TRIECA CONFERENCE

LECA Great Lakes Chapter

Toronto and Region Conservation for The Living City

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Lake Simcoe Region Conservation Authority

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WATER CANADA THE COMPLETE WATER MAGAZINE

Stormwater Management Systems: Asset Sustainability

(TRIECA Conference, March 25 - 26, 2015)

By: Donald Moss and Andrew Palmer

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"An Engineering and Technologies Enterprise"
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GREENLAND® Group - Mission Statement

Through the dedication of multi-disciplinary teams of reputable professionals, the **GREENLAND® Group** provides integrated professional engineering and landscape architecture services. We strive to offer excellence in our niche disciplines and provide exceptional service in developing new environmental technologies, while also maintaining the integrity of our services for the Public, First Nations, Business Community, our Clients and Employees.

Since 1994, the GREENLAND® Group has been committed to developing ***innovative solutions*** with a ***conservationist ethic*** that respects the **environment** from the outset **and incorporates best available science, open data, and defendable technologies to address climate change concerns (and opportunities).**

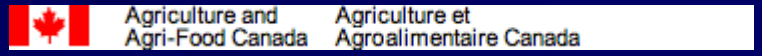
GREENLAND® consulting engineers

Urban Watershed Group

STRAGIS Environmental Services Inc.

Greenland technologies group

Some of Our Corporate Science Partners *(Since 2003)*



What is Asset Management?

Asset management is maintaining a desired level of service for what you want your assets to provide at the lowest life cycle cost.

Lowest life cycle cost refers to the best appropriate cost for rehabilitating, repairing or replacing an asset.

Asset management is implemented through an **asset management program** and typically includes a written **asset management plan**.

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Challenges Facing Municipal SWM Infrastructure Systems

- Optimal times to rehabilitate and replace aging assets.
- Climate change uncertainties.
- New regulatory requirements.
- Asset failures and emergency response.
- Asset protection.

Benefits of Asset Management

- Prolonging asset life and focused operations and maintenance.
- Budgets focused on maintenance critical to sustained performance.
- Design service expectations and regulatory requirements.
- Improved emergency response.
- Improving security and public safety of assets.

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Implementing Asset Management for SWM Infrastructure

* Five Core Framework Questions for SWM Ponds *

1. Current State of Assets (incl. sediment accumulation) ?

2. Levels of Service for Runoff Quantity and Quality Control?

3. Critical Assets?

4. Minimum Life Cycle Cost?

5. Long - term Funding Plan?

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Current Approach (Status Quo) for Stormwater Management Systems (Ponds, Urban Lakes and OG Separators)

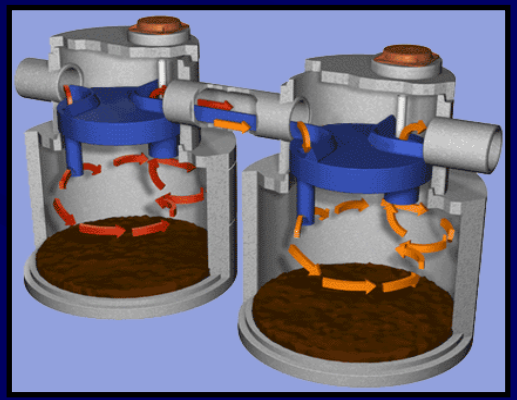
(without a Science-based Asset Sustainability "Roadmap")

Minimal Savings $
=
No opportunity for re-investment !!!

$ Maintenance

+

Possible Regulatory Non-compliance



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Current Challenges Facing the Lake Simcoe Basin

In 2011, the LSRCA identified *98 municipal SWM Ponds* in the Lake Simcoe Basin requiring sediment removal ($380/m^3).

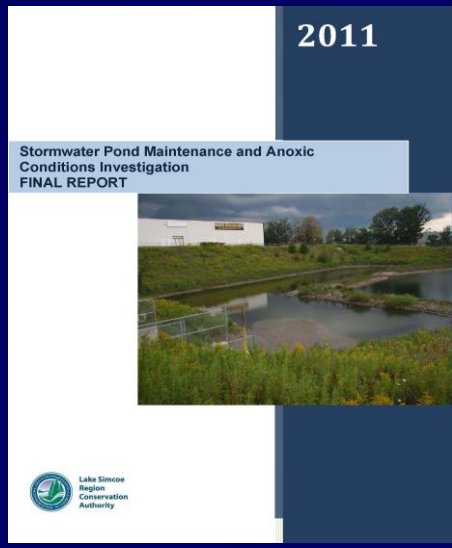
Total Cost = $18 Million

Phosphorus reduction = 4,253.7 kg in loadings to the ultimate Lake Simcoe receiver.

For example, the LSRCA report identified sediment disposal costs for 10 SWMFs in the **Town of Newmarket** alone could total at $**5.1 Million**

Additional restoration works needed for some ponds include:

2) Seeding @ $30/m^2;
3) Aquatic plants = 1,500 LS; and,
4) Access road resurfacing @ $20/m^3.



