Addressing Climate Change Uncertainties in Project Environmental Impact Assessments

Prof. Philip Byer and Dr. Andrew Colombo
Department of Civil Engineering
University of Toronto

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Overview

- Planning infrastructure for climate change
- Methods for addressing uncertainties
- Deciding on adaptation with uncertainties

Effects of climate change on environment and on projects

- Streamflow ----> Hydroelectric plants
- Water levels -----> Marinas
- Rainfall ----> Stormwater collection systems
- Winds ----> Structures
- Permafrost -----> Pipelines

UNCERTAINTIES

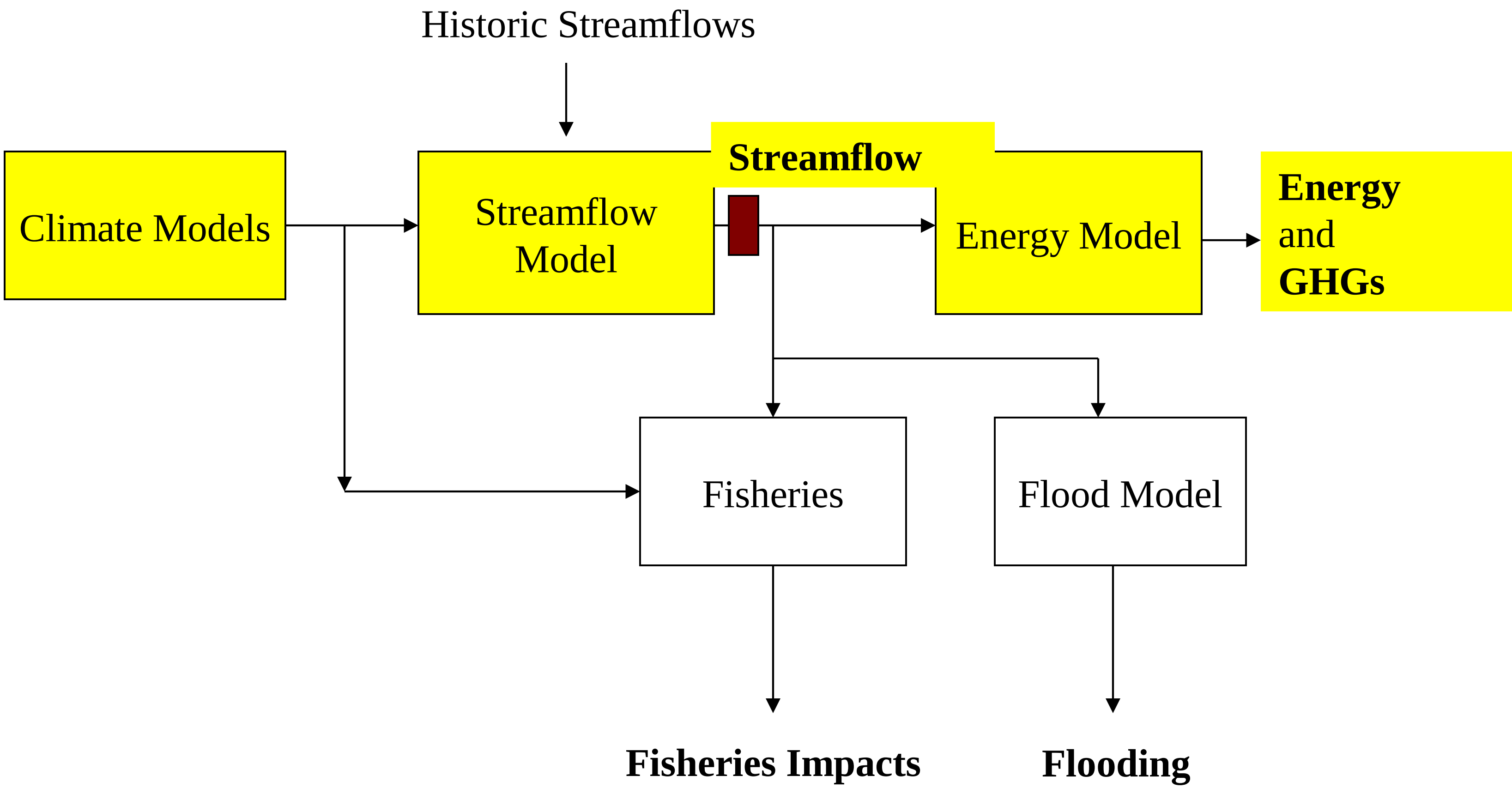
Hypothetical example: Proposed hydroelectric project

