Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING

Natural Channel Vulnerabilities to Climate Change Spencer Creek Watershed

Natural Channel Design Conference 2016

Project Partners


Study Overview

Purpose

- Recent increase in damage caused by extreme weather
- Analyze effects of future climate conditions.
- Model watershed-specific potential impacts

Approach

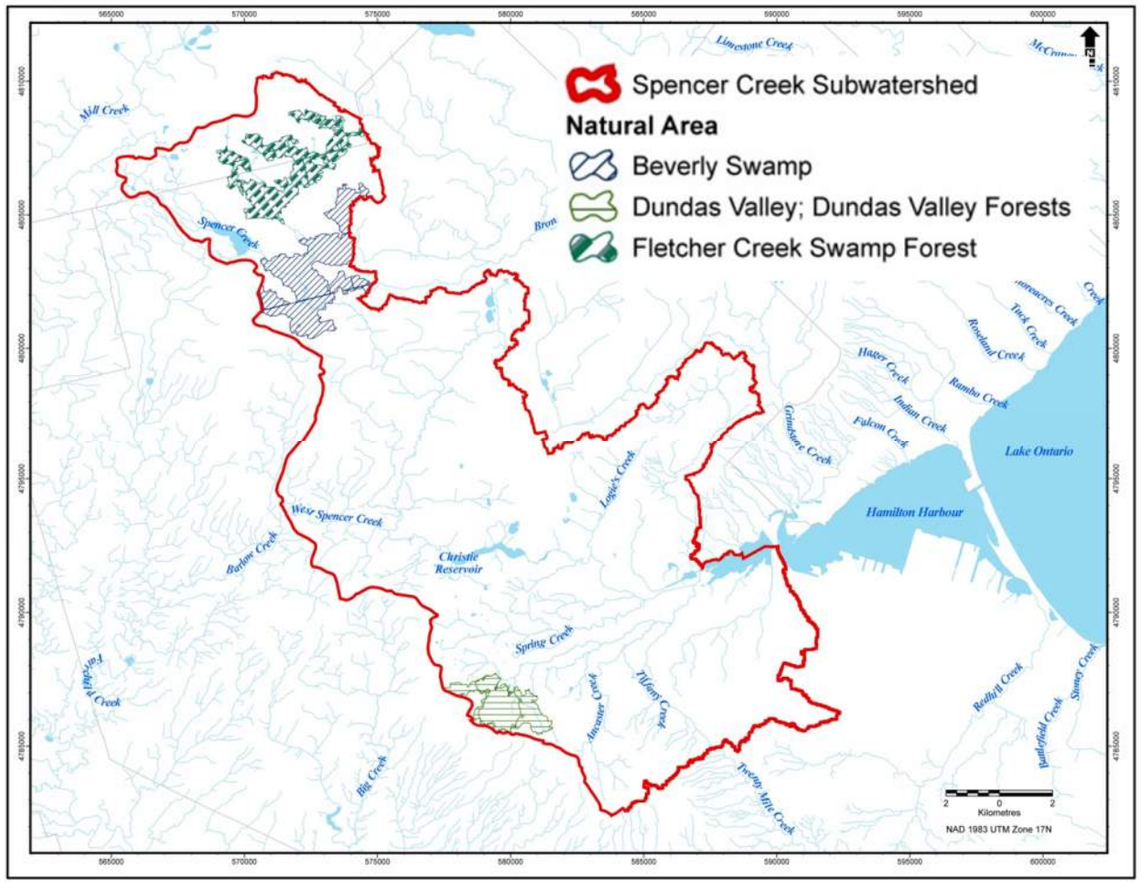
- Develop 100 years of potential future climate data
- Use hydrologic and hydraulic models and predictive datasets to assess
  - Environmental vulnerabilities
  - Infrastructure vulnerabilities

Study Area

- Spencer Creek watershed located in the City of Hamilton
- Tributary to Lake Ontario
- Discharges into the Hamilton Harbour

Spencer Creek Watershed

- Drainage area: 230 km^2
- Headwaters rural
- Lower reaches urban
- Natural areas include:
  - Dundas Valley Forest
  - Fletcher Creek Swamp
  - Beverly Swamp
  - Christie Lake Reservoir

