DETERMINING PRACTICLE KEY PERFORMACE MEASURES FOR ECOLOGICAL RESTORATION PRACTITIONERS: CHALLENGES AND CONSIDERATIONS

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Toronto and Region Conservation Authority

Why?

- As a measure to determine success and trajectory
- Illustrate effects of restoration on overall system health

- To inform design suitability and best practices
- Restoration program can be adopted and utilized by partner agencies and practitioners.

Challenges

- Environmental restoration was often considered a new science that was excelling at great speed

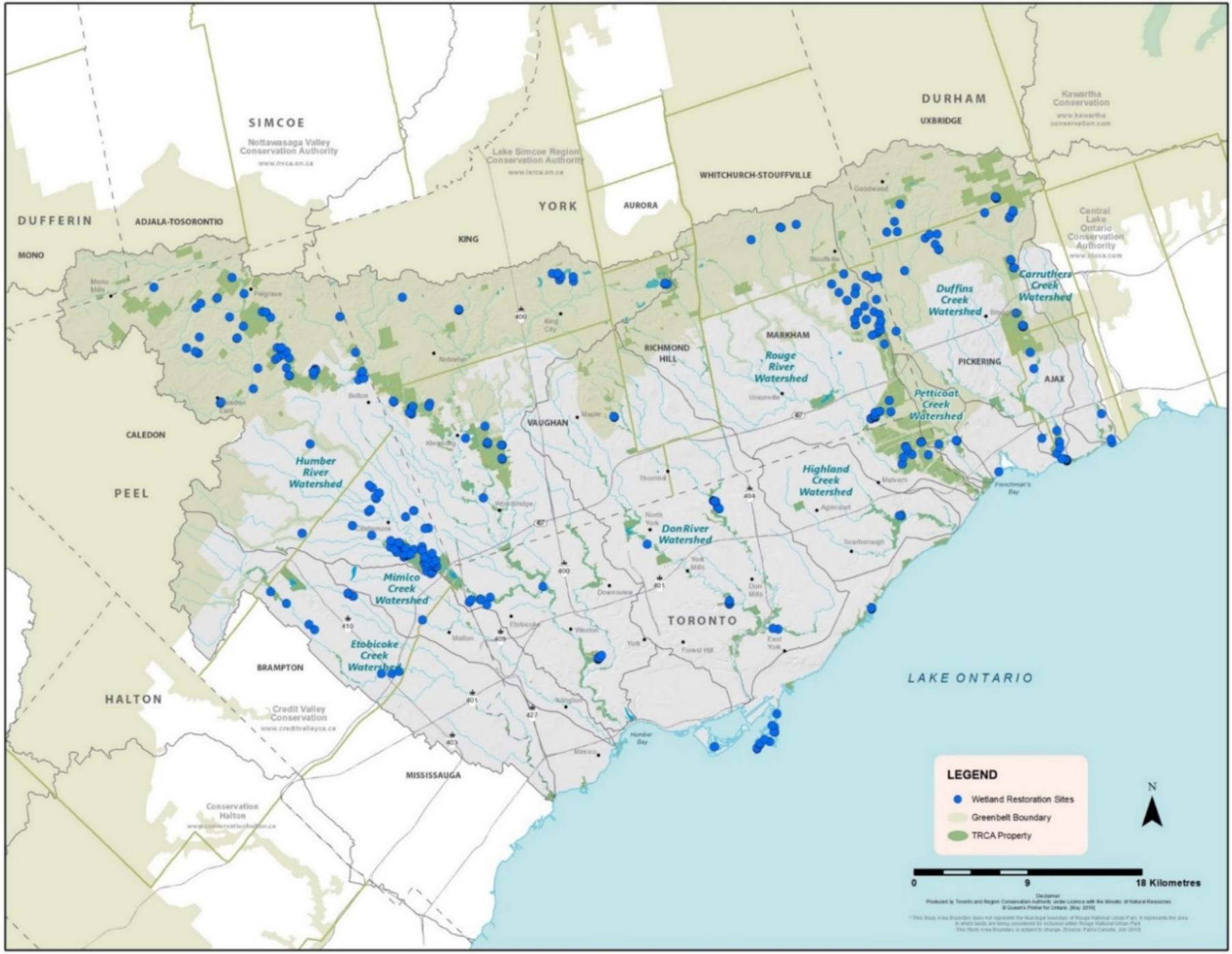
- Funding often does not support long term monitoring.
- Landscapes have been heavily altered making the ecological history of the site sometimes difficult to determine.

Restoration Projects Group: Total Restoration 2007-2017

Year	Area Restored (ha)	Length Restored (m)
2007	51.78	760
2008	74.65	2,036
2009	42.28	2,300
2010	52.94	2,360
2011	84.59	1,890
2012	66.16	5,725
2013	95.70	11,224
2014	51.38	5,919
2015	100.43	6,838
2016	102.67	10,412
2017	105.00	7,500
Totals	**827.57**	**56,964**

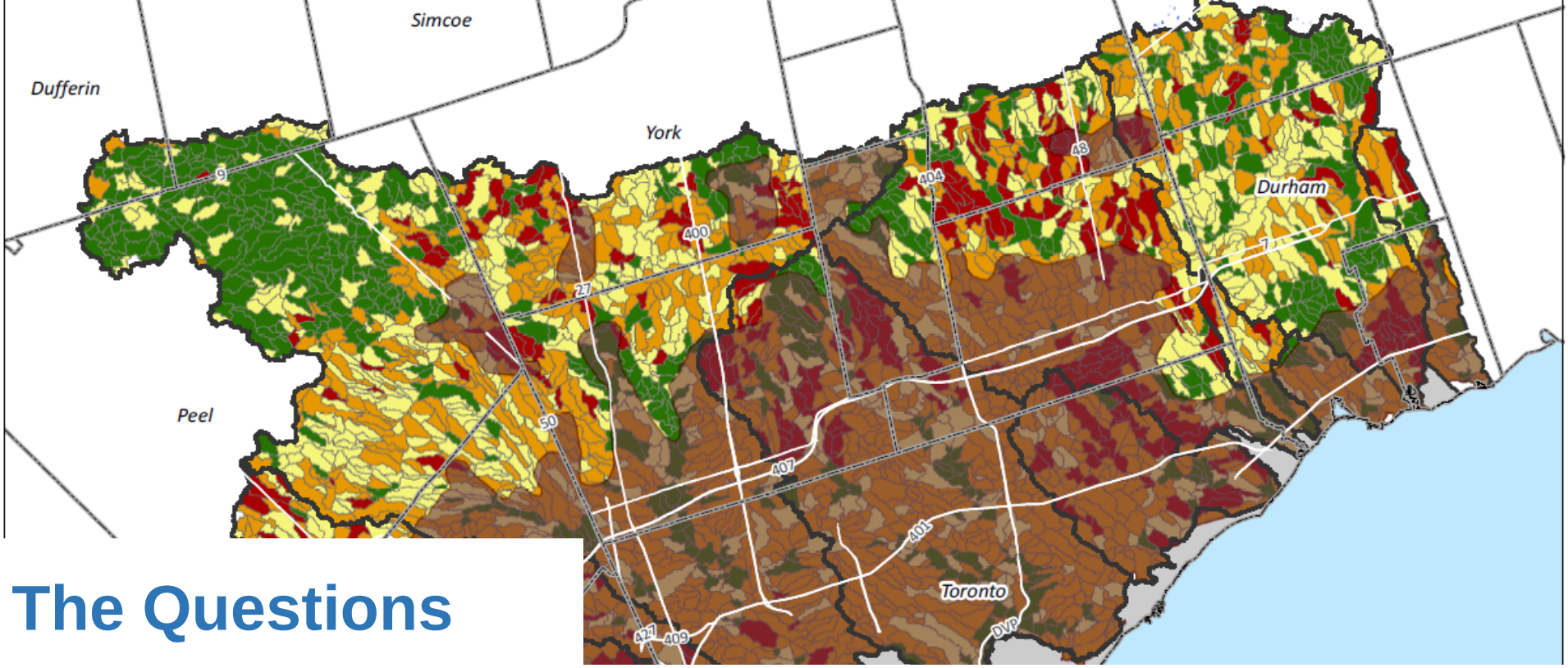
** Area restored includes wetland, riparian, forest and meadow restoration.

