PIEVC WEBINAR SERIES:

High Level Screening Guide, Part 2

February 9, 2023
PIEVC Program Webinar Series – Webinar #6

Dan Sandink, Director of Research, ICLR (dsandink@iclr.org)
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In association with:

2022 - 2023 WEBINAR SERIES

Date	Topic
August 25, 2022	PIEVC Program: Background, Status and New Directions
September 22, 2022	From Assessment to Implementation of Adaptation Action
October 20, 2022	Institutionalizing Climate Change and Infrastructure Vulnerability and Risk Assessment (CCVRA): PIEVC in Adaptation Plans, Professional Practice, and other Mechanisms
November 17, 2022	Climate services for CCVRA: Lessons learned and new tools supporting steps 1 and 2 of the PIEVC Protocol
December 15, 2022	Large Portfolio Analyses using PIEVC Process
January 19, 2023	**PIEVC High Level Screening Guide ….. February 9th HLSG Part Two!**
February 16, 2023	PIEVC GREEN
March 16, 2023	Integration of PIEVC into Asset Management Toolkits
April 18 – 20, 2023	Join us for the GLOBAL FORUM in Vancouver, BC

For recordings of previous webinars and for updates on future speakers, go to CRI website: climateriskinstitute.ca or CRI YouTube page

January 19 Webinar

- **An Introduction to the PIEVC High Level Screening Guide:** Jeff O'Driscoll, Associated Engineering
- **Application of the PIEVC High Level Screening Guide for BC MOTI Cariboo Road Recovery Projects:** Zane Sloan, IBI, Sarah Gaib, Government of BC
- **Adapting the PIEVC HLSG and BC HRVA processes for High Level Assessments of New Buildings:** Charling Li, City of Vancouver
- **BGIS Federal Government Building Portfolio – Climate Risk and Vulnerability Assessments (2021-2022), Gatineau, Quebec, Canada**: Andrew Harkness, Morrison Hershfield and Joel Nodelman, Nodelcorp Consulting

Registration Now Open!

PIEVC GLOBAL FORUM

April 18-20, 2023

Sheraton Wall Centre, Vancouver, BC

https://pievc-practitioners-network.earthnet.org/p/pievc-global-forum

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ENGINEERS & GEOSCIENTISTS BRITISH COLUMBIA

Royal Roads UNIVERSITY

CITY OF VANCOUVER

metrovancouver

- **Officially launch the Practitioners' Network**
- **Foster contact** and **facilitate active engagement** across PIEVC practitioners and infrastructure owners and operators
  > 135 participants, including practitioners from Brazil, Costa Rica, Nile Basin, Vietnam, Georgia, Suriname, Thailand
- **Share proven methods, tools, and approaches** for conducting assessments and implementing recommendations
- **Provide direction** to input for updates and additions to PIEVC Program
- **Support newcomers** to the PIEVC methodology

UPCOMING COURSE

Climate Change and Infrastructure Risk Assessment: The PIEVC Protocol

Start Date: February 13, 2023

Course Length: 5 weeks

Delivery: Online, mix of live and pre-recorded sessions

REGISTER NOW

This online course, offered by the Climate Risk Institute and led by climate, risk and resilience experts, will provide participants with information about infrastructure risk and the PIEVC Protocol. The Protocol is a practical tool and process that supports the systematic assessment of the risks of extreme weather and future climate in relation to public infrastructure.

https://climateriskinstitute.ca/training-and-credentialing/

Today's Webinar

- **HLSG in Municipal Climate Adaptation Plans: An Ontario Example:** Quentin Chiotti, Matrix Solutions Inc.
- **Use of HLSG for Private Investment in Real Estate Portfolios:** Glenn Milner, JLL
- **HLSG Application to Wastewater System in Charlottetown, PEI:** Abhishek Pokharel, UPEI
- **Application of HLSG for Three Bridges in Ontario:** Lindsay Allen, CBCL

Applying a Relative Measure of Likelihood to Climate Risk Assessment: PIEVC High Level Screening Guide (HLSG) at the Municipal Asset Level

Dr. Quentin Chiotti
David Van Vliet
Tara Roumeliotis
Melani-Ivy Samson

February 9th, 2023

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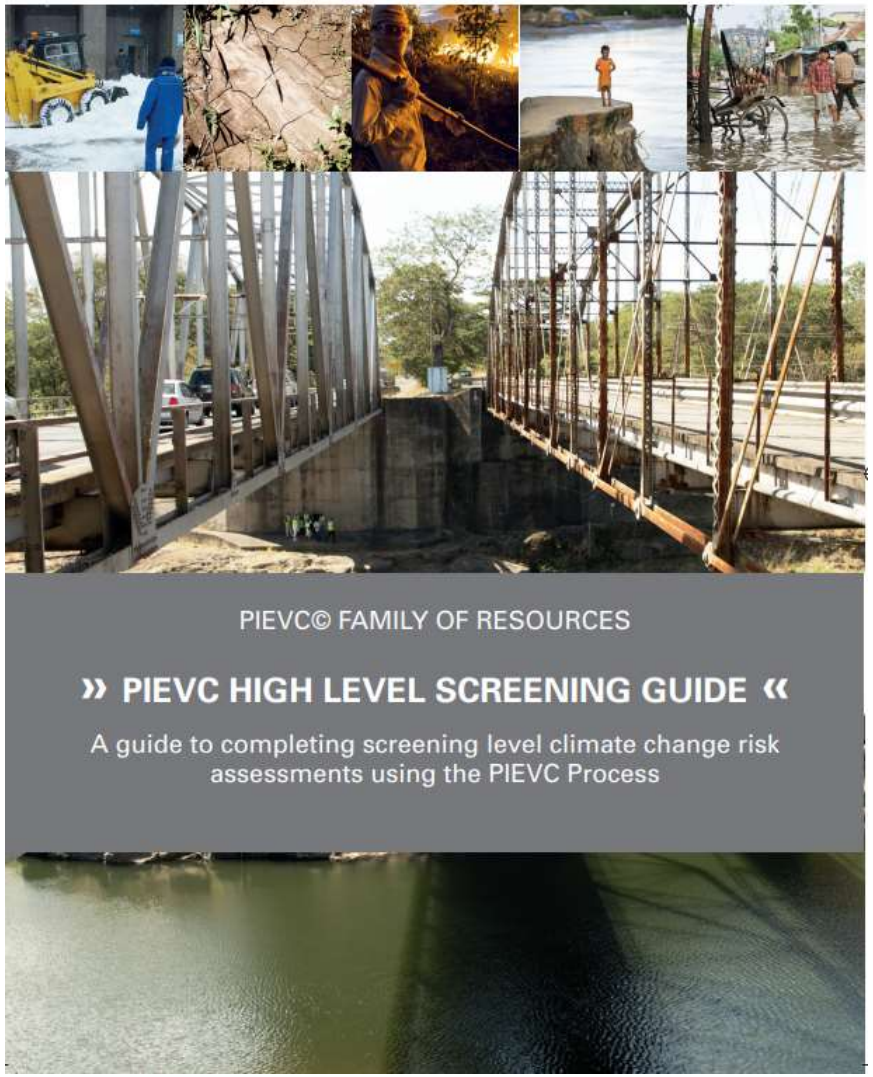
PIEVC HLSG: PROBABILITY SCORING



Applications of the PIEVC HLSG Process

- Asset management, capital and master planning
- Infrastructure operations and management evaluation and review
- Asset portfolio assessment and evaluation
- Municipal climate vulnerability & risk assessment

PIEVC HLSG Probability Scoring			
Likelihood	**Middle Baseline Approach**	**Method**	**Suggested Rational**
1	↑	Likely to occur less frequently than current climate	50% to 100% reduction in frequency or intensity with reference to baseline mean
2	↑		10% to 50% reduction in frequency or intensity with reference to baseline mean
3	Establish Current Climate Baseline Per Parameter	Likely to occur as frequently as current climate	Baseline mean conditions or a change in frequency or intensity of ±10% with reference to the baseline mean
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5	↓	Likely to occur more frequently than current climate	50% to 100% increase in frequency or intensity with reference to baseline mean

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LIKELIHOOD SCALES

IPCC		
Score	Term	Likelihood of the Outcome
1	Exceptionally unlikely	0-1% probability
2	Very unlikely	0-10% probability
3	Unlikely	0-33% probability
4	About as likely as not	33-66% probability
5	Likely	66-100% probability
6	Very likely	90-100% probability
7	Virtually certain	99-100% probability

Climate Lens		
Score	On-going/Cumulative Occurrence	
1	Very Low	Not likely to become critical/beneficial in period
2	Low	Likely to become critical/beneficial in 30-50 years
3	Moderate	Likely to become critical/beneficial in 10-30 years
4	High	Likely to become critical/beneficial in a decade
5	Very	Will become critical/beneficial within several years

PIEVC Protocol		
Score	Method A	Method B (years)
0	Negligible Not applicable	< 0.1% < 1 in 1,000
1	Highly unlikely Improbable	1% 1 in 100
2	Remotely possible	5% 1 in 20
3	Possible Occasional	10% 1 in 10
4	Somewhat likely Normal	20% 1 in 5
5	Likely Frequent	40% 1 in 2.5
6	Probable Often	70% 1 in 1.4
7	Highly probable	>99%

MUNICIPAL CLIMATE ADAPTATION PLANS

Score	Likelihood rating	Recurrent impacts
Qualitative or none at all		

Score	Likelihood rating	Recurrent impacts
7	Virtually certain	99 – 100% probability
6	Very likely	90 – 100% probability
5	Likely	66 – 100% probability
4	About as likely as not	33 – 66% probability
3	Unlikely	0 - 33% probability
2	Very unlikely	0 - 10% probability
1	Exceptionally unlikely	0 - 1% probability

Score	Likelihood rating	Recurrent impacts	
5	Almost Certain (5)	Could occur several times per year	Could occur several times per year
4	Likely (4)	May arise about once per year	May arise about once per year
3	Possible (3)	May arise once in 10 years	May arise once in 5 years
2	Unlikely (2)	May arise once in 10 years to 25 years	May arise once in 5 to 10 years
1	Rare (1)	Unlikely during the next 25 years	Unlikely during the next 10+ years

