GOLDER

Climate Change Decision Making – Mining Association of Canada Best Practices

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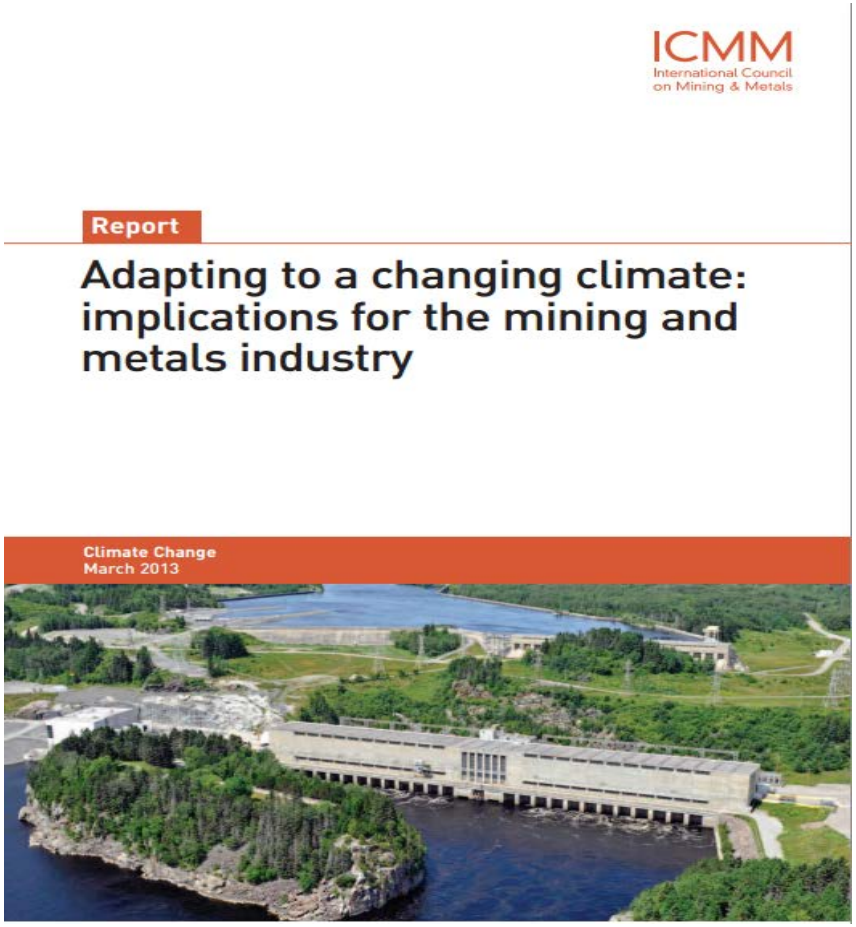
May 7, 2019

Industry Recognition of the Problem

SETTING THE STAGE



- Mines are often located in areas with extreme weather and challenging conditions
- ICMM identified a growing awareness that a changing climate and its impacts can affect the mining industry
- Report identifies potential climate impacts and how mining and metals companies can evaluate risks
- Provides available options for adapting to climate change impacts

Canadian Response to the Problem

MINING ASSOCIATION OF CANADA

- The Mining Association of Canada (MAC) has acknowledged the climate change adaptation is a gap
- Working Group formed has made recommendations on how to address this gap
- MAC has committed to 13 actions addressing climate change
- Based on recommendations from the Community of Interest Advisory Panel through the Towards Sustainable Mining (TSM) initiative
- MAC is has received funding from NRCan to develop best practices for mining sector

Guidance Document: Mining Association of Canada

DOCUMENTING A DECISION MAKING PROCESS

1) A two-day workshop for representatives of MAC members and associate members with expertise in both climate change adaptation and mine operations/tailings management to:
   - assess and formulate a common definition of the problem;
   - identify existing practices that are candidates for consideration as best practices; and
   - identify gaps in existing practices.
2) An in-depth study involving multiple stakeholders in order to develop an industry guidance for best practice to address uncertainty regarding a changing climate.

