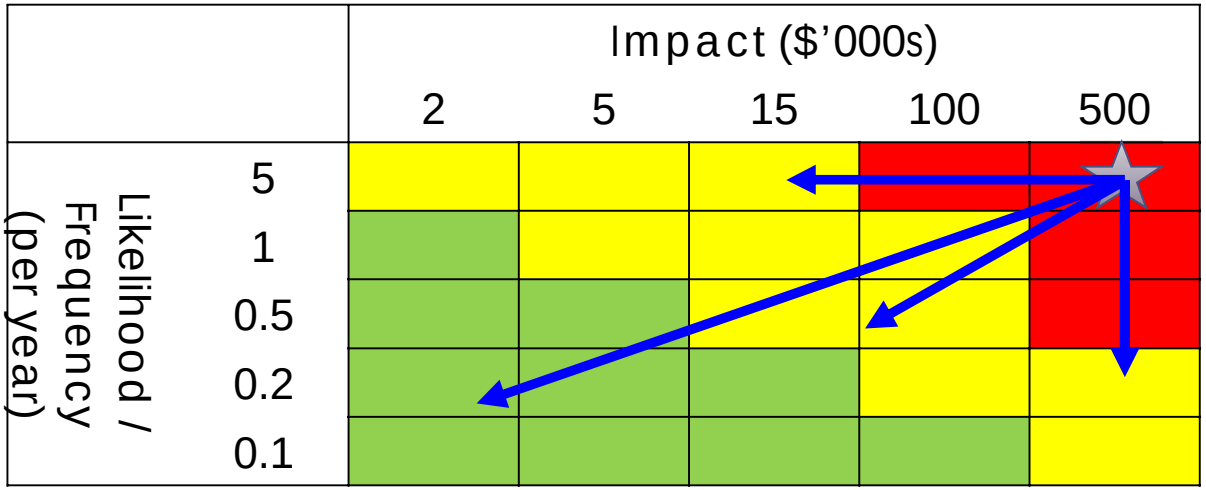
Likelihood	Consequence				
	Insignificant	Minor	Moderate	Major	Severe
Frequent					
Likely					
Possible					
Unlikely					
Rare					

* Also known as a heat map or risk matrix.

More Terms

Risk appetite / risk tolerance: The amount of and type of risk that an organization is prepared to pursue, retain or take

Residual risk: The risk remaining after defined actions have been taken



Topic 2: What has risk got to do with climate change (10 mins)

Why is Climate Change important

Will wildfire refugees in Canada finally spur action on climate change?

BY RYAN MEILI MAHLI BRINDAMOUR | JULY 23, 2015

Climate change is threatening these 10 species in Canada

Jackie Dunham CTVNews.ca Writer

B.C. salmon prices set to skyrocket with climate change, according to new study

Report predicts a sharp decline in B.C. fish numbers due to climate change

The ongoing collapse of the world's aquifers

wired.com | Jan. 20

As the growing human population and more intense droughts brought on by climate change are putting ever more stress on water supplies, land is su...

Climate change is killing off bumblebees: study

Unlike other animals, bumblebees can't seem to move north into cooler areas

By Emily Chung, CBC News Posted: Jul 09, 2015 2:00 PM ET | Last Updated: Jul 14, 2015 9:28 AM ET

The Guardian

David Pocock warns of devastating impact on sport if climate crisis inaction continues