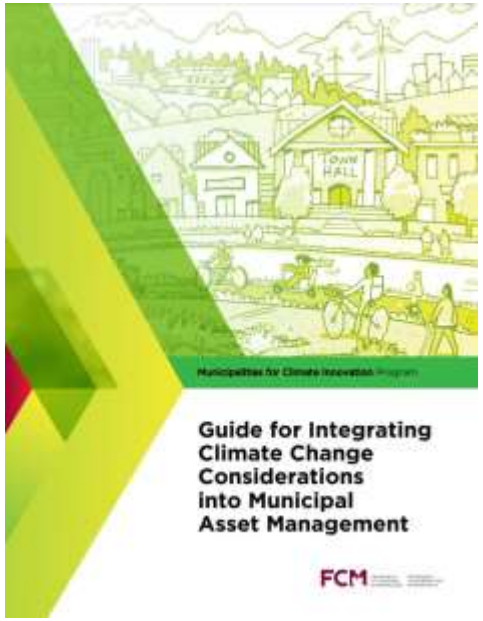
MUNICIPAL CLIMATE VULNERABILITY AND RISK ASSESSMENTS – COMMON EXAMPLES

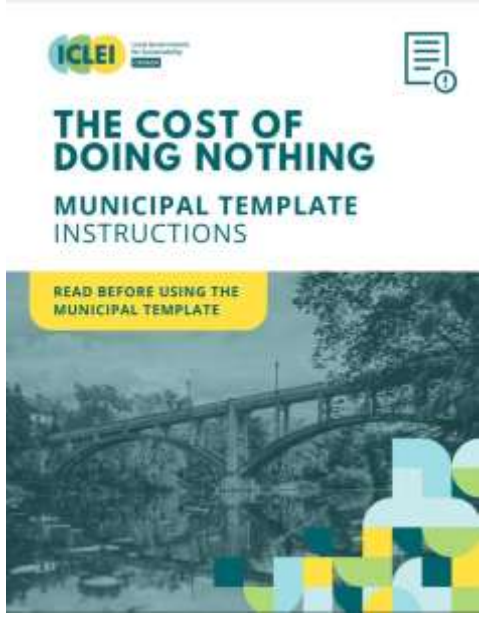
Impact Statements	Departments	Actions	Plans, Policies, Strategies

• Goals
• Thematic
  • Health & safety
  • Buildings and property
  • Infrastructure
  • Business & tourism
  • Ecosystems & biodiversity
  • Community services
  • Household resilience
	• Planning
	• Engineering - water
	• Transportation - roads and fleet
	• Parks
	• Corporate facilities
	• Human resources
		• Investigate and explore opportunities to collect and recycle water and storm water
		• Update flood risk mapping
		• Research and explore options for transporting those in need to warming and cooling facilities
			• Official plans
			• Seasonal control plans
			• Emergency response plans
			• Stormwater management master plan
			• Asset management plan (AMP)

Infrastructure assets and services, and AMPs considered among the mix

CLIMATE CHANGE AND ASSET MANAGEMENT: NEXT FRONTIER





https://fcm.ca/en/resources/mamp/learning-journey-climate-resilience-and-asset-management

https://icleicanada.org/wp-content/uploads/2022/11/CODN-Municipal-Template-Instructions.pdf

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INFRASTRUCTURE ASSET FOCUSED: FCM EXAMPLES

Asset Group	Asset Type	Service provided to the community	Climate Hazard	Impacts to Assets	Impacts to Levels of Service	Actions
Water infrastructure	Dams, reservoirs, pipes, valves, natural assets	Potable water supply	• Changes to freeze/thaw cycles • Debris flow from extreme rain events • Extreme heat and rain • Increase in the frequency of freezing rain events • Mudslides • Rising sea levels, storm surges and coastal erosion • Changes in precipitation patterns • Increased runoff and landslides • Severe weather causing more frequent damage to trees • Wildfire in the watershed	• Accelerated erosion of trails • Decreased road comfort due to raveling, rutting, cracking and potholes • Increased operating, maintenance, and renewal costs, leading to increased pressure on budgets and overall decline of service levels • Damage to ecosystem due to increase pollutants in runoff • Higher operational energy demand and pressures on utilities • Loss of shade, habitat, and water management due to increased tree mortality	• Inability to use parks during extreme heat events, flood events, or wildfire in natural areas • Increased O & M costs of sewer infrastructure, leading to increased rates • Total loss of service, potentially leading to evacuations • Temporary closure of facilities	Operate and Maintain Measures Renewal Measures • Adaptation actions • Co-benefit actions • Mitigation actions • Implement load restrictions on routes • Increase frequency of crack-filling and pothole repair • Clear fallen trees from watercourses to remove hazards and maintain flows • Install backflow prevention devices, sump pumps, and other backup systems
Sewer infrastructure	Pipes, lift stations, manholes, natural assets, treatment plants	Wastewater collection and treatment				
Drainage infrastructure	Pipes, culverts, chambers, natural assets	Flood protection				
Transportation infrastructure	Roads, bridges, sidewalks, traffic signals, street lighting	Transportation				
Parks infrastructure	Playfields, playgrounds, trails, natural assets	Recreational parks				
Buildings	Civic offices, public works yard, fire and police buildings, parkades, recreational and cultural buildings	Community facilities Civic facilities				
Vehicles	Fire trucks, heavy equipment, snow ploughs	Emergency response				
IT infrastructure	Hardward, SCADA, telemetry, communication equipment	Support for departments to serve the community				

PIEVC HLSG: MORE RELATABLE LIKELIHOOD

PIEVC HLSG Probability Scoring			
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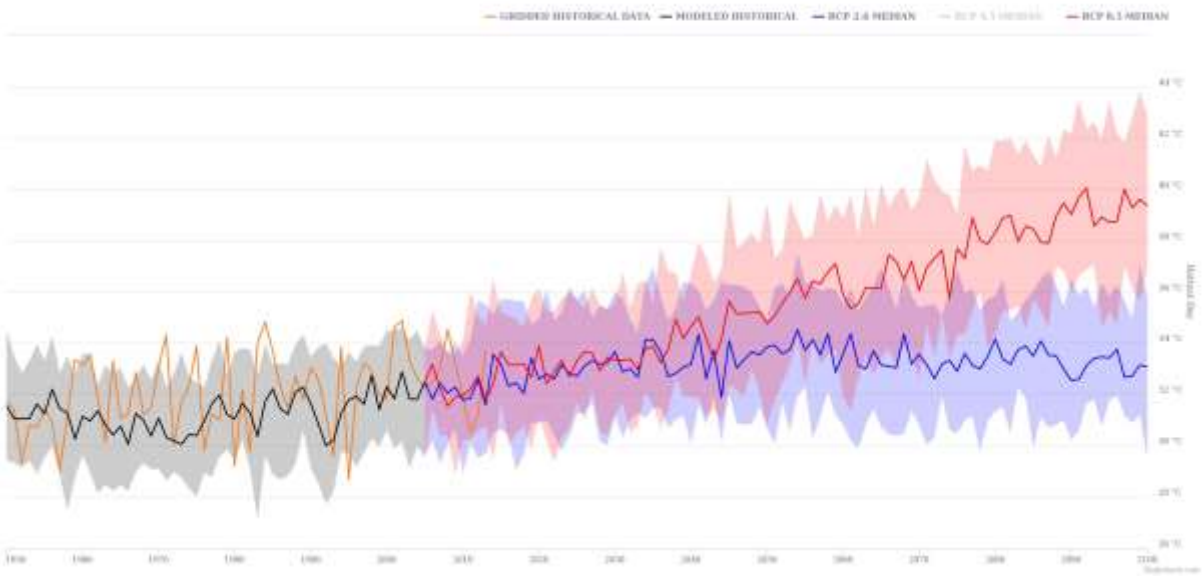
MANAGING CHANGE IN FUTURE CONDITIONS VIS-À-VIS HISTORICAL EXPERIENCE

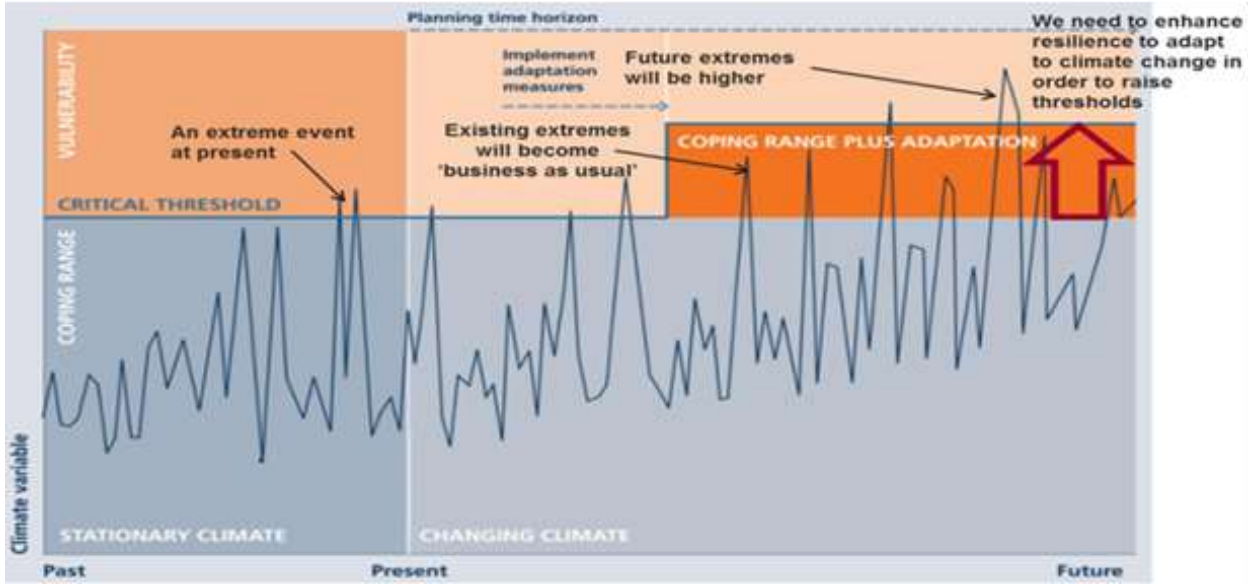
IS THE PAST A GOOD INDICATOR OF THE FUTURE?



Tmax for Calgary: Low and High Emissions Scenarios

Source: climatedata.ca

Managing Extreme Weather Events: Asset Management Application



Source: Lemmen, D.S., Warren, F.J., Lacroix, J. and Bush, E. (eds) (2008) From Impacts to Adaptation: Canada in a Changing Climate 2007 (Ottawa: Government of Canada).