Guidance Document: Mining Association of Canada

PROGRESS TO DATE

- Literature review identified no similar guidance document globally
- The stakeholder workshop identified that there was not one single priority area, rather the guidance needs to cover the entire mine life cycle and be multidisciplinary
- The guidance will provide a framework that can be integrated in individual company/site practices
- The guidance will provide case studies to support key points

The Mining Association of Canada | L'association minière du Canada

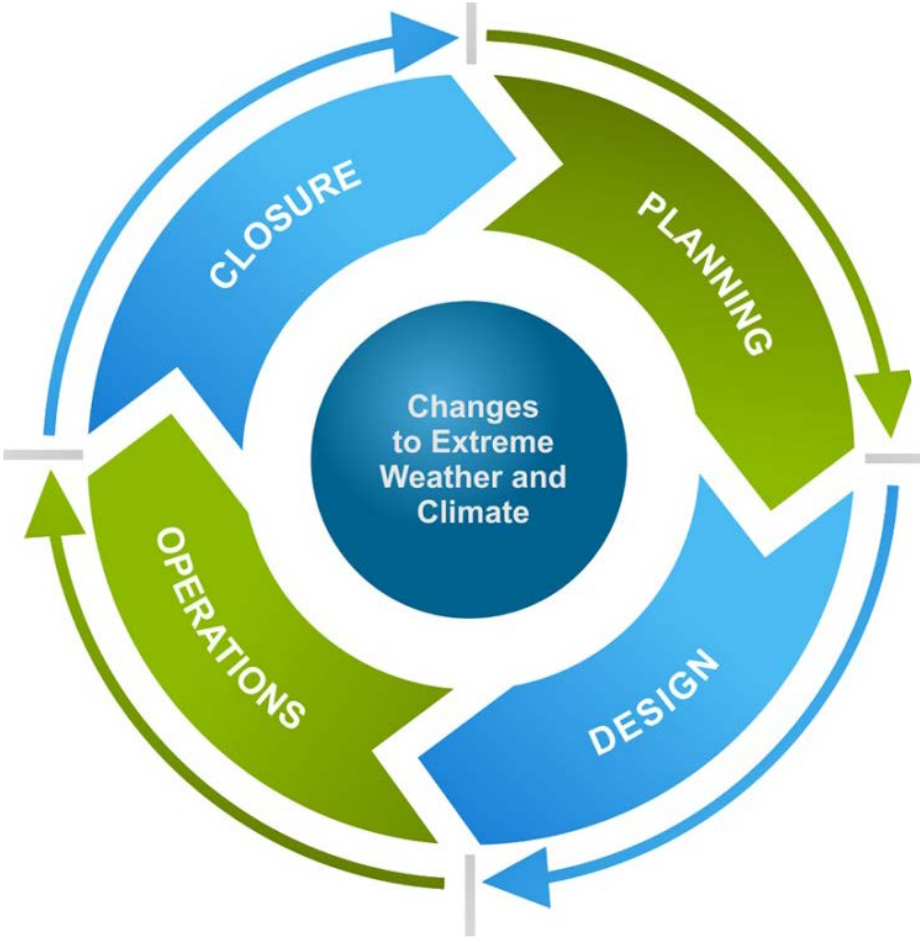
The Future is Always Uncertain

RISK ASSESSMENT CAN BE APPLIED TO ADDRESS UNCERTAINTY

When to Consider a Changing Climate?