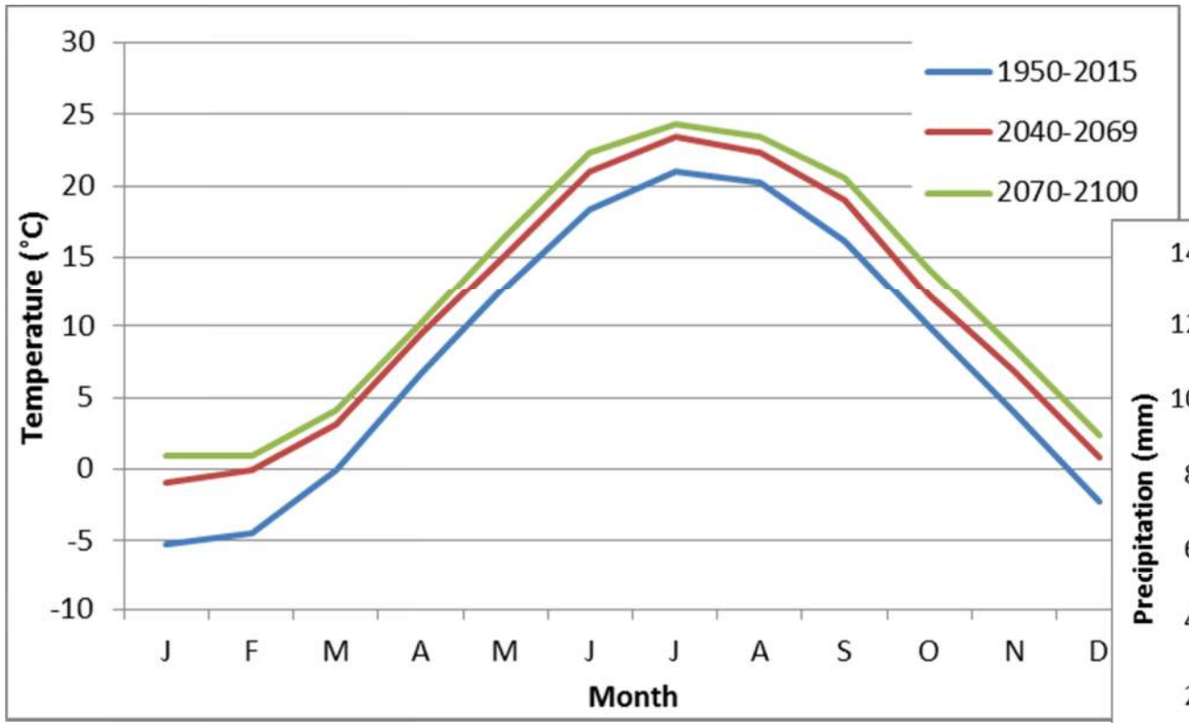


Study Application – Geomorphology

- Watershed model to predict the impacts of climate change
- Estimate future sediment loading
- Evaluate geomorphic impacts of future climate