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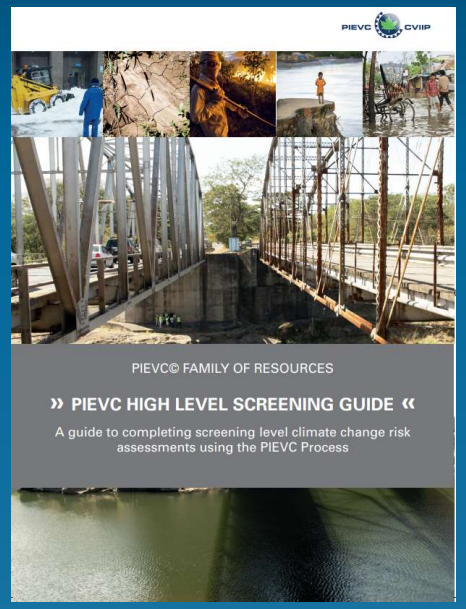
PROJECTED CHANGE IN FUTURE RISKS AND ADJUSTMENTS IN ASSET MANAGEMENT MEASURES

Climate Hazard	Consequence	Likelihood	Risk Score
Heavy rainfall and flooding	4	4	16

High risk culverts: Increased flood risk with likelihood increasing between 10-50%, requiring an increase in O & M resources, and higher design standards for new stormwater management systems

Medium risk potholes: decreased costs for repairs, with likelihood decreasing between 10-50%, but remains as a persistent and chronic problem

Final Thoughts



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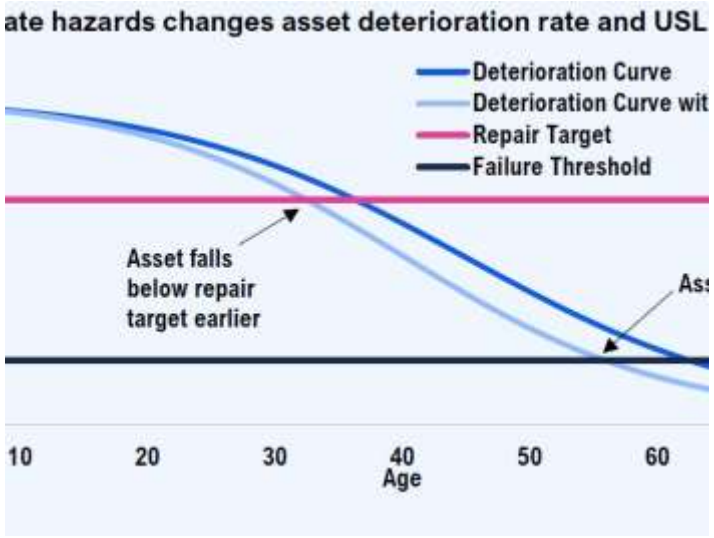

Source: Financial Accountability Office of Ontario (2021)

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Contact Us

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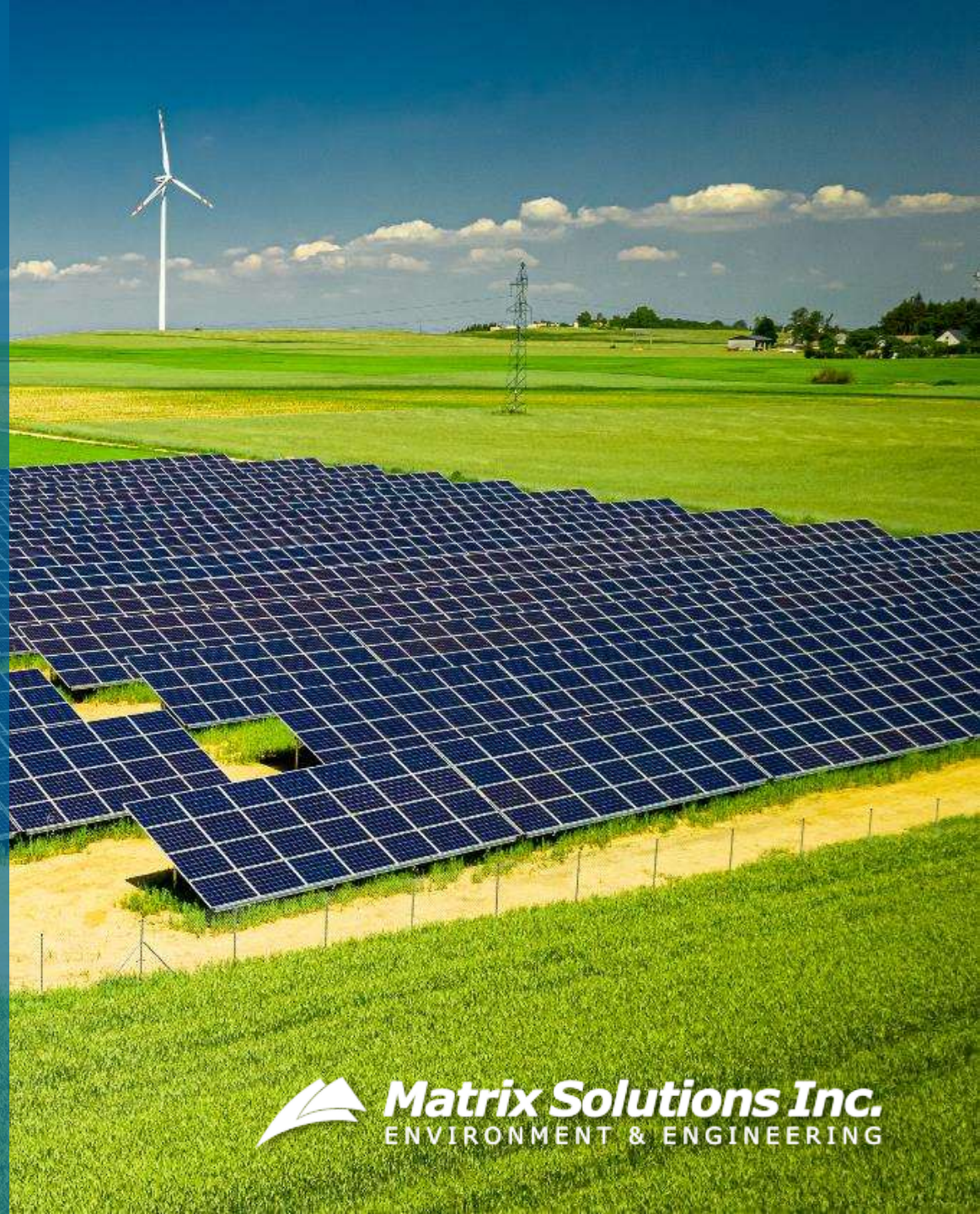


matrix-solutions.com

Scoping the PIEVC High Level Screening Guide for Use in Private Real Estate Portfolios

PIEVC HLSG Case Studies Webinar

Feb 9th, 2023

JLL SEE A BRIGHTER WAY

About JLL

Jones Lang LaSalle Real Estate Services, Inc. (NYSE: JLL) is a leading professional services firm that specializes in real estate and investment management. JLL shapes the future of real estate for a better world by using the most advanced technology to create rewarding opportunities, amazing spaces and sustainable real estate solutions for our clients, our people and our communities.

JLL is a Fortune 500 company with annual revenue of $19.4 billion, operations in over 80 countries and a global workforce of more than 102,000 as of June 30, 2022.

Americas
10 countries
146 owned offices

EMEA
26 countries
115 owned offices

Asia Pacific
16 countries
76 owned offices

4.6B square feet managed in property and facilities management

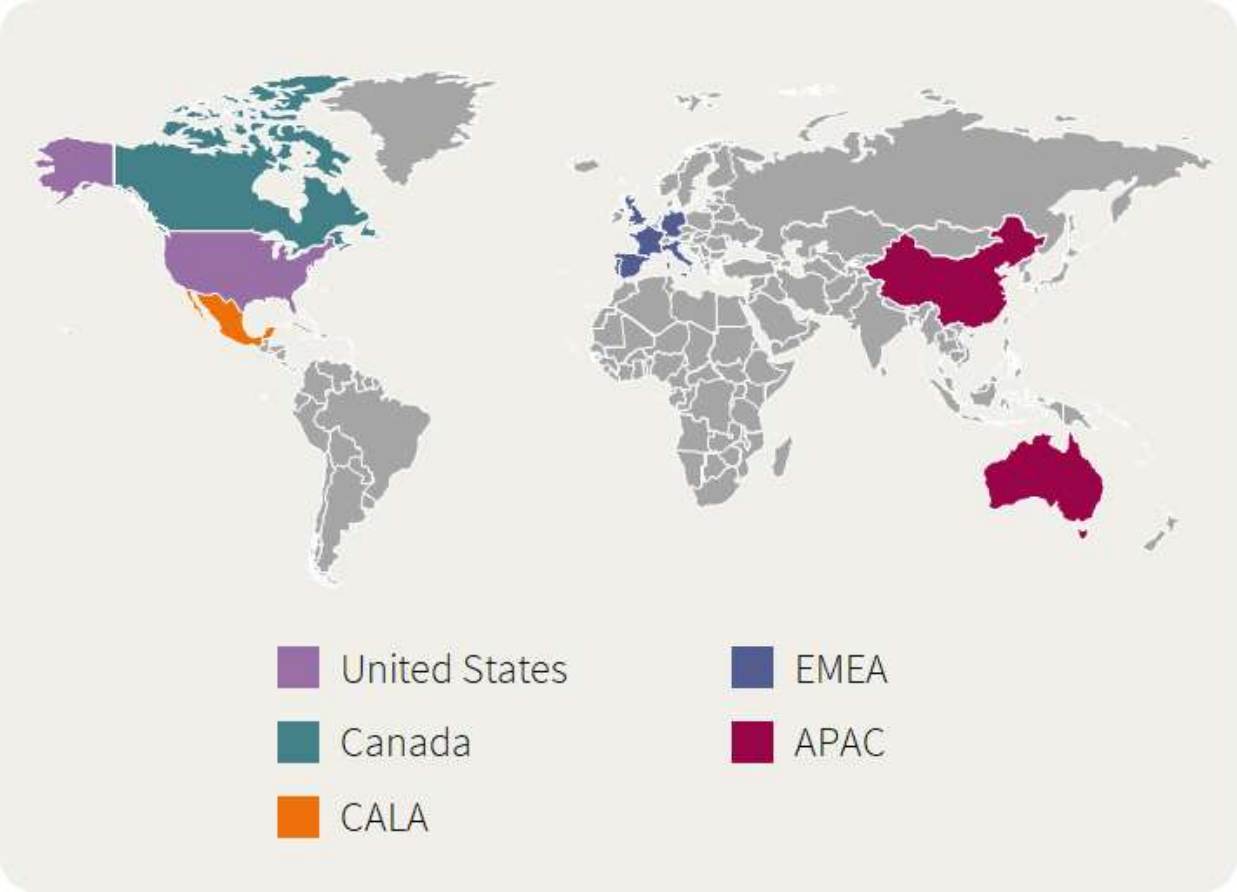
37,500 leasing transactions, totaling 1.07B square feet leased

97,957 hours spent volunteering in local communities

$5,325,935 in charitable contributions

239,749 metrics tons of CO_2 conserved

What is a Typical Real Estate Portfolio?



Office
Buildings within the portfolio with the designated primary use of office.

Retail
Buildings within the portfolio with the designated primary use of retail.

Residential
Buildings designated with the primary use of single- or multi-family residential.

Industrial and Logistics
Buildings in the portfolio that are designated to data centers, warehousing or other industrial facilities.

Hotels
Buildings within the portfolio designed as hotels.

Mixed Use
Buildings within the portfolio with mixed use or multi-purpose.