Questions to Consider

- Does your stormwater “Asset Roadmap” now include provisions to maintain, operate and construct new stormwater management facilities with other connected drainage system infrastructure?

- What are the consequences of continuing down your current (conventional) “business as usual” path?

- Have you fully comprehended this reality in terms of your municipal employee or consultant contract responsibilities? What does this mean to you professionally and personally?

- Are you open to explore “new” science-based / sustainable possibilities and options to generate new forms of capital and re-investment for LID (source control) practices?

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Stormwater Management System Asset Sustainability / Maintenance Plan

(incl. a Sewershed or Subwatershed Remediation and LID Opportunity Implementation Plan)

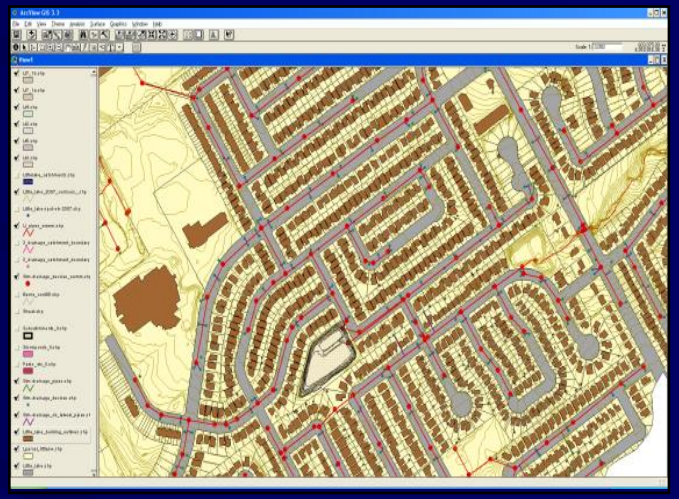
Maintenance Costs $

Revenue from Nutrient Credits for Future Phosphorus Trading Programs

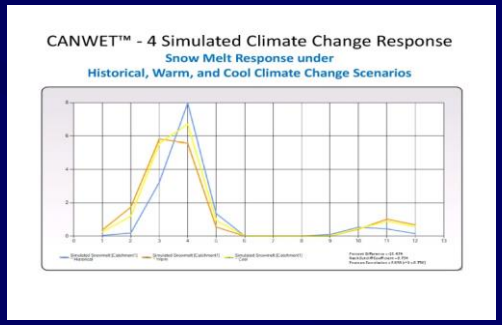
$ Savings

=

Re-investments and Compliance



PHOSLOCK®



- WWTP upgrades for legislated watersheds (e.g. Lake Simcoe Protection Plan).
- LID construction for problem headwater areas.
- Support climate change (flood) & source water programs.

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UNIVERSITY of GUELPH

Research Webdatabase

Monitoring of Phosphorus Load in Stormwater Runoff

CHANGING LIVES IMPROVING LIFE

http://dev.web.uoguelph.ca/engineering/swm/

Research Summary

Design of Erosion and Sediment Controls for construction sites in Ontario are rapidly evolving; particularly in the Lake Simcoe region, which is experiencing rapid growth, the Ontario Regulation 60/08 under the Ontario Water Resources Act, seek to reduce the phosphorus entering Lake Simcoe by making stormwater management facilities serving new development meet the highest design standards. The Lake Simcoe Protection Plan (2009) requires municipalities to incorporate into their official plans policies related to

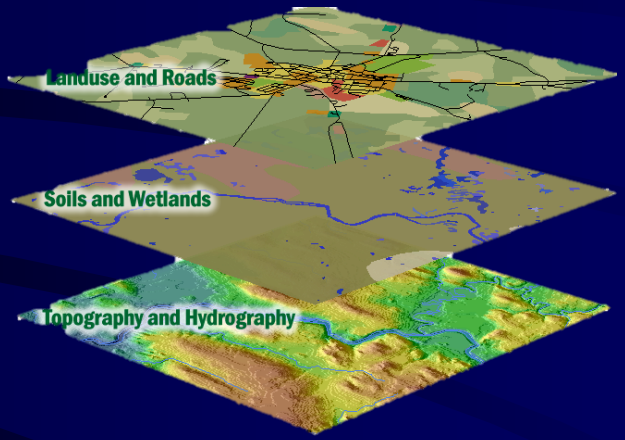
MONITORING DATA

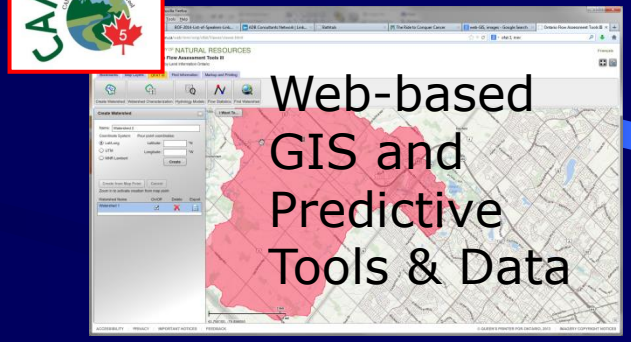
Evolution of Computer Tools for Preparing SWM Asset Plans