- Climate change will affect streamflows

  ______________ energy production

  ______________ flooding

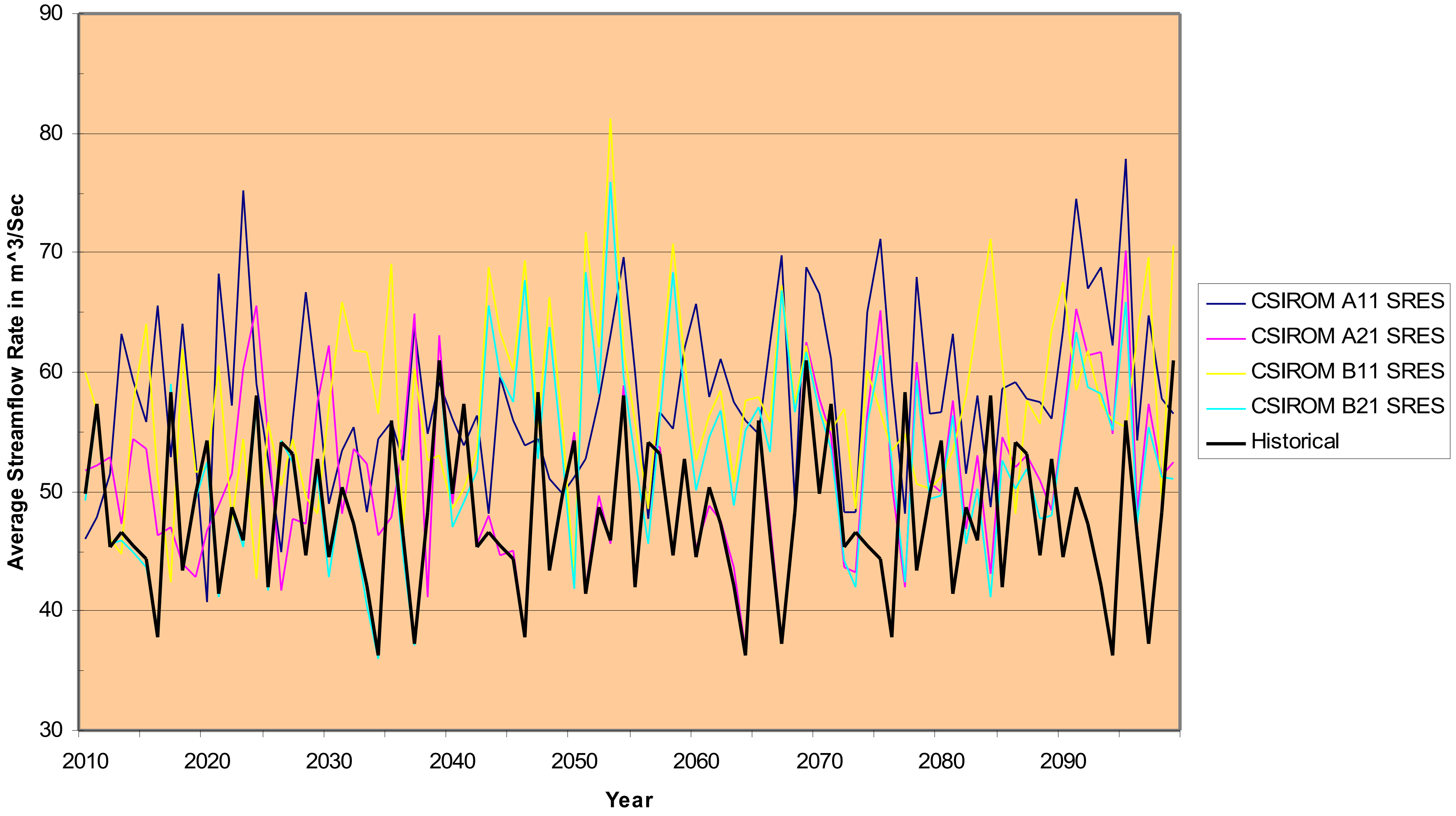
Streamflows based upon Climate Change Data



Scenario analysis

- Projection of HISTORICAL streamflow data into the period 2010-2099
- Use range of scenarios