In 2021, commercial real estate contributed $1.2 trillion to U.S. GDP (5%) and $148 billion (13.5%) of Canada's GDP (NAIOP, 2022)

Majority Owned
Co-Invested or Joint-Venture
Occupier or Tenant Leased

What Drives Investment in Real Estate?

14% rent premium
BREEAM Outstanding buildings (UK)
JLL Central London Report

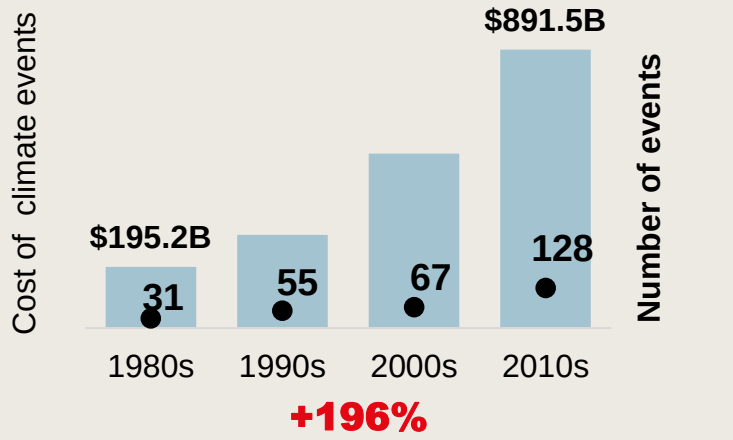
Almost 100% pre-leased
BREEAM Outstanding buildings
JLL Central London Report

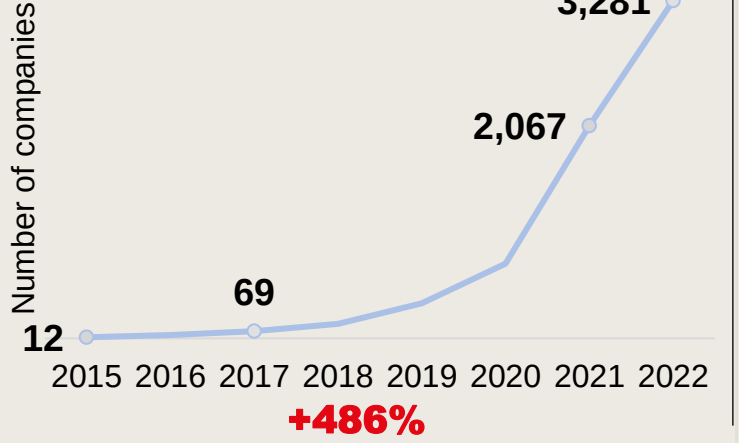
4-7% rent premium
FitWel & WELL buildings (US)
MIT Center for Real Estate Study

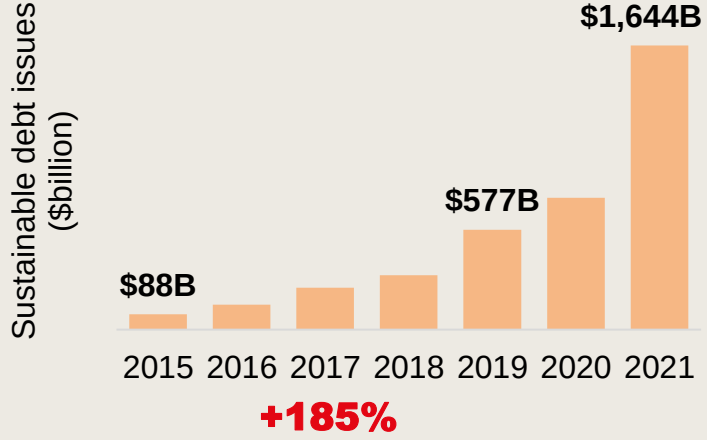
~20%-40% savings
Cost savings in operating building with green building to net zero strategies

The Real Estate Market is Changing

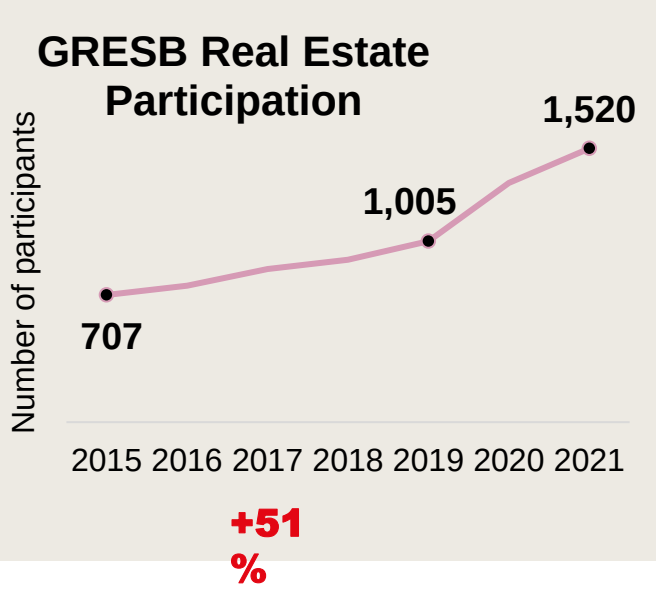
2019 vs. 2021 growth:

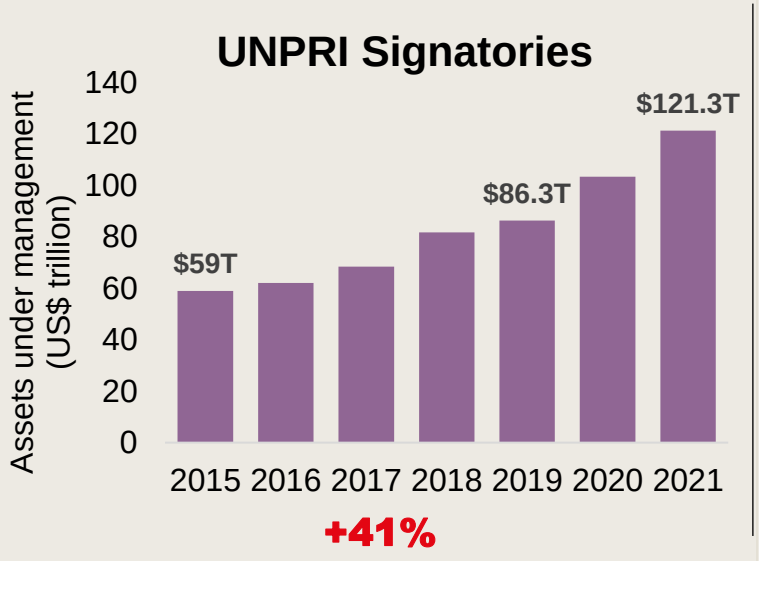


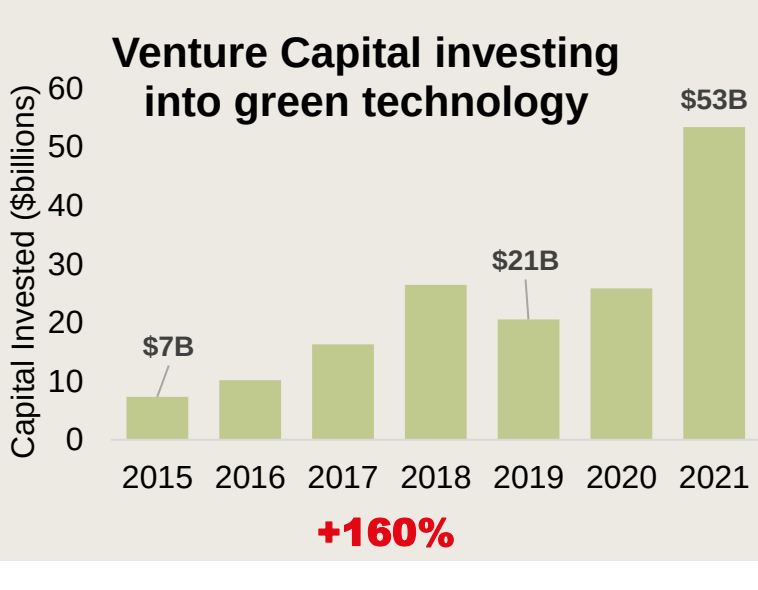




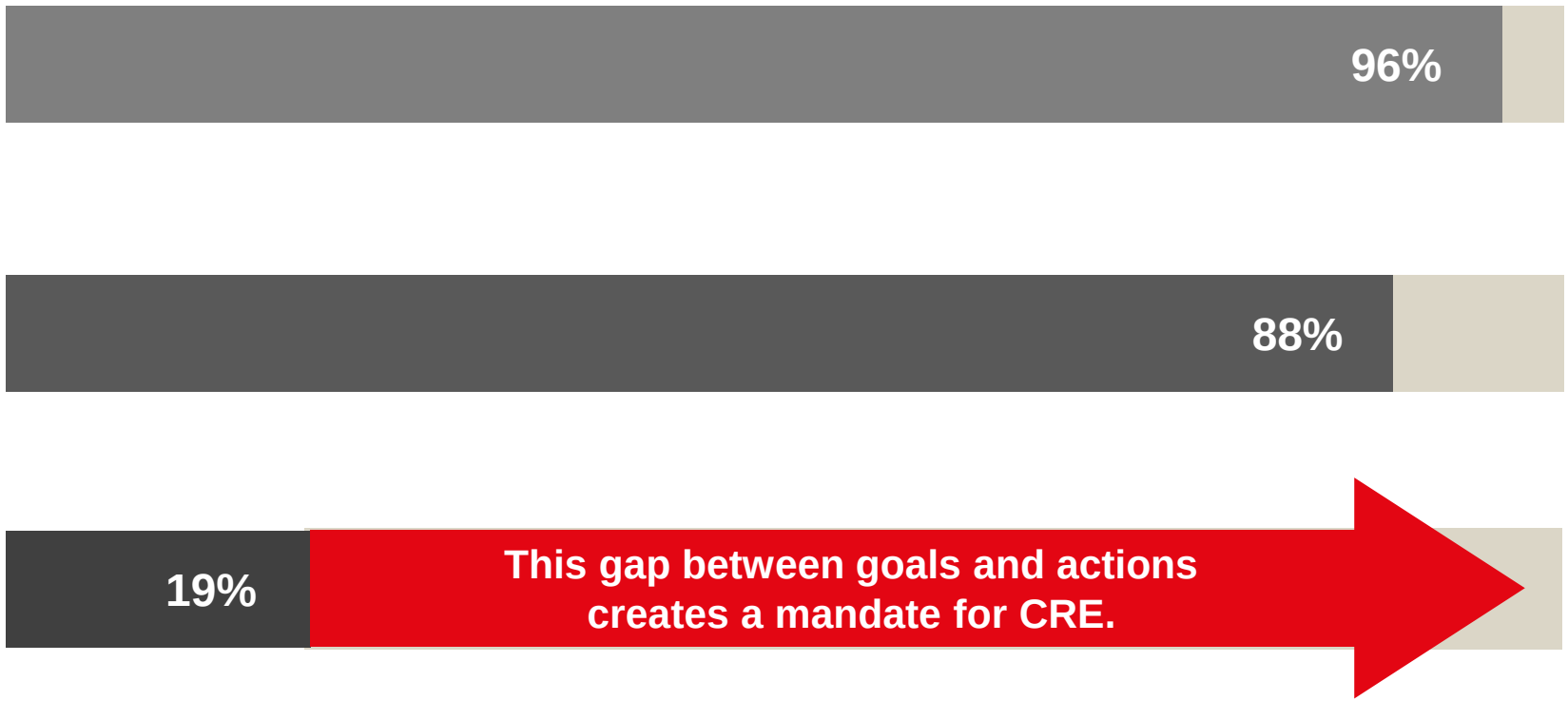
2019 vs. 2021 growth:







The Opportunity for Action



9.6 of 10 commercial real-estate owners and occupiers have set ambitious, publicly-stated sustainability goals.