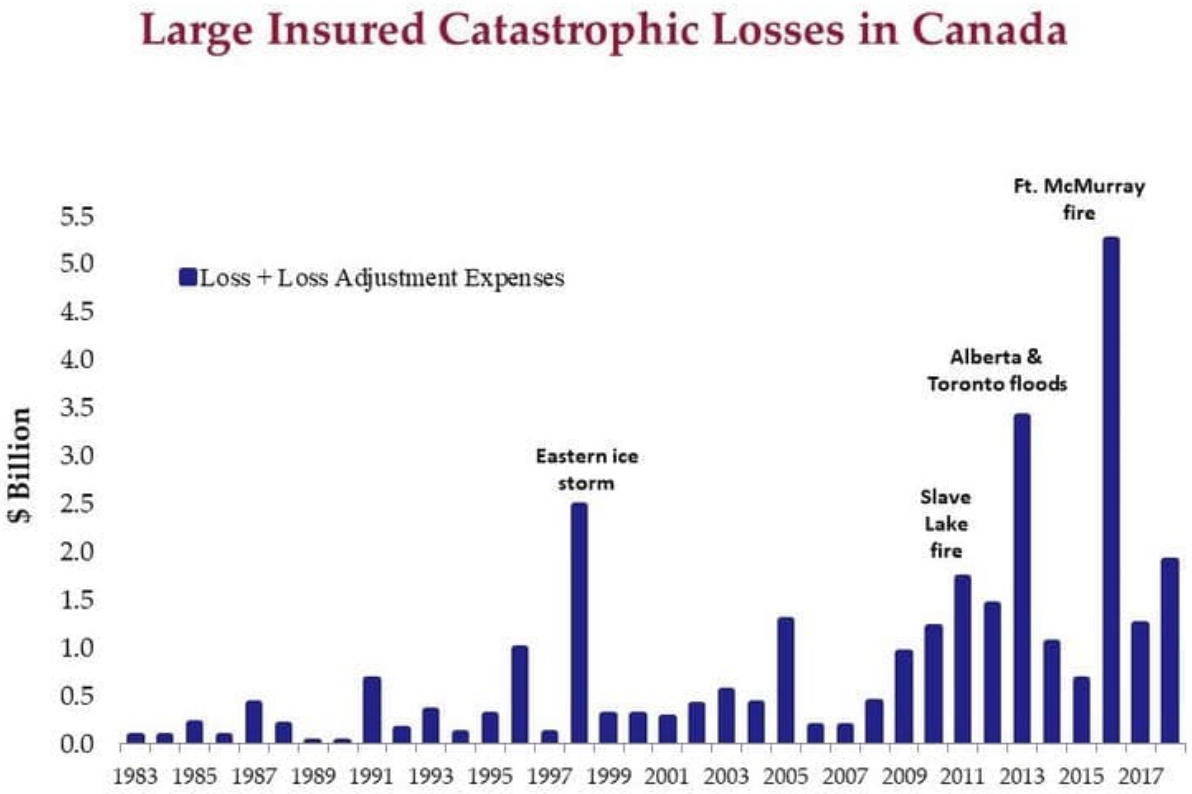
Is this drought caused by climate change?

By Charles Mandel in News, Politics | July 13th 2015

Sleeping Giant: Canada's Wildfire Risk

Canadian underwriter

Insured losses due to weather



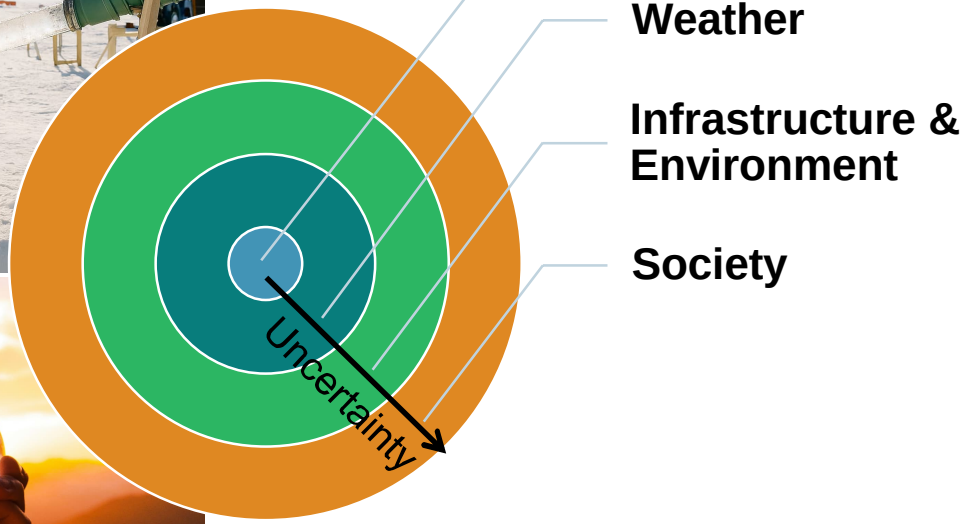
Top Damage-Causing Severe Weather Events in 2019

- **JANUARY**
  Winter Storm in Eastern Canada - $40 Million
- **FEBRUARY**
  Winter Storm in Ontario- $70 Million
  Winter Storm in Southern Ontario - $48 Million
- **MARCH**
  Two Winter Storms in the GTA and Eastern Canada - $114 Million
- **APRIL - MAY**
  Floods in Quebec and New Brunswick - $208 Million
- **JULY - AUGUST**
  Hailstorms in Western Canada- $181 Million
- **SEPTEMBER**
  Hurricane Dorian in Eastern Canada - $105 Million
- **OCTOBER**
  Storm in Eastern Canada- $250 Million