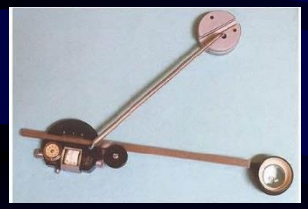
Since 2012

Cloud Computing & Storage

Integrated GIS and Geo-processing that incorporates best-available science





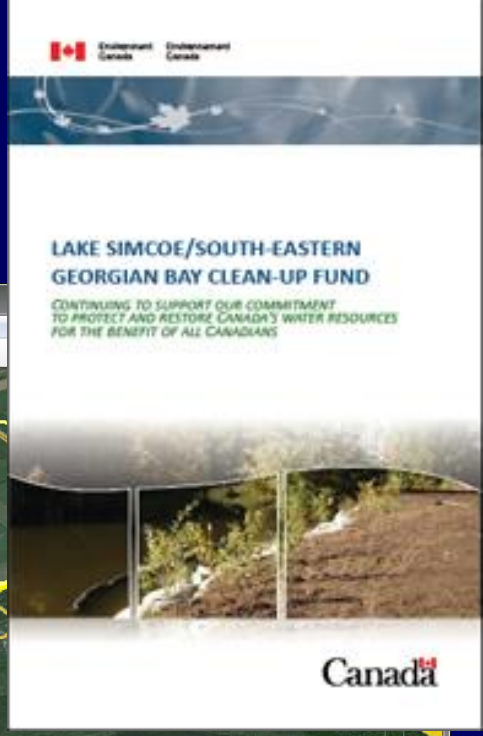


Mobile Devices + Sharing

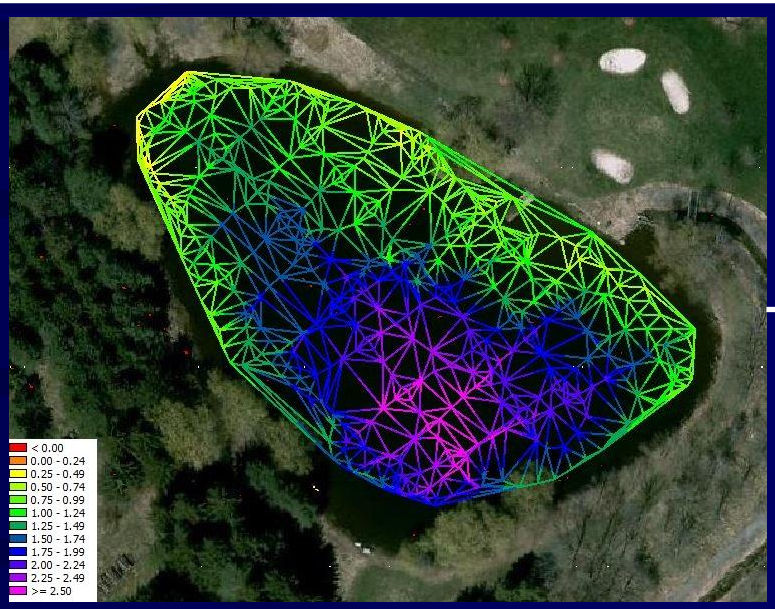
1980-90's

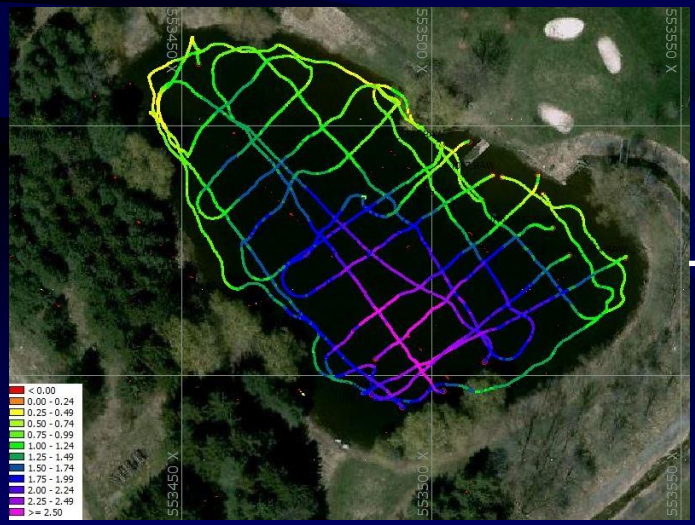
Since 2000

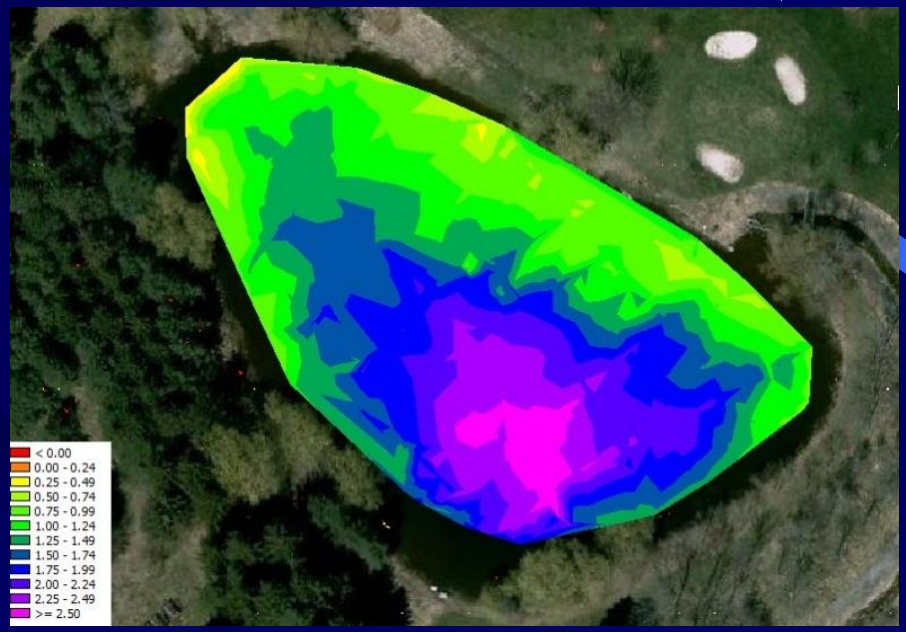
CANWET™ Now Used to Identify How to Cost-Effectively Implement Phosphorus Reduction and SWM Master Plans



Utilization of New Technologies (e.g. Accurate Pond Sediment Accumulation Estimates)







Phoslock™ – An Overview

- A modified clay product which removes bio-available phosphorus from water bodies.
- Reduces phosphorus concentrations below detection limits.
- Caps sediment and prevents remobilization of phosphorus, even at varying pH and redox conditions.
- Low in toxicity.
- Easy and safe to apply.

❖ ***Province of Ontario led program (since 2008) with all agencies!***

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consulting engineers

1994 GREENLAND® 20th ANNIVERSARY CONSULTING ENGINEERS 2014

An award-winning Canadian business
with a global impact

Since 2008, Greenland has been Phoslock Water Solutions' partner in Ontario and Manitoba to provide phosphorus management strategies for stormwater management facilities that use Phoslock™.

Phoslock™ is a modified clay product that locks up bio-available phosphorus from a water body. By removing phosphorus from the water body, Phoslock™ limits the main nutrient which algae require.

For more information, please contact www.grnland.com