Almost **9 of 10** have set goals that will expire by 2025.

But only 2 of 10 have a clear action plan with committed capital to help them achieve those goals.

And we need to move beyond RISK DISCLOSURE:

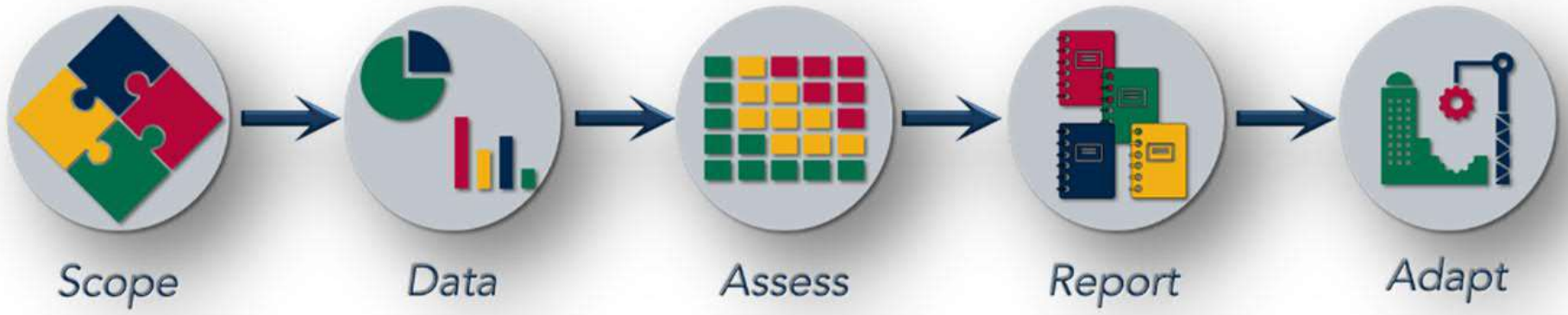
GRESB

TCFD TASK FORCE ON CLIMATE-RELATED FINANCIAL DISCLOSURES

…to building confidence in rapid risk assessment to integrate outputs into DECISION-MAKING.

PIEVC CVIIP

That’s Where PIEVC HLSG Comes In



- Data Availability
- Representative Regions
- Representative Asset Classes

- Majority vs. JV Ownership
- Site acquisition/due diligence vs. existing
- Reinforcing ambition via related initiatives

- Climate hazards and indicators
- Climate projections and data sources
- Likelihood Scoring

- Investment vs. asset life-cycle implications
- Role of private sector “climate tech” market
- Quantifying value-at-risk

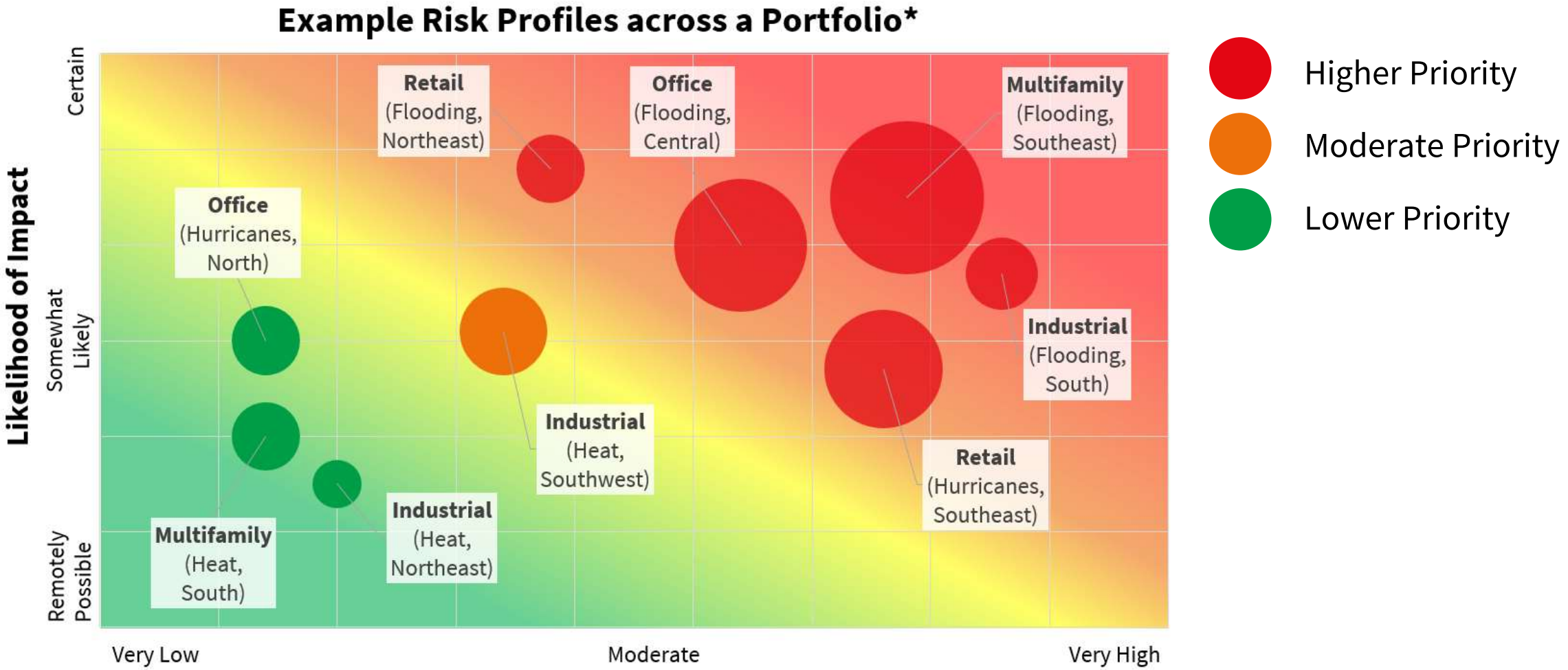
- Evaluation of consequences
- Risk scoring and extension across portfolio
- Portfolio-wide risks and unique geographic or asset risks

- Opportunity to extend outputs and apply pilot asset-specific options
- Costing of options typically a major priority

- Asset upgrades and capital planning
- Monitoring
- Further investigation

- Align with portfolio data programs
- Embed in existing software used
- Align with decarbonization efforts

Visualizing Portfolio Archetypes – Americas Case Study

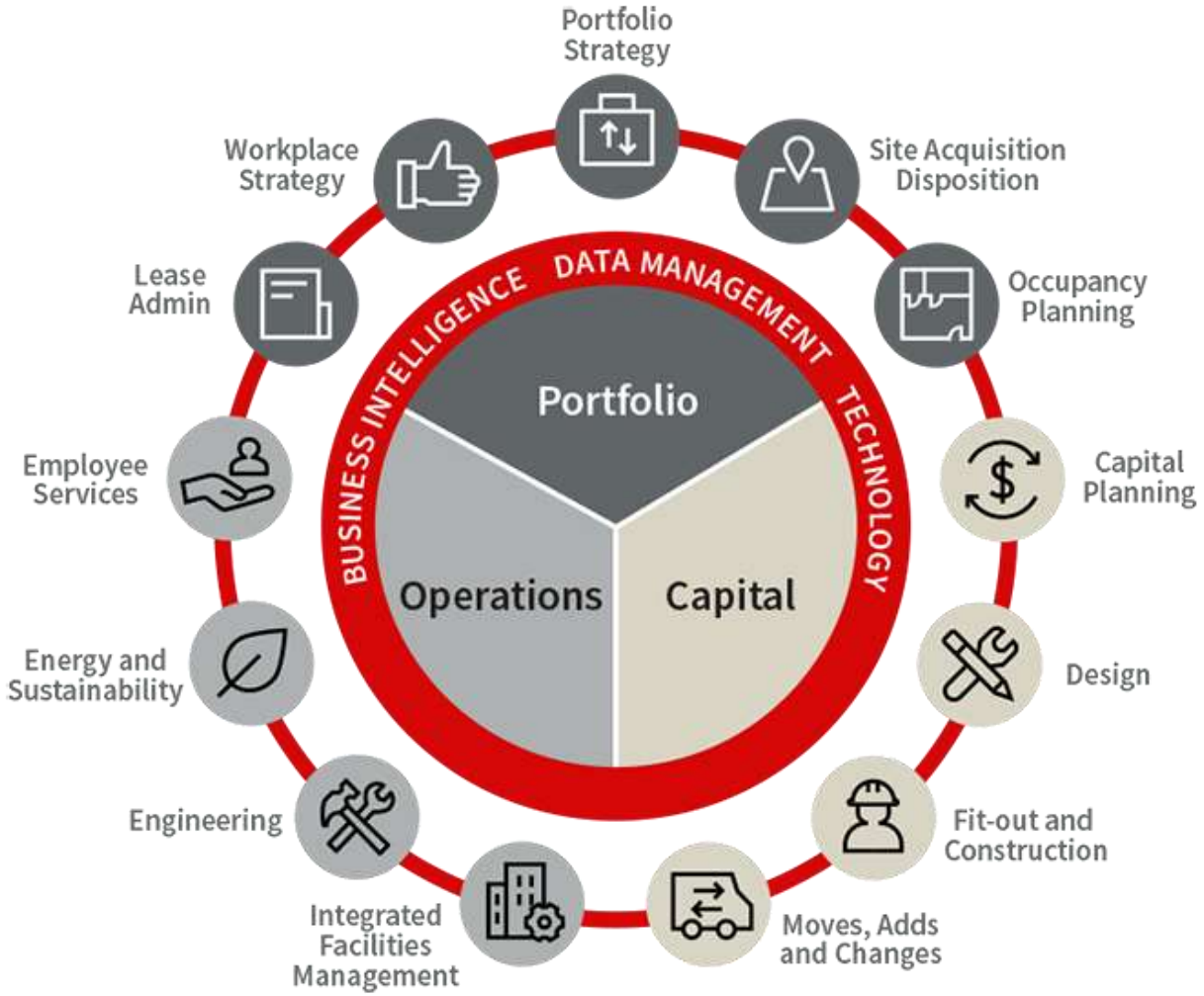


**The size of each circle denotes the number of assets in the portfolio exposed to the risk. Only shown based on asset locations and for relevant exposure.*

Adaptation across the Real Estate Cycle

Climate risk assessment and related outputs can inform various stages of the real estate cycle.