** Length restored includes riparian, streambank and shoreline restoration.


SIMCOE
Nottawasaga Valley Conservation Authority
www.nvca.on.ca
Lake Simcoe Region Conservation Authority
www.lsrca.on.ca
DURHAM
UXBRIDGE
Kawartha Conservation
www.kawartha conservation.com
WHITCHURCH-STOUFFVILLE
YORK
AURORA
DUFFERIN
ADJALA-TOSORONTIO
KING
MONO
Central Lake Ontario Conservation Authority
www.cloca.com
Carruthers Creek Watershed
Duffins Creek Watershed
MARKHAM
RICHMOND HILL
Rouge River Watershed
PICKERING
AJAX
Petticoat Creek Watershed
VAUGHAN
CALEDON
Humber River Watershed
PEEL
Highland Creek Watershed
DonRiver Watershed
Mimico Creek Watershed
TORONTO
Etobicoke Creek Watershed
BRAMPTON
HALTON
LAKE ONTARIO
Credit Valley Conservation
www.creditvalleyca.ca
MISSISSAUGA
Conservation Halton
www.conservationhalton.ca
LEGEND
Wetland Restoration Sites
Greenbelt Boundary
TRCA Property
N
0
9
18 Kilometres

The Questions

- How do we measure functional equivalency ?
- Is the true measure of success in form or functions?
- What is the best method of monitoring a restoration site for success?
- How can a long term effective monitoring strategy be put in place?



The Questions

- How can we measure various metrics of different values to ensure we aren't missing successful aspects of the project.
- How do we address spatial differences due to varying site conditions creating different results
- On what scale can the restoration program be monitored.
- What metrics are quickest, easiest to assess, most cost effective
- Can our success be measured using the IRP tool.

What are we doing?

Project Monitoring

- Follow up assessments of completed projects
- Helping to inform future restoration techniques
- Decision making tool for employment of contingency measures

Regional Impact Monitoring

- Regional monitoring metrics: water quality, water quantity, temperature, natural cover gain, enhancement to existing cover, corridor connections
- Continued Research: hydrological studies, wetland storage model, Developing indicators for forest restoration.
- Updates to the IRP tool.

What are we doing?

