ECS Lunch and Learn

Supporting internal knowledge transfer within TRCA

August 24, 2022

Toronto and Region Conservation Authority

Conducting Carbon Calculations with Clarity and Consistency

Using the Natural Asset Carbon Assessment Guide and Toolbox (NACAGT)

AUGUST 24, 2022

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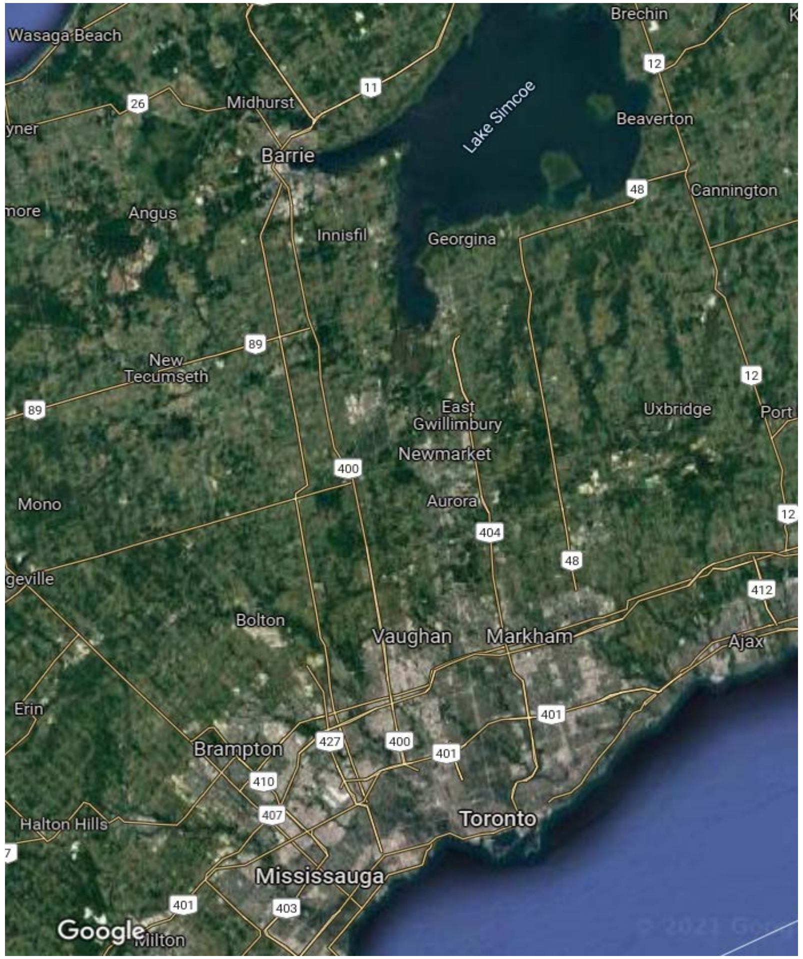
Outline