- Site Acquisition & Disposition
- Capital Planning
- Design
- Integrated Facilities Management
- Engineering
- Energy & Sustainability
- Portfolio Strategy



Key Takeaways

This decade is being seen as the tipping point in decarbonizing real estate. Now is the time to embed climate risk as part of the action on that priority.

Policy & regulation are lagging behind the science. We need to build confidence among portfolio owners to take risk-informed approaches and not only disclose.

Leveraging and applying a robust framework like the PIEVC HLSG is critical in a rapidly growing real estate market, including sharing private sector case studies.

We anticipate a large supply of climate-related data and tech companies to emerge. It is paramount decision makers interpret these data with limitations and outcomes in mind.

No one can do it alone: we must collaborate among private and public partners to enable the adaptation of real estate and those who rely on it.

Thank you!

Glenn Milner
Senior Manager, Climate Resilience
Glenn.Milner@jll.com

JLL SEE A BRIGHTER WAY

PIEVC HLSG application to Wastewater System in Charlottetown, PEI

Prince Edward Island is the traditional and unceded territory of the Mi'kmaq First Nations.

Natural Resources Canada | Ressources naturelles Canada
Canada
Prince Edward Island CANADA
UNIVERSITY of Prince Edward ISLAND
Architects Association of Prince Edward Island
PRINCE EDWARD ISLAND WATERSHED ALLIANCE
EngineersPEI
PEIIPP

Meet the Speaker

Abhishek Pokharel

MSc. Sustainable Design Engineering, UPEI , PE, Canada
B.Tech. Environmental Engineering, Kathmandu University, Nepal

Work done as:
Climate-Sense Infrastructure Resilience Intern, 2021

Host:
Town of Stratford (February-July) & City of Charlottetown (August-January)

Current Position:
Client Manager
Sentry Water Control and Monitoring Inc., PEI
mail.apokharel@gmail.com , apokharel@upeialum.ca

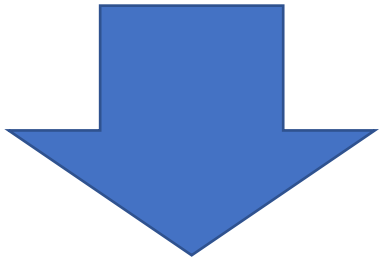
Climate-Sense Internship

UNIVERSITY of Prince Edward ISLAND

- NRCan BRACE (Building Regional Adaptation & Capacity Expertise) Initiative.
- Designed to build adaptation capacity in recent post-secondary students, as well as host organizations within the public and private sectors of PEI.
- Interns worked with mentors within the host organization to complete a sector-specific adaptation project, and also took part in ClimateSense Training and Development Programs.

STEP1 : THE SCOPE

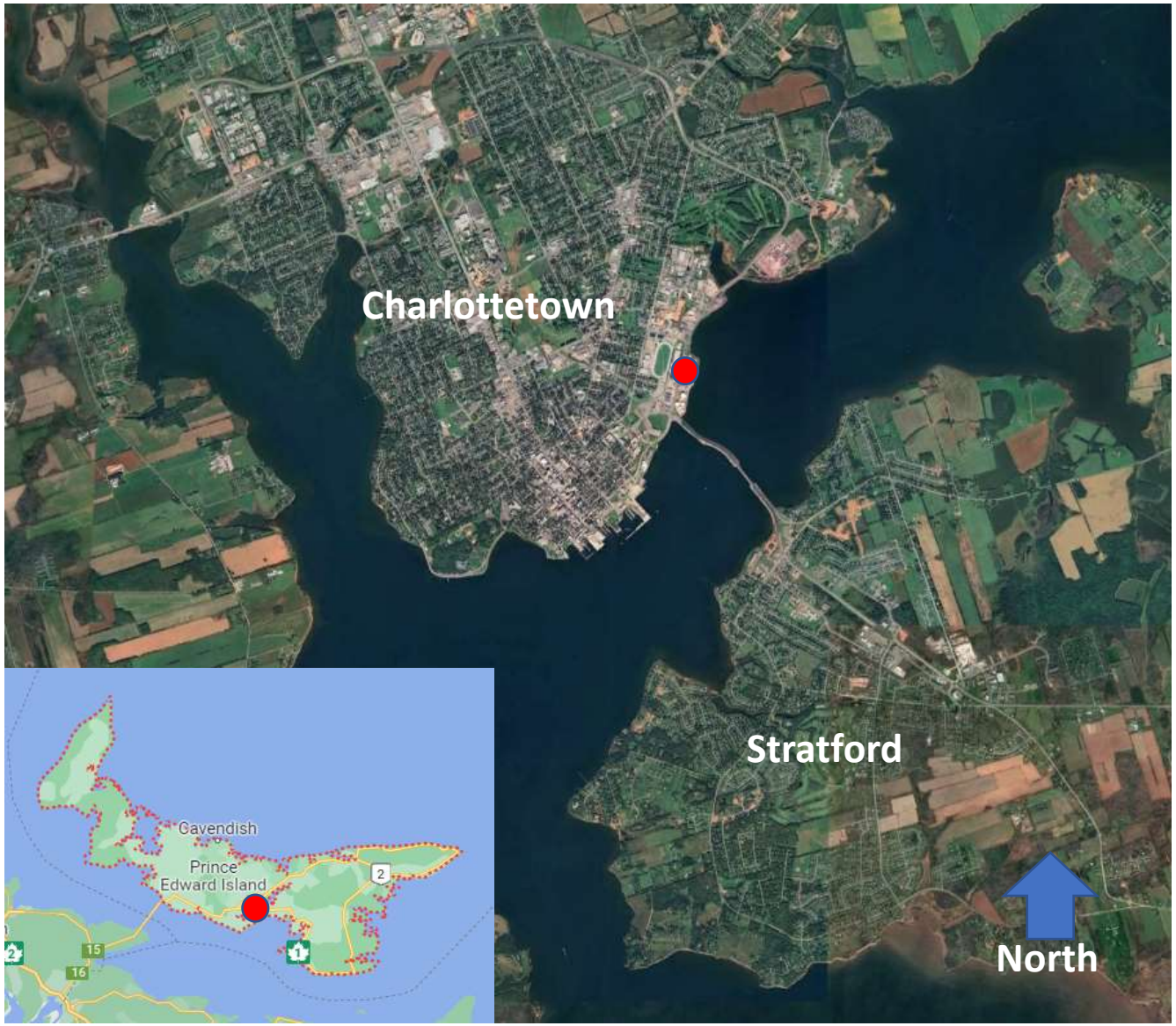
- Climate Adaption Plan /Climate Action Plan /Climate Change Mitigation and Adaption Plan /Climate Change Adaption Report , etc.



  - Analyze resilience of existing wastewater infrastructure against coastal hazards

  - Review climate change risks to City Infrastructures (wastewater)

Wastewater systems in Charlottetown/Stratford



- Charlottetown Pollution Control Plant
- Charlottetown + Stratford sewer system
- Population ≈ 50,000
- Average flow = 20,000 cubic meter/day
- Separate sewer system since 2015 in Charlottetown
- Stratford's sewer is transfer for treatment to Charlottetown since 2021.

STEP 2 : THE DATA

Types of data acquired:

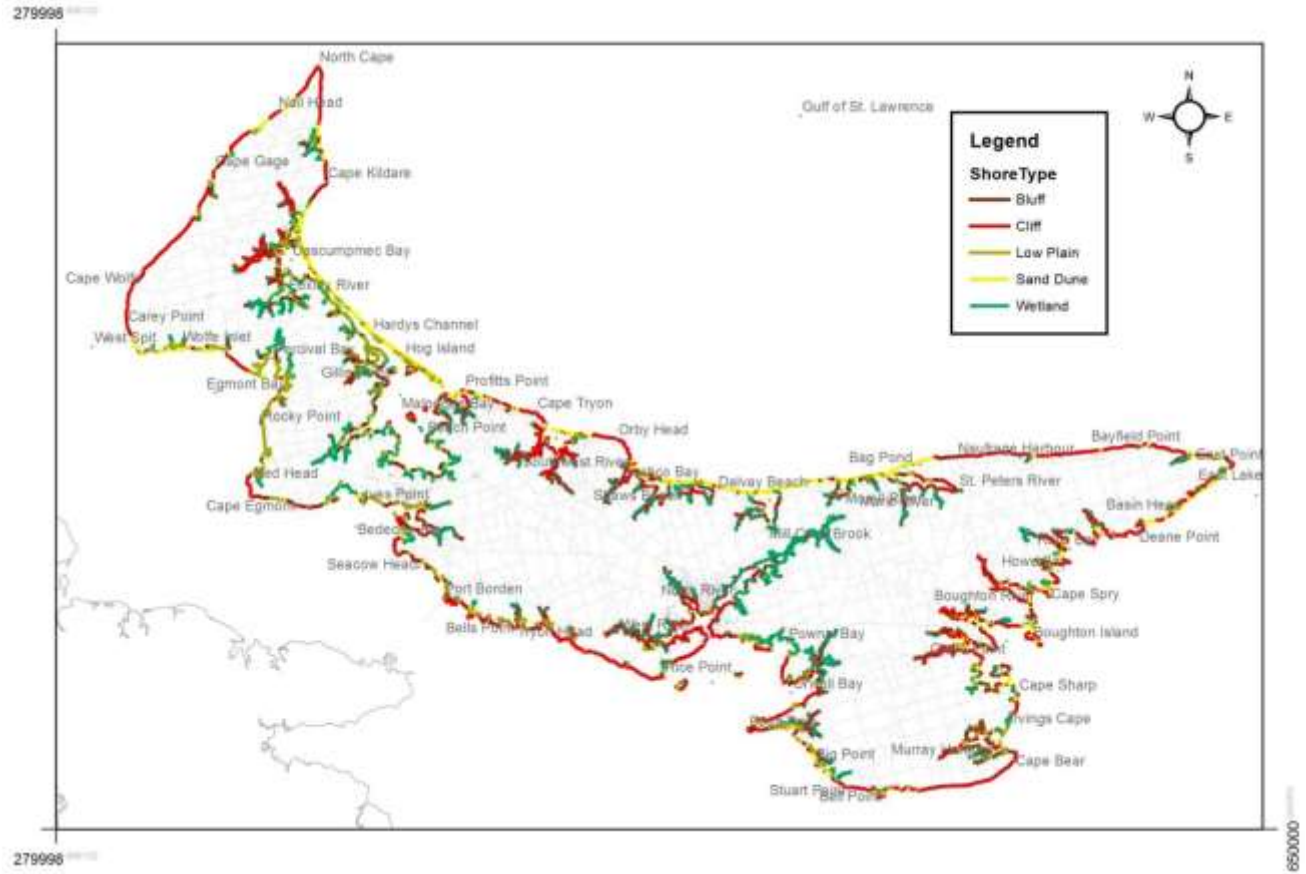
- Impact of rainfall derived inflow and infiltration
- Coastal hazards
- Power failures