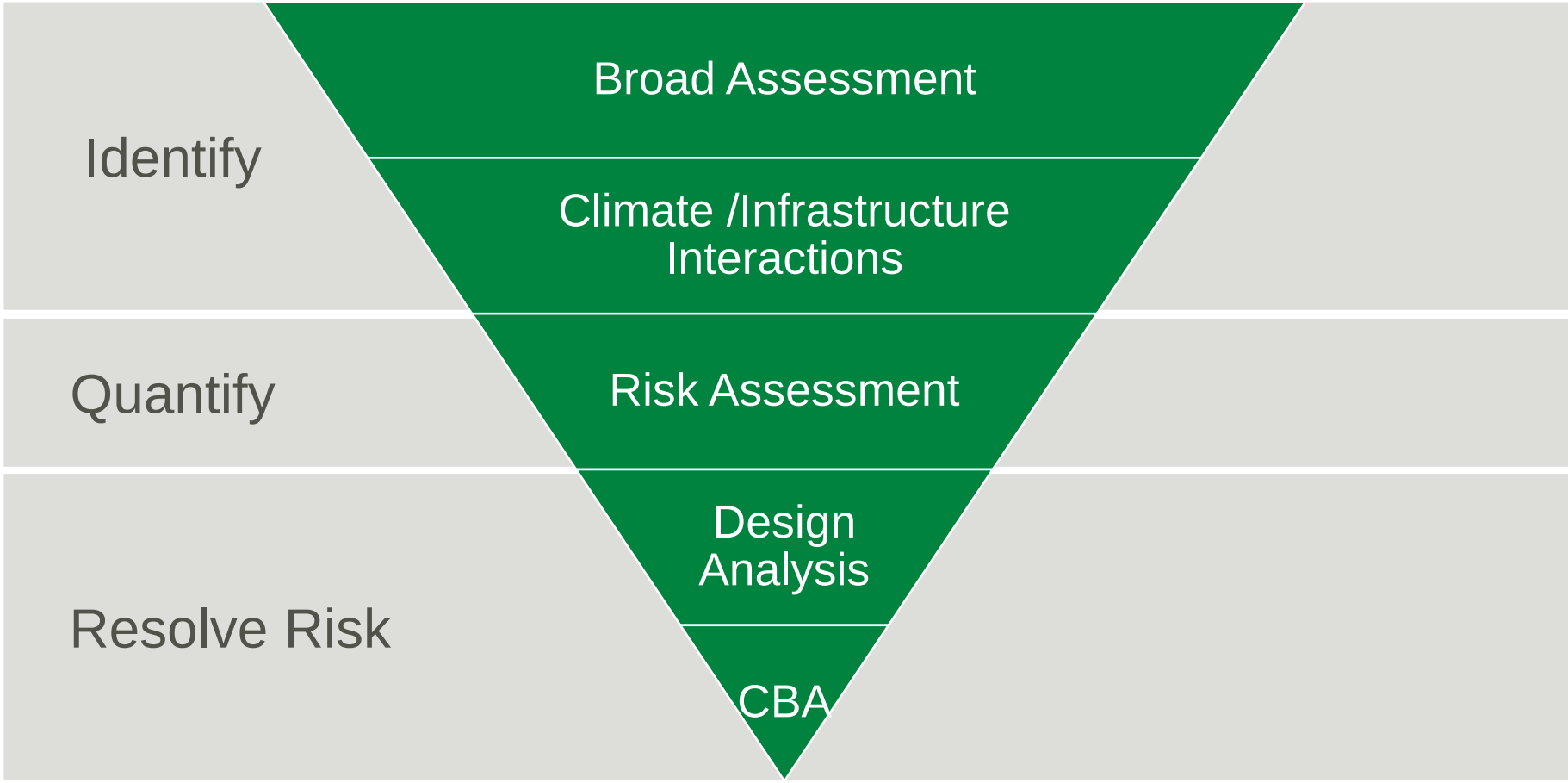
CLIMATE DECISIONS ARE REQUIRED AT EACH STAGE OF A PROJECT LIFE

The approach should be the same, however, the level of effort and available information varies with the project life cycle