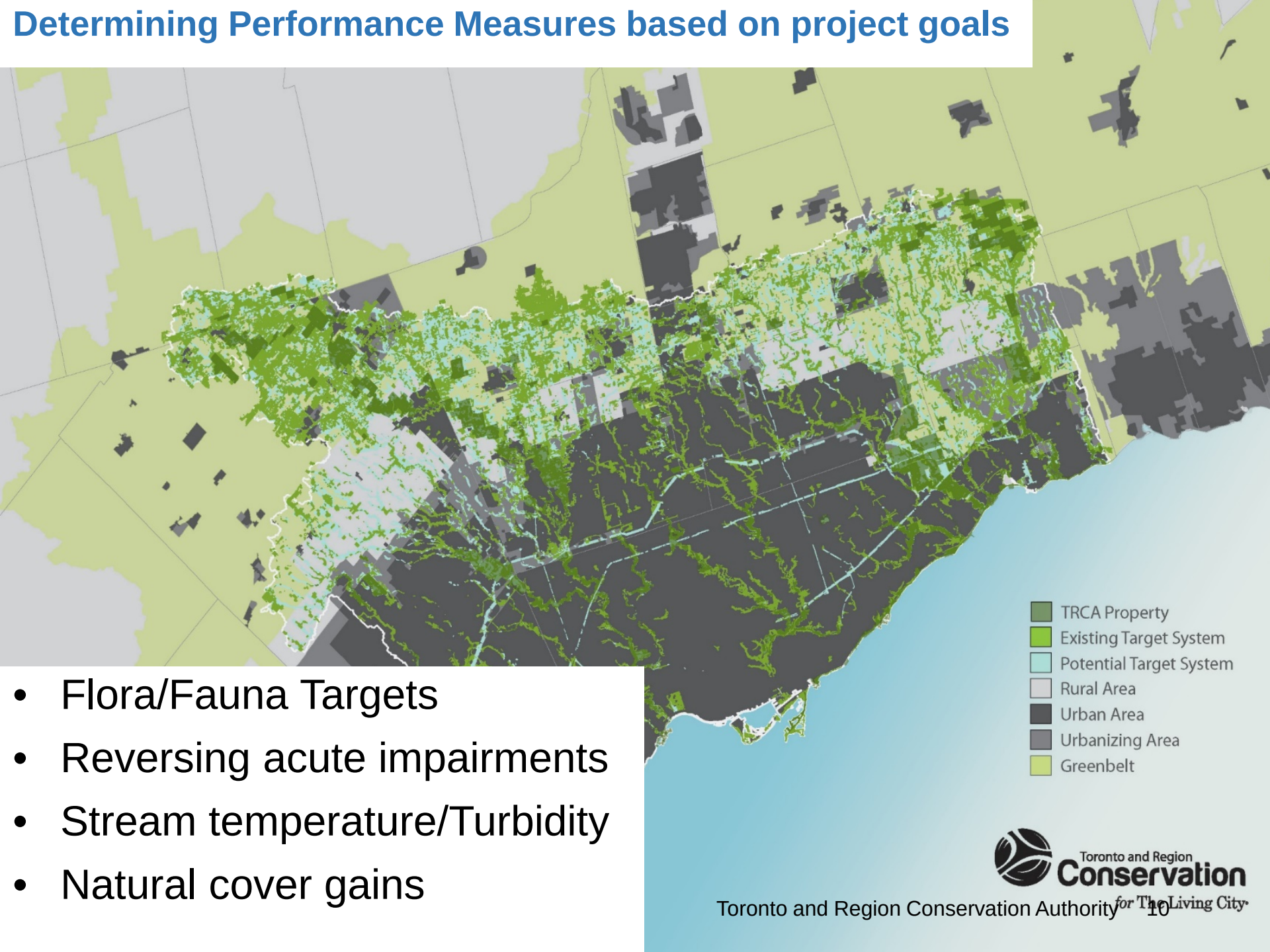
Program Partnership and Uptake

- Partnership agreements
- Reflective of current and future objectives both internally and with external stakeholders (meeting the needs..)
- Requesting expertise for other programing
- Incorporating restoration planning and implementation into municipal/agency budgeting