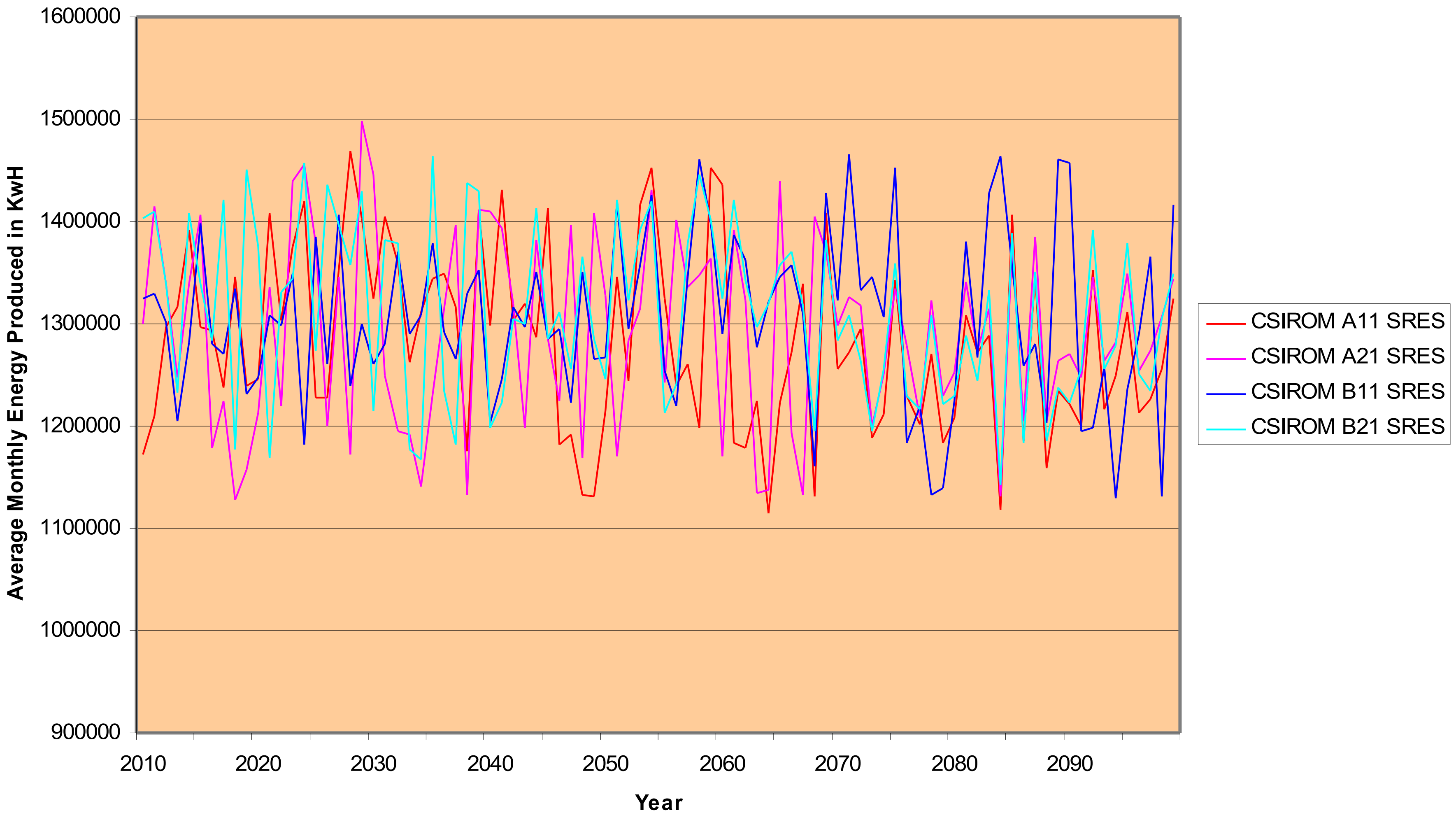
Average Rate of Monthly Streamflow under a Projection of Historical Data and Several CSIROM Scenarios

