Credit Valley Conservation
inspired by nature

CVC-led Natural Assets Valuation Studies

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Outline

1. Background and Rationale for Natural Asset studies
2. Inventory and assessment of stormwater services provided by natural assets in Peel Region (2016-2018):

- Study Approach
- Hydrologic Modeling Results
- Valuation and Mapping Results

3. Business Case for Natural Assets in Brampton and Caledon (2019-2020):

- Methodology and key steps

CVC-led Natural Asset Projects: Background and Timeline


PARKING ONLY IN
DESIGNATED AREAS
DO NOT PARK ON GRASS
Parks Close
11PM

Background on Natural Assets Projects

Goal:
To support municipalities in recognizing, measuring and managing the *contribution of natural systems to people and municipal service delivery* using asset management processes and frameworks

https://www.assetmanagementbc.ca/framework/

Rationale:

- Reduce risk, capital and operating expenses of related grey infrastructure
- Increase infrastructure resiliency to CC
- Provide additional benefits to communities

Mnai Making Nature Count

Natural Assets (NAs)Projects Timeline

Pilot Phase (MNAI):
Stormwater Service Assessment for NAs in 2 CRW subwatersheds

- 2017

Phase 1:

Inventory and Stormwater Services Assessment for Natural Assets in the Region of Peel

- 2018

Phase 2:

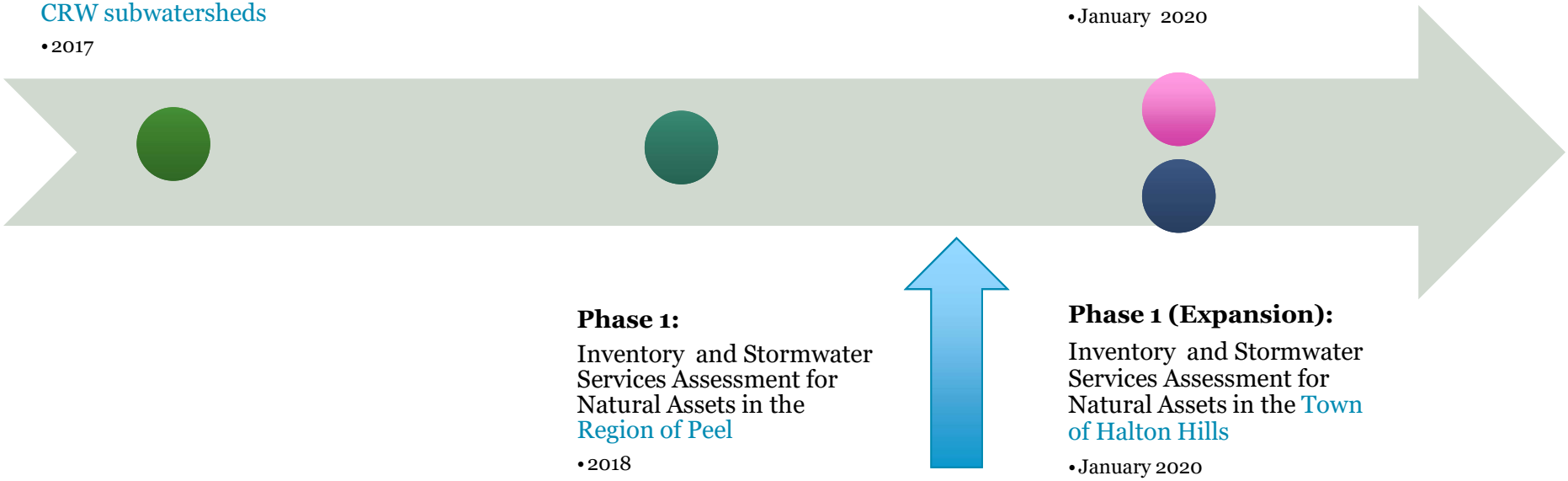
Business Case for Natural Assets (Caledon, Brampton)

- January 2020

Phase 1 (Expansion):

Inventory and Stormwater Services Assessment for Natural Assets in the Town of Halton Hills

- January 2020



Natural Assets Inventory and SWM Services Valuation in the Region of Peel (2016-2018)

Pilot Phase: Stormwater Service Assessment for NAs in 2 subwatersheds
Phase 1: Expansion of Pilot Phase to the Region of Peel

To develop and apply the model/approach to:

- assess level and value of stormwater management (SWM) services provided by NAs (*existing conditions*);
- assess the impact of climate change on the level and value of these services (*future climate conditions*)

• Pilot Phase (2017) • Expansion for RoP (2018)	**Study Area:** •Fletcher's Creek and East Credit Subs •Peel Region (CVC's and TRCA's boundaries)
Scope of the Natural Assets	Wetlands (3 types), Woodlands, Open Space
Scope of the Services	Peak Flow Reduction, Water Quality Control
Model/ Valuation Method	EPA SWMM/ Replacement Cost

Data Preparation and GIS Analysis

- Data Sources
- Natural assets
- What we did with them

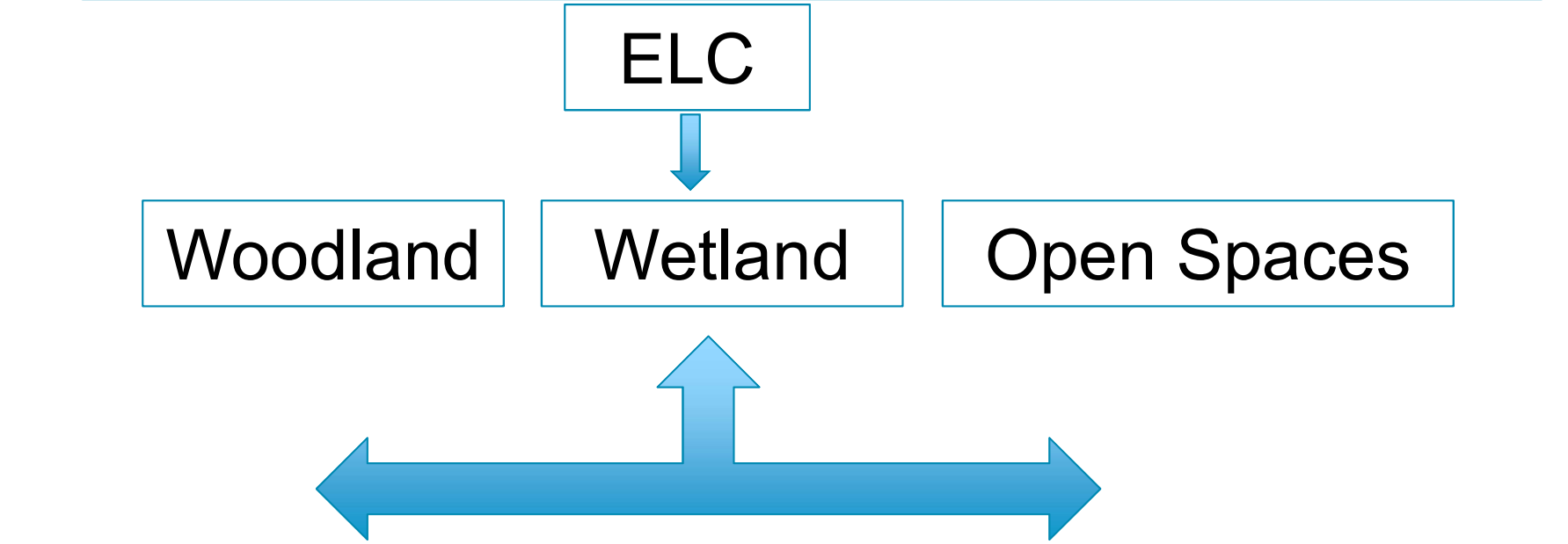
Key Data Sources: What do you need to begin?

GIS Layers	Data Source	Year
ELC land cover and land use	CVC	2016
Forests (derivative from ELC)	CVC	2016
Wetlands (derivative from ELC)	CVC	2016
Open green spaces	CVC	2016
DEM	CVC	2016
Soil layer	Ontario Soil Survey	1953
Drainage network (for reference)	CVC	2016

Ecological land classification (ELC) / land use classification (2016)

- ❑ Other CAS might have ELC
- ❑ SOLRIS Version 2. (MNRF – Link)
- ❑ Any other data
- ❑ Woodland
- ❑ Wetlands
- ❑ Open Spaces