Climate Trends

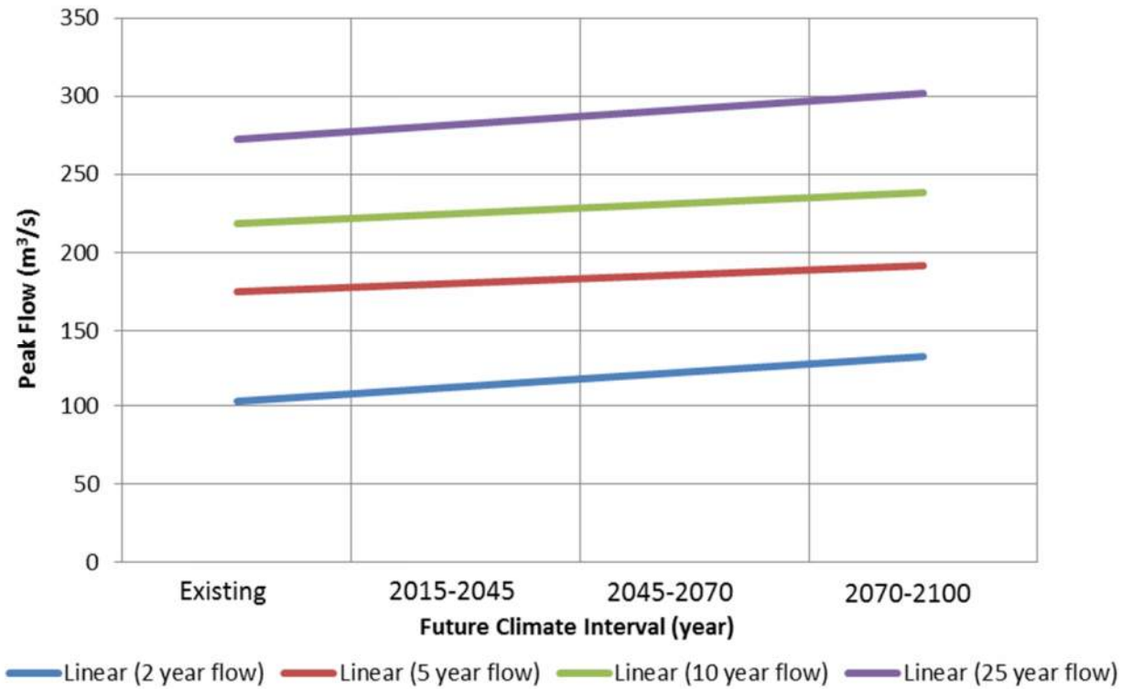
Climate Model Forecast

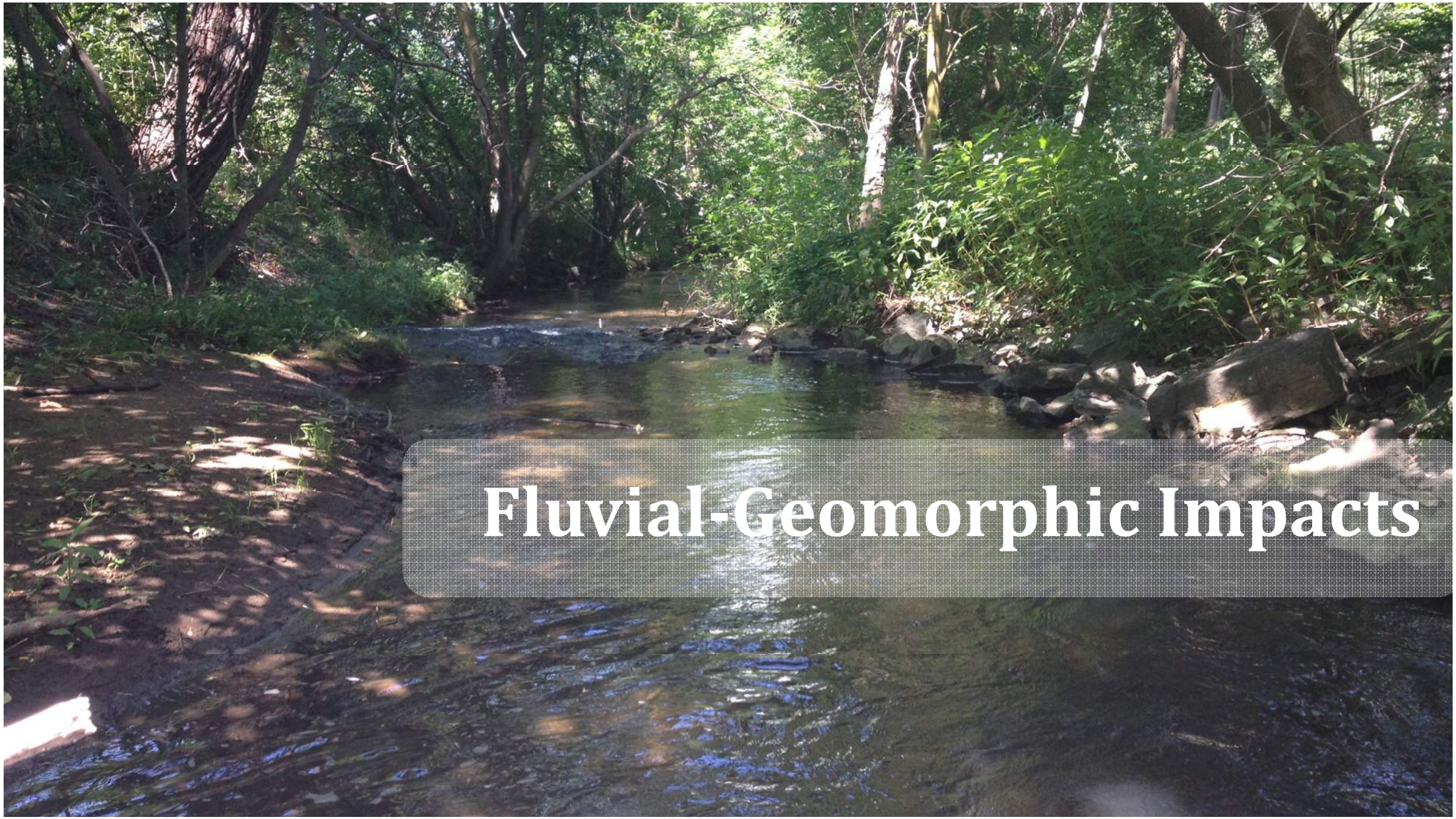


Climate Trends

- Higher temperatures, greater annual precipitation, larger precipitation events