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120 Hume Street, Collingwood, ON L9Y 1V5• Tel: 705-444-8805 • Fax: 705-444-5482

LAKE SIMCOE REGION CONSERVATION AUTHORITY

PHOSLOCK®

Phoslock Use in Canada

- Used in Ontario since 2008.
- MOECC allocated $250,000 for comprehensive independent pilot testing that involved Federal Government agencies (EC and DFO) too.
- Tested efficacy at MOECC laboratories and field scale tests (incl. 2 SWM ponds in 2008 and 2009 and also located within the Lake Simcoe Basin).
  - Toxicity testing by MOECC on 3 sediment dwelling organisms, daphnia, & rainbow trout.
  - Provincial and Federal Steering committee established “SOP” for large water bodies.
- Ontario MNR work permit required for lakes on Crown Land.
- For SWM ponds and urban lakes in Ontario, a Municipal Class E.A. process to be followed (i.e. typically a Schedule A+ process for SWM ponds) and which should include qualified professional engineering oversight.
- To-date, SWM ponds and urban lakes have been treated in the Greater Toronto Area.
- NSF Standard 60 certification for drinking water obtained in November 2011.
- Outside ON, applications have been completed in NB and NS. Projects now underway in AB and discussions ongoing with municipalities and agencies in MB and QUE.

City of Brampton, ON
Loafer's Lake

Municipal Class E.A.
(Schedule 'A')

(Application: Oct. / 12)

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Overview of Loafer's Lake Project

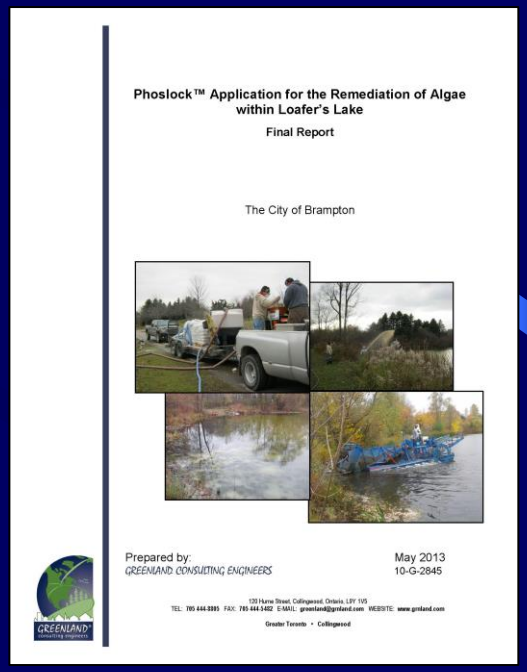
Size:

Area - 2.4 ha.
Depth - 4.1m
City of Brampton and located within the Etobicoke Creek floodplain.