How the assets were prepared



Asset Types

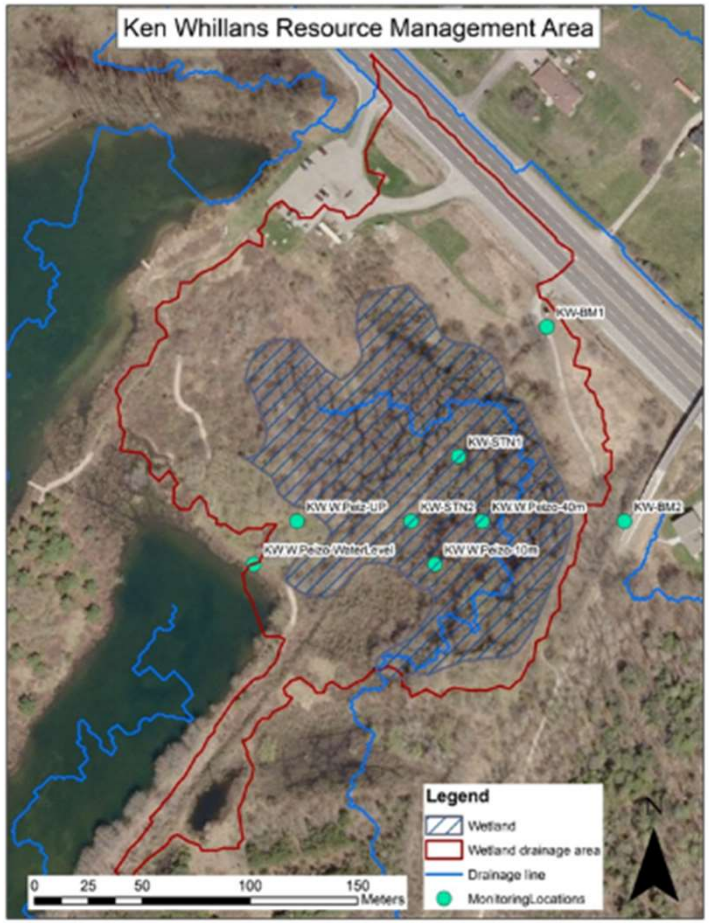
ELC Type Names	Natural Asset Type
Deciduous plantation	Forest/ Woodland
Mixed plantation	Forest/ Woodland
Coniferous plantation	Forest/ Woodland
Cultural woodland	Forest/ Woodland
Coniferous forest	Forest/ Woodland
Deciduous forest	Forest/ Woodland
Mixed forest	Forest/ Woodland
Commercial / industrial open space	Open Green Space
Institutional open space	Open Green Space
Other open space	Open Green Space
Private open space	Open Green Space
Recreational open space	Open Green Space
Manicured open space	Open Green Space
Marsh	Wetland- MNAI
Coniferous swamp	Wetland- MNAI
Deciduous swamp	Wetland- MNAI
Mixed swamp	Wetland- MNAI
Thicket swamp	Wetland- MNAI

Integrated Watershed Monitoring Program (IWMP)

- IWMP –since 1999 (Link)
- CVC monitors climate conditions and living/not living attributes in groundwater, streams, forests and wetlands
- Monitors surface and ground water
- Groundwater: chemistry and water level
- Select wetlands are monitored
- For the pilot, selected wetlands were used (data limitation)

Catchment delineation

- Lowest elevation per pilot feature identified using DEM
- Catchments using ArcGIS (Spatial analyst and ArcHydro)
- Total of 5 features (3 wetlands, 1 woodland and 1 open space)



Data and Other Limitations

- Wetland definitions based on watercourses
- Watercourse mapping and headwaters
- Limited data collection (not all wetlands are monitored)
- Staff time for feature type verifications
- Poor quality of soil dataset
- If you plan to use SOLRIS data (with or without monitored data)
  - Generalization
  - Raster to vector conversion
  - Lack of monitored data for calibration

Hydrology Modeling Approach

- Model existing Natural assets (NA's) and determine **peak flow reduction and water quality control (Total suspended solids reduction)** under existing and future climate