Climate Assessment Change Approach

CONCEPTUAL FRAME WORK



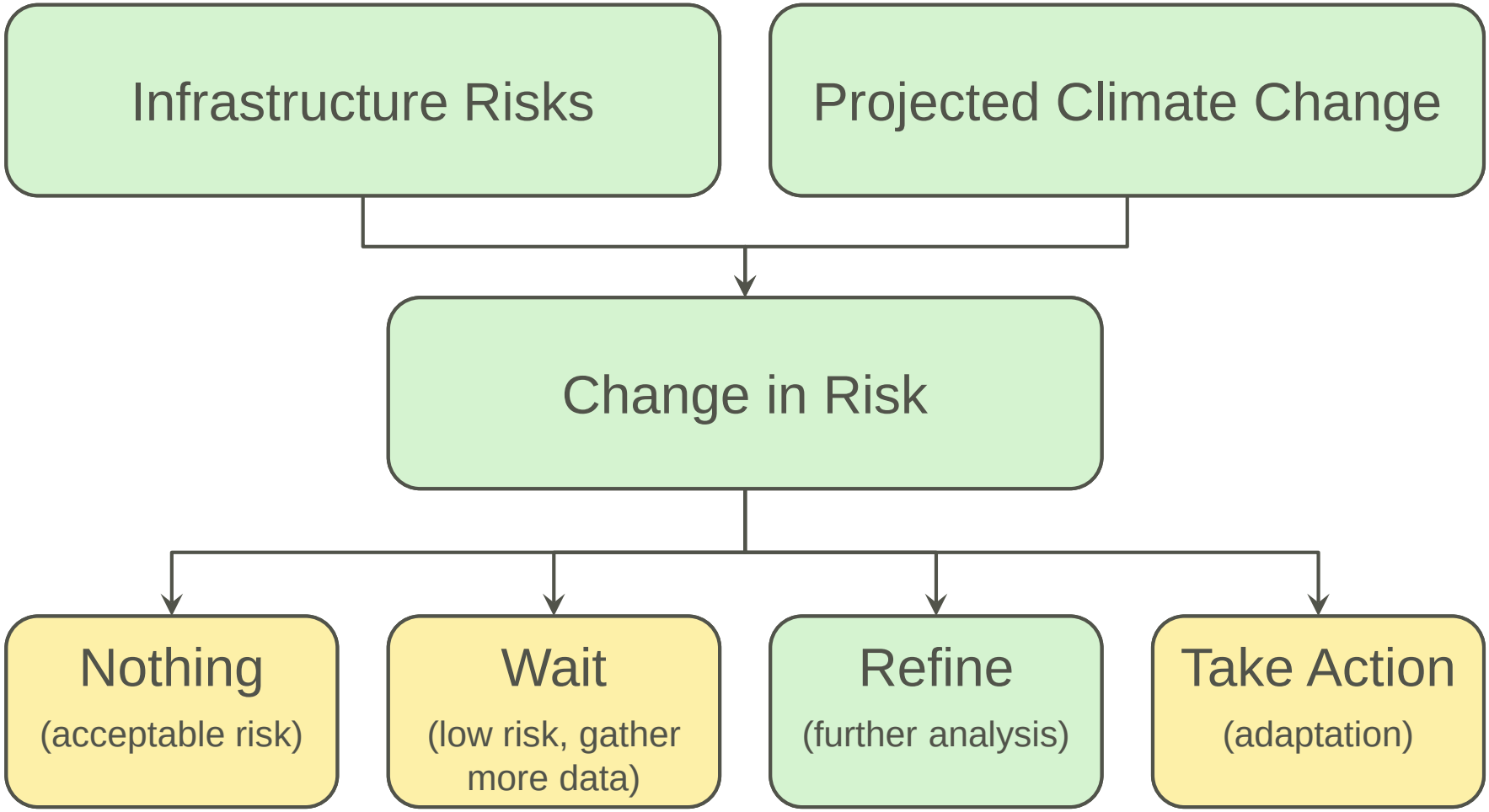
Climate Infrastructure Interactions

IDENTIFY

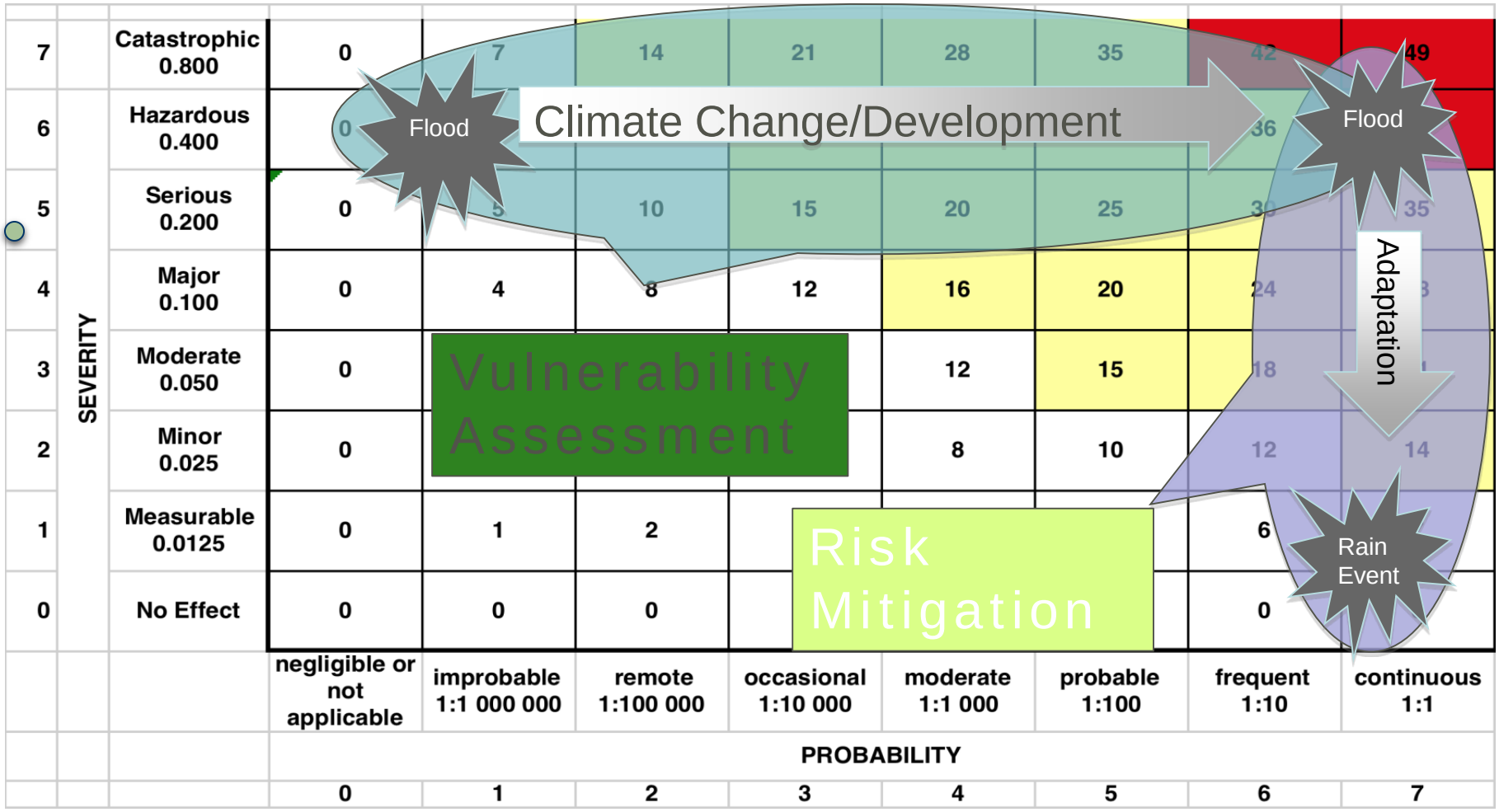
Physical Work or Activity	Climate Factor or Variable	Potential Interaction	Can Activity Be Impacted by Projected Climate Change?	Rationale
Construction Phase (2018)				
All activities in the construction phase	Extreme precipitation events	Project schedule	Unlikely	The timescale of activities is too short for observable climate change (beyond the variability of the current climate) to be verified.
Operation Phase (2019 through 2045)				
Ground transportation	Extreme precipitation events	Road erosion	Unlikely	The timescale of activities is too short for observable climate change (beyond the variability of the current climate) to be verified.
Surface drainage structures	Extreme precipitation events	Water flow through drainage structures	Likely	The activities may be impacted by projected climate change that could impact the water balance.
Closure and Post Closure Phase				
Reestablishment of hydrogeological conditions in the mine area	Annual and seasonal precipitation	Changes in the hydrogeological regime	Unlikely	Changes in projected precipitation may impact the rate at which the pit naturally fills with water but is unlikely to require any design changes to address change in fill rate.
Physical stability of long-term surface structures	Extreme precipitation events	Potential for erosion	Uncertain	An increase in the frequency and intensity of intense rainfall events is projected. It is not possible to determine if this increase will be relevant to maintaining the stability of the structures in the long term.
Restoration and stability of long-term vegetation and wildlife conditions	Temperature and precipitation	Projected changes in the climate conditions relevant to flora and fauna	Uncertain	There is insufficient information to assess the adaptability of local flora and fauna to projected temperature and precipitation changes over the long term.

