CWWA PRESENTATION

ENVISIONING A SUSTAINABLE FUTURE FOR WATER & WASTEWATER INFRASTRUCTURE

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PRESENTATION OUTLINE

1. Introduction
2. Water & Wastewater Infrastructure and Climate Events
3. What is Sustainability?
4. Envision Framework
5. Other Resilience Assessment Methodologies
6. Examples of Climate Resilience Assessments and Implementation
7. Conclusion

WATER AND WASTEWATER INFRASTRUCTURE

- Sanitation – the greatest medical advance since 1840 in BMJ (2007).
- Water or wastewater system damages lead to contamination.
- Transmission of diseases in the aftermath of disasters.

Use Safe Water After a Natural Disaster or Emergency

Print

CDC Website: https://www.cdc.gov/disasters/foodwater/safe-water.html#:~:text=Floods%20and%20other%20disasters%20can,bathing%2C%20and%20other%20hygiene%20activities.

If you are in a disaster or emergency, it's important that you take steps to prevent illness from unsafe water.

After a disaster

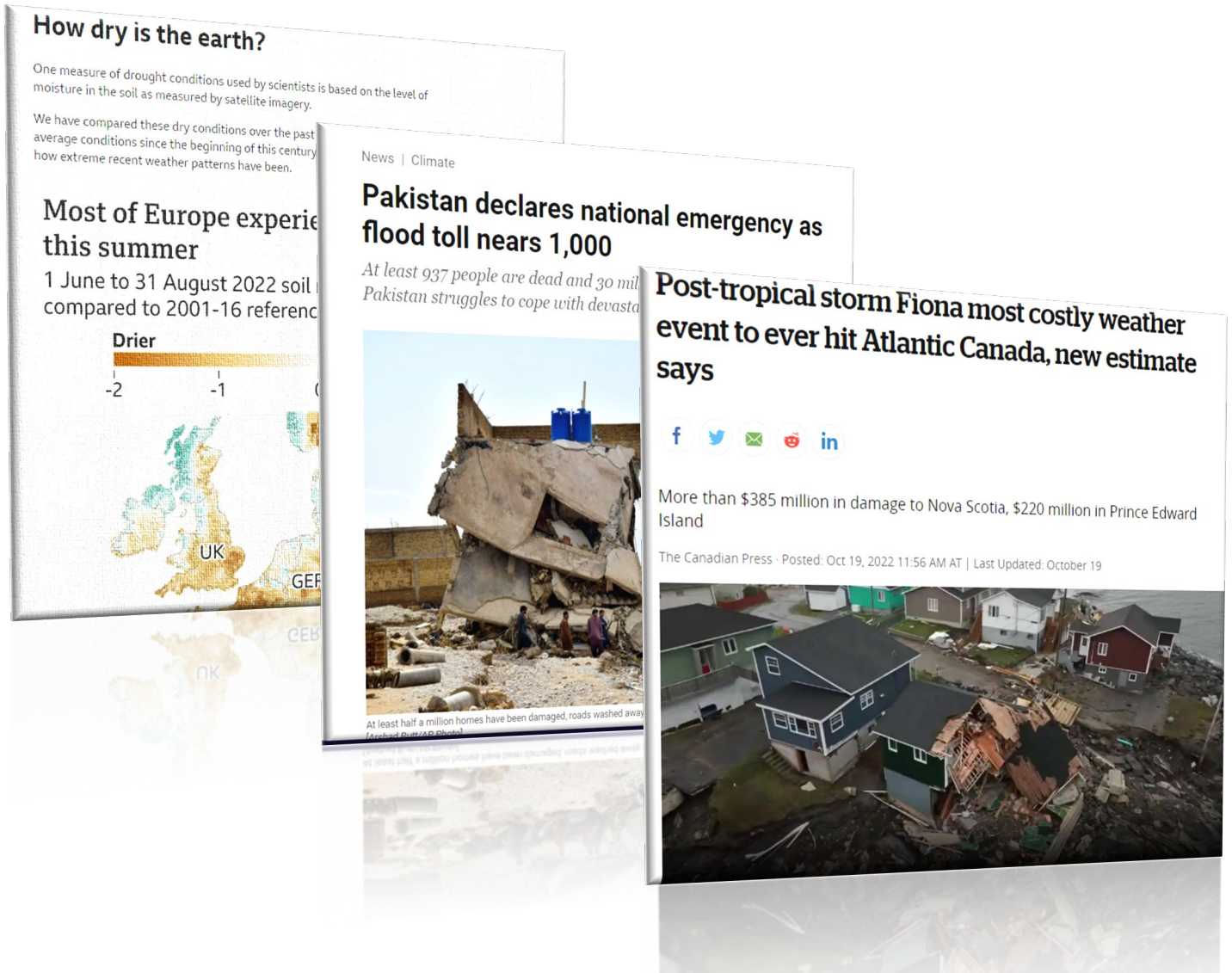
- Do not use water you suspect or have been told is contaminated to drink, wash dishes, brush your teeth, wash and prepare food, wash your hands, make ice, or make baby formula.

News

BMJ readers choose the "sanitary revolution" as greatest medical advance since 1840

BMJ 2007 ; 334 doi: https://doi.org/10.1136/bmj.39097.611806.DB (Published 18 January 2007)
Cite this as: BMJ 2007;334:111

CLIMATE EVENTS AFFECTING INFRASTRUCTURE



- Events
  - Floods
  - Rising water levels
  - Storms
  - Drought
  - Heatwaves
- Frequency
- Severity

DESIGNING FOR CLIMATE EVENTS

- Are you on a waterbody or floodplain with rising water levels?
- Increasing groundwater levels?
- Increased power outages?
- Increased wind strength?

What RISKS do you need to mitigate?

How to go about designing for the risks?

WHAT IS SUSTAINABILITY?

"development that meets the needs of the present without compromising the ability of future generations to meet their own needs"

- the Brundtland Commission Report, 1987

WHAT IS SUSTAINABILITY?

"development that meets the needs of the present without compromising the ability of future generations to meet their own needs"

- the Brundtland Commission Report, 1987

- But...
  - Sustainability is more than Climate Resilience.
  - How can you measure sustainability?
  - Is there a standard to determine what is sustainable?