1. Introduction/ Background

2. Why create a Guide and Toolbox?

3. Guide and Toolbox structure

3. Potential Future Directions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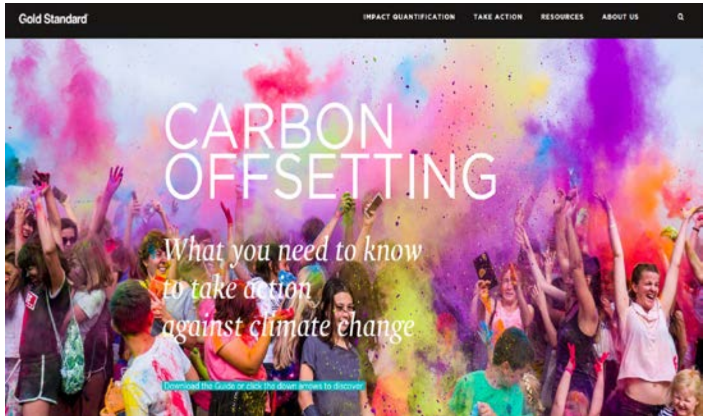
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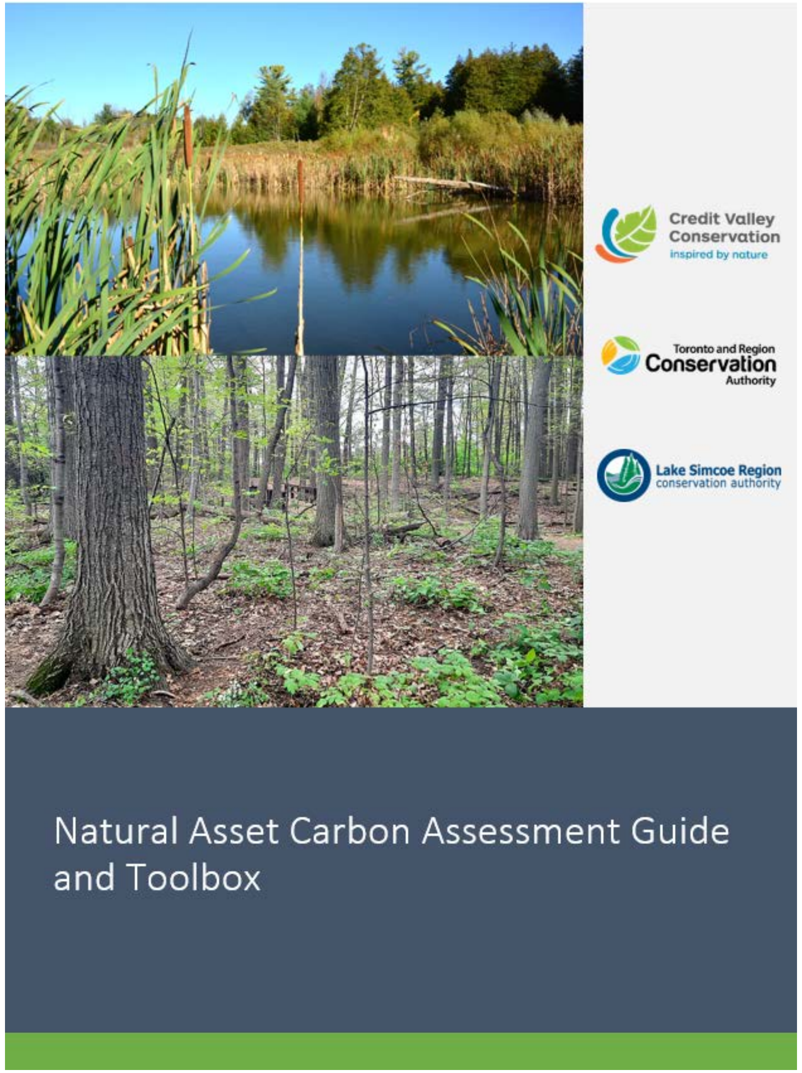
What you need to know to take action against climate change

Why create a Guide and Toolbox?



A document to **provide guidance** and **standardization** for carbon assessments in our jurisdictions…

Natural assets: the stock of natural resources or ecosystems that are relied upon and managed, or could be managed, by a municipality for the sustainable provision of one or more local government services.

Navigating the Guide and Toolbox

Section 1:

- Background, rationale, objectives

Section 2:

- Land cover-based carbon sequestration and storage data

Section 3:

- A collection of tools, methods, and resources to conduct carbon assessments and guidance about appropriate use

Section 2: Land Cover-based Carbon Data

Land Cover/ Natural Asset Type	Land Cover Community Type/ Ecosystem	Relevant ELC Community Code(s)	Land Cover Details/ Notes	Net Carbon Seq. Rate (t C/ha/yr)	Soil Organic Carbon (t C/ha) [Depth of Soil Measurement (cm)]	Reference(s)	Location(s) of Study/ Measurements	Confidence in Applying this Rate Locally	Reasoning for the Confidence Ranking
Forest	Deciduous	FOD	Mature (based on data from a 53-year-old Trembling Aspen forest)	**2.49**	**97.2 [70]**	Gower et al. (1997)	Manitoba, ON	Medium	Data is not from Ontario, so environmental/ climatic conditions may differ from those in Ontario. The study is also quite outdated. However, these tree species are typical in Ontario.
Forest	Deciduous	FOD	Mature (based on data from a 90-year-old Red oak, Sugar Maple, Red Maple, Large-tooth Aspen forest)	**1.5**	**-**	Gough et al. (2013)	Michigan, US	Medium	Data is not from Ontario, so the environment and climate may differ from those in Ontario. However, these tree species are typical in Ontario.
Forest	Deciduous	FOD	Mature (based on data from a 70-110-year-old White Oak, Sugar Maple, Red Maple, American Beech forest)	**2.06** (NEP)	**-**	Beamesderfer et al. (2020)	Turkey Point, Ontario	Medium	Data is local, and the study is recent. However, NEP was estimated.