Open green spaces

Forests/Woodlands

Wetlands –
Isolated, Palustrine, and Riverine

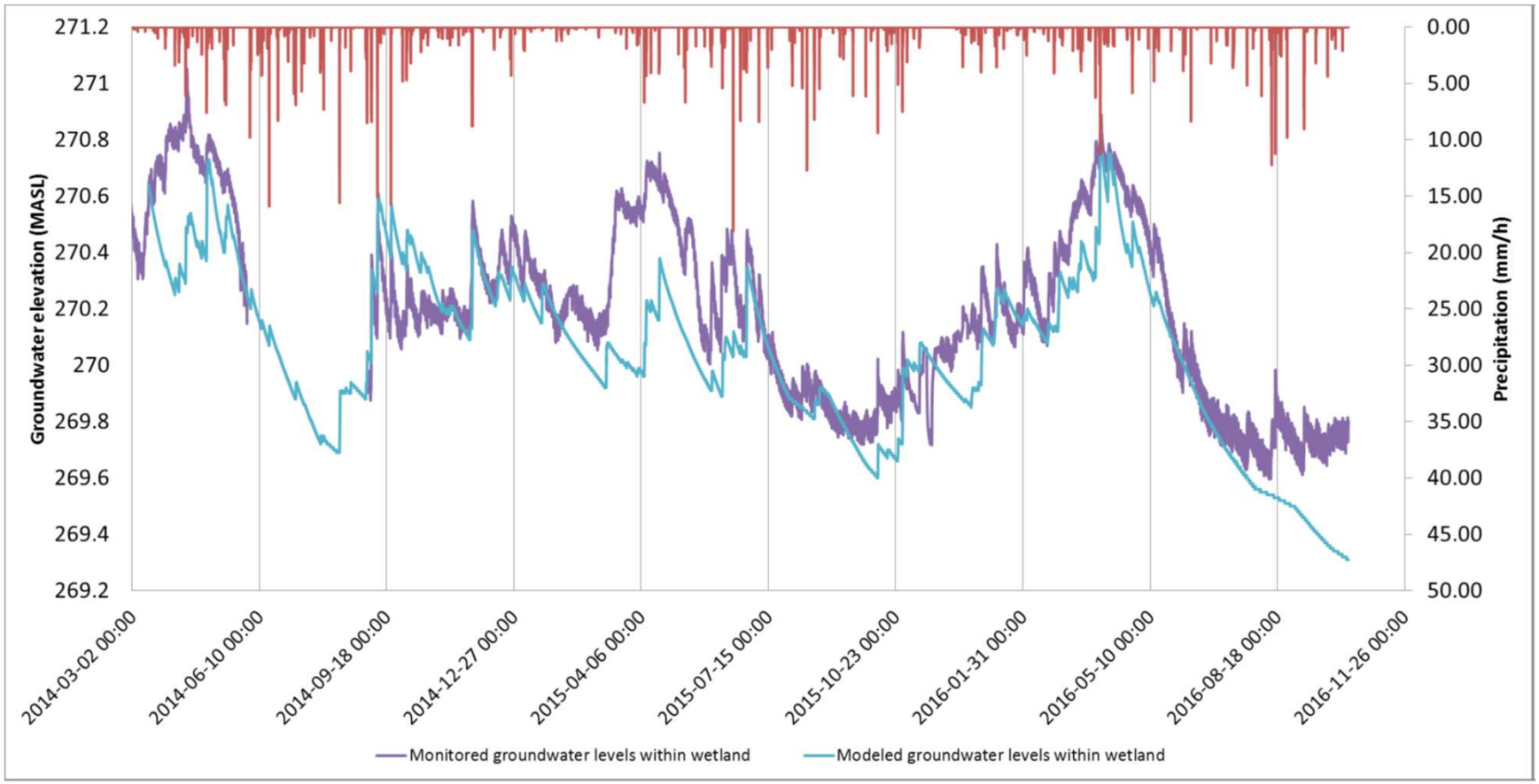
- Remove NAs and determine size of stormwater infrastructure required to match flow/ water quality services provided by NA's under existing drainage area configuration
- Determine capital cost of required constructed assets to valuate existing NA's under existing climate and future climate (2065)

	Rainfall depth (mm)
Existing Climate	124.5
Climate Change (2065)	132.0

Modeling Natural Assets in EPA-SWMM

Natural Asset	Surface Attenuation	Subsurface Attenuation	Water Quality – Removal Efficiency
Wetland 1: Palustrine	Storage unit for surface storage with a stage-discharge curve	Subcatchment for sub-surface storage	70% removal of TSS, and 50% removal of TP
Wetland 2: Isolated	Storage unit with infinite storage		100% removal for TSS and TP
Wetland 3: Riverine	Open Channel with increased roughness = 0.2; and subcatchment for direct drainage area	Subcatchment for sub-surface storage	10% removal of TSS and TP
Woodland	Subcatchment with depression storage of 7.62 mm and surface roughness of 0.8		70% removal of TSS, and 50% removal of TP
Open Green Space	Subcatchment with depression storage of 5 mm and surface roughness of 0.25		60% removal of TSS, and 20% removal of TP