ENVISION BACKGROUND

ENVISION™

Institute for Sustainable Infrastructure

ZOFNASS PROGRAM FOR SUSTAINABLE INFRASTRUCTURE

Graduate School of Design Harvard University

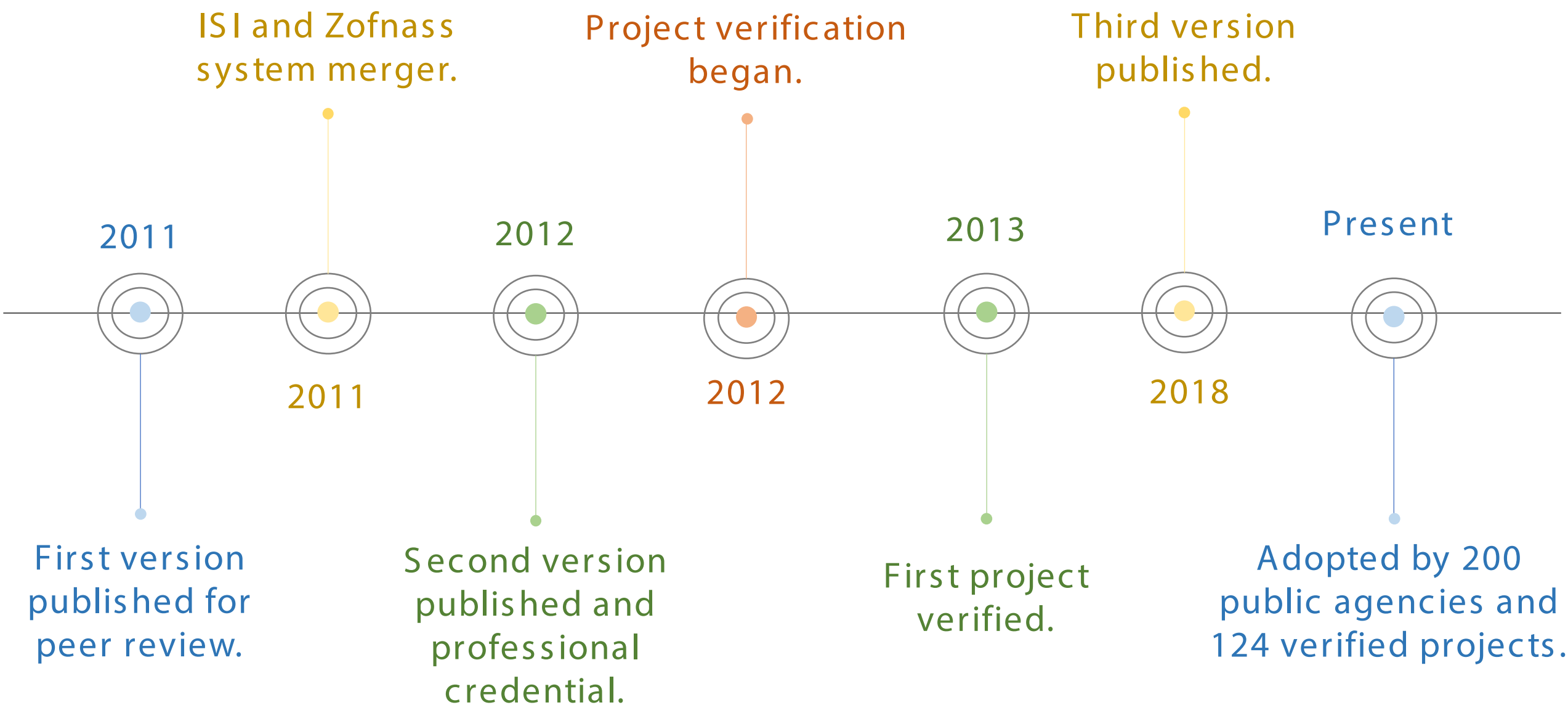
ISI Founding Organizations

APWA Your Comprehensive Public Works Resource

ASCE AMERICAN SOCIETY OF CIVIL ENGINEERS

ACEC American Council of Engineering Companies 100 Years of Excellence

ENVISION BACKGROUND

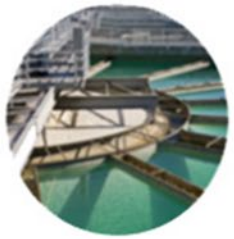


ENVISION METHODOLOGY

- Envision is a Triple-Bottom Line analysis, measuring a projects contributions towards Environmental, Social and Economic prosperity.
- Traditional infrastructure projects overlooked this balance.
- Consider " Big Picture".

ENVISION METHODOLOGY

Envision is applicable to all types and sizes of infrastructure



ENERGY
- Geothermal
- Hydroelectric
- Nuclear
- Coal
- Natural Gas
- Oil/Refinery
- Wind
- Solar
- Biomass

WATER
- Potable water distribution
- Water / wastewater treatment
- Capture / storage
- Stormwater Management
- Flood control

WASTE
- Solid waste
- Recycling
- Hazardous Waste
- Collection & Transfer

TRANSPORT
- Airports
- Roads
- Highways
- Bikes
- Pedestrians
- Railways
- Public Transit
- Ports
- Waterways

LANDSCAPE
- Public realm
- Parks
- Ecosystem services
- Natural infrastructure

INFORMATION
- Telecomm.
- Internet
- Phones
- Data Centers
- Sensors

ENVISION METHODOLOGY

1) Envision Guidance Manual

- The written framework.

2) Pre-Assessment Checklist

- An early-phase high-level pre-assessment.

3) Online Scoresheet

- The detailed online assessment tool and calculator.

4) Sustainability

- Professional training in Envision use.