Source: Insurance Bureau of Canada

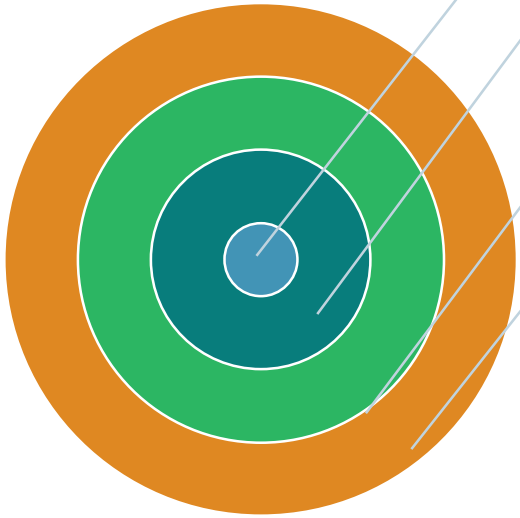
Relationships between climate change and society

- These interactions create layers of uncertainty that requires huge interpretation.
- It is not a precise science and can sometimes feel like crystal ball gazing.



Using this information in risk assessment

Do we understand these relationships?



Climate

Weather

Likelihood

What are the likelihoods – today / tomorrow?

What will be the impacts?

Infrastructure & Environment

Society

Consequence

What are the consequences and how severe?

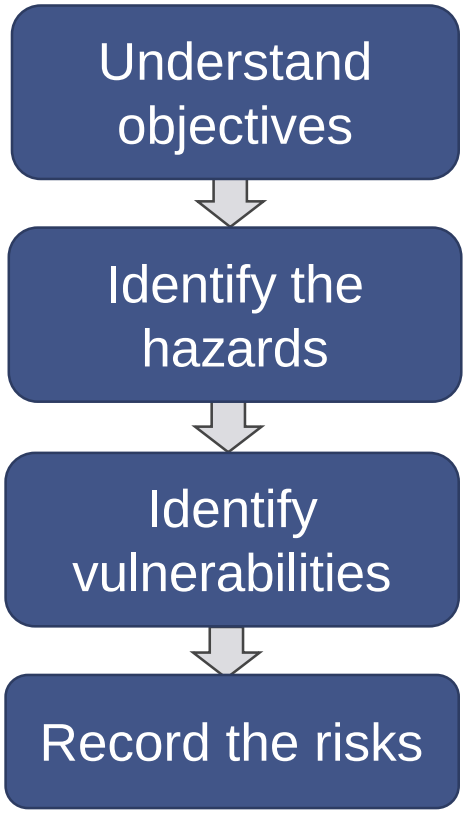
Measure impacts and benefits here.

Some consequences to consider:

- Flooding, pollution. Property damage / loss.
- Interruption to supply. Water quality.
- Safety.
- Inconvenience / delay. Organizational impacts.

Topic 3: Identifying risks (10 mins)

Risk identification process



Context: What is important to you / your business?