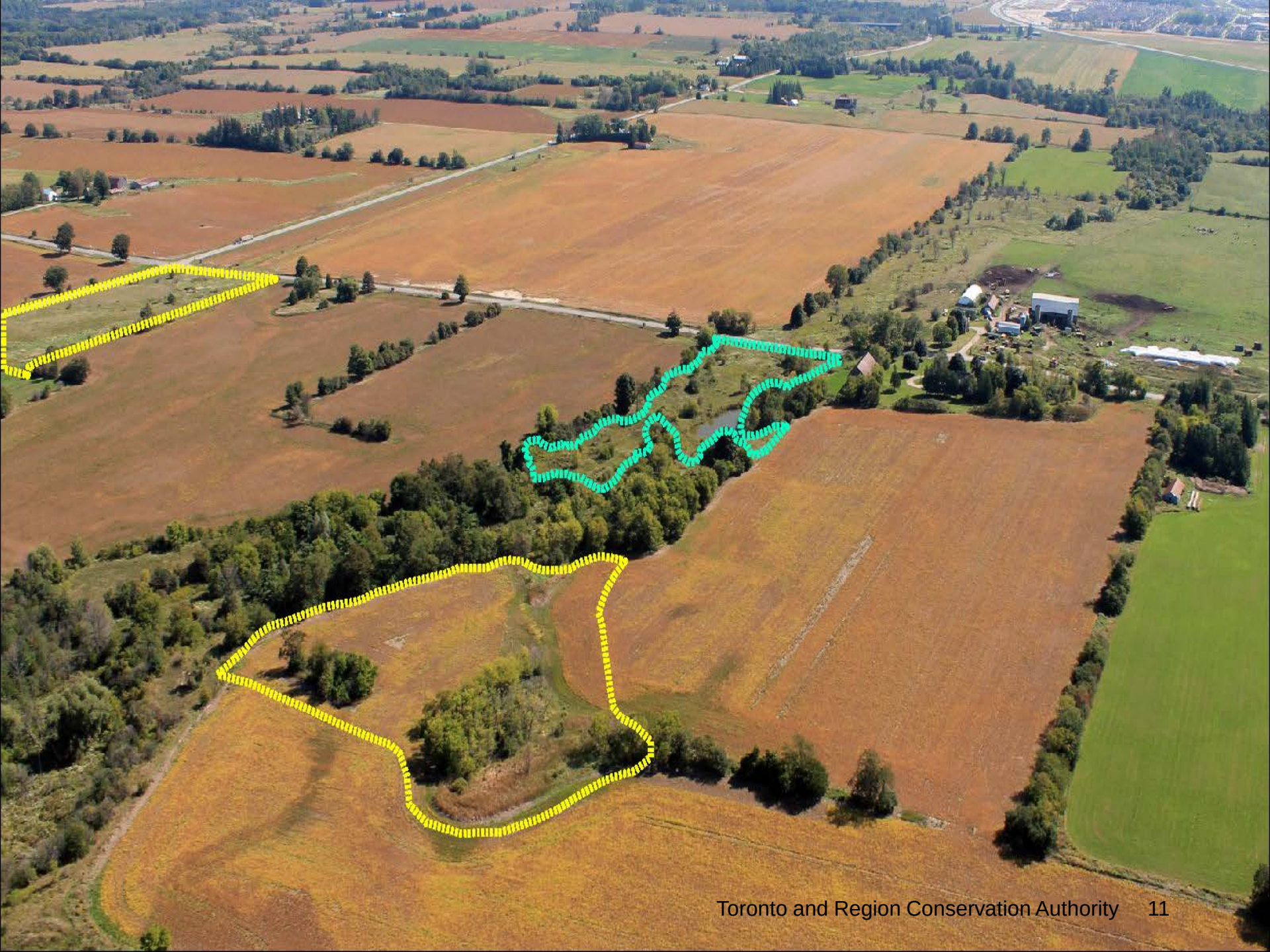
Before

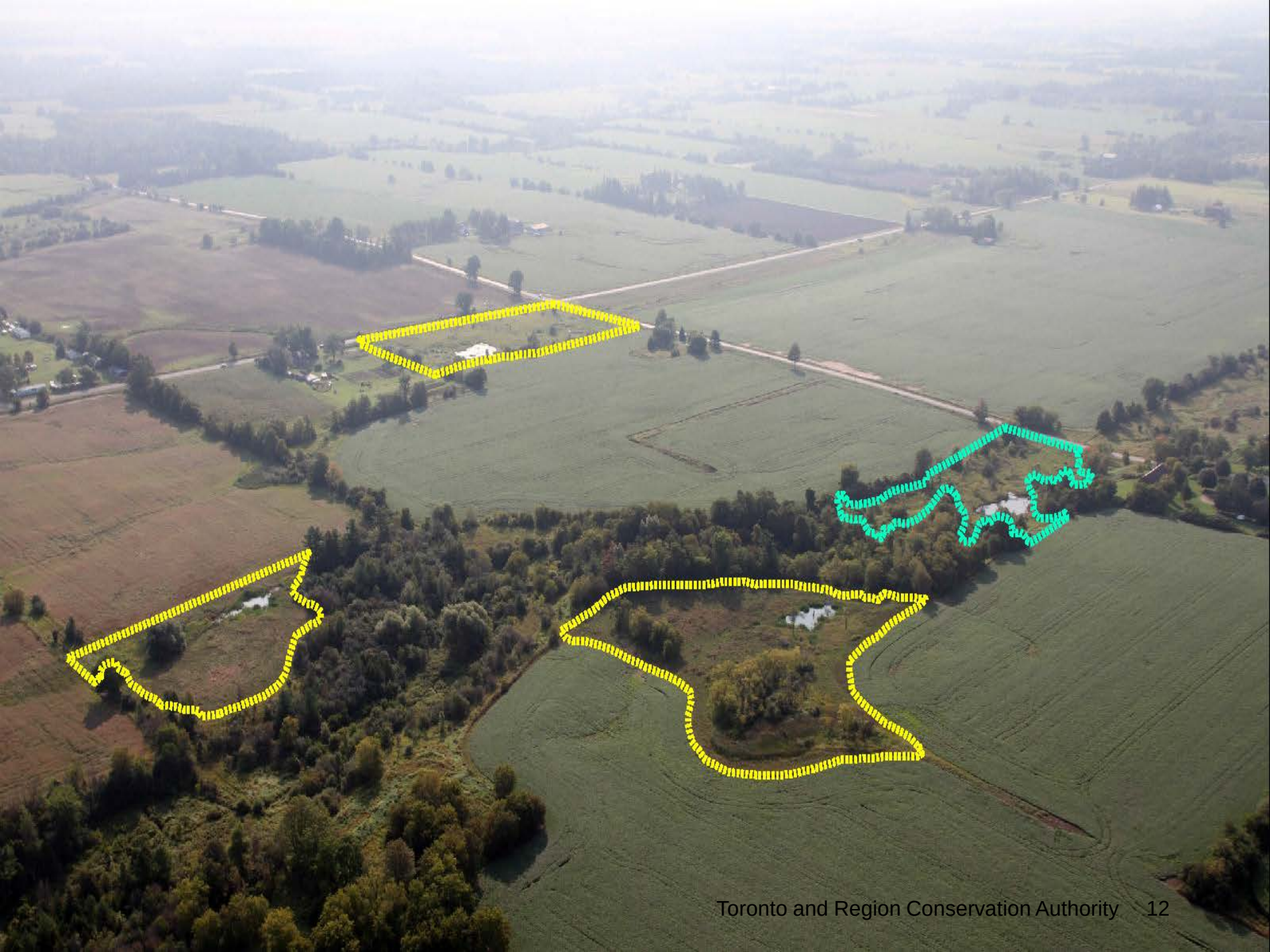
After

Determining Performance Measures based on project goals



- Flora/Fauna Targets
- Reversing acute impairments
- Stream temperature/Turbidity
- Natural cover gains





Project Monitoring

- Monitoring Sites at 1,3 and 5 years.
- To ensure project is on the right trajectory (functional equivalency)
- Guides the decision making process (Adaptive management)
- Helps to Informs future restoration efforts. (ie. Determining what works and what doesn’t)
- Informs decisions made on a spatial scale

Project Monitoring – Scoring Categories

PLANTED VEGETATION SCORE = SURVIVAL SCORE x HEALTH OF AVERAGE SURVIVING PLANTING

SURVIVAL SCORE ***(Depends on an accurate deliverable map / gps track of planting area / nodes)***

4	75% ≤ survival
3	50% ≤ survival < 75%
2	25% ≤ survival < 50%
1	10% ≤ survival < 25%
0	survival < 10%

HEALTH OF AVERAGE SURVIVING PLANTING

4	Average surviving plant experiences virtually no (<5%) dieback, disease, or browse and no competition from aggressive invasives. Project component should succeed.
3	Average surviving plant experiences minor (6-29%) dieback, disease, or browse and/or little competition from aggressive invasives. Should not affect project component success.
2	Average surviving plant experiences moderate (30-59%) dieback, disease, or browse and/or moderate competition from aggressive invasives. May affect project component success.
1	Average surviving plant experiences heavy (60-90%) dieback, disease, or browse and/or heavy competition from aggressive invasives. Project component likely to fail.
0	Average surviving plant experiences complete or almost complete (>90%) dieback, disease, or browse and/or extreme competition from aggressive invasives. Failure is imminent.

NATURAL NATIVE REGENERATION SCORES

4	Native natural regeneration is responsible for the success of 75-100% of the deliverable area entirely on its own.
3	Native natural regeneration is responsible for the success of 50-74% of the deliverable area entirely on its own.
2	Native natural regeneration is responsible for the success of 25-49% of the deliverable area entirely on its own.
1	Native natural regeneration is responsible for the success of 10-24% of the deliverable area entirely on its own.
0	Native natural regeneration is responsible for the success of <10% of the deliverable area entirely on its own

NATURAL COVER COMPONENT SCORES

** Complete Natural Cover Component Scores after completely filling out the Natural Cover Field Evaluation form and the General Project Field Evaluation form.*

4	**Native natural cover *(plantings and matching type of naturally spreading native vegetation)* should achieve project goals without any intervention.**
3	**Native natural cover requires minor maintenance and/or replacement plantings** (e.g. infill < 33% of deliverable area, deer fence repairs, additional mulch, etc.)
2	**Native natural cover requires moderate maintenance or replacement plantings** (e.g. 33% ≤ infill <66% of deliverable area, spot herbicide application recommended, deer fence requiring major repair, etc.)
1	**Native natural cover will very likely fail without major intervention** (e.g. infill ≥ 66% of deliverable area required, another year of deer browse likely to kill all plants, intense invasive control necessary, bollard installation required to prevent further destruction, etc.).
0	**Entire planting has failed and there is no appreciable spread of matching type of native species into area** (e.g. DSV overwhelmed meadow, complete or nearly complete dieoff due to drought, plants completely defoliated, etc.).

CONSTRUCTED COMPONENT SCORING

** Complete Constructed Component Scores after completely filling out the Constructed Component Field Evaluation form and the General Project Field Evaluation form.*

4	**No intervention needed. Constructed component is complete, stable and not under threat.**
3	**Constructed component requires minor repairs, maintenance, or modifications. If there is a deficiency, it is not an emergency** (e.g. handwork, clean-up, fence removal, sign installation, etc.).
2	**Constructed component requires moderate repairs, maintenance, or modifications (i.e. a greater expense of equipment, time, or materials is required). If there is a deficiency, it is not an emergency** (e.g. pools in stream are infilled and need to be cleaned out, bollards should eventually be installed, part of revetment has failed but the remainder of the installation is not affected, etc.).
1	**Component failure is very likely and emergency and/or major repairs, maintenance, or modifications are required** (e.g. collapse of a section of log cribs is directing current behind remainder of the installation, major leakage around water control structure, major erosion affecting spillway, etc.)
0	**Component has entirely failed and will require original investment or greater to achieve success.** (e.g. entire revetment has failed, culvert is undermined, etc.)

Project Monitoring Over Time

- How do projects hold up over time?
- Monitoring past 5 years
- Determine length of monitoring plans
- Assessment of experimental techniques over the long term.