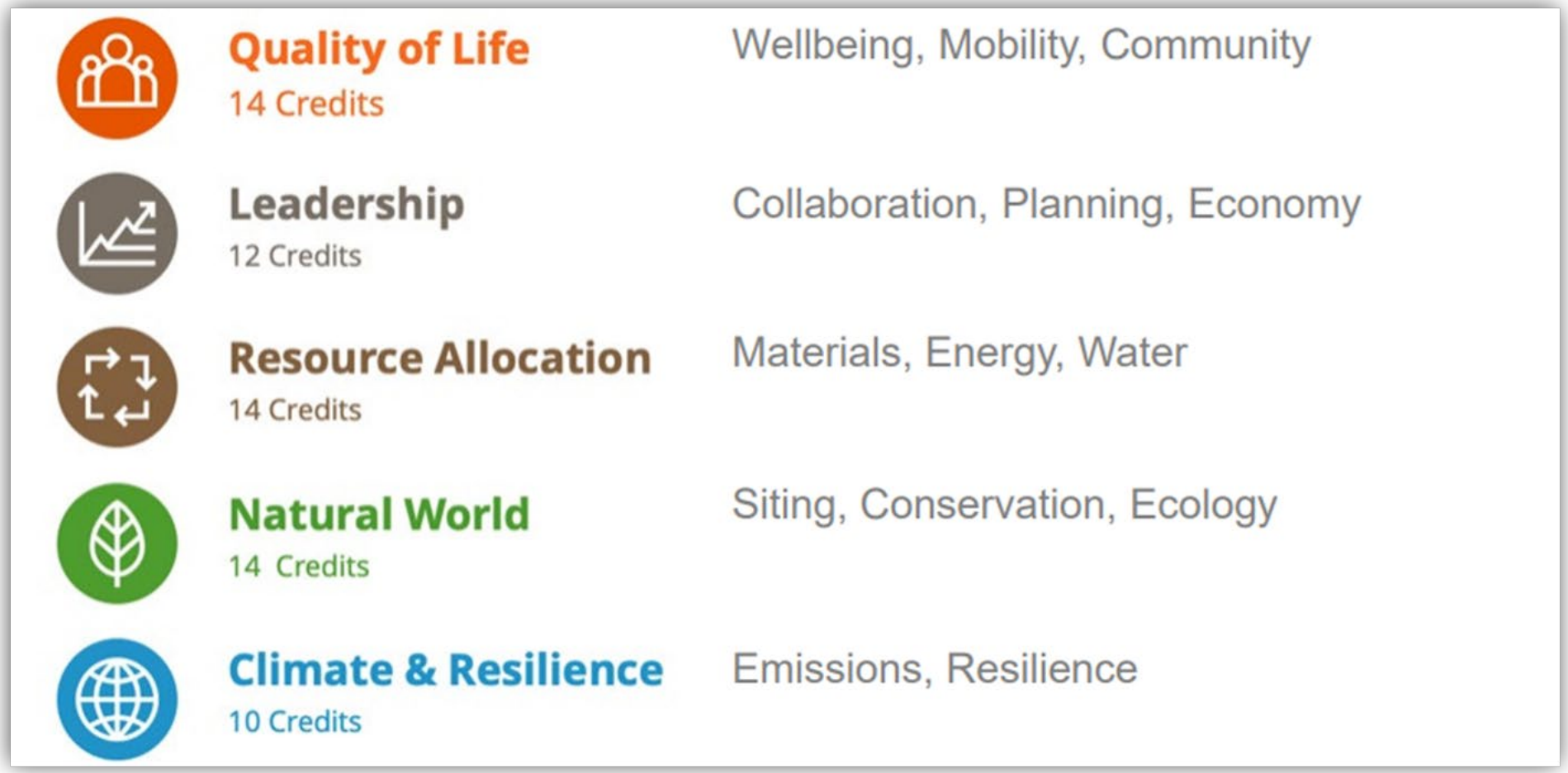
5) Verification

- Independent third-party project review process.

6) Envision Awards

- Recognition for qualifying verified projects.

ENVISION METHODOLOGY



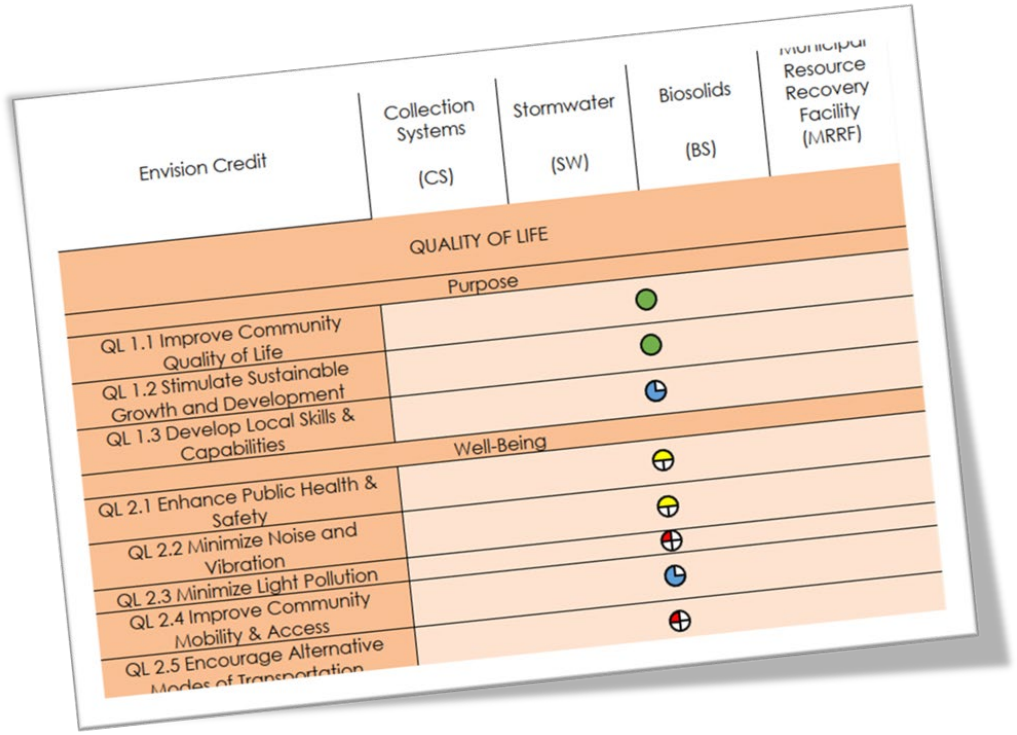
ENVISION METHODOLOGY

- Climate and Resiliencecategory consists of 10 credits to address the following:

1. Does the project reduce greenhouse gas emissions?
2. Does the project reduce air pollutant emissions?
3. Does the project avoid unsuitable sites?
4. Does the project reduce climate change vulnerability?
5. Is the project resilient and adaptable?

WEF Manual

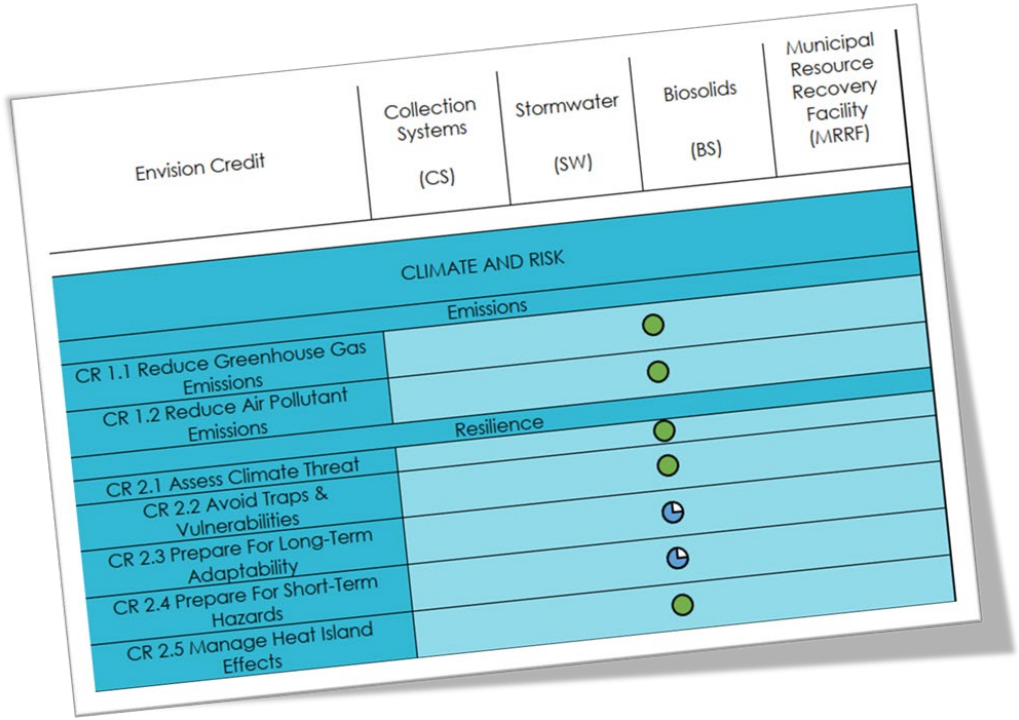
- Guidance for:
  - Collection Systems
  - Stormwater
  - Biosolids
  - Municipal Resource Recovery Facility