Section 2: Land Cover-based Carbon Data

Land Cover/ Natural Asset Type	Land Cover Community Type/ Ecosystem	Relevant ELC Community Code(s)	Land Cover Details/ Notes	Net Carbon Seq. Rate (t C/ha/yr)	Soil Organic Carbon (t C/ha) [Depth of Soil Measurement (cm)]	Reference(s)	Location(s) of Study/ Measurements	Confidence in Applying this Rate Locally	Reasoning for the Confidence Ranking
Wetland	Marsh	MA	Shallow Marsh	**8.55**	**1.1 [average of 15 & 21]**** (t C/ha/yr)	Pendea (2019)	Lake Simcoe, Ontario, Canada	High	Data is local, and rates are comparable to those presented in other studies.
Wetland	Marsh	MAM	Meadow Marsh	**4.17**	**1.3 [average of 20 & 16]**** (t C/ha/yr)	Pendea (2019)	Lake Simcoe, Ontario, Canada	Medium	Data is local, but this land cover has not been widely examined in other studies, so the rate was difficult to verify.
Wetland	Marsh	OA	Open Water	**2.38**	**0.95 [22]**** (t C/ha/yr)	Pendea (2019)	Lake Simcoe, Ontario, Canada	High	Data is local and comparable to similar land cover rates in other studies.
Wetland	Swamp	SWM	Treed	**2.94**	**0.87 [average of 14 & 18]**** (t C/ha/yr)	Pendea (2019)	Lake Simcoe, Ontario, Canada	High	Data is local and comparable to similar land cover rates in other studies.

Section 3: Guidance for Tool Selection

Table 2. Carbon sequestration and storage estimation tools and methods for different asset types

Minimum Data Requirements	Asset Types					
	Local-scale ←			→		Landscape-level
	Individual trees	Street and park trees	Urban forest	Wetlands	Forest patches or stands	Land cover patches / landscapes
• Tree species • Diameter at breast height (DBH)	• i-Tree MyTree • i-Tree Design					
• Tree inventory		• i-Tree Eco				
• Plot based data			• i-Tree Eco			
• Area of the restoration project				• Blue Carbon Calculator		
• Forest type • Forest age or volume					• CBM-CFS3 • Volumetric Method	
• Land use land cover						• InVEST Carbon Storage & Sequestration • InVEST Forest Carbon Edge Effect
• Ecological Land Classification (ELC) map						• Business Case for Natural Assets (BC4NA)
• No data						• ABC-Map • i-Tree Canopy

Section 3: Guidance for Tool Selection

Table 3. Outputs of carbon sequestration by various tools and methods

Tool/ Method	Outputs					
	Current Carbon Stored	Current Gross Sequestration	Current Net Sequestration	Projected Carbon Stored	Projected Gross Sequestration	Projected Net Sequestration
ABC-Map	X			X		
Blue Carbon Calculator			X			X
Business Case for Natural Assets	X	X		X	X	
CBM-CFS3	X	X	X	X	X	X
InVEST Carbon Storage & Sequestration	X	X				
InVEST Forest Carbon Edge Effect	X	X				
i-Tree Canopy	X	X				
i-Tree Eco	X	X	X	X	X	X
i-Tree Design	X	X		X	X	
i-Tree MyTree	X	X				
Volumetric Method	X	X		X	X	