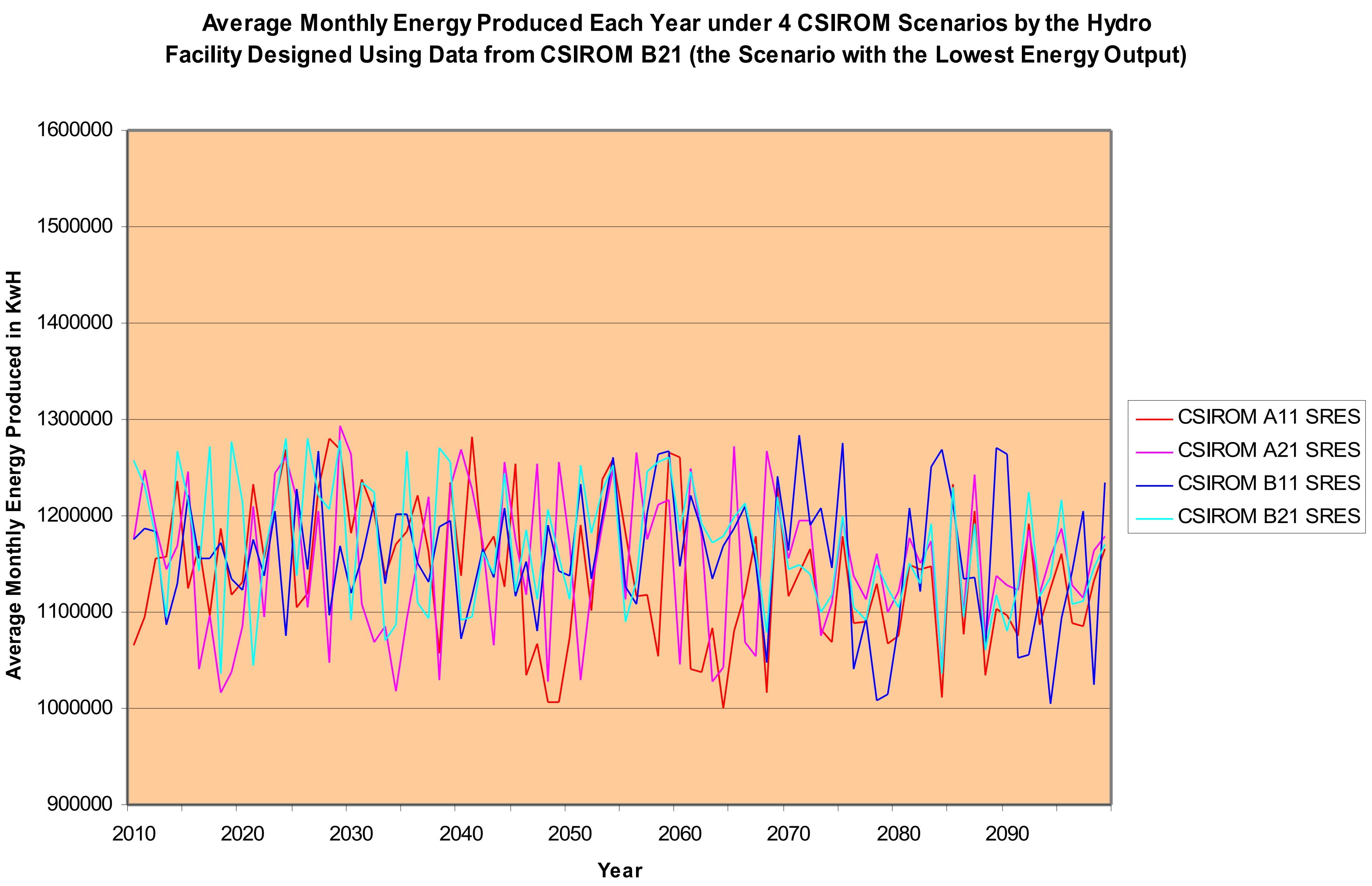


Design for climate change

- Choose capacity (size) based on a future climate change scenario

Average Monthly Energy Produced Each Year under 4 CSIROM Scenarios by the Hydro Facility Designed Using Data from CSIROM B11 (the Scenario with the Highest Energy Output)




Average Monthly Energy Produced Each Year under 4 CSIROM Scenarios by the Hydro Facility Designed Using Data from CSIROM B21 (the Scenario with the Lowest Energy Output)
Average Monthly Energy Produced in KwH
1600000
1500000
1400000
1300000
1200000
1100000
1000000
900000
2010
2020
2030
2040
2050
2060
2070
2080
2090
Year
CSIROM A11 SRES
CSIROM A21 SRES
CSIROM B11 SRES
CSIROM B21 SRES

Expected Monthly Energy Production in kwh for 2010-2099		
	Facility Capacity Design Based Upon Data From:	
Scenario	CSIROM B21 Scenario	CSIROM B11 Scenario
Historical	1,194,325	1,344,701
CSIROM A11	1,140,190	1,282,184
CSIROM A21	1,152,737	1,291,820
CSIROM B11	1,158,754	1,305,290
CSIROM B21	1,168,313	1,311,126

Which scenario to design for?

- Higher capacity facility produces more energy under all scenarios

But

- Higher cost for facility
- Effect on probability of downstream flooding

Must make decision given high uncertainty

Approaches

- Criteria for decision making under uncertainties
  - Minimize the maximum impacts
  - Minimize the maximum regret
  - Etc.