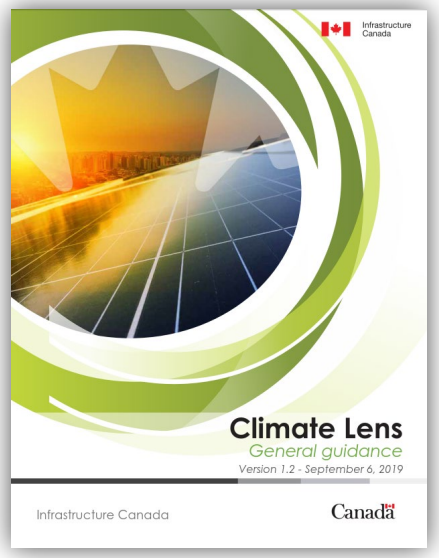
https://www.wef.org/globalassets/assets-wef/direct-download-library/public/03---resources/envision---compiled-conversion---final.pdf

WEF Manual

- Applicability of credits:
  - Highly applicable
  - Applicable
  - Moderately applicable
  - Limited applicability
- Relevant actions
- Credit application
- Additional resources

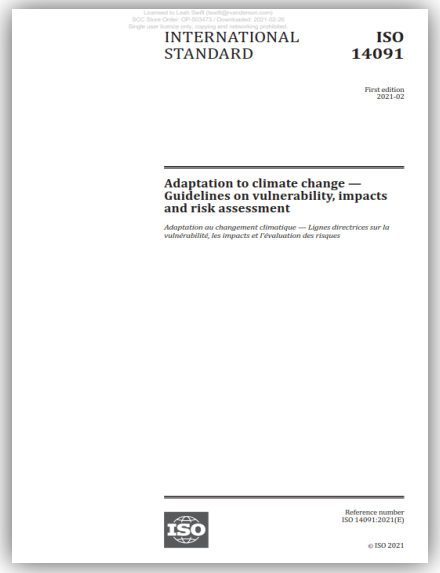


RESILIENCE ASSESSMENT METHODOLOGIES



Climate Lens Assessment
Infrastructure Canada

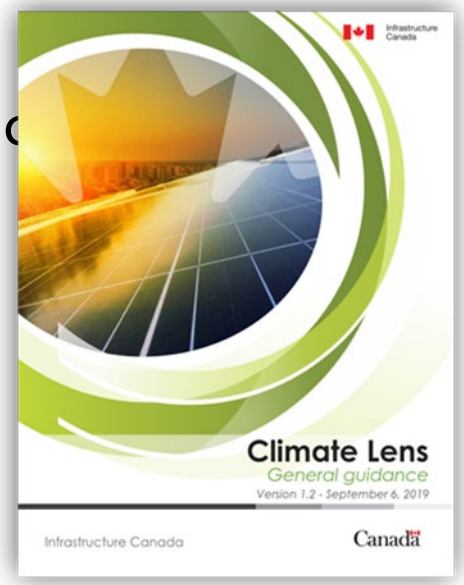
PIEVC Protocol
Institute for Catastrophic Loss Reduction



Adaptation to climate change – guideline on vulnerability, impacts and risk assessment
ISO 14091:2021

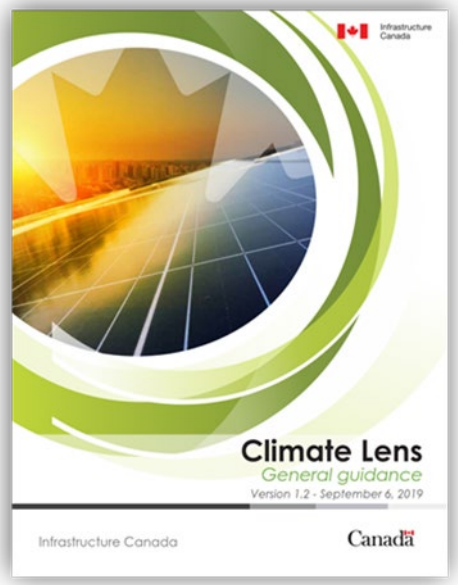
CLIMATE LENS ASSESSMENT

- Requirement under Infrastructure Canada's ICIP and DMAF Programs.
- Consists of two components:
  1. GHG Mitigation Assessment.
  2. Climate Change Resilience Assessment.
- Key tool to assess the climate impacts of the infrastructure projects.
- Assists engineers identify vulnerabilities and improve resilienc through design, construction or operation activities.