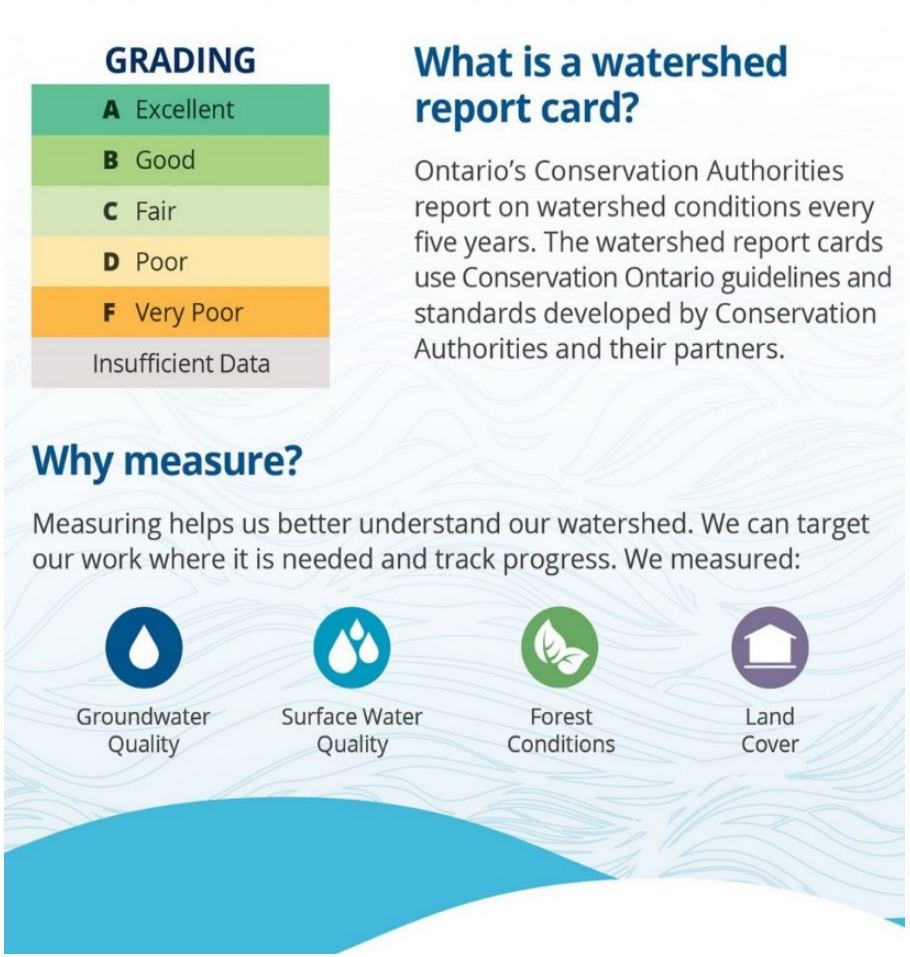
Variation of Restoration Techniques

- Adaptation of techniques and practices based on rural and urban environments.
- Variation by watershed
- Refinement of restoration practices in low risk settings
- Avoid cookie cutter designs.

Background on Current and Past Performance measures

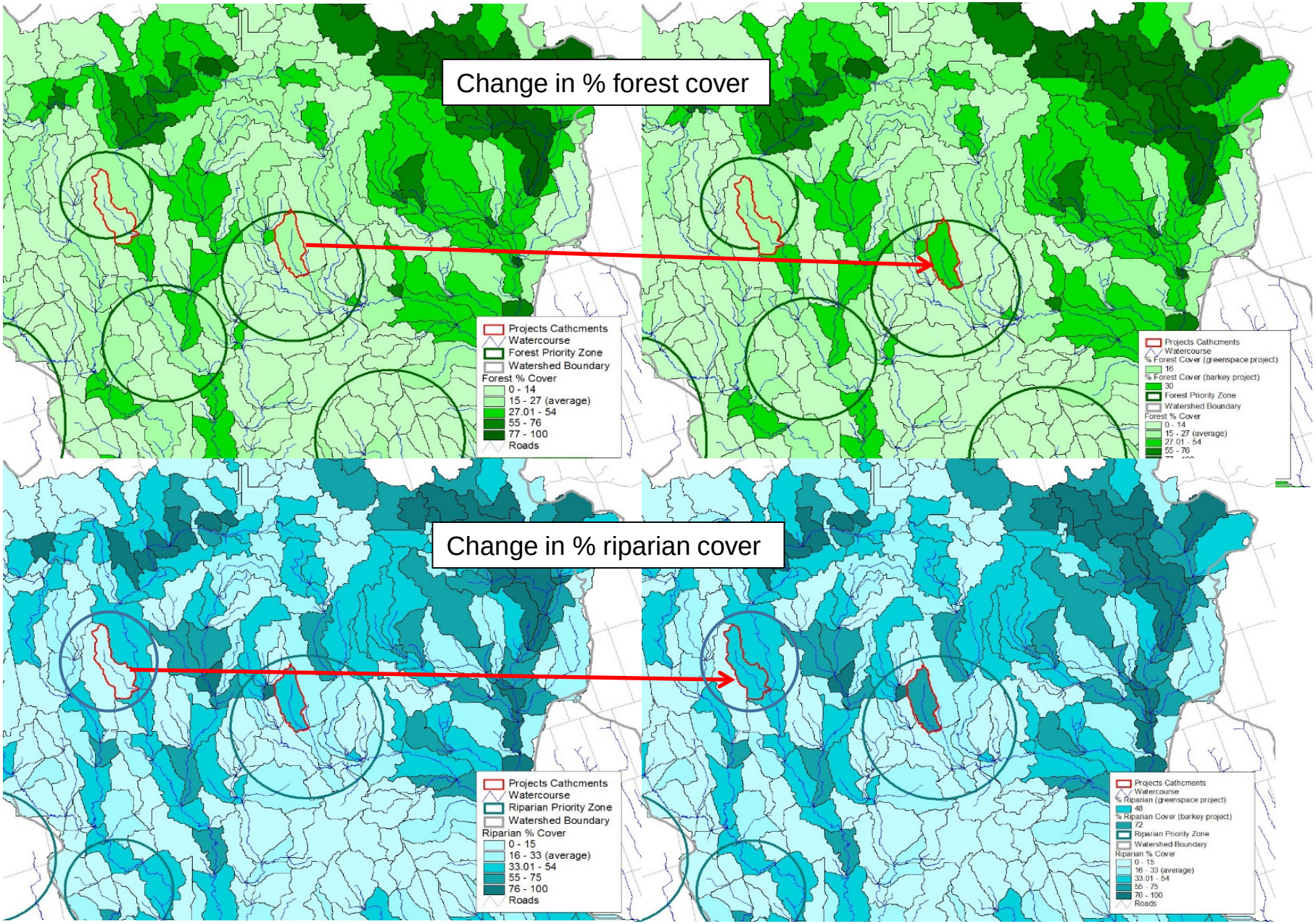
Watershed Report Cards

- Periodic check up on conditions
- Tracks and reports on a standard set of conditions.
- Why are we doing this?
- Provides a snapshot of restoration success