Project Timeline:

- Late August 2012 – Project Initiation
- Mid- October 2012 – Vegetative Harvesting
- October 29, 2012 – Phoslock Application (10 tonnes)

❖ Post - Phoslock Application Monitoring for 1-year


Phoslock™ Application for the Remediation of Algae within Loafer's Lake

Final Report

The City of Brampton

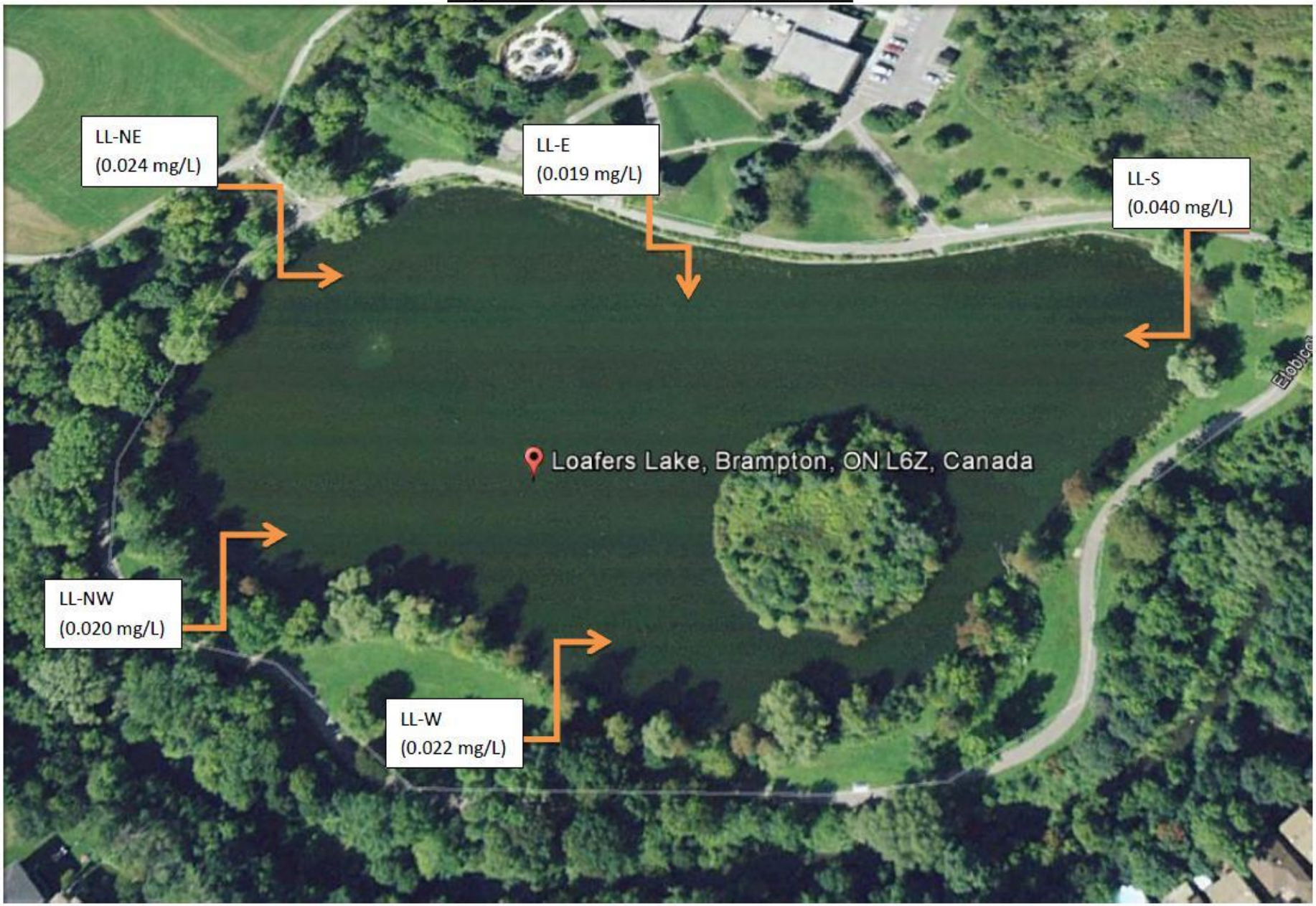
Prepared by:
GREENLAND CONSULTING ENGINEERS