- Information on the changing and predicted climate (UPEI Climate Lab)

Historical Data

- PEI Department of Environment, Energy and Climate Action ; Agriculture and Land

Coastline Changes 1968-2010



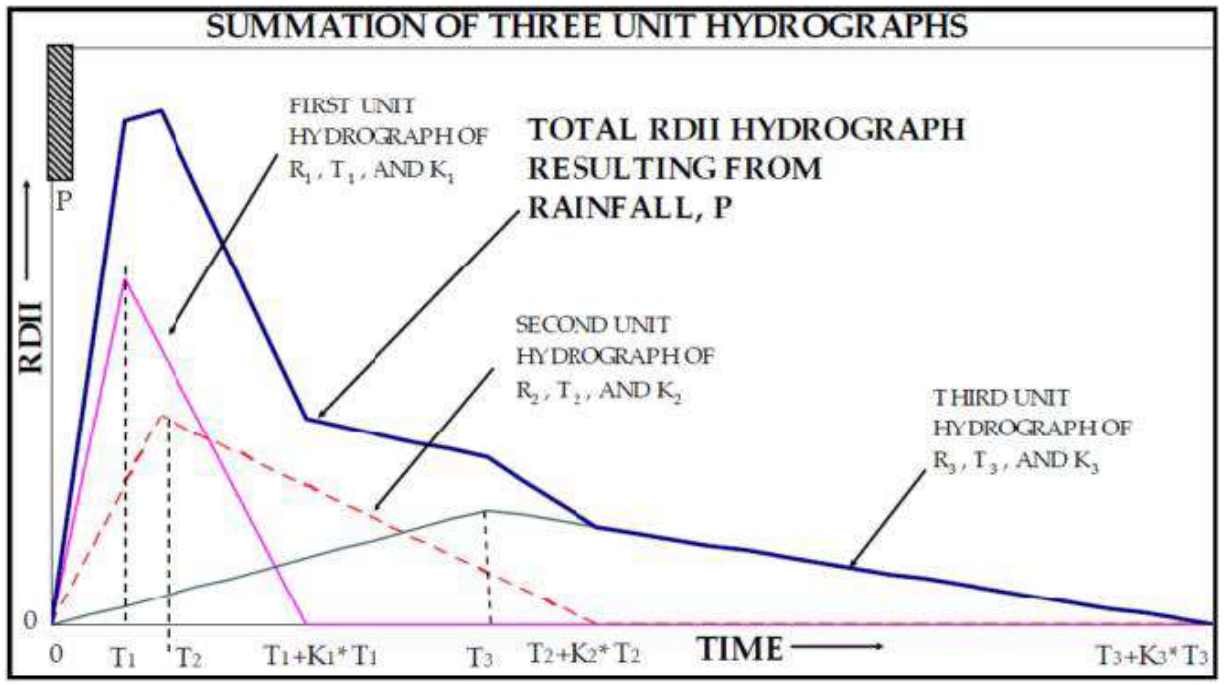
Shoreline types around PEI, GIS map

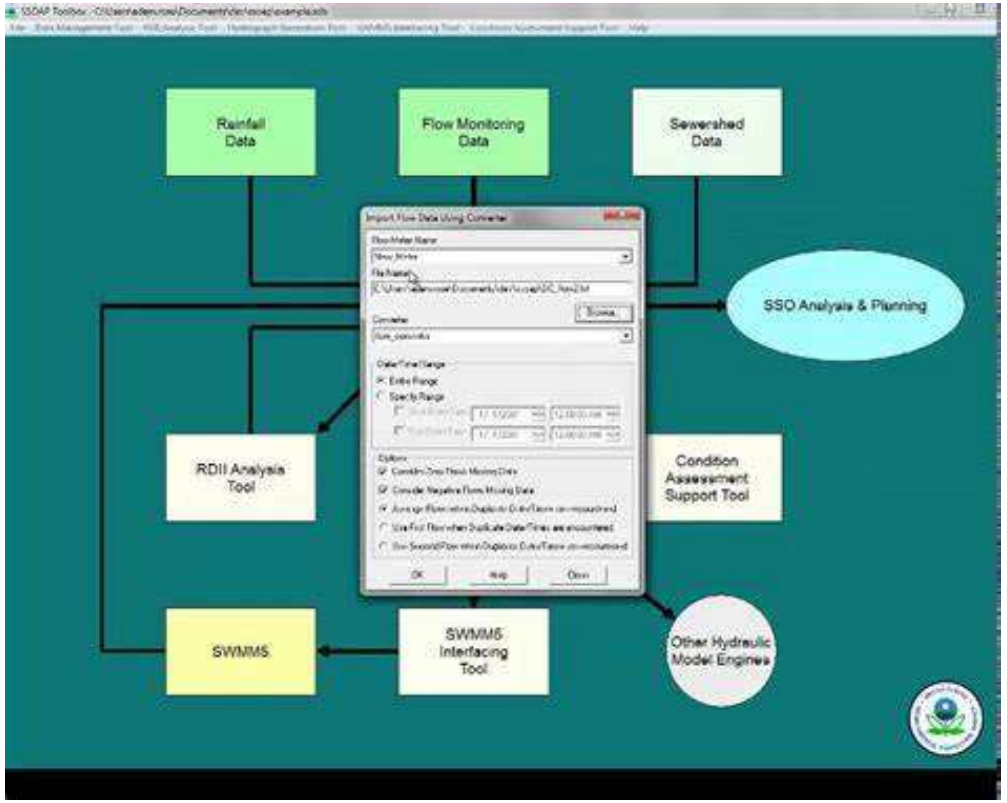
Predicted Data

- PEI Department of Environment, Energy and Climate Action ; UPEI Climate Lab

Measured Data

- USEPA's Sanitary Sewer Overflow Analysis and Planning (SSOAP) Toolkit
- UPEI Climate Lab predicting Climate Change at local level





Second-hand Data

These are the data from

- Operators
- Maintenance logs,
- Failures report
- Department budgets
- Customer complaints
- Emergency response
- Previous failures and lesson learnt

STEP 3: ASSESSMENTS

- Coastal Hazard Assessment

Identifying important and vulnerable pump stations

ASSESSMENTS

- Coastal Hazard Assessment through PEI Department of Environment, Energy and Climate Action

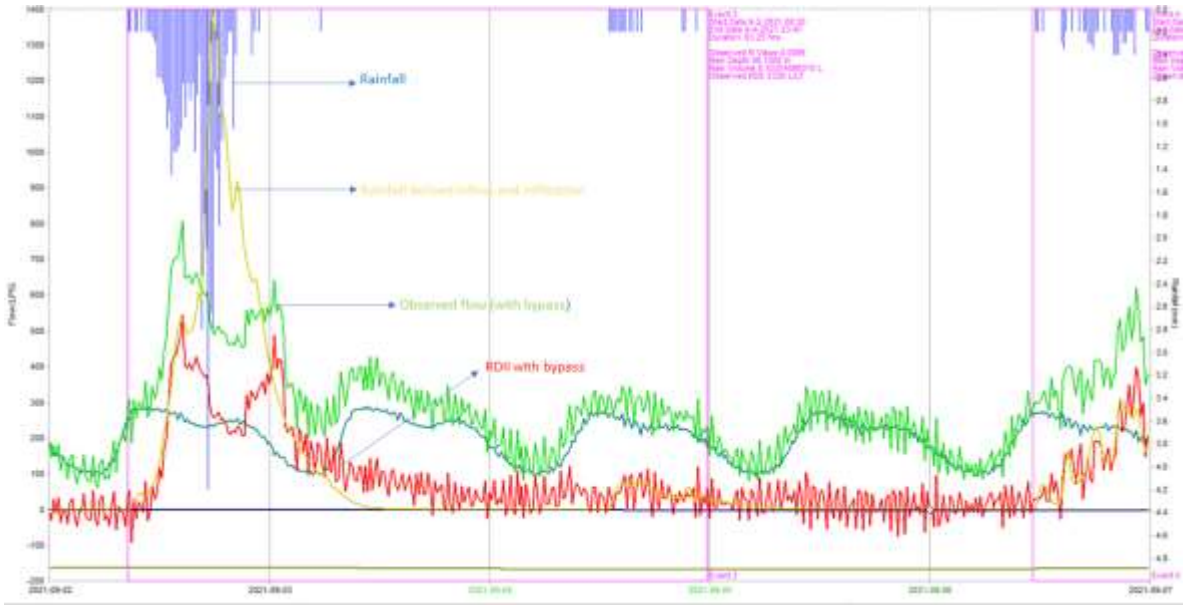
Coastal Erosion Hazard Assessment	
Average Coastal Erosion Rate (cm/year)	4
Maximum Coastal Erosion Rate (cm/year)	9
Coastal Erosion Hazard Classification:	LOW

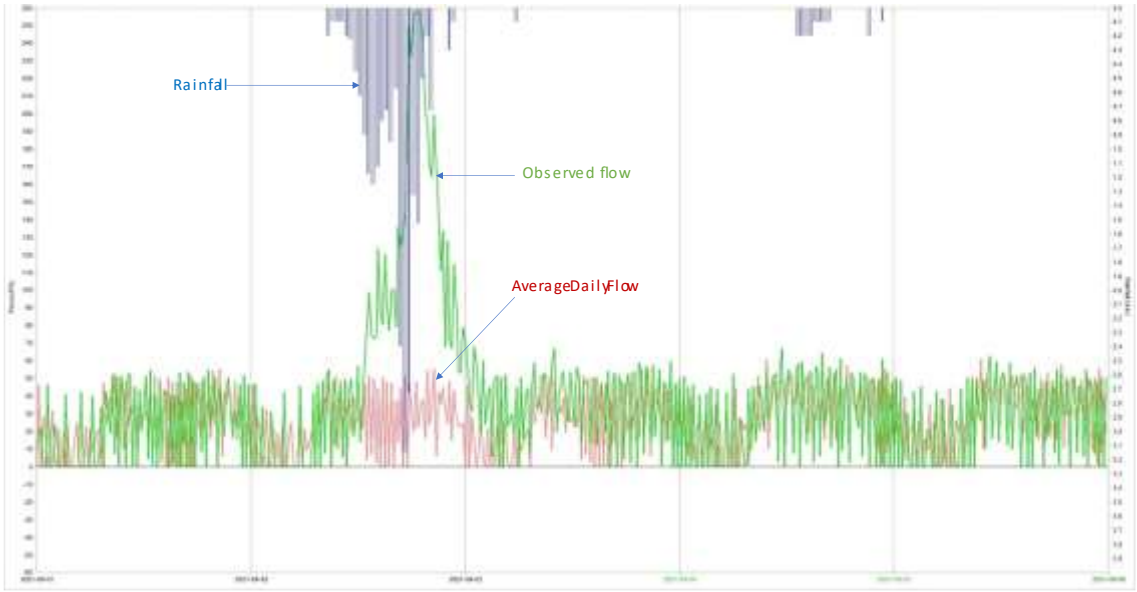
Coastal Flood Hazard Assessment	
	Approximate area of the property within the hazard zone
High Flood Hazard:	35
Moderate-High Flood Hazard:	25
Moderate-Low Flood Hazard:	30
Minimal Flood Hazard:	10

Comments:
Approximately 35% of this property falls within the High Flood Hazard Zone. If available, local knowledge of previous occurrences of flooding will also help to inform the property owner regarding current and future flood risk.