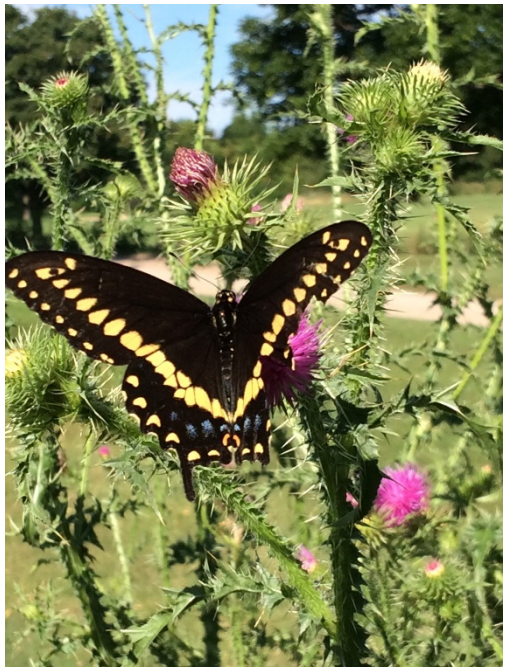
Utilizing current monitoring efforts to quantify restoration success

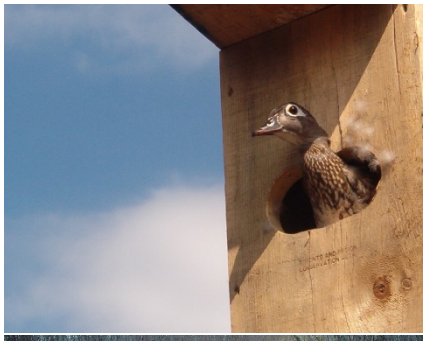
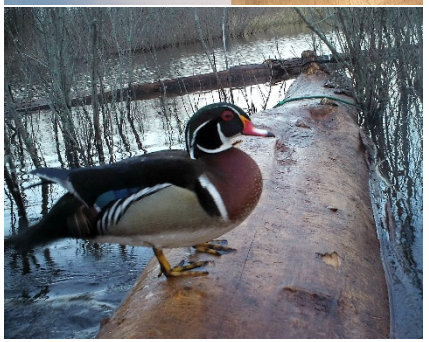
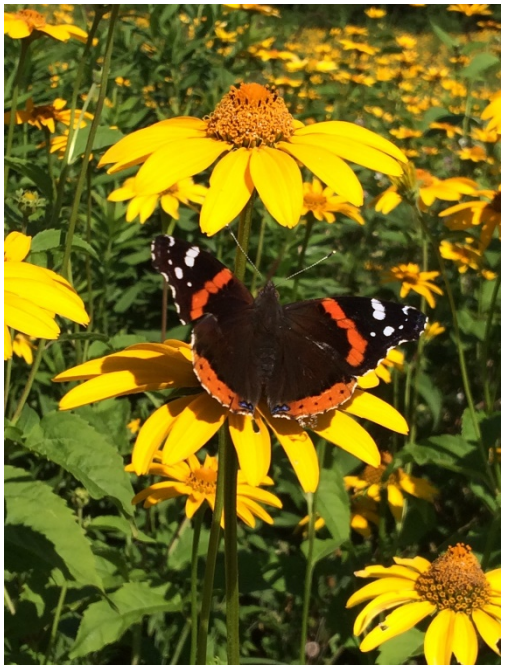
- The IRP tool utilizes Report Card information collected through:
  - Region Monitoring Program collecting data on a 4 year cycle
  - Natural Cover and Terrestrial Natural Heritage updates every 5 years
- Using our reach based approach restoration on a large enough scale should reflect change.
- A focus on headwaters restoration.


Change in % forest cover
Projects Cathcments
Watercourse
Forest Priority Zone
Watershed Boundary
Forest % Cover
0 - 14
15 - 27 (average)
27.01 - 54
55 - 76
77 - 100
Roads
Projects Cathcments
Watercourse
% Forest Cover (greenspace project)
16
% Forest Cover (barkey project)
30
Forest Priority Zone
Watershed Boundary
Forest % Cover
0 - 14
15 - 27 (average)
27.01 - 54
55 - 76
Change in % riparian cover
Projects Cathcments
Watercourse
Riparian Priority Zone
Watershed Boundary
Riparian % Cover
0 - 15
16 - 33 (average)
33.01 - 54
55 - 75
76 - 100
Roads
Projects Cathcments
Watercourse
% Riparian (greenspace project)
48
% Riparian Cover (barkey project)
72
Riparian Priority Zone
Watershed Boundary
Riparian % Cover
0 - 15
16 - 33 (average)
33.01 - 54
55 - 75
76 - 100
Roads