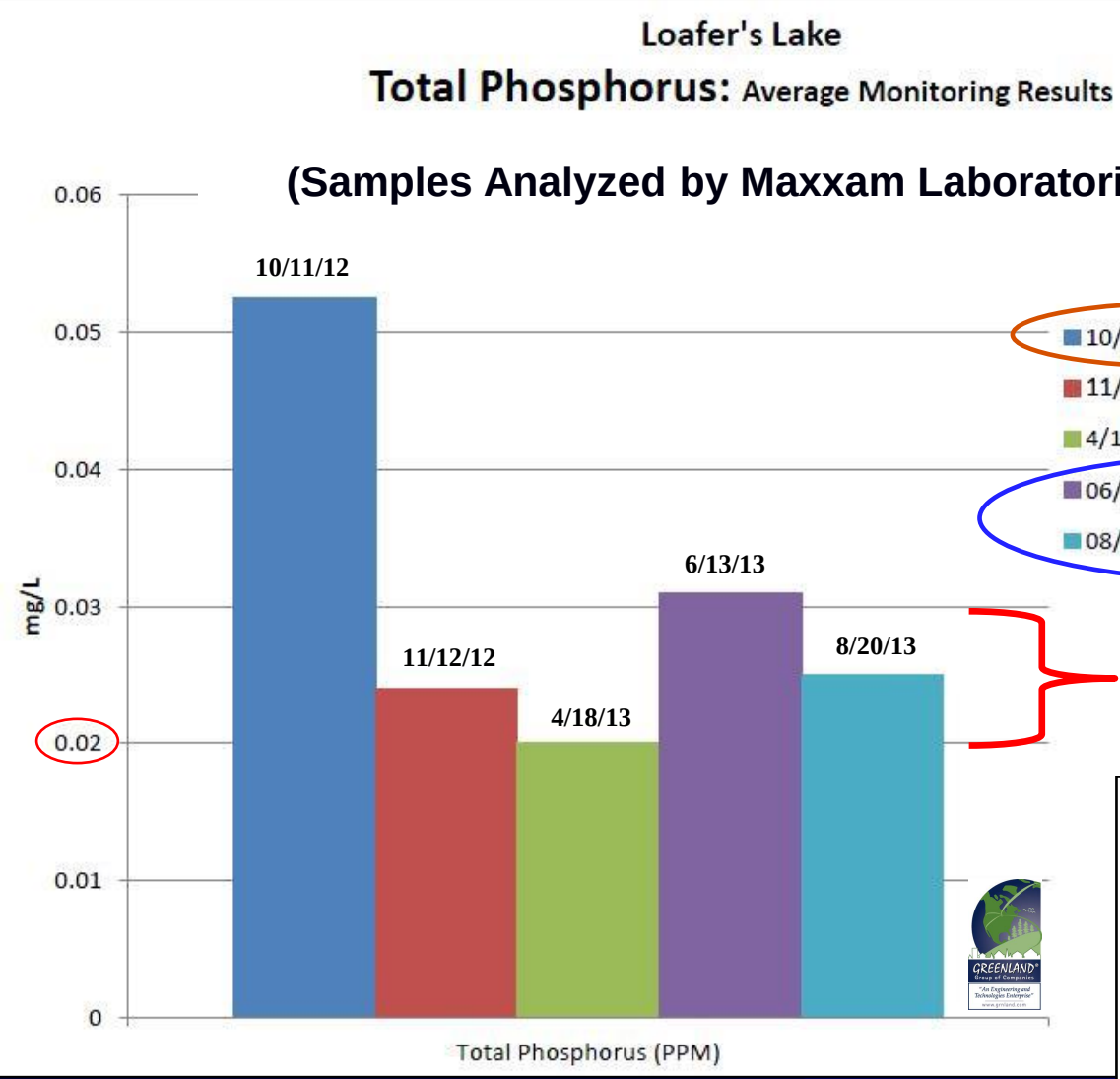
May 2013
10-G-2845


September 2012

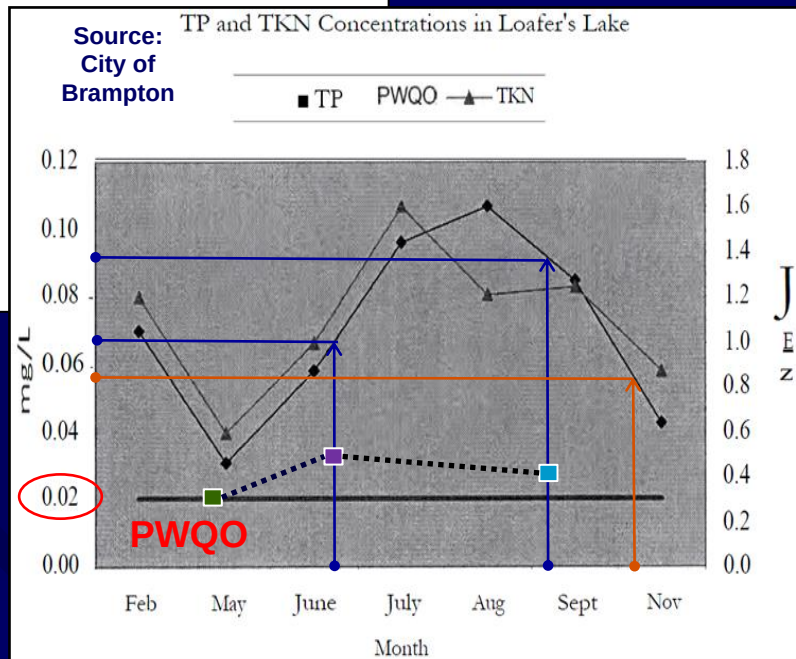
Loafer's Lake

August 20, 2013 Sample Locations & Results





Historical Data Comparison



Loafer's Lake Monitoring Results

(Oct. 11, 2012 through Aug. 20, 2013)

Loafer's Lake – Results (cont…)

(September 2012)

(August 20, 2013)

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Swan Lake, Markham ON

The Site:

• 5.1 hectare pond within a mixed commercial and residential area

Treatment:

• 25.2 tonnes of Phoslock in April/13

The Problem:

• Filamentous algae

• Blue green algae

• Regular algaecide treatments

Swan Lake, Markham ON

Phoslock Treatment Results

#1 Lake TP concentration was reduced by 60% in the mid and surface layers.