Section 3: Guidance for Tool Selection

Details about Carbon Sequestration and Storage Tools and Methods

Tool/ Method	ABC-Map: The Adaptation, Biodiversity and Carbon Mapping Tool
Developer	UN FAO, Agence française de développement, Federal Ministry of Food and Agriculture, Germany
Year Developed/ Updated	2021
Asset Types	Continuous land cover across an area of interest
Purpose of Tool/ Method	• The Adaptation, Biodiversity and Carbon Mapping Tool (ABC-Map) is a new geospatial app based on the Google Earth engine. This tool holistically assesses the environmental impact of national policies, plans, and investments in the Agriculture, Forestry and Other Land Use (AFOLU) sectors.
Outputs	• Tonnes of carbon stored per hectare, total carbon, the social cost of carbon at baseline (2015-2019) and in a future period following intervention.
Inputs	• Area of interest (draw on-screen) • First and last year of intervention, intervention area, land use type, and management type
Methodology	• Very little information is provided about the methods and data sources used. • Data at a resolution of 100 m x 100 m is used to produce outputs within the baseline period (2015-2019). Users can also assess the impact of an intervention, but it is not clear what assumptions are built in. • A map showing tonnes of carbon per hectare within the area of interest is produced for the baseline period based on existing data. This section has been developed using the Intergovernmental Panel on Climate Change (IPCC) Guidelines for National Greenhouse Gas Inventories 2006, 2014 and 2019 (IPCC, 2006, 2014 and 2019). • Other outputs include graphs of total carbon stocks and the social value of carbon for each year within the baseline period. • The social value of carbon is estimated based on carbon shadow prices obtained from the High Level Commission on Carbon Prices report (Stiglitz et al., 2017). The total carbon stock is converted to tCO_2e (metric tons of Carbon Dioxide equivalents) and then multiplied by the shadow price of carbon, adjusted for its net present value.

Appendix A: Methods for Literature Review

Appendix A: Methods for Literature Review Used to Obtain Carbon Storage and Sequestration Information for Land Cover Types

This appendix outlines the literature review process and selection of carbon sequestration and storage information specific to each land cover type.

Manicured Open Space

The literature was reviewed to obtain carbon storage and sequestration information for Kentucky Bluegrass (*Poa pratensis*), which comprises most manicured open spaces and lawns in Ontario[19]. Carbon sequestration and storage information grouped by lawn age (i.e. establishment to 25 years old; and over 25 years old). This distinction was chosen because carbon sequestration significantly decreases after 25 years of establishment as the soils become saturated with carbon (Qian and Follett 2002; Selhorst and Lal. 2013). Within each lawn age group, carbon sequestration rates were averaged from the literature[20] to create a single rate for lawns up to 25 years old and another rate for lawns over 25 years old. The carbon storage rate from Selhorst and Lal (2013) was selected for reference in the database because it was the most recent study on turfgrass and lawns referenced in the literature review.

Forest

The literature was reviewed to obtain carbon sequestration and storage information for forest land cover types, with preference given to studies from Ontario. Research suggests that carbon sequestration and storage rates for forests are highly dependent on environmental conditions, including soil type, pH, climate, historic and current land use, and species composition (Chen et al. 2003, Morris et al. 2007, Nowak 2020). Therefore, it was essential to prioritize local studies or studies with environmental conditions and species similar to those in CVC, TRCA, and LSRCA's jurisdictions.

Carbon sequestration and storage rates also change with forest growth and development (Chen et al. 2003, Nowak 2020), so it was important to account for this in our database. Therefore, carbon sequestration and storage information was grouped by forest age notably, Young, Mature, and Old-Growth Forest, as defined by the Ecological Land Classification Manual (CVC 1998).