- Adaptive management
  - Build in flexibility to change in future

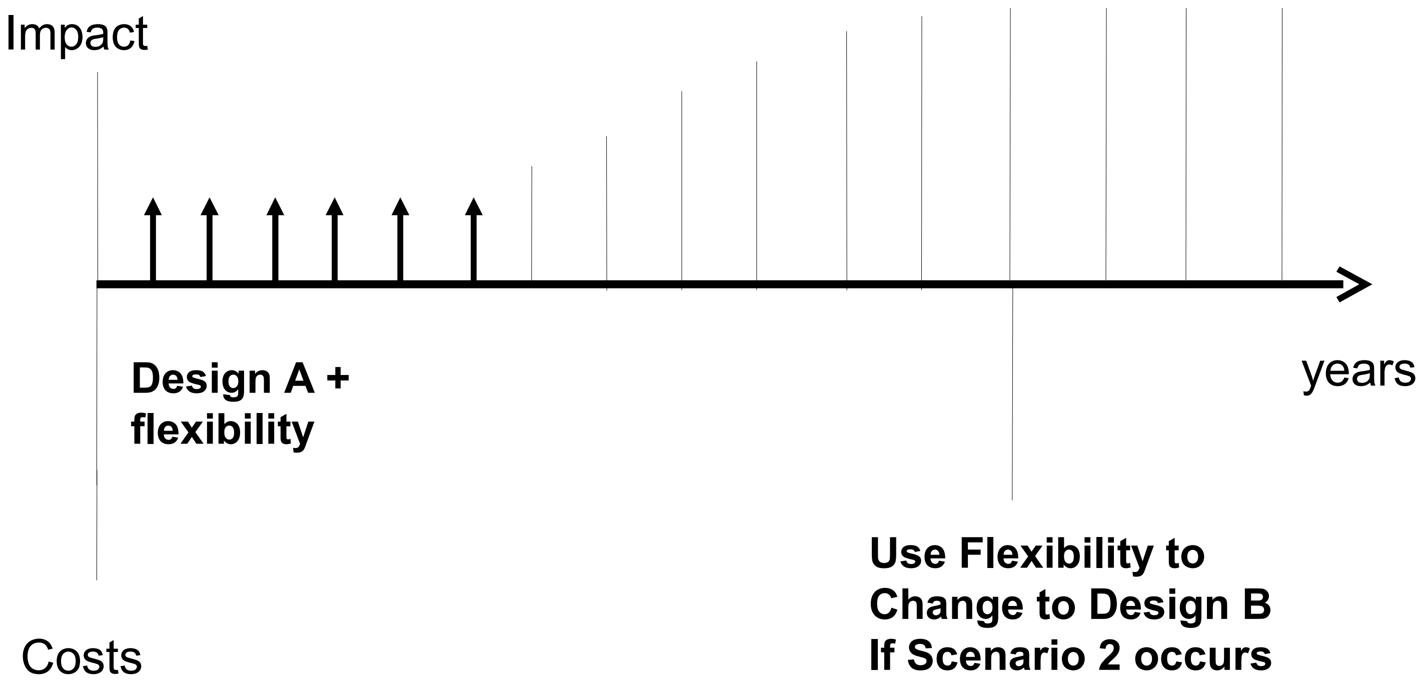
Which is best? Minimize the Maximum Adverse Impact

Possible Futures	Design A	Design B
Scenario 1	40	60
Scenario 2	70	20
Scenario 3	50	80

Which is best? Minimize the Maximum **Regret**

Possible Futures	Design A	Design B
Scenario 1	0	20
Scenario 2	50	0
Scenario 3	0	30

Adaptive management for climate change



Which is best?

Possible Futures	Design A	Design B	**Design F**
Scenario 1	40	60	**40**
Scenario 2	70	20	**20**
Scenario 3	50	80	**50**

Conclusions

Should:

- Identify how climate change might affect project
- Consider range of alternatives to respond to climate change
- Predict impacts for these alternatives for range of alternative future climate scenarios
- Consider attitudes toward uncertainties when making a decision
- Be transparent in all of the above

Acknowledgements and Publications

- Canadian Environmental Assessment Agency
- Our report for first project available at:

  http://www.ceaa-acee.gc.ca/default.asp?lang=En&n=A246A4F7-1&toc=show&offset=1

- Journal papers:
  - Byer, P. and J.S. Yeomans, “Methods for addressing climate change uncertainties in project environmental impact assessments,” Impact Assessment and Project Appraisal, Vol. 25, No. 2, June 2007, pp. 85-99.
  - Byer, P., M. Lalani and J.S. Yeomans, “Addressing and communicating climate change and its uncertainties in project environmental impact assessments,” forthcoming in Journal of Environmental Assessment Policy and Management.
- Report for second project is forthcoming.

Thank you

Questions/Comments?