- Increase frequency of high flow events

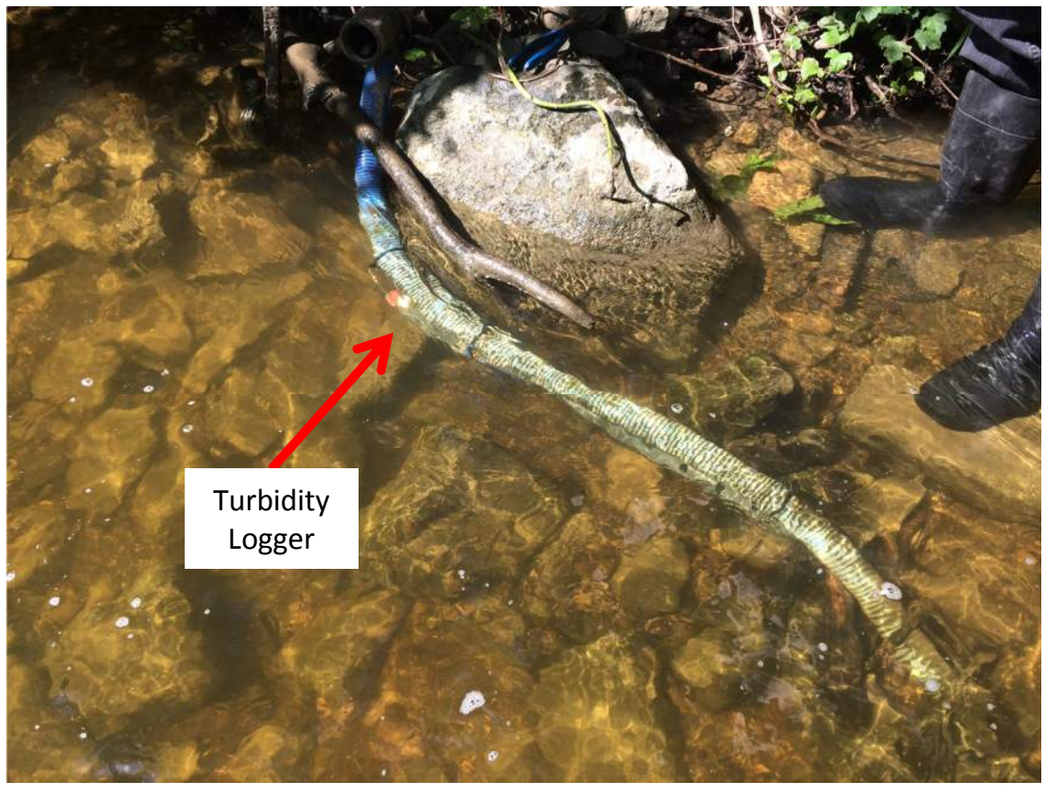
	Future Trend
Mean Annual Temperature	↑
Days Above 35°C	↑
Days Below -15°C	↓
Annual Precipitation	↑
Days with > 20 mm	↑