CLIMATE LENS ASSESSMENT

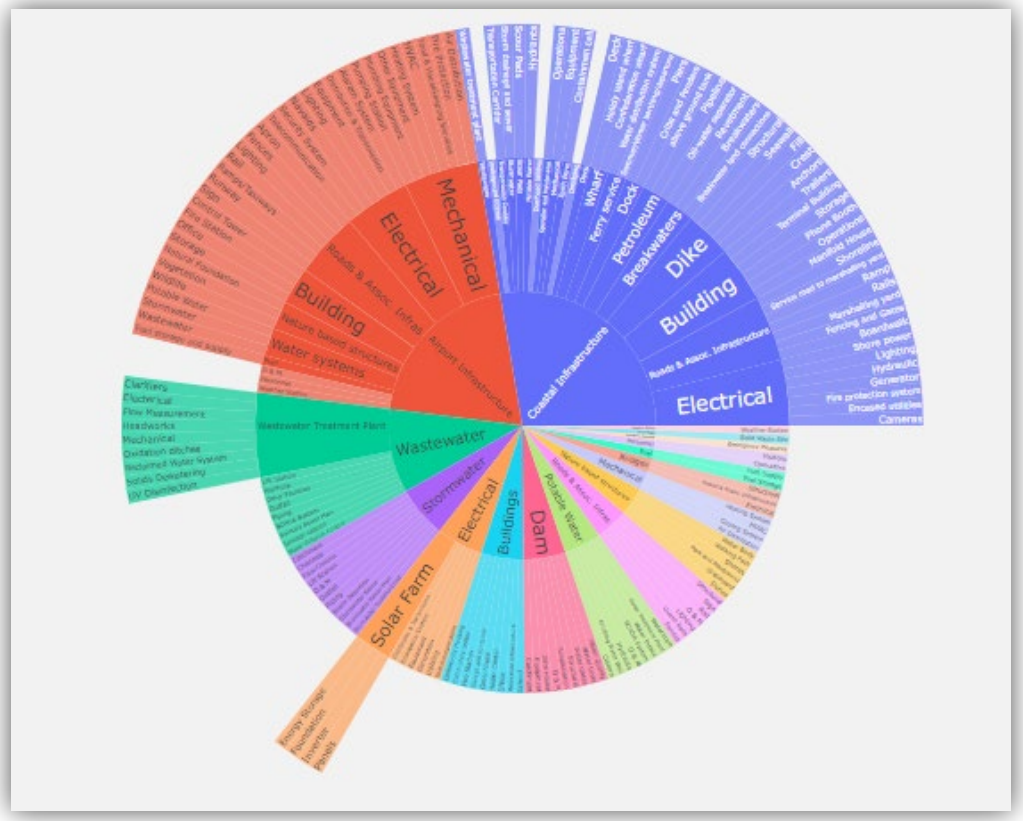
- Climate Lens provides "scope and general approach of the resilience assessment".
- Chosen methodology must be consistent with ISO 31000 (Risk Management).
- Envision and PIEVC – accepted Climate Lens Resilience methodologies.

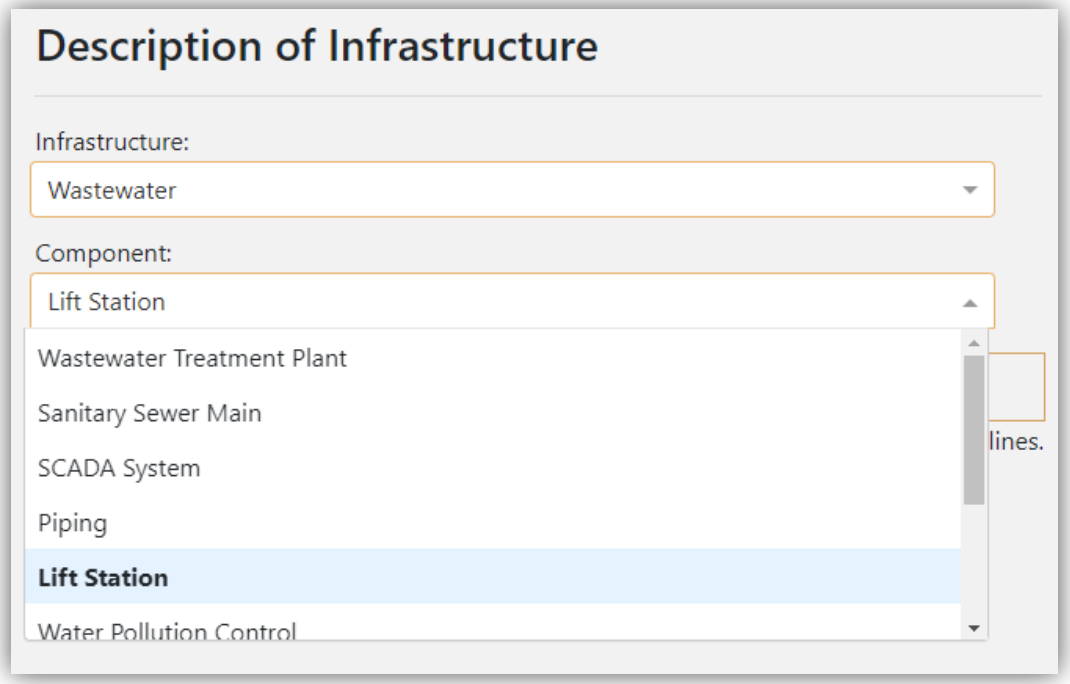


PIEVC PROTOCOL

- Public Infrastructure Engineering Vulnerability Committee (PIEVC).
- Systematic assessment of climate change risks.
- Climate and infrastructure data used to estimate risk (i.e. probability and severity).
- Identify unacceptable risks to support engineer's decision making.
- Requires extensive input data and detailed risk evaluation.
- Approach yields high -quality results.
- Guideline available to users at no cost.

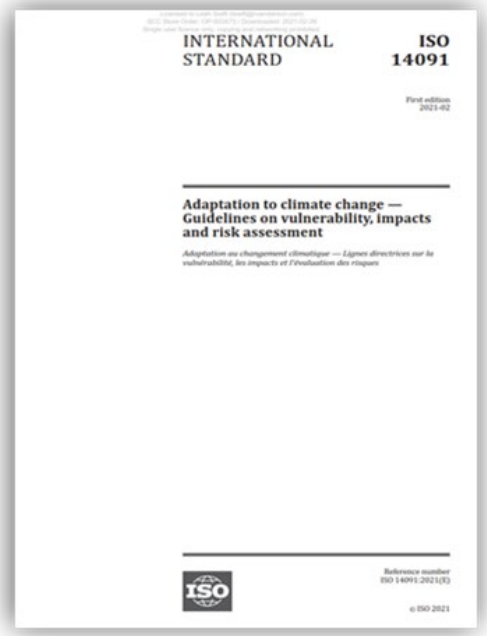
- Over 100 risk assessments completed, available online via the Report Analysis Utility.





ISO 14091:2021

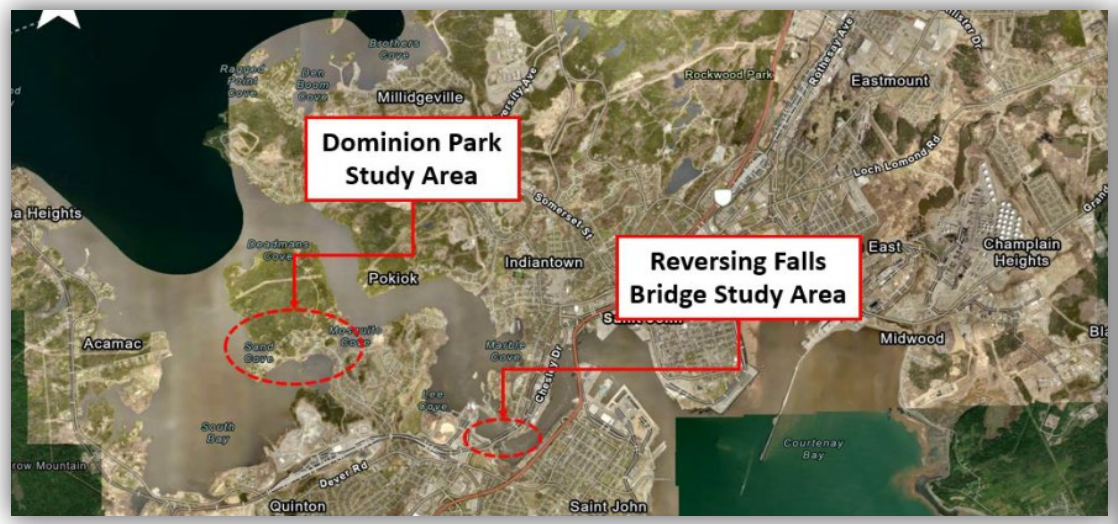
- Adaptation to climate change — Guidelines on vulnerability, impacts and risk assessment.
- Guide on use of screening assessments allowing for qualitative or quantitative analysis.
- Emphasizes use of impact chains.
- Promotes communication and transparency.
- Assessments provide a basis for adaptation planning, implementation, and evaluation for any organization.
- Recognized assessment methodology by CCME.