Climate Vulnerability Assessment

QUANTIFY



Climate Vulnerability Assessment



7		Catastrophic 0.800	0	7	14	21	28	35	42	49
6	SEVERITY	Hazardous 0.400	0	6	12	18	24	30	36	42
5		Serious 0.200	0	5	10	15	20	25	30	35
4		Major 0.100	0	4	8	12	16	20	24	28
3		Moderate 0.050	0	3	6	9	12	15	18	21
2		Minor 0.025	0	2	4	6	8	10	12	14
1		Measurable 0.0125	0	1	2	3	4	5	6	7
0		No Effect	0	0	0	0	0	0	0	0
			negligible or not applicable	improbable 1:1 000 000	remote 1:100 000	occasional 1:10 000	moderate 1:1 000	probable 1:100	frequent 1:10	continuous 1:1
			PROBABILITY							
			0	1	2	3	4	5	6	7

Preliminary response assessment

RESOLVE RISK

No regrets – An action that we currently perform, no major change

Adaptive – A minor change to actions we already perform

Assess further – Evaluate change to our systems/processes

Cost Benefit Analysis

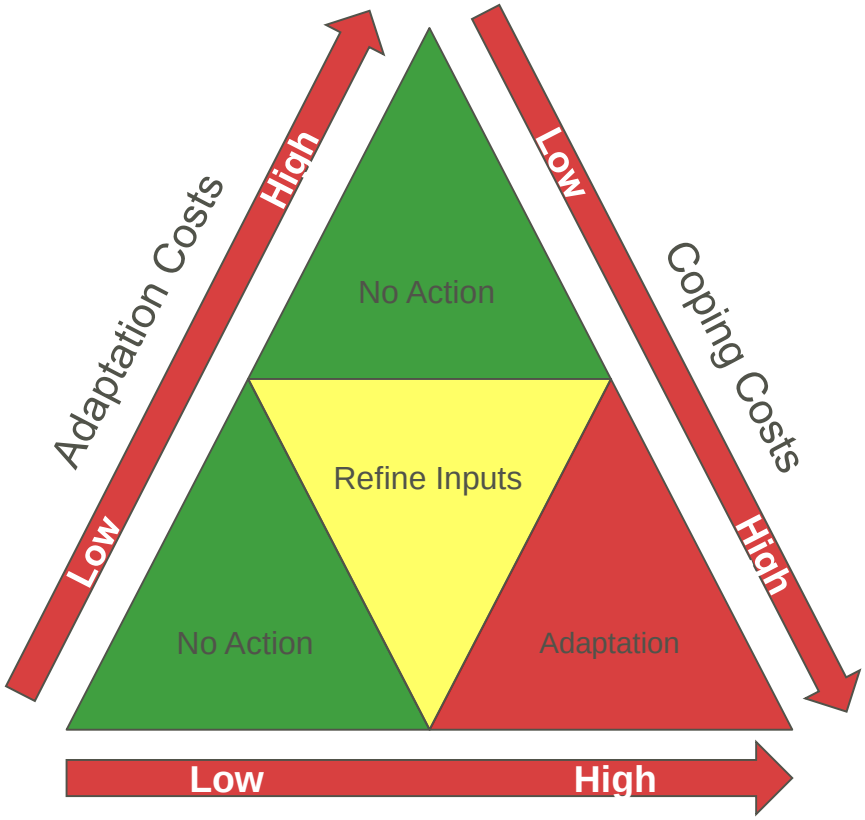
IDENTIFY AND REFINE ADAPTATION UNCERTAINTIES