Appendix B: Detailed Carbon Information

Carbon Net Flux in Forest (including Sequestration, Storage, and Emissions, where appropriate)											
		Carbon Pool									
				Biomass		Dead Organic Matter		Soils			
Land Cover	Land Cover Details	Net Carbon Sequestration (tC/ha/yr)	Reported measurement	Above Ground (SEQ = sequestration (tC/ha/yr); or STORAGE (tC/ha) over long term)	Below Ground (SEQ = sequestration (tC/ha/yr); or STORAGE (tC/ha) over long term)	Dead Wood (tC/ha)	Litter (tC/ha/yr)	Soil Carbon (tC/ha)	Depth of Measurement (cm)	Location	Source of Information
Plantation	Young (based on data from a 12 year old Black Spruce plantation)	0.80	aboveground NPP	STORAGE by live trees/saplings = 17.55 STORAGE in understorey = 0.73		trees, saplings = 1.88	1.08 (13tC/ha/yr over 12 years)	14.1	15	Beardmore, Ontario	Hunt et al. (2010)
Plantation	Mature (based on data from a 34 year old White Pine plantation)	3.83	aboveground NPP	NEP = 3.60 SEQ below ground (BNPP) = 1.94 SEQ by understorey = 0.25 SEQ soil respiration = -6.32 STORAGE by live trees/saplings = 56 ± 7 STORAGE by understorey and ground veg = 2.2 ± 0.4		trees, saplings = 2.9	1.61			Turkey Point, Ontario	Kula 2013 (thesis) for ages and Peichl et al (2010) for carbon data
Plantation	Mature (based on data from a ~35 year old Jack Pine plantation)	3.50	aboveground NPP	STORAGE by live trees/saplings = 68 STORAGE in understorey = 0.79		trees, saplings = 3.39	0.57 (20tC/ha/yr over 25 years)	12.7	15	Beardmore, Ontario	Hunt et al. (2010)
Plantation	Mature (based on data from a 69 year old White Pine plantation)	4.09	aboveground NPP	NEP = 1.29 SEQ below ground (BNPP)= 1.44 SEQ by understorey = 0.32 SEQ soil respiration = -6.9 STORAGE by live trees/saplings = 112 ± 19 STORAGE by understorey and ground veg = 5.3 ± 0.5		trees, saplings = 8.5	2.71			Turkey Point, Ontario	Kula 2013 (thesis) for ages and Peichl et al (2010) for carbon data

Lawn and Open Space | Forest | Wetland | Grassland | Comments

Potential Future Directions

Research

Agriculture, soil carbon, carbon storage for young trees, carbon sequestration from LID/ green infrastructure, other GHGs incorporated?

Case study applications

Applying tools and comparing outputs

Update mechanism/ frequency

Presentation and training through workshops

Questions?

Contact us!

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LINK:

HTTPS://CVC.CA/WPCONTENT/UPLOADS/2022/06/RPT_NACAGT_V1.4_AND_APXA_F_20220106-1.PDF

Upcoming ECS Lunch and Learns!

Tuesday, September 27
11:00am-12:00pm

TRCA Trail Strategy Implementation

By Corey Wells and Caitlin Harrigan

(Tentative)