#2 There was little to no deep water P accumulation in the summer and autumn.

#3 Only a decrease of lake TP concentration throughout the summer and autumn was observed*.

#4 The sediment fraction that is responsible for anoxic sediment release was extremely small after the treatment.

Lethbridge 9th Avenue SWM Pond, AB

The Site:

- 1 hectare pond (industrial area)
- Catchment area: 35 ha
- Maximum depth: 6 m
- Outflow pumped

The Problem:

- Filamentous algae
- Blue green algae
- Regular algaecide treatments

Treatment:

- 2.1 tonnes of Phoslock end of April/14
- Re-applications of 0.5 tonnes after significant rainfall events

Lethbridge 9th Avenue SWM Pond, AB

Phoslock Treatment Results

Taren Hager, Storm Water Pond Manager, City of Lethbridge:

"*….. the visual observations at this storm pond show **compelling results**.*"

The main success here is a healthier looking pond in which the algae levels were controlled after only a few months of treatment with Phoslock."

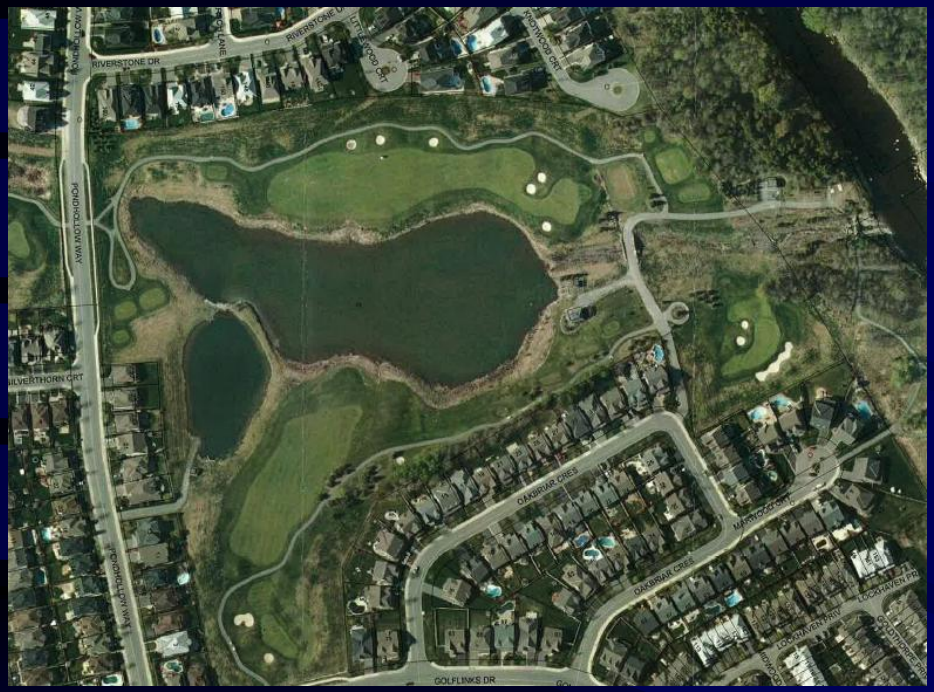
Silverberry 4 SWMF, Edmonton AB

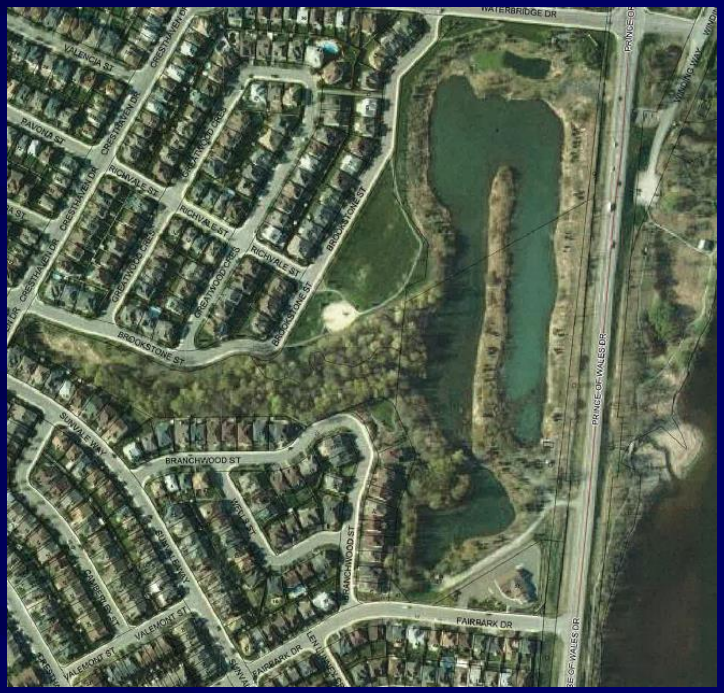
The Site:
- Area = 1.9 hectares.
- Depth = 0.5m – 1.5 m.
- Constructed in 2001