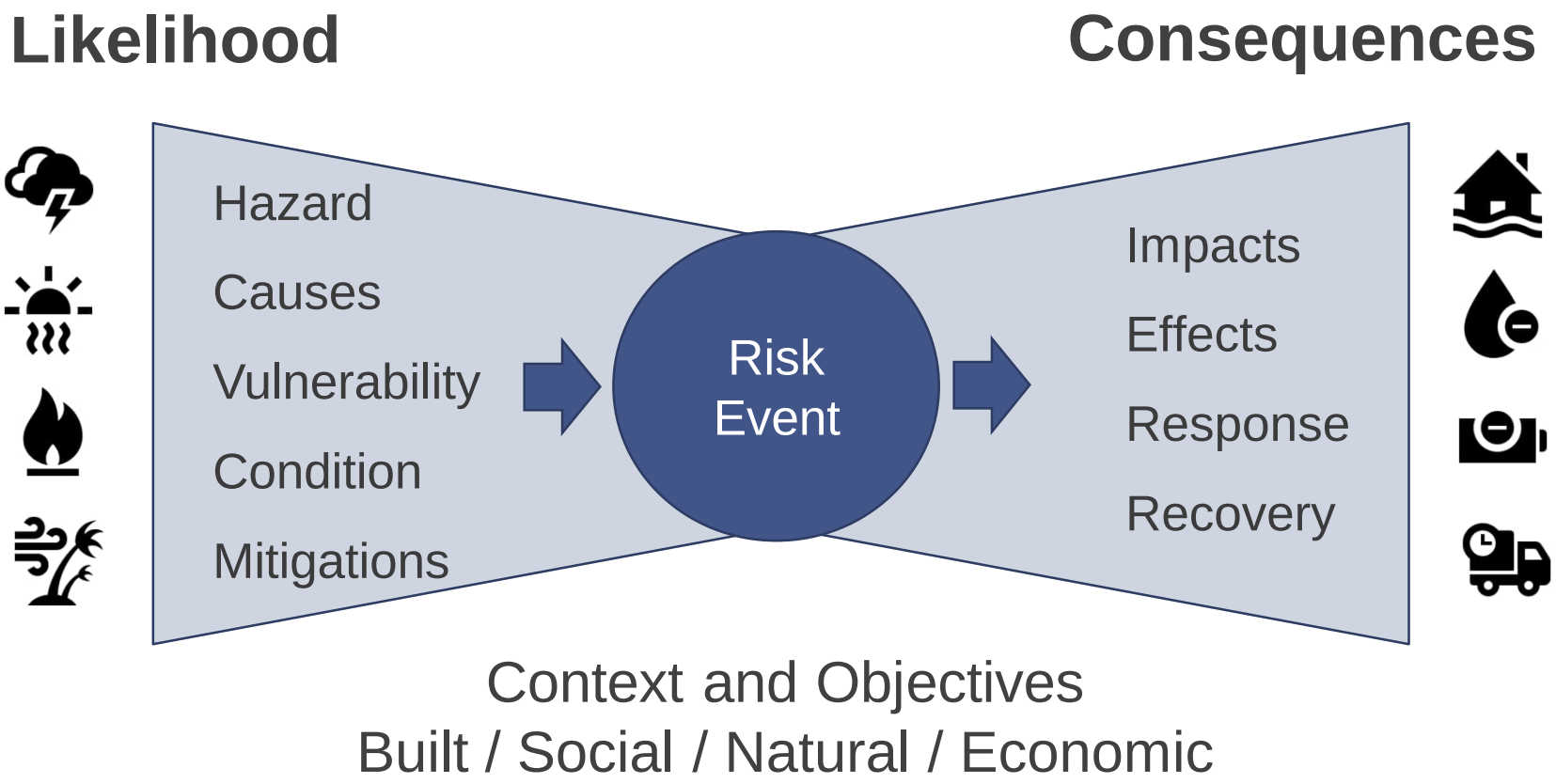
What climate hazards do we face?
How do those hazards change over time?

What systems are sensitive to those hazards?
Do you already have control measures in place?
Are they effective?

Who needs to know?

Risk assessment may be unique to your business

Describing risk



Risk identification

- Very much a brain-storming process
- Get relevant stakeholders involved – business owners, scientists, engineers, government
- Use tools/matrices as prompts to help you such as:
  - Public Infrastructure Engineering Vulnerability Committee (PIEVC) Protocol developed by Engineers Canada
  - Building Adaptive and Resilient Community (BARC) developed by ICLEI

	Fire	Drought	Wind	Flood	Tornado
Bridges & culverts				✓	
Buildings & structures	✓		✓	✓	✓
Rural communities	✓	✓		✓	
Roads				✓	
Buried utilities				✓	
Natural environments	✓	✓		✓	

- Begin to build information – where, when, who, extent, why, existing controls

Topic 4: Assessing and evaluating risks (15 mins)

Risk evaluation

- Use the basic evaluation of risk

Risk = Consequence x Likelihood

Likelihood	Consequence				
	Insignificant	Minor	Moderate	Major	Severe
Frequent					
Likely					
Possible					
Unlikely					
Rare					

* Also known as a heat map or risk matrix.

Likelihood evaluation

But what do these words mean?