Balancing investment and risk

Develop and refine cost benefit analysis

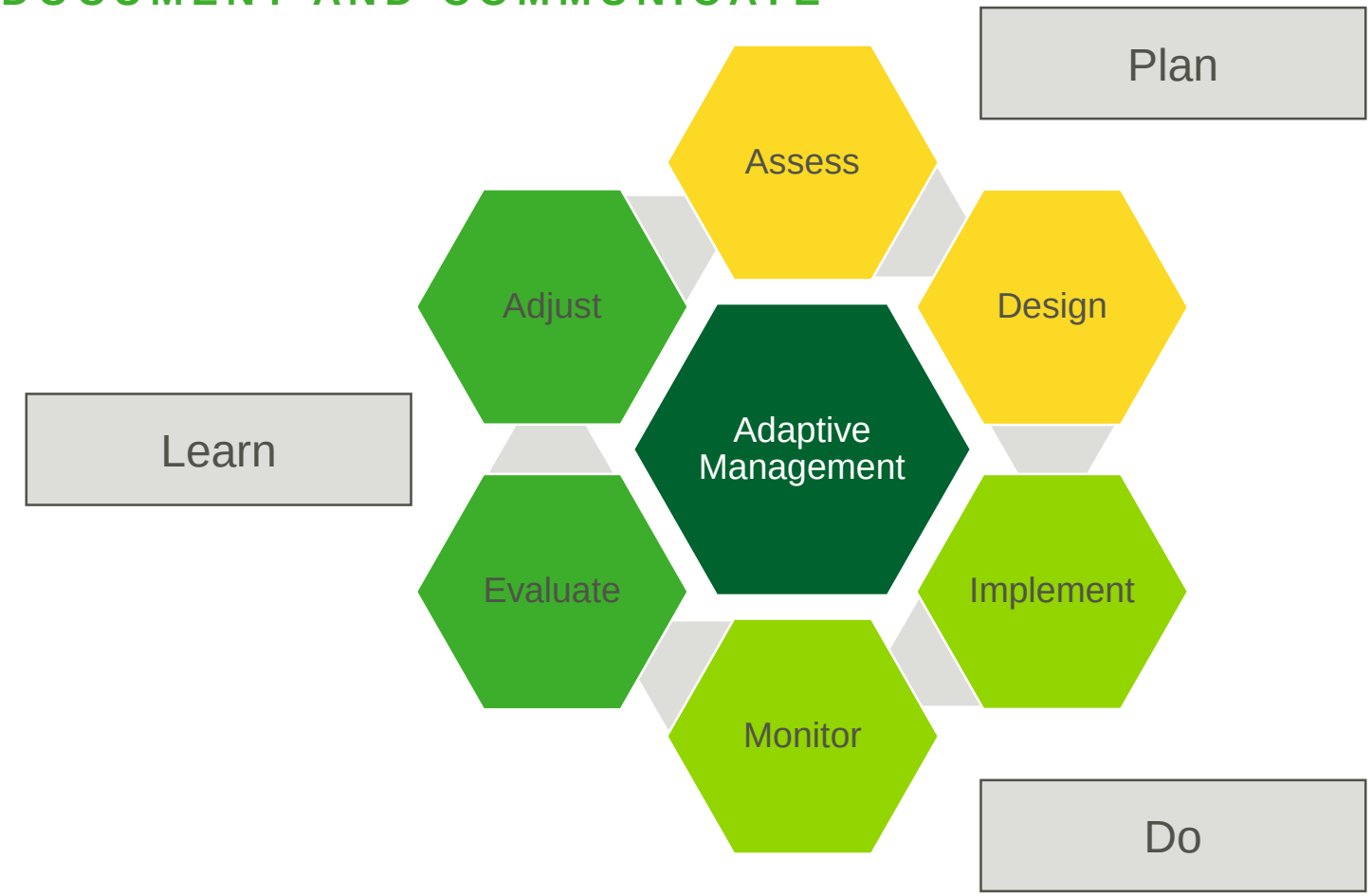
- Define current events and triggers
- Define cost estimates
- Describe future climate

Capture probability of current and future events with refined climate data



Adaptation Management Plan

DOCUMENT AND COMMUNICATE



Questions?

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