Fluvial-Geomorphic Impacts

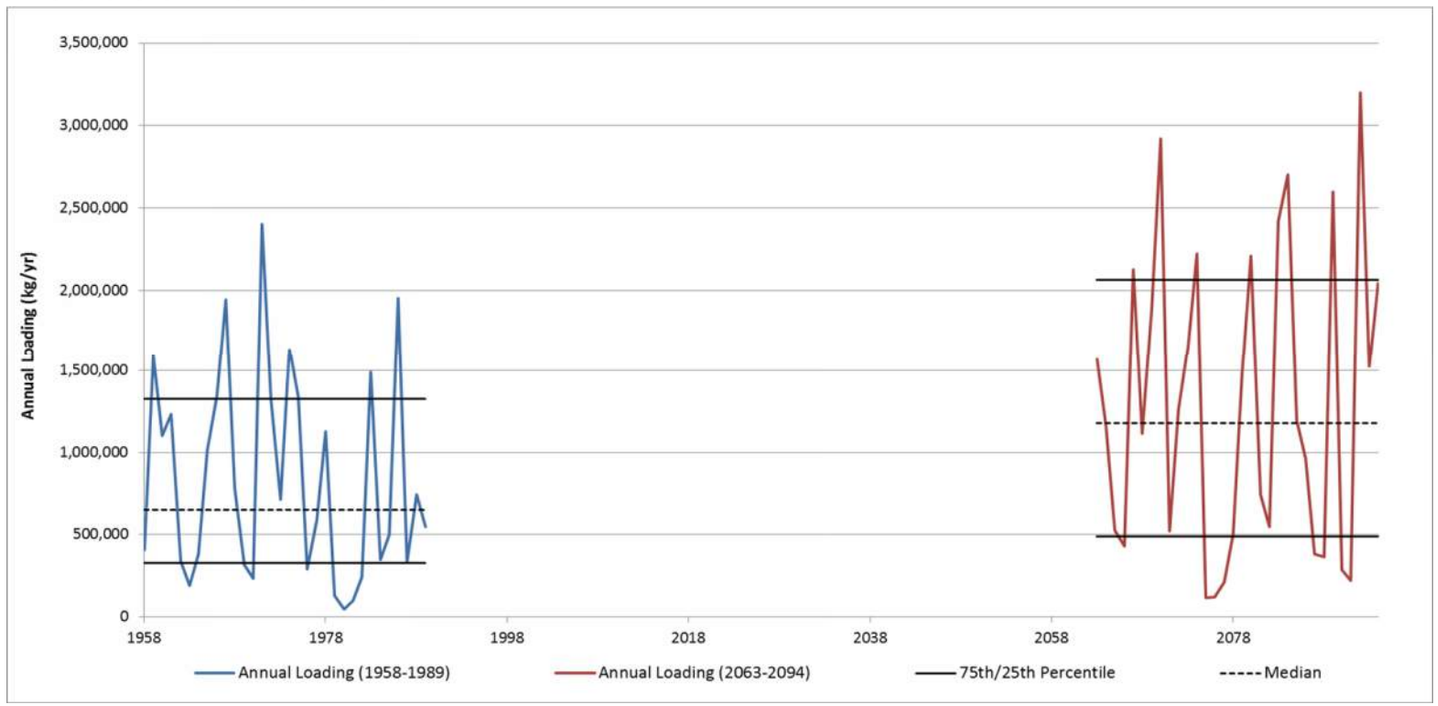
Sediment Analysis

- Continuous turbidity monitoring
  - Coincides with flow gauge location
- Developed TSS-Flow Rating Curve



Sediment Loading

- Future climate scenario predicts a 40% increase in future TSS loading
  - Increased variable