Calibration Results – modeled Palustrine Wetland



Results: Stormwater Quantity Performance of Natural Assets (Existing Conditions)

Natural Asset Type	Asset and Drainage Area			Design Storm (100-year return period)		
	Feature Area (Ha)	Drainage Area (Ha)	Imperviousness of Drainage Area	Volume in/out (m^3)	Volume Reduction	Peak Flow Reduction
Wetland 1: Palustrine	1.58	1.98	5%	3,192/2,010	37%	69%
Wetland 2: Isolated	1.11	13.9	5%	2,650/0	100%	100%
Wetland 3: Riverine	12.08	2,643	34%	2,005,050/ 1,980,330	1%	20%
Woodland	28.74	46.8	5%	57,776/34,602	40%	84%
Open Green Space	1.80	30.2	3%	15,361/13,950	9%	26%

Results: Stormwater Quality Performance of Natural Assets (Existing Conditions)

Natural Asset Type	Stormwater Quality Results			
	TSS Load In/Out	TSS Load Reduction	TP Load In/Out	TP Load Reduction
Wetland 1: Palustrine	77.5/ 1.8	98%	0.31/ 0.01	96%
Wetland 2: Isolated	1,111/ 0	100%	1.68/ 0	100%
Wetland 3: Riverine	634,060/ 413,470	35%	1,673/ 1,088	35%
Woodland	2,659/ 28.6	99%	5.97/ 0.11	98%
Open Green Space	775/ 116.3	85%	2.08/ 0.59	72%

Results: Equivalent Stormwater Storage Capacity

	Existing Climate Conditions		Climate Change Conditions	
Natural Asset Type	SWM Capacity Required to provide services equivalent to NA (m^3)	SWM Capacity per unit Area (m^3/ha)	SWM Capacity Required to provide services equivalent to NA (m^3)	SWM Capacity per unit Area (m^3/ha)
Wetland 1: Palustrine	874	246	934	262
Wetland 2: Isolated	5528	368 (177)	6284	419 (201)
Wetland 3: Riverine	59190	22	63675	24
Woodland	26550	351	29400	389
Open Green Space	4020	126	4303	134

Limitations of Modeling Analysis

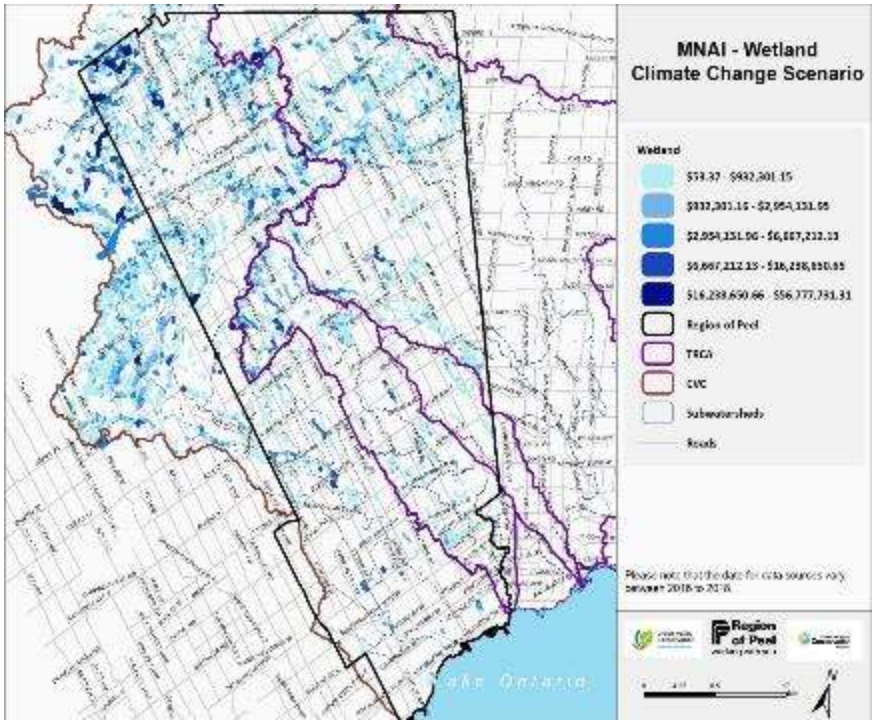
- Benefit of upstream features to downstream is not assessed
- Existing built stormwater infrastructure not included in model
- Pollutant transport through groundwater not assessed
- Retention Ponds cannot provide the level of water quality control provided by NAs
- Retention Ponds do not provide any volume reduction