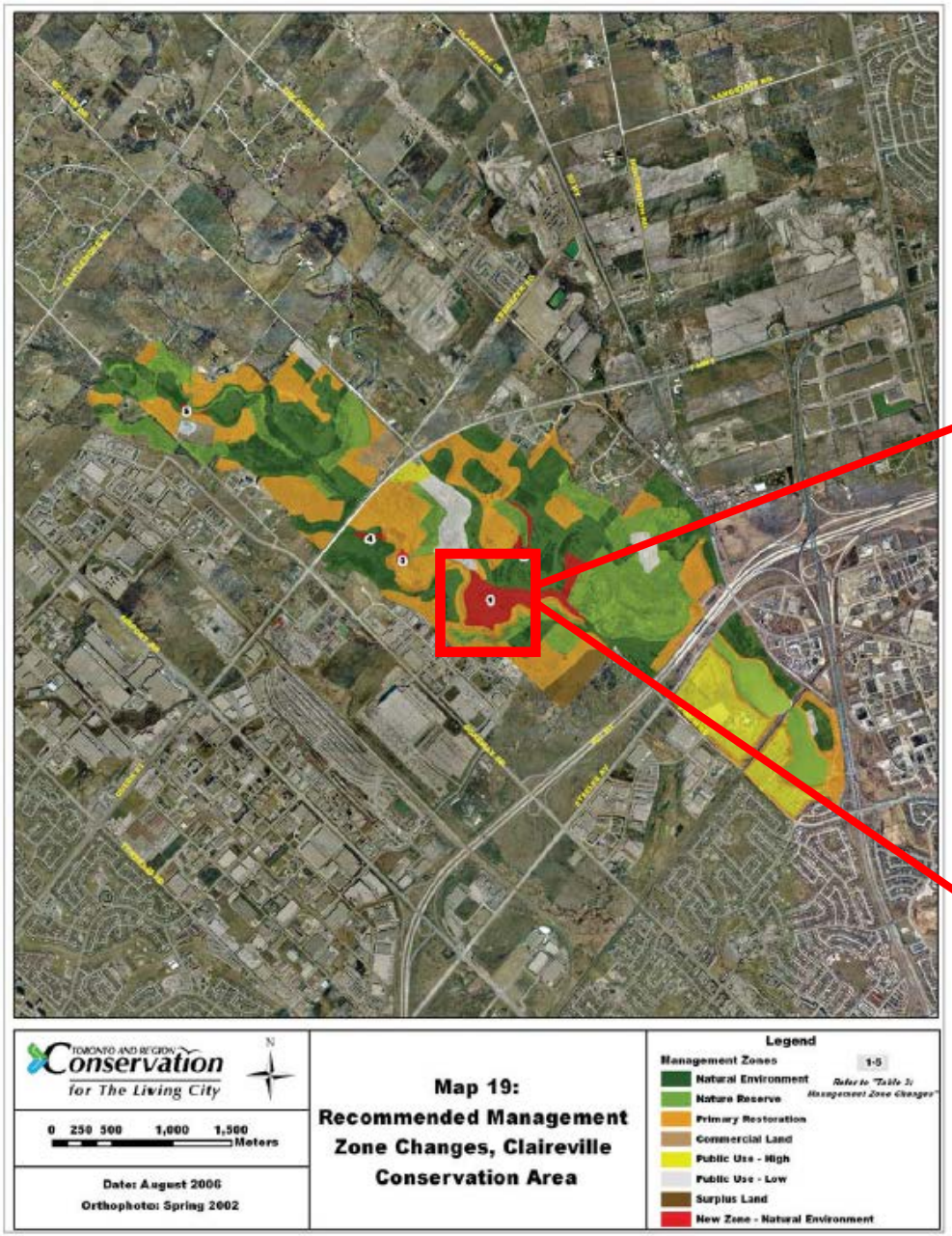
Pre and Post Flora and Fauna Surveys

- Utilizing existing flora and fauna information.
- Comparing species richness and diversity.
- Focus can be placed on indicator/sensitive species.
- Offsetting habitat loss for development.

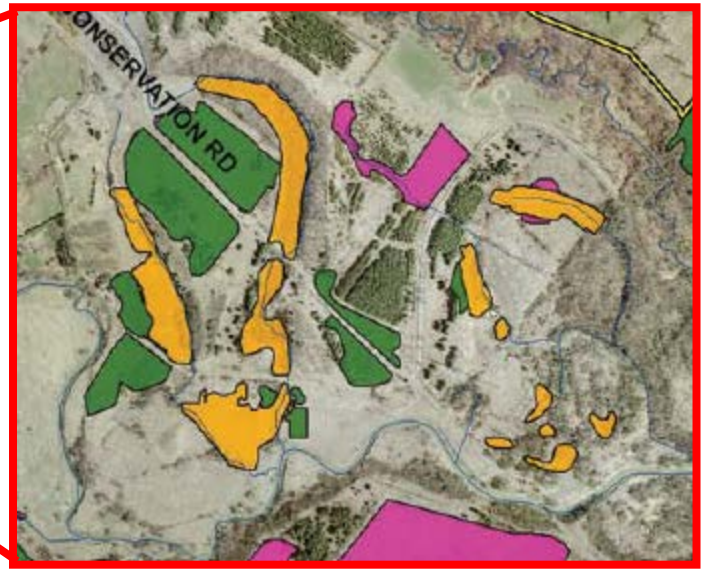


Conservation land designation changes as a result of successful restoration projects



- New protection zoning (red areas) based on amphibians presence in restored wetlands (spring peeper and chorus frog)