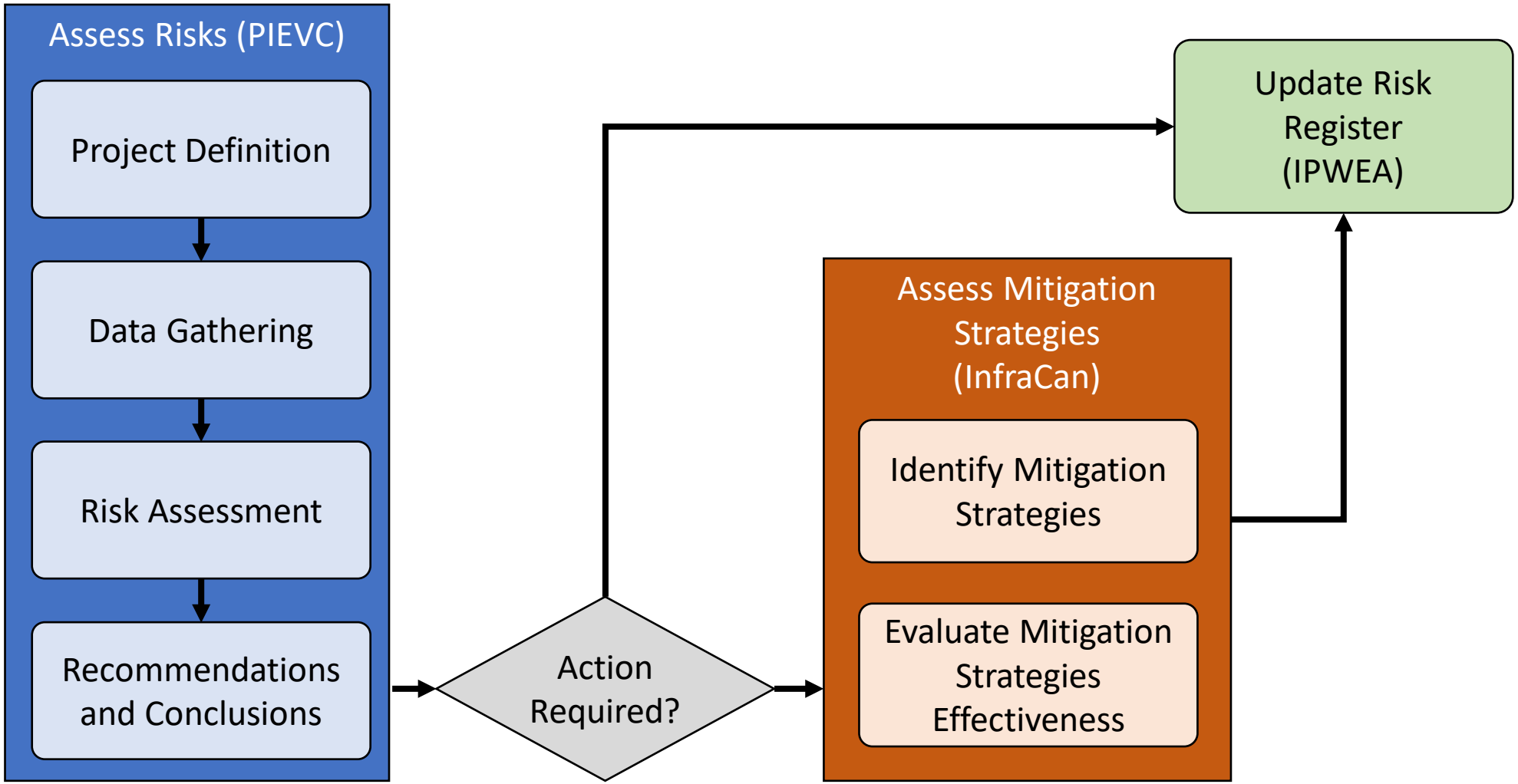
City of Saint John, NB – Background

- Problem: Expand on traditional risk rating framework to incorporate climate change risks.
- Objective : Create standardized methodology to evaluate climate change risks and identify mitigation opportunities.
- Approach : Develop based on industry standards, tailor based on organizational needs.

City of Saint John, NB – Background



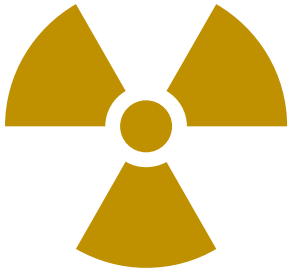
City of Saint John, NB – Methodology



City of Saint John, NB – Project Definition

- What is the assessment boundary?
- What is the assessment time horizon?
- What are the relevant climate change risks?
- Who will comprise the project working group?