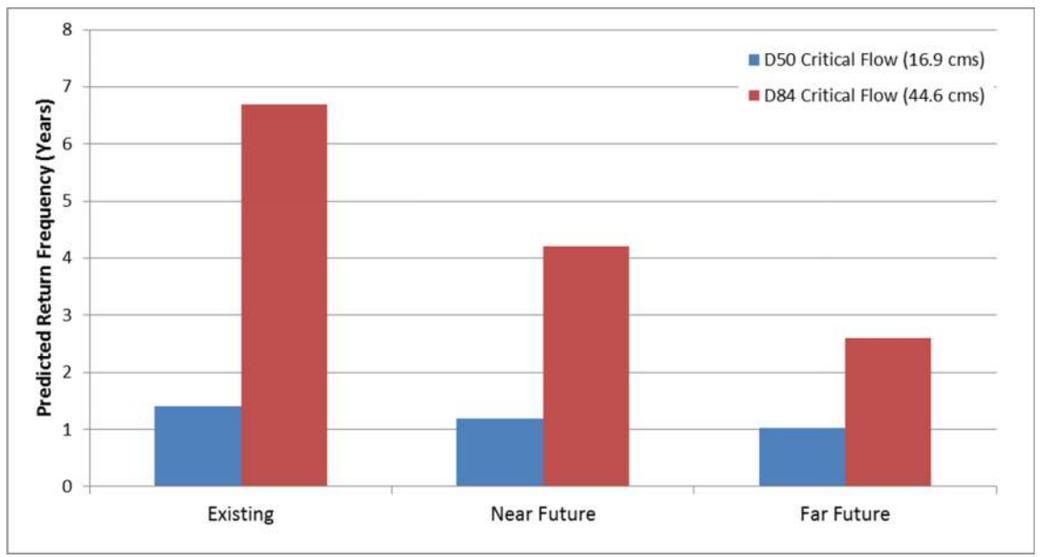


Critical Flow Exceedance

- Return periods for critical flows are reduced future scenarios
- Larger storms more frequent in near and far future

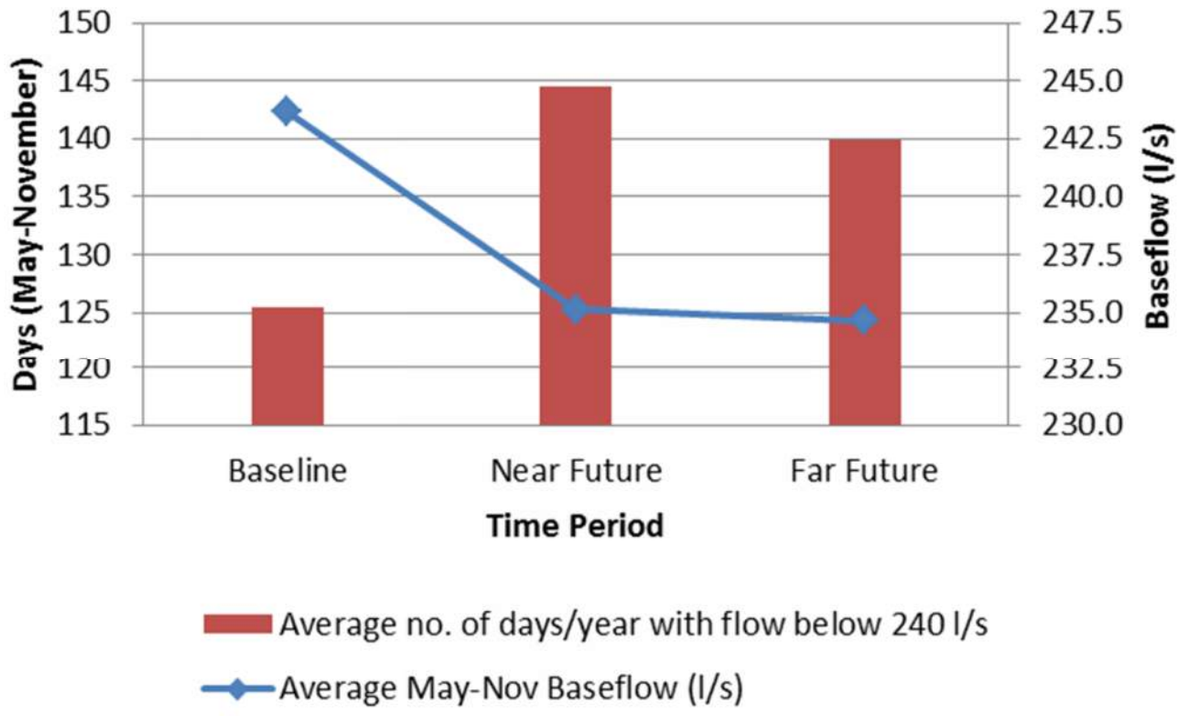
Reference Flow		Predicted Return Frequency (Years)		
Description	m^3/s	Existing	Near Future	Far Future
D_{50} Critical Flow	16.9*	1.4	1.2	1.02
D_{84} Critical Flow	44.6*	6.7	4.2	2.6

* From Lower Spence Creek Subwatershed Study



Baseflow Impacts

- Lower baseflow
- Baseflow occurs more often
- Potential impacts on rates of aggradation




Discussion

Higher Flows Lead to…

- Erosion Vulnerability
  - Increased risk of erosion damages to infrastructure
- Infrastructure impacts
  - Crossings may need to be larger
- Erosion thresholds exceeded more frequently
- Greater sediment loading in watercourses