Wednesday, October 5
11:00am-12:00pm

Update on TRCA's New Head Office

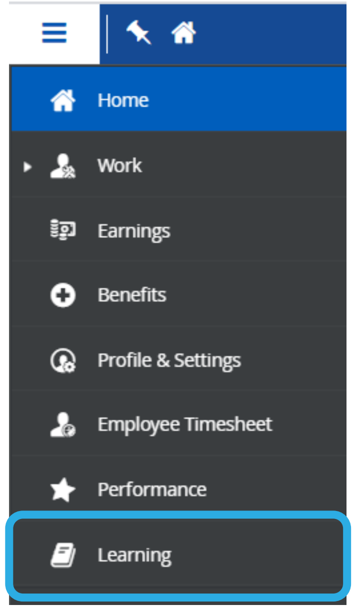
By Bernie McIntyre and Steve Heuchert

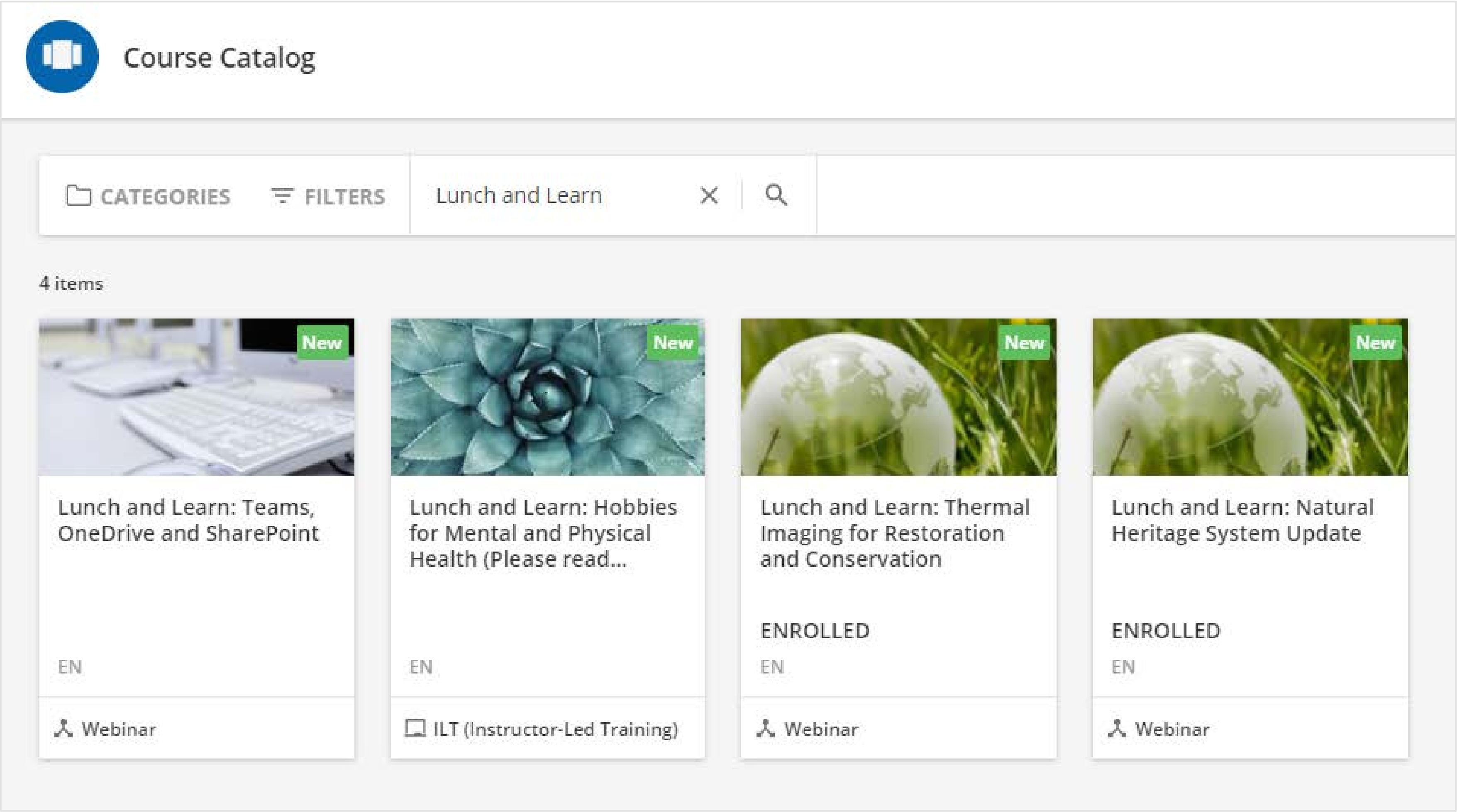
Tuesday, October 18
11:00am-12:00pm

Identifying and Prioritizing Agricultural Best Management Practices

By Aidin Akbari

Learning Management System





Scientific Knowledge Sharing Hub

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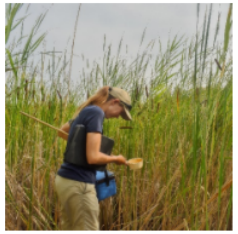
Scientific Knowledge Sharing

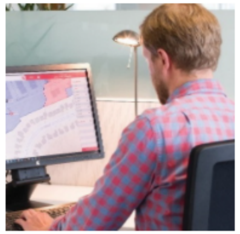
Evidence-based decision making is at the core of what TRCA does. Several of our Business Units engage in generating new scientific knowledge to support watershed management actions and decisions.

It is critical that the knowledge generated is effectively shared.

The Scientific Knowledge Sharing platform is dedicated to sharing the latest scientific knowledge generated by TRCA and our partners. It is a place where staff can learn about and engage in the scientific work TRCA is undertaking.