ASSESSMENTS

RDII analysis using USEPA's SSOAP Toolkit





RDII analysis using SSOAP Toolkit for Plant influent and Stratford pump, 02/09/2021, 128 mm rainfall

- X mm/hr rainfall has significant impact on microbiology of the treatment
- X mm/hr rainfall increases RDII more than 30% in Charlottetown
- X mm/hr is the threshold for rainfall where inflow becomes significant for Stratford

RISK ANALYSIS

- Based on the assessment and numbers the climate parameters that can impact infrastructure were identified.
- Collaboration with institutions like UPEI Climate Lab for predictions and identifying severity of climate change impacts.
- Utilizing power usage during RDII to evaluate energy cost, decrease in pump run-hours , aeration , etc. were roughly estimated.
- Cost of operation, decommission ,failure, coastal hazard prevention measures and other alternatives

RISK ANALYSIS

- One pump station with moderate risk of coastal flooding and overload.
- Moderate-to-high risk of RDII in Charlottetown.
- Low risk of rainfall derived inflow in Stratford.

RECOMMENDATIONS

- Pump station: short-term measures against coastal hazard and long-term alternative to decomission : New station to decrease load started in 2022.
- RDII in Charlottetown: Work on assets management and master plan
- RDII in Stratford: Bylaw for stormwater connections and keeping an eye on inflows.
- Power failure: Emergency response , backup power and standby equipment/manpower.

Town of Stratford

Maddy Crowell, Environmental *Sustainability coordinator*

Stratford Utility

Mayor and Staffs

City of Charlottetown

Ramona Doyle, *Manager Environment and Sustainability*

Richard MacEwen, Manager Charlottetown Water and Sewer

Jessica Brown, *Sustainability officer*

City of Charlottetown, Environment and Sustainability

Climate-Sense Internship

Krystal Pyke, *Intern Professional Development coordinator*

Ross Dwyer, *Climate Sense Project Coordinator*

Fellow Climate-Sense Interns

Collaboration

PEI Watershed Alliance

Helping Nature Heal

CBWES

Note: Image does not depict the infrastructure assessed for this project.

Climate Risk Assessment using the PIEVC HLSG

Ontario Bridge Infrastructure

CBCL

Assessment Context

PSPC engaged CBCL to conduct a climate change risk assessment for real property assets to inform ongoing operations, future upgrades and long-term planning.

Three bridge sites throughout Ontario:

- One lift bridge
- One bascule bridge
- One span bridge

Each site consists of multiple assets such as structural bridge components, site civil features, electrical and mechanical equipment, buildings, etc.

Assessment Steps

- Step 1 – Scope
- Step 2 – Climate Analysis and Impact Assessment
- Step 3 – Risk Assessment
- Step 4 – Recommendations and Reporting

RISK =

Exposure

x

Probability of a climate event/scenario occurring

x

Severity of potential impacts

Step 1 - Scope

- **Three bridge sites located throughout Ontario.**
  - Main bridge (two lift bridges, one span bridge)
  - Coastal infrastructure
  - Supporting buildings
  - Electrical equipment (lift bridge)
  - Mechanical equipment (lift bridge)
  - Contaminated sites

- **Stakeholders**
  - DFO, ECCC, PSPC

- **Team**
  - Risk assessment specialist
  - Climate specialist
  - Subject matter experts from various disciplines
    - Structural, civil, bridge engineering, mechanical, electrical, etc.

Step 1 - Scope

- **Performance Response Factors**
  - Structural
  - Operational
  - Economic
  - Health and Safety
  - Regulatory

- **Time horizons**
  - Baseline
  - 2030s
  - 2050s
  - 2080s

Step 2 – Climate & Impacts

- **Data Gathering to Characterize Assets**
  - Review of background data
    - Engineering drawings and reports
    - Lifecycle and Planned Upgrades
    - Feasibility studies/options analyses
  - Fill data gaps
    - Site visit
    - Questionnaire to bridge operators

- **Climate Analysis**
  - Identify relevant parameters
  - Assign climate-asset interactions
  - Conduct projections and likelihood scoring

Note: Images do not depict the bridges assessed for this project.

Precipitation and Water Levels

- Extreme Rainfall: 1 in 100 (24 hour)
- Snow Days (Days with Snow > 10cm)
- Wet Days
- Extreme Lake Levels

Wind

- Hourly Wind Pressures (1 in 50)
- Wind Speeds > 80 km/hr

Temperature

- Extreme Temperatures
  - Coldest Day of the Year
  - Hottest Day of the Year
- Heat Waves (3 days with Tmax > 30°C)
- Seasonal Freeze - Thaw Cycles
- Extreme Diurnal Temperature Variability
- Cold Spell (3 days with Tavg < -15°C

Combination Events

- Driving Rain Pressures (1 in 5)
- Ice Accretion Thickness (1 in 20)
- Hurricanes
- Tornados
- Tropical and Post Tropical storms
- Lightning
- Ice Days
- Rainfall and Freeze

Precipitation and Water Levels

- Flooding and drainage issues
- Pressure imbalances
- Corrosion, wear and tear
- Reduced visibility
- Short- and long-term closures
- Contaminant migration

Wind

- Structural damage
- Operational disruptions (bridge unable to lift)
- Flying debris
- Short- and long-term closures
- Contaminant migration
- Power outages

Temperature

- Expansion and contraction of structural elements
- Increased pressure on elements
- Wear and tear, decreased long term durability
- Reduced efficiency/lifespan of electrical and mechanical equipment
- Power outages

Combination Events

- Structural loading
- Water ingress
- Corrosion
- Ice buildup, falling ice
- Health and safety
- Short term bridge closures
- Contaminant migration
- Power outages

PIEVC HLSG Risk Assessment - Impacts

Likelihood Scoring

- **Modified middle baseline approach**
  - Used for non extreme events (anticipated to occur annually)
  - For extreme events,1-5 scale based on return periods

- **Data Sources**
  - Climatedata.ca
  - Cannon et al. (2020)
  - Literature
  - ECCC Climate Normals/Historical Data

Likelihood Score (L)	Middle Baseline Approach - Establish Base	Method	Suggested Rationa
1		Likely to occur less frequently than current climate	50 – 100% reduction in frequency or intensity with reference to Baseline Mean
2			10 – 50% reduction in frequency or intensity with reference to Baseline Mean
3	Establish Current Climate Baseline Per Parameter	Likely to occur as frequently as current climate	Baseline Mean Conditions or a change in frequency or intensity of ±10% with reference to the Baseline Mean
4			10 – 50% increase in frequency or intensity with reference to Baseline Mean
5		Likely to occur more frequently than current climate	50 – 100%+ increase in frequency or intensity with reference to Baseline Mean

Step 3 - Assessment

- **Workshops**
  - Series of workshops held for each bridge with operators, engineering, asset managers, etc.
- **Consequence scoring**
  - Preliminary severity scores assigned before workshop
  - Scores discussed and confirmed with relevant stakeholders input during workshop
- **Calculate risk**
- **Prioritize for recommendations**

Score		Operations	Integrity	Financial
1	Very Low	No impacts to site operations or maintenance	Typical Wear and Tear to Infrastructure	No financial loss or increase in operational plan/operational expenses
2	Low	Minor changes to daily operations and maintenance. Vehicular traffic interruptions (less than 1 day)	Minor physical impacts to infrastructure assets. No change to function of the bridge.	Minor changes to operating costs.
3	Moderate	Significant changes in Operations & Maintenance. Short term closure (days to week)	Moderate physical impacts to infrastructure assets (beyond normal wear and tear)	Significant changes in operating costs. Rehabilitation requiring capital funding.
4	High	Extended closure for repairs or loss of operation.	Major physical damage resulting in loss of asset function or capacity.	Major Rehabilitation Project. More than one construction season required for rehabilitation or full bridge closure required to complete rehabilitation.
5	Very High	Complete loss of function.	Extreme damages beyond repair or maintenance abilities.	Extreme financial loss. Full replacement.

Step 4 – Recommendations & Reporting

- **Project is currently in the recommendations phase**

- **Recommendations focus on moderate and high-risk items, including high-level cost estimates (low, med, high opinion of probable cost)**

- **Potential types of recommendations:**
  - Infrastructure upgrades
  - Modifications to operational plans
  - Scheduled monitoring
  - Cyclical maintenance
  - Emergency Planning
  - Communications protocols between relevant parties

Consequence					
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5
	Likelihood				
	1	2	3	4	5

Risk Score (R)	Risk Classification		
1 - 9		Low Risk	Risks requiring minimal action
10 - 16		Medium Risk	Risk that may require further action
17 - 25		High Risk	Risks that require action

Note: Image is not a representation of the infrastructure assessed for this project.

Questions?

2022 - 2023 WEBINAR SERIES

Date	Topic
August 25, 2022	PIEVC Program: Background, Status and New Directions
September 22, 2022	From Assessment to Implementation of Adaptation Action
October 20, 2022	Institutionalizing Climate Change and Infrastructure Vulnerability and Risk Assessment (CCVRA): PIEVC in Adaptation Plans, Professional Practice, and other Mechanisms
November 17, 2022	Climate services for CCVRA: Lessons learned and new tools supporting steps 1 and 2 of the PIEVC Protocol
December 15, 2022	Large Portfolio Analyses using PIEVC Process
January 19, 2023	PIEVC High Level Screening Guide
February 16, 2023	**PIEVC GREEN**
March 16, 2023	Integration of PIEVC into Asset Management Toolkits
April 18 – 20, 2023	Join us for the GLOBAL FORUM in Vancouver, BC

For recordings of previous webinars and for updates on future speakers, go to CRI website: climateriskinstitute.ca or Practitioners' Network

Thank You for Joining Us!

February 9, 2023
PIEVC Program Webinar Series – Webinar #6, Part 2

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