Physical Effects

Combined with higher peak flows and lower baseflow, altered sediment transport regimes could change the way our rivers form and adjust

Potential Downstream Impacts

- Water quality in receiving channels and water bodies
  - Turbidity
  - Organic Loading
  - Sediment Loading
  - Increased Dredging
  - Infrastructure

April 5, 2005 Taughannock Creek photo by Bill Hecht

Climate Change Impacts to Infrastructure

- Increased Erosion
- Increased Flood Risk
- Operational changes at Christie Dam

Environmental Vulnerability

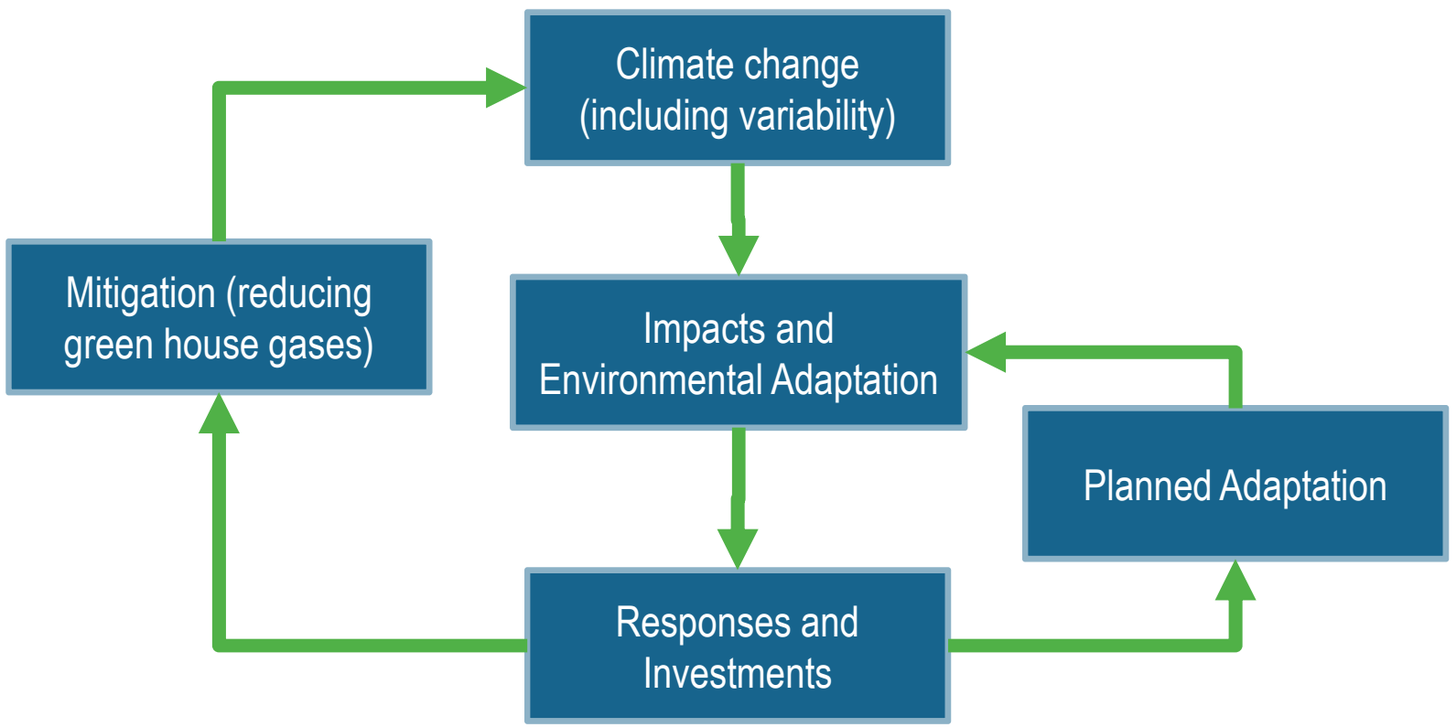
- Change in vegetation
- Change in habitat
  - Increase in invasive species
- Drying wetlands
  - Further stress to S.A.R.
- Fish in warm turbid water


Ongoing Monitoring and Adaptation

Ongoing Monitoring

- Enhance monitoring programs
- Identify hydrologic and environmental changes as they occur

Mitigation and Adaptation



Matrix Solutions Inc.
ENVIRONMENT & ENGINEERING