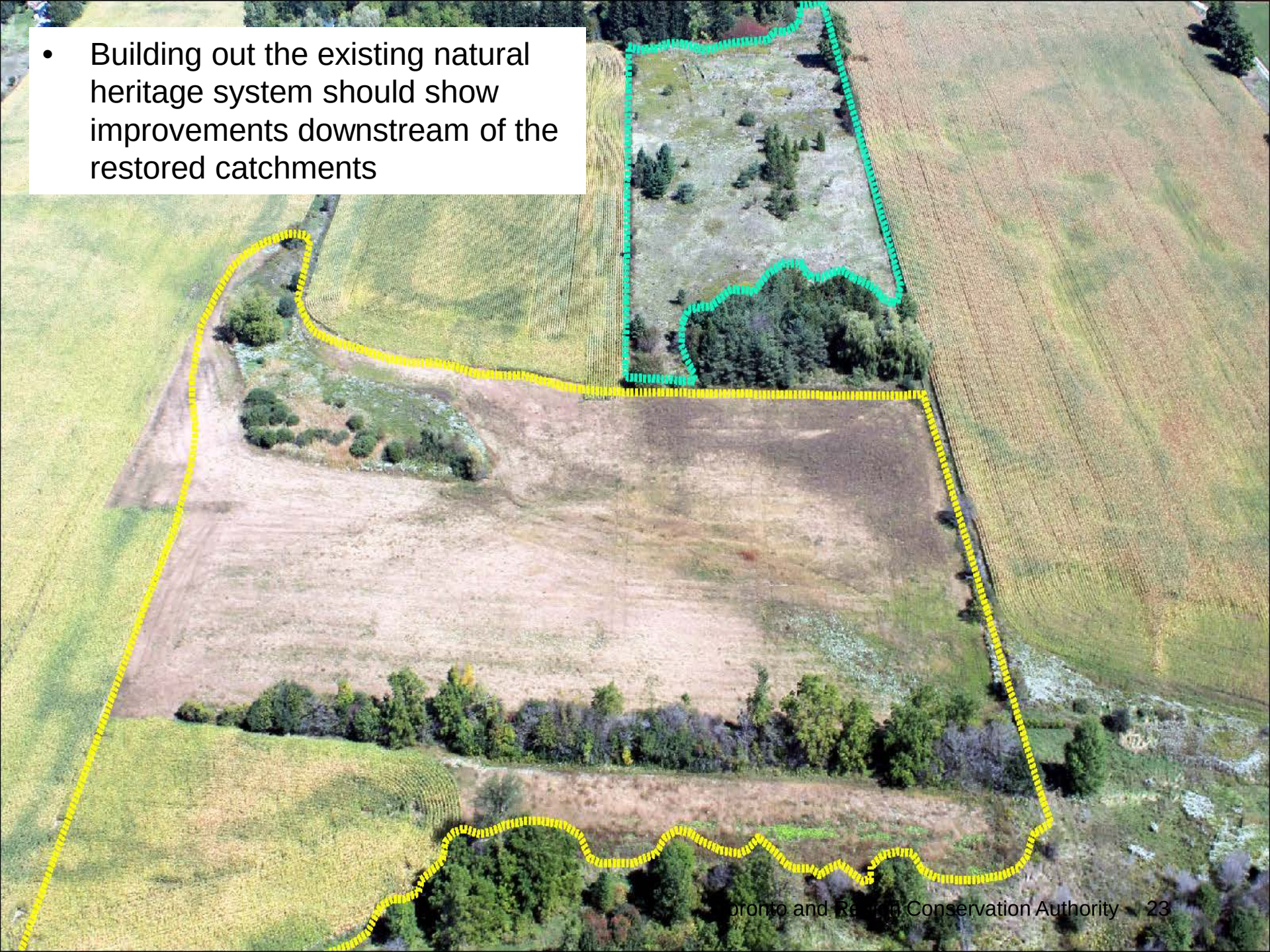
Restored Areas

Rouge Park Monitoring

Before

After

- Parameters currently being measured (flow, turbitity, temperature, nutrients, fisheries data (species/composition, benthics)
- Chosen based on the high intensity agricultural practices that surround the remaining natural areas along with consistency with other monitoring programs.
- Monitoring for impacts downstream of restored catchments to measure a cumulative impact
- Metrics being measured can be used to infer the health of the system in the absence of other metrics.
- Deliverables
- IRP metrics

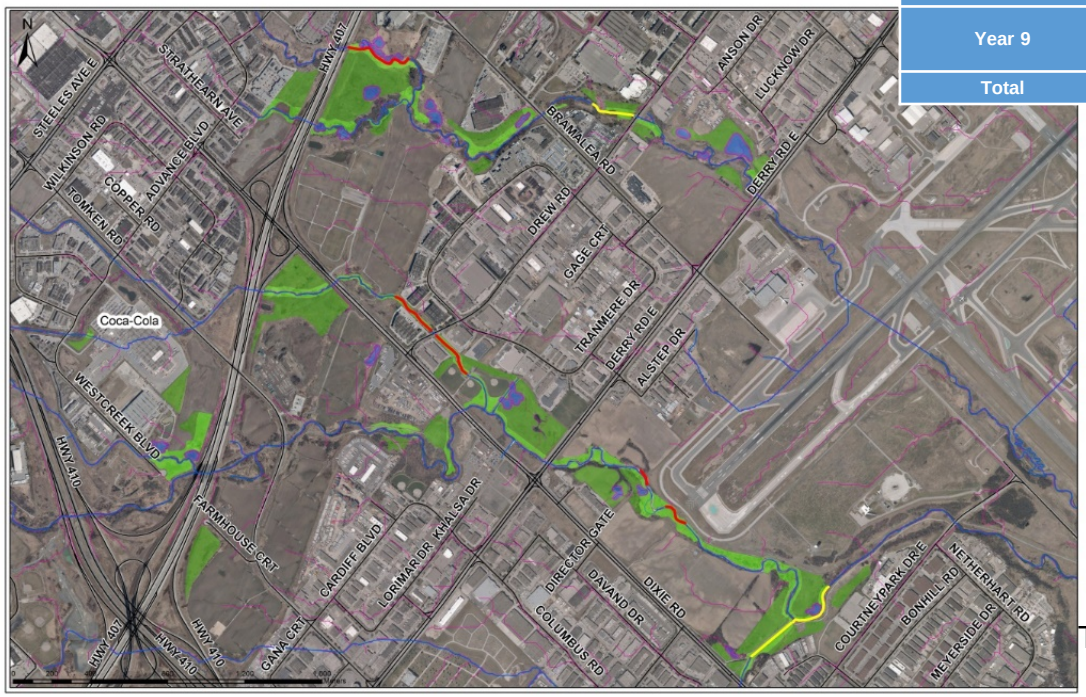


- Building out the existing natural heritage system should show improvements downstream of the restored catchments

Coca Cola Water Replenishment

- To determine the water quality and quantity benefits
- Projections provide a means to measure against future monitoring
- Dependent on proving success of project through post-monitoring

Implementation Year	Cumulative Area of the Proposed Restoration Work (ha)			Total Water Replenishment Benefits (L)
	Forest Planting	Riparian Planting	Wetland	
Year 1	1.96	0.09	0.00	12,046,485
	1.38	0.56	0.00	
Year 2	3.84	2.71	0.32	22,545,486
Year 3	4.02	0.51	1.87	47,701,843
Year 3 & 4	8.13	1.55	1.91	93,853,172
	1.26	2.32	1.25	
Year 4	0.00	0.20	0.52	43,653,459
	0.00	0.00	0.07	
	6.34	3.16	0.34	
	0.05	0.37	0.00	
Year 5	0.00	0.96	0.00	1,453,291
Year 6 & 7	0.85	0.27	0.00	3,221,518
Year 7	6.93	2.89	0.92	98,956,948
	11.59	1.40	0.49	
	1.46	0.52	0.00	
Year 8	3.44	1.69	0.35	40,596,874
	1.58	4.86	0.43	
Year 9	2.79	0.29	0.39	38,716,662
	5.14	2.15	0.09	
Total	60.76	26.49	8.96	402,745,739



- Lead to the development of the Wetland Storage Model

Wetland Water Storage Model – Expected Goals

- Current study in early stages still.
- Goal of understanding benefits to overall catchment hydrology.
- Assist the prioritization of restoration efforts and inform future design.
- Will also assist in overall watershed planning and reporting
- Impacts to ground water/ water tables, base flow conditions
- Extent of impact beyond surface water

Wetland Storage Model

- Series of continuous models
- Utilizing a 21 –year meteorological dataset.
- Site selection parameters
  - Zero/first order systems
  - Generally limited interaction with groundwater and very low to moderate infiltration rate
  - No or limited effect of unmonitored inputs or outputs such as tile drains
  - Relatively simple storage basin topography
- Model will help quantify restoration success but will also help inform future practices and how specific types of wetland restorations are targeted.

Agency Uptake

- Municipalities incorporating/partnering Restoration planning
- Grants and private funding
- Demonstrating expertise
- Maximizing success (ecological gains) while limiting costs
- Embedded in internal programs
  - Compensation Protocol
  - Land acquisition Decisions
  - Natural Heritage Modelling
  - Watershed strategies
  - Climate change scenarios
  - Development and future block planning
  - Green Infrastructure and sustainable technologies
  - Private land owners
  - Land trust agencies

Measuring Success based on client happiness

- Restoration efforts undertaken with private landowners
- Local government agencies
- Urban environment – LID and green infrastructure
- Overall happiness of client with completed projects.

How are we influencing the science?

- Approached by local academia to assess past restoration sites
- Partnering with academia to help conduct research into new restoration techniques (Bumblebee nesting boxes - Species at risk targeted habitat).
- Experimenting on our own by varying restoration techniques.

Thank you!

Toronto and Region Conservation Authority