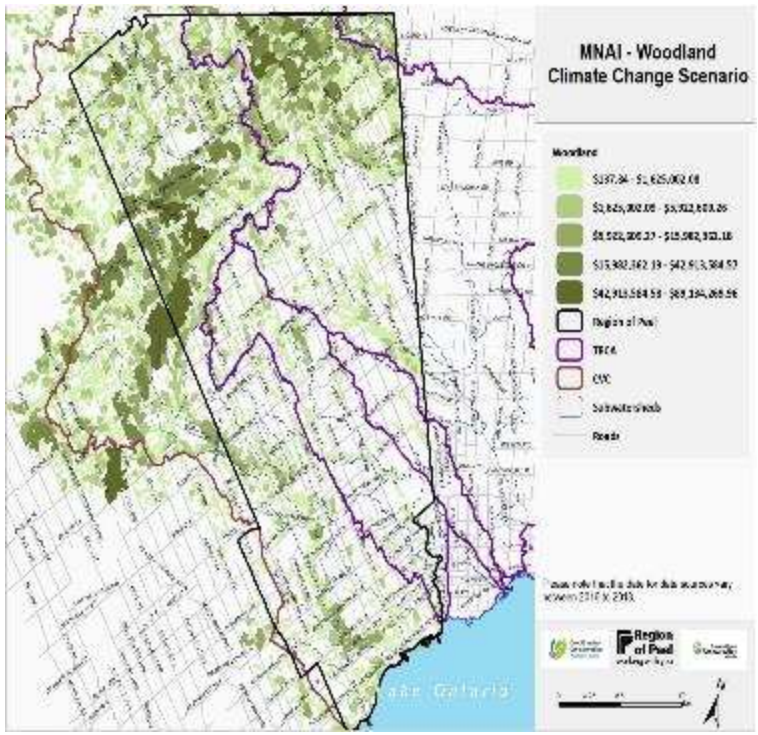
Valuing SWM services of Natural Assets: Replacement Cost Method

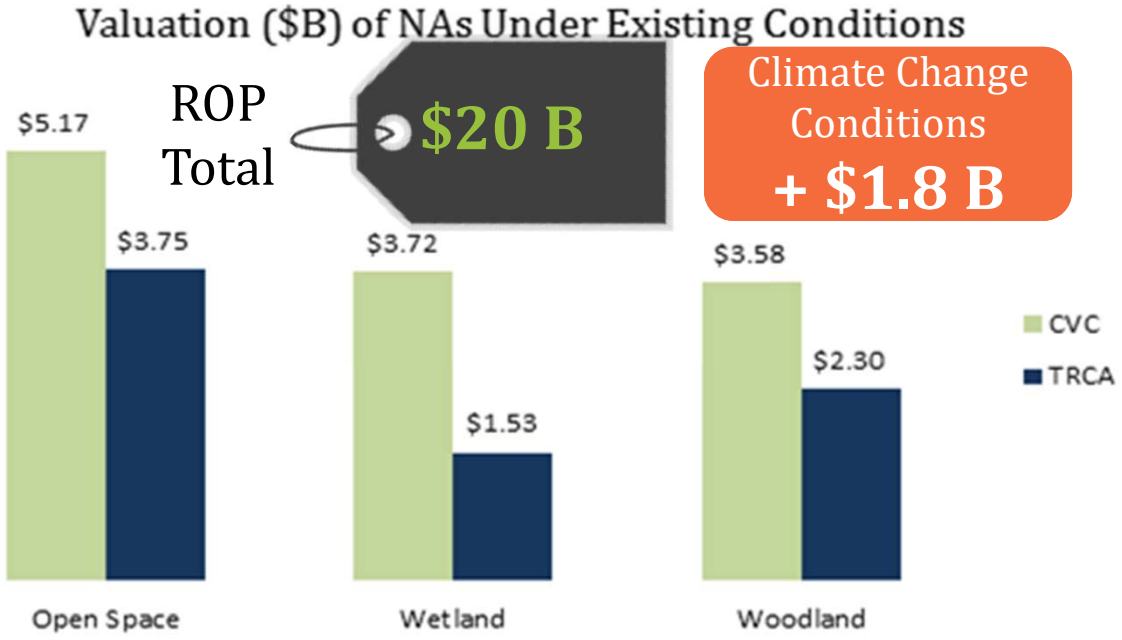
- **Assumption**: Value of the natural assets is at least equal to the cost of replacing them with the engineered infrastructure capable of providing the same level of stormwater services
- Stormwater Infrastructure:
  - cost of constructing wet stormwater management pond was assumed to be at $175 per cubic meter of storage
  - cost for constructing infiltration chamber was assessed at $460 per cubic meter of storage