Common approach:

Likelihood	Score
Frequent	5
Likely	4
Possible	3
Unlikely	2
Rare	1

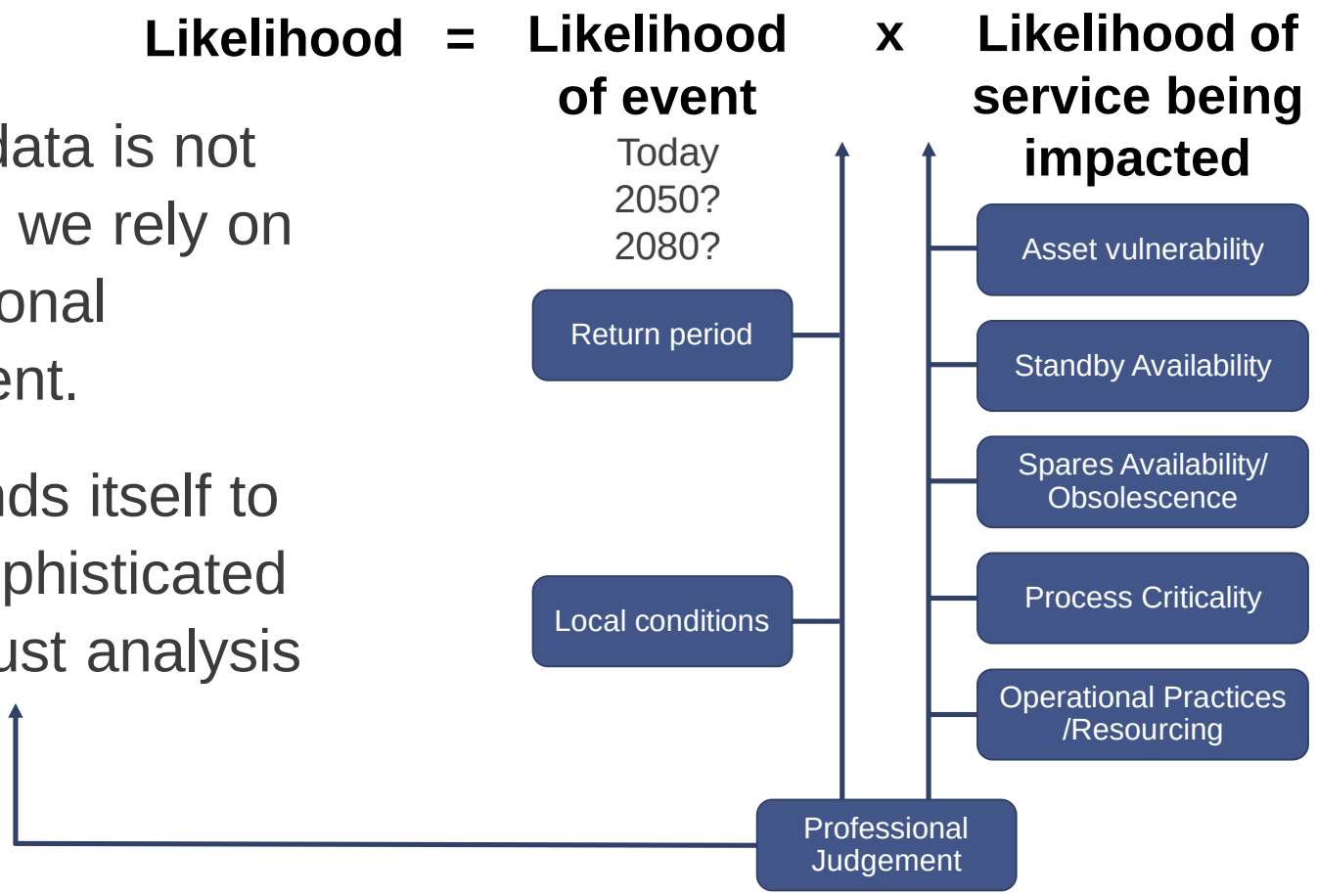
vs

How soon?	How frequent?	Likelihood
	Twice in one year	2
Within a year	Once per year	1
Within two years	Once every two years	0.5
Within five years	Once every five years	0.2
Within ten years	Once every ten years	0.1
. . .	. . .	. . .

Better to adopt something a bit more meaningful and continuous

Understanding likelihood

- Where data is not present, we rely on professional judgement.
- Data lends itself to more sophisticated and robust analysis



Consequences

There may be many consequences associated with a hazard and each consequence could have a different likelihood

- **Personal injury or loss:** health / injury / fatality
- **Service loss:** water supplies / property flooding / congestion
- **Economic loss:** damage / business / response costs
- **Social loss:** lost time / inconvenience
- **Environmental loss:** pollution / degradation / wildlife

Consequence evaluation

But what do these words mean?