PLEASE NOTE: *There are several TRCA teams engaged in generating new scientific knowledge. Currently the content on the platform is specific to the Watershed Planning and Ecosystem Science business unit. Additional content from other TRCA teams will be added as the platform develops.*





Knowledge Sharing: Learn More

- Watershed and Ecosystems Reporting Hub
- Environmental Monitoring
- Research and Science Working Group
- TRCA Research Agenda
- Development and Engineering Services Hub Space

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Knowledge Sharing: Latest Updates

Knowledge Sharing – Climate Change Analysis at the Local Scale

April 19, 2021 by Hub Admin Featured

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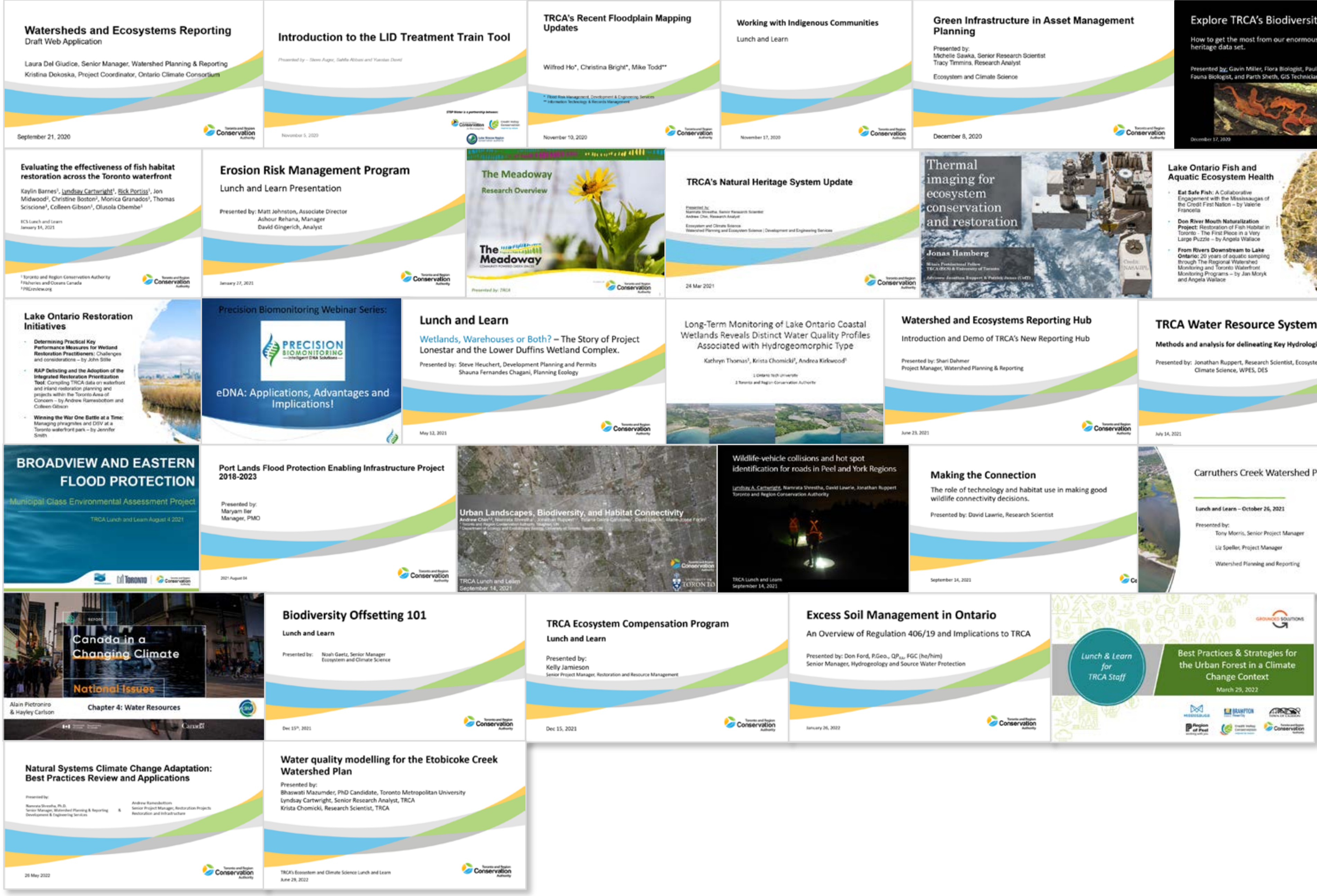
Past Recordings



Thank you

For questions about the ECS Lunch and Learn Series, please contact:

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