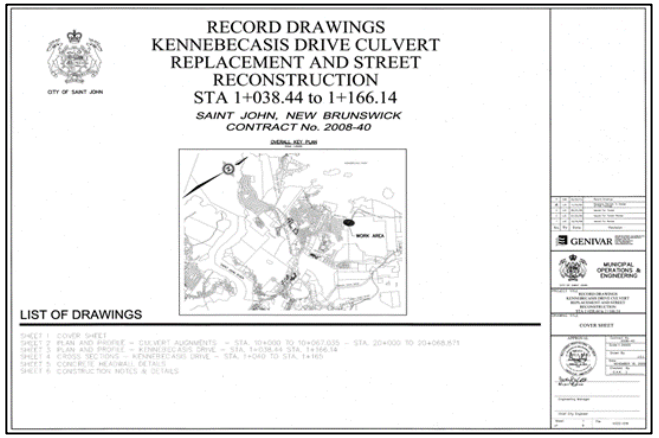



City of Saint John, NB – Data Gathering

Historic & Future Climate Data

O&M Records & Condition

GIS Data & Flood Mapping



As-built Drawings

City of Saint John, NB – Data Gathering

Climate Event	Historic	Future	Commentary / Assumption
High/Low Temperature	29 °C, -25.2 °C	35.8 °C, -13.3 °C (2095)	Daily extreme temperatures will be significantly warmer in the future.
Freeze/Thaw Cycles	80.7 days	50.7 days (2095)	Free-thaw cycle frequencies will be reduced in the future.
Heavy Rain	1-hr, 100-year = 50.2 ± 10.2 mm/hr	4 – 5 times more frequent (2080-2099)	Short-term high intensity rainfall will become much more frequent and severe in the future.
Multi-Day Rainfall	74 and 85 mm	95.9 & 109.6 mm (2095)	Multi-day precipitation totals to increase by approximately 30% in the future.
Spring Freshet	2.7 jams / year	5.2 jams / year (2095)	Increased frequency of ice jams suggests increased likelihood of annual spring freshet flooding.
High Winds	6.43 m/s	6.39 m/s (2080)	Negligible change in average annual wind speed.
Sea Level Rise (SLR)	NA	0.9 ± 0.5 m (2100)	Approximately 1 cm increase of mean sea-level per year.
Storm Surge	NA	1.49 ± 0.38 m (2100)	Occurrence of storm surges will be more frequent due to more hurricanes and higher sea-level.
Hurricanes	19.5 storms / year	34 storms / year (2095)	Hurricane type events will occur more frequently and likely be more severe, resulting in an increase threat of heavy rain and storm surge events.

City of Saint John, NB – Risk Assessment

Probability Rating	Qualitative	Quantitative	
		Expected Occurrence	Statistical Probability
1	Improbable	> 20 years	0 - 5%
2	Unlikely	10 – 20 years	5 – 10%
3	Possible	4 – 10 years	10 – 25%
4	Likely	2 – 4 years	25 – 50%
5	Highly Probable	1 year	50 – 100%

City of Saint John, NB – Risk Assessment

Consequence Rating	Recovery Cost	Health and Safety	Loss of Service	Environment
1 **Insignificant**	< $,2000	Negligible or no injury.	Small number of customers experiencing minor disruption.	Negligible or no environmental impact.
2 **Minor**	$2,000 - $20,000	Minor personal injury.	Small number of customers experiencing significant disruption.	Impact reversible within 3 months.
3 **Severe**	$20,000 - $100,000	Serious injury with hospitalization.	Significant localized service loss over an extended period.	Impact reversible within 1 year.
4 **Major**	$100,000 - $1M	Loss of life.	Major localized disruption over an extended period.	Impact reversible with 5 years.
5 **Catastrophic**	> $1M	Multiple loss of life or city-wide epidemic.	Major long-term city-wide disruption.	Impact not fully reversible.

City of Saint John, NB – Risk Assessment

		Consequence				
		1 Insignificant	2 Minor	3 Severe	4 Major	5 Catastrophic
Probability	1 Improbable	1	2	3	4	5
	2 Unlikely	2	4	6	8	10
	3 Possible	3	6	9	12	15
	4 Likely	4	8	12	16	20
	5 Highly Probable	5	10	15	20	25

City of Saint John, NB – Assessment Results

Reversing Falls Transmission Main (Future)

Risk Category	Count
Low	1
Medium-Low	1
Medium	1
Medium-High	1
High	0
Total	4

Highest risk events:

- Hurricanes.

City of Saint John, NB – Assessment Results

Dominion Park (Future)

Risk Category	Count
Low	1
Medium-Low	0
Medium	4
Medium-High	2
High	0
Total	7

Highest risk events:

- Spring Freshet.
- Storm Surge.

City of Saint John, NB – Mitigation Strategies

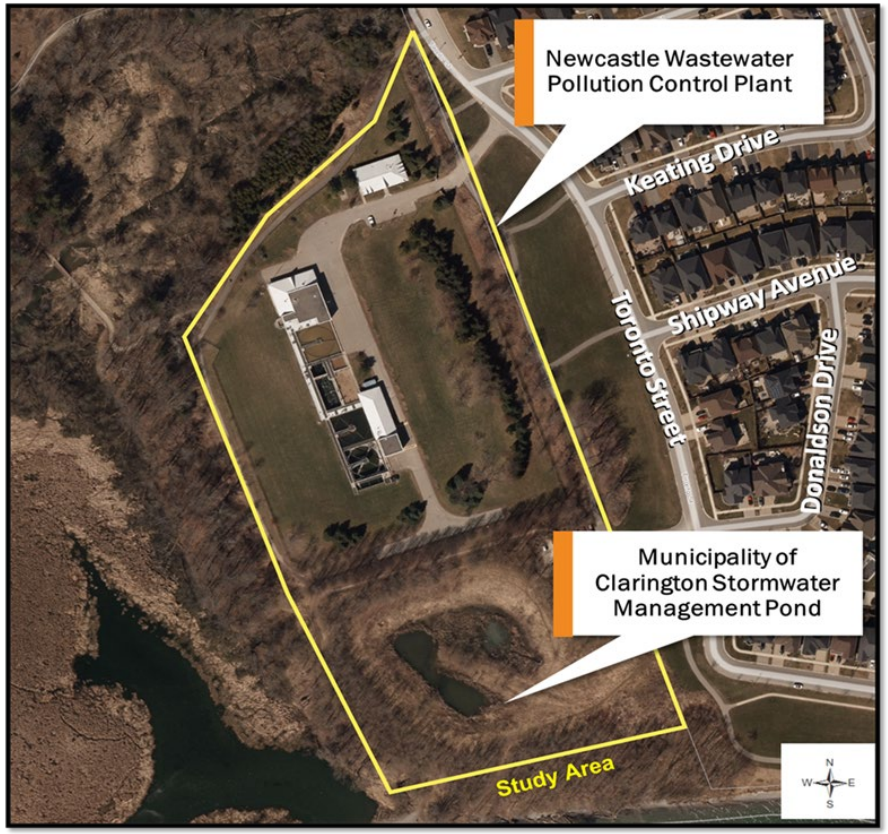
- Identify unacceptable risks and potential strategies to mitigate/eliminate those risks.
- RVA used two approaches to evaluate mitigation strategy effectiveness:
  1. Mitigated Risk Evaluation – re-calculate risk ratings based on mitigation strategy, use "residual risk" as measure of effectiveness.
  2. Return on Investment (ROI) Analysis – mitigation strategy cost compared to losses avoided from implantation, calculated via detailed (bottom up) analysis or proxy analysis.

City of Saint John, NB – Risk Register

- Document results in risk register for further action and prioritization.
- Append results to specific asset IDs in City's asset inventory.
- Developed based on IPWEA standard.
- Tool developed by RVA for City's use.