Common approach:

Consequence	Score
Severe	5
Major	4
Moderate	3
Minor	2
Insignificant	1

Consequence Equivalence

Consequence equivalence helps us to compare the severity of different types of events and scale them.

	Very Low	Low	Moderate	High	Extreme
People	Trips	Minor Injury	Major Injury	Severe / multiple injuries	Fatalities
Environment	Temporary loss of low grade habitat	Minor pollution	Moderate pollution	Major pollution Seasonal loss of habitat	Permanent loss of habitat
Critical Service	Hour - Few people	Day – few people Hour – lots of people	Week – few people Day – lots of people	Month – few people Week – lots of people	Month – lots of people
Non-Critical service	Hour	Day	Week	Month	Months/Year +
Financial	$5k	$50k	$250k	$500k	Millions

* This is an example, but these will be determined for each risk assessment based on the scale and type.

Consequence:
How do events affect Society ?

- Event Response
- Water Service Disruption
- Business Loss
- Evacuation & Rehousing
- Damage & Recovery
- Environmental Loss
- Public Health

Flooding in *Mytown* – Likely Impacts

Impact Category	Economic Risk
Property Damage	$400M
Business loss	$300M
Event management	$2M
Traffic and other economic loss	$10M
Health & safety	$3M
Total event impact	**Approx. $715M**

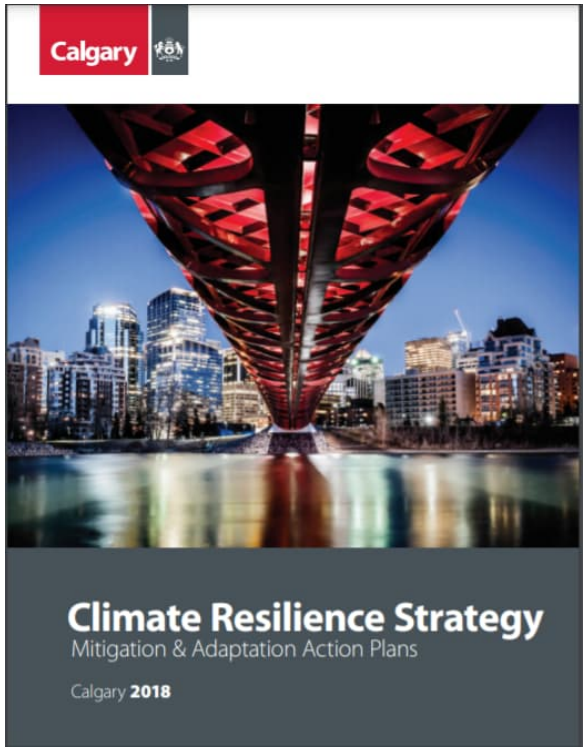
Likelihood (today)	1 in 100 yrs
=	0.01
Risk =	**$7M**

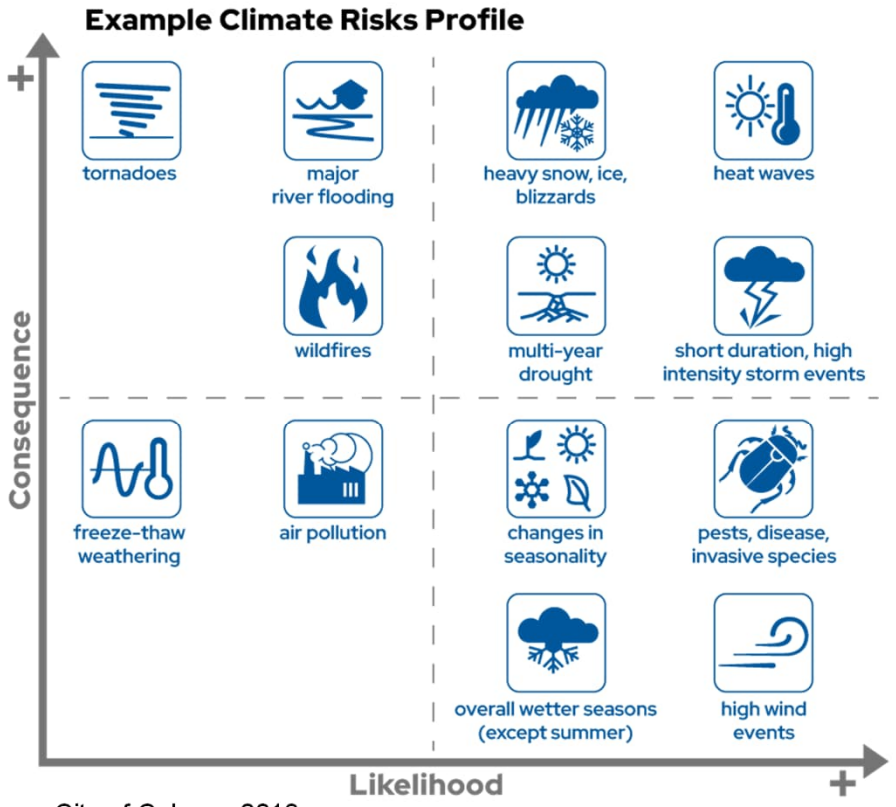
Likelihood (2050)	1 in 20 yrs
=	0.05
Assume ↗ mpact	$1.5B
Risk =	**$75M**