Valuation of Stormwater Services provided by Natural Assets in Region of Peel

Natural Asset Type	Scenario	Value of NAs in CVC Watershed	Value of NAs in TRCA Watershed	Value of NAs in CVC & TRCA Watersheds
Wetland 1: Palustrine	EC	$311,992,058	$52,881,552	$364,873,610
	CC	$333,410,194	$56,511,851	$389,922,045
Wetland 2: Isolated	EC	$1,090,737,821	$653,868,589	$1,744,606,410
	CC	$1,239,905,415	$743,290,632	$1,983,196,046
Wetland 3: Riverine	EC	$2,314,864,780	$826,757,767	$3,141,622,546
	CC	$2,490,395,165	$889,448,733	$3,379,843,897
Woodland	EC	$3,581,738,538	$2,295,440,044	$5,877,178,582
	CC	$3,966,219,209	$2,541,843,381	$6,508,062,590
Open Green Space	EC	$5,166,967,966	$3,746,732,543	$8,913,700,509
	CC	$5,530,721,511	$4,010,501,789	$9,541,223,301
All NAs	**EC**	**$12,466,301,163**	**$7,575,680,495**	**$20,041,981,658**
	CC	**$13,560,651,494**	**$8,241,596,385**	**$21,802,247,879**







Stormwater Quality Benefits

- Phosphorous Load Reduction
- Suspended Solids Reduction

Stormwater Quantity Benefits

- Volume Reduction
- Peak Flow Reduction

Business Case for Natural Assets in Brampton and Caledon (2019-2020)

Business Case for Natural Assets: Alton, Caledon (2019)

Project Outcomes

- Natural Asset Registry for Case Study Locations
  - Condition Assessment
  - Risk Assessment
  - Monetary Value of Service Provision
- Scenario Analysis of Management Option Outcomes:
  - Scenarios and associated costs
  - NOV/Benefit-Cost Ratios
  - Interactive Tool

GREEN ANALYTICS
measuring environmental values

Range of Services Being Considered for Assessment

- Stormwater Management
- Recreation
- Drinking Water Provision
- Heat Stress/Urban Heat Island Reduction
- Air Quality Improvement
- Carbon Sequestration
- Aesthetic Appreciation/Property Values

Condition Assessment

- Assess the quality of a wetland, woodland, grassland, or open space natural asset/identify factors which influence service provision
- Present condition assessment information similar to built assets