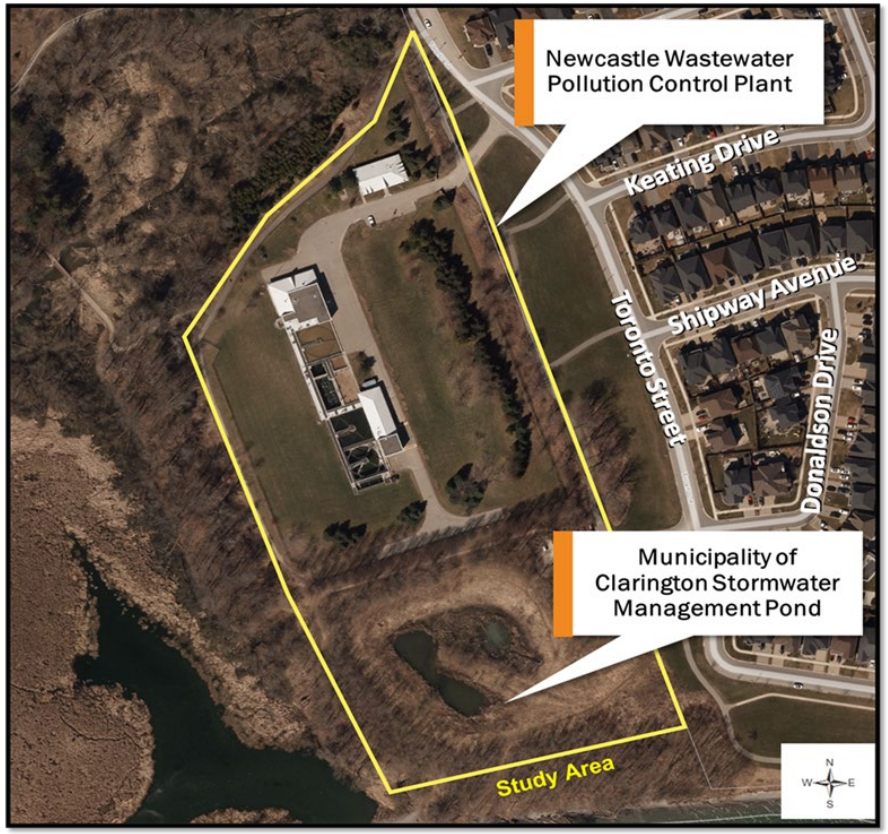
AUI.Name	AUI.Asset Type	Future Climate Risk	Asset ID
Green Head Road	Road	20	RWA-1214
Green Head Road	Road	20	RWB-1255
Rothesay Avenue	Road	15	RWA-91
Rothesay Avenue	Road	15	RWA-96
Rothesay Avenue	Road	15	RWA-469
Rothesay Avenue	Road	15	RWB-83
Rothesay Avenue	Road	15	RWB-46
Rothesay Avenue	Road	15	RWB-2709
Brother's Cove	Culvert	20	WWN-STM-36803
Brother's Cove	Culvert	20	WWN-STM-36804

Newcastle WPCP – Improving Climate Resilience



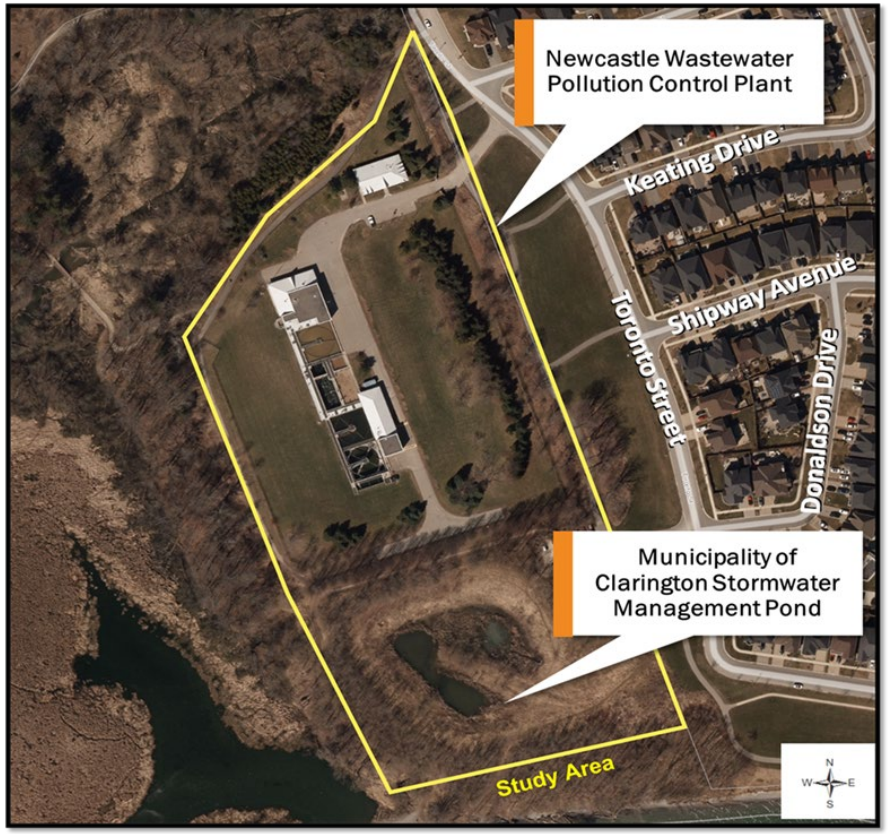
- Client: Region of Durham
- Project: Increase rated capacity
- Plant Commissioned: 1996
- Surrounded by conservation area and marshland
- Discharge to Lake Ontario

Newcastle WPCP – Improving Climate Resilience



- Site stormwater connected to the outfall
  - Reduced outfall capacity.
  - Insufficient/unsustainable SW treatment.
  - Disconnect SW from outfall.
  - Regrade the site.
  - Provide grassy swales.
  - Direct to SW pond.

Newcastle WPCP – Improving Climate Resilience



- Increasing WL in Lake Ontario
  - Plant hydraulic capacity implications.
  - Review plant hydraulic capacity.
  - Adjust weir / gate levels.
  - Provide check valve on plant. emergency bypass.

CONCLUSION

- Goal of Resilience Assessments:
  - Improve decision making capabilities.
  - Prioritize infrastructure improvements.
  - Promote sustainability.

- Next Steps:
  - Proactive implementation.
  - Continued education and training.
  - Collaboration and public engagement.

https://www.activesustainability.com/sustainable-development/what-is-sustainability/

"Infrastructure investment will be crucial. The world should adopt a simple rule: if big infrastructure projects are not green [sustainable], they should not be given the green light. Otherwise, we will be locked into bad choices for decades to come."

-United Nations Secretary General Antonio Gutteres (2017)

THANK YOU!

Questions?