Plotting risk in risk space

- A risk like this is on the watch list today (yellow)
- But will become unacceptable by 2050

Climate Adaptation Risk Assessment **Example**



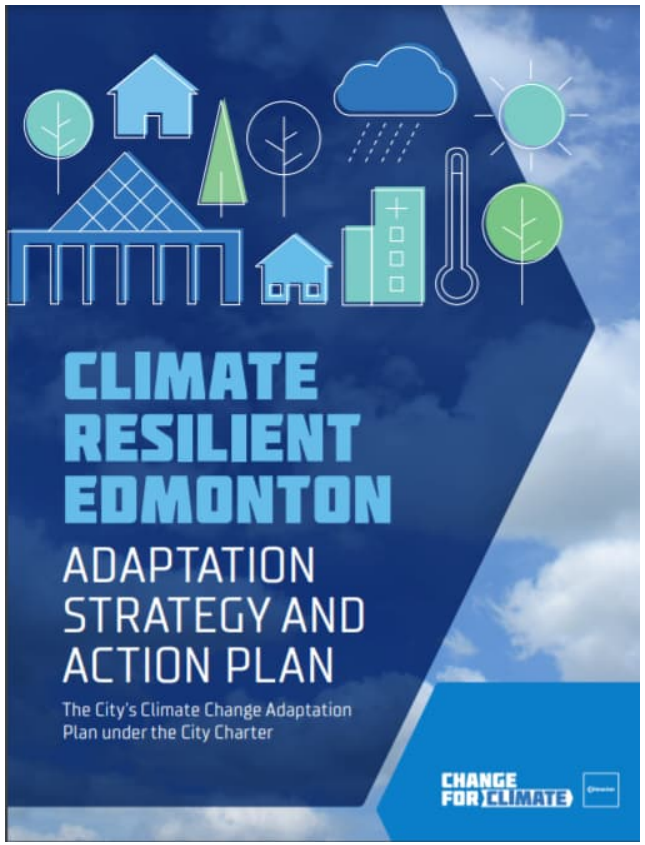


Source: Climate Resilience Strategy, Mitigation & Adaptation Action Plans, City of Calgary, 2018.
Retrieved from: https://www.calgary.ca/uep/esm/climate-change/climate-actions.html

Climate Adaptation
Risk Assessment Example

Vulnerability and Risk Assessment

While multiple inputs were used to develop this strategy, one of the primary tools was the stakeholder-led vulnerability and risk assessment. This assessment helped to define Edmonton's adaptation needs by identifying areas of highest vulnerability (see Chapter 4).



Source: Climate Resilient Edmonton, Adaptation Strategy and Action Plan, City of Edmonton, 2018. Retrieved from: https://www.edmonton.ca/city_government/environmental_stewardship/climate-change-adaptation.aspx

Key takeaways for risk identification...

1. Climate risk is one of many different types of risk.
2. There are key terms that are often used ambiguously. Don't assume that everyone understands your terms.
3. We all have a different tolerance for risk.
4. When we describe risk we should consider causes, likelihood and consequences.
5. Risk identification is essentially a brainstorming process. We need to get the right brains involved to help us.
6. Quantifying risk in dollar terms helps us to evaluate and make risk decisions.

Questions and discussion

Owen James – Asset Management National Practice Lead, Associated Engineering (jameso@ae.ca)