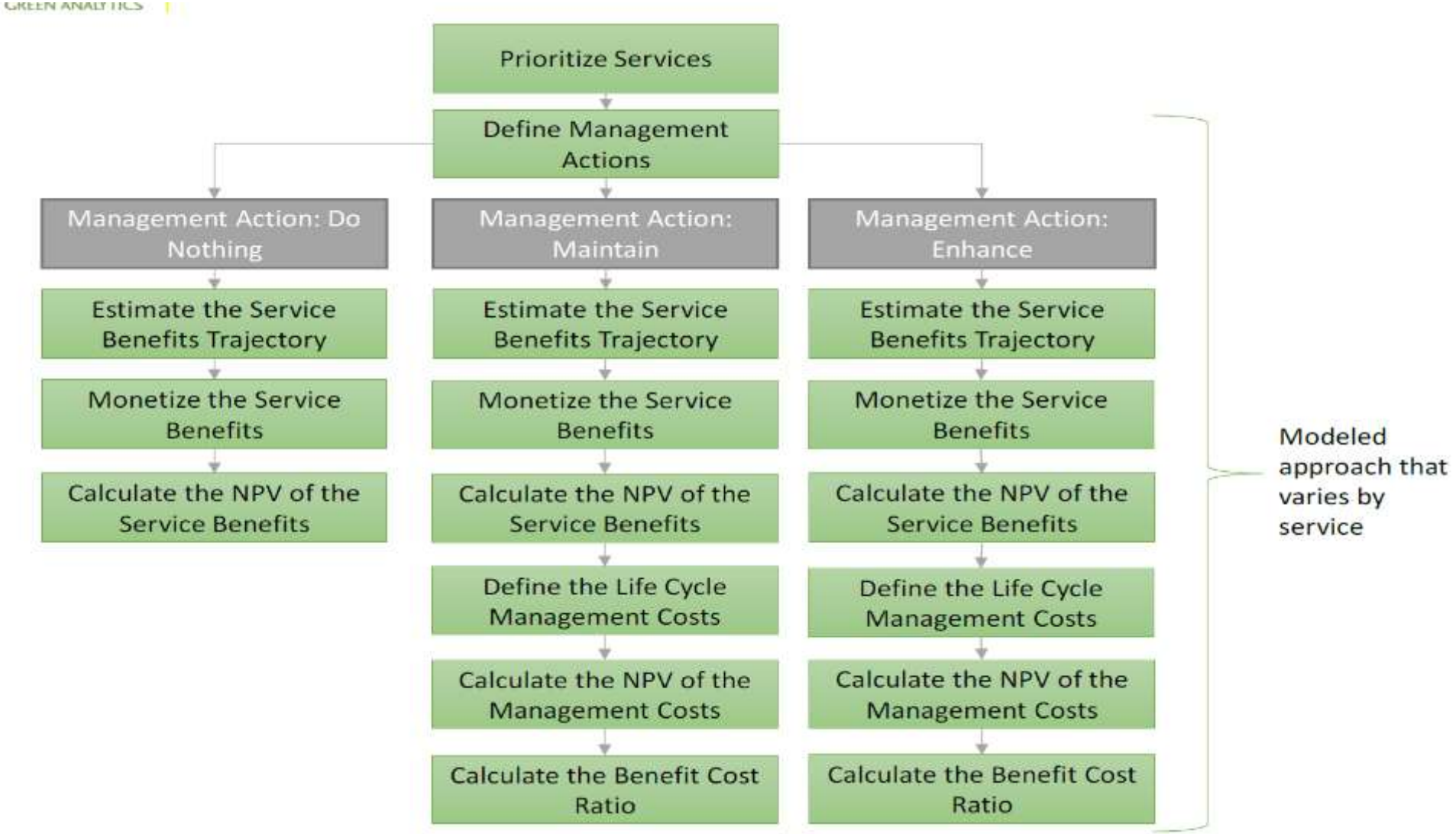
IIMM General Condition Grading System	Bridge Condition Index (BCI)
Very Good	80 to 100
Good	70 to 80
Fair	60 to 70
Poor	40 to 60
Very Poor	0 to 40

Risk Assessment

Want to identify the range of risks or pressures which may lower service provision of natural assets over time, including:

- Climate Change
- Development pressure
- Pollutant loading (from urban/agricultural/industrial sources)
- Invasive species

Framework for modelling NA management actions



Management Scenarios

Based on the condition and risk assessments, we want to conduct a scenario analysis of:

- **Do Nothing**
  - What are the consequences of allowing the environment to succumb to the identified risk factors
- **Maintain** Existing Service Levels
  - What is required to address the identified risk factors to maintain existing service provision
- **Enhance** Existing Service Levels
  - In addition to maintenance scenario—what is required and what are the benefits of enhancing existing service provision

Calculating NPV/Benefit-Cost ratio

- **Monetary Valuation of Services**
  Variety of economic valuation techniques to assess the range of ecosystem services provided by the NAs (depend on the service, utilize previous work)
- **Life-cycle cost** component for each management scenario
- Calculate **NPV/benefit-cost ratio**
- Make it into **interactive web-based tool**

CVC-led Municipal Natural Asset Projects: Partners and Funders

FCM
FEDERATION OF CANADIAN MUNICIPALITIES
FÉDÉRATION CANADIENNE DES MUNICIPALITÉS

Toronto and Region Conservation Authority

Region of Peel
Working for you

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