The Problem:
- Filamentous algae
- Duckweed
- Frequent algaecide treatments

Treatment:
- 4.2 tonnes of Phoslock in April/14
- 1 tonne re-applications **by City** after significant rainfall events
- Total amount applied: 10.5 tonnes

City of Ottawa, ON
(Scheduled 2015/16 SWM Pond Applications)





Stonebridge SWM Facility

Standherd SWM Facility

PHOSLOCK®

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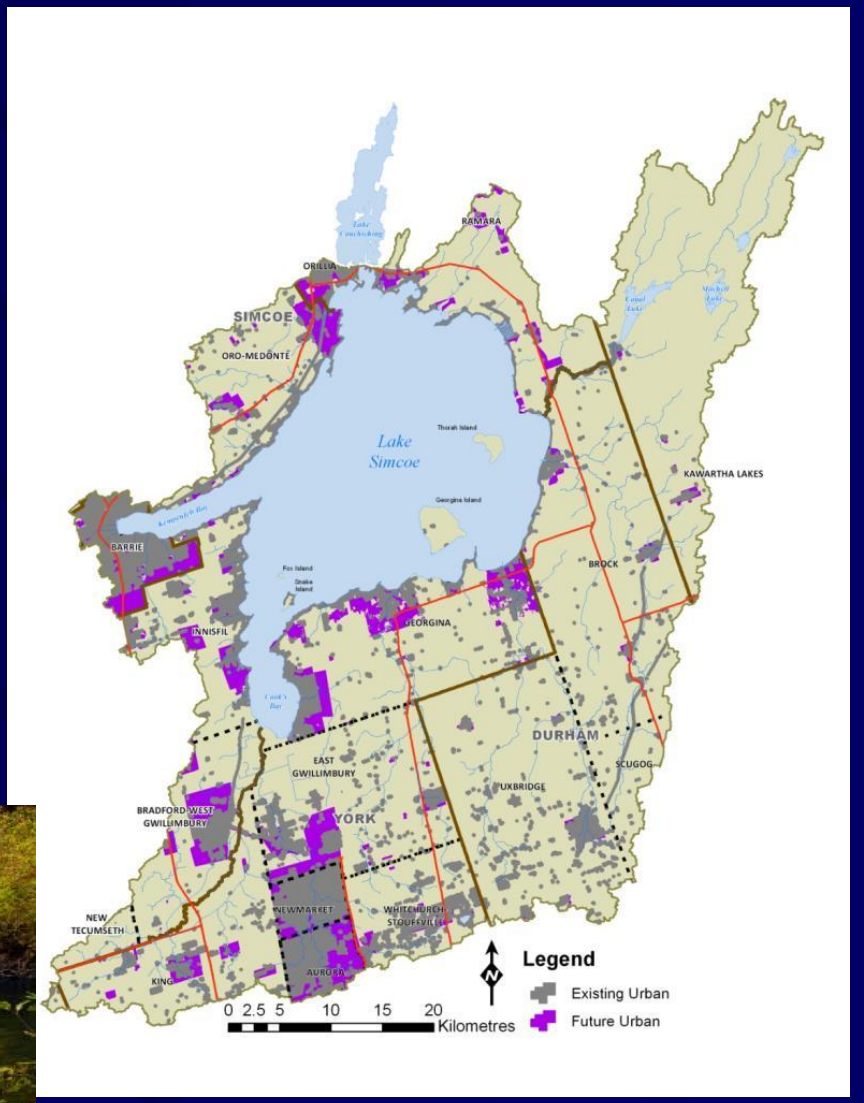
Phoslock Use for Algae / Eutrophication Control with Municipal SWM Pond Asset Plans (E.g. within the Lake Simcoe Basin)



Example Municipality in the Lake Simcoe Basin

Completed SWM Master Plan Per Legislated Requirements of the *Lake Simcoe Protection Plan*

- 31 opportunities for SWM pond retrofits
  - 8 "High retrofit"
  - 11 "Medium retrofit"
  - 12 "Low retrofit"

- Opportunities for Total Phosphorus (TP) reductions to Lake Simcoe about 128 kg/year

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GREENLAND® Case Study to Utilize Phoslock for Example SWM Pond Asset Plan

TWO MAIN COMPONENTS:

1) Maintenance to comply with current Certificate of Authorization (CofA) for all SWM facilities (i.e. sediment removal and nutrient loading to Lake Simcoe)

2) Capital Improvements to achieve future (i.e. soon) regulated *Lake Simcoe Protection Act* "TP - targets":
   - Expand SWM ponds through retrofits
   - Install (when appropriate) oil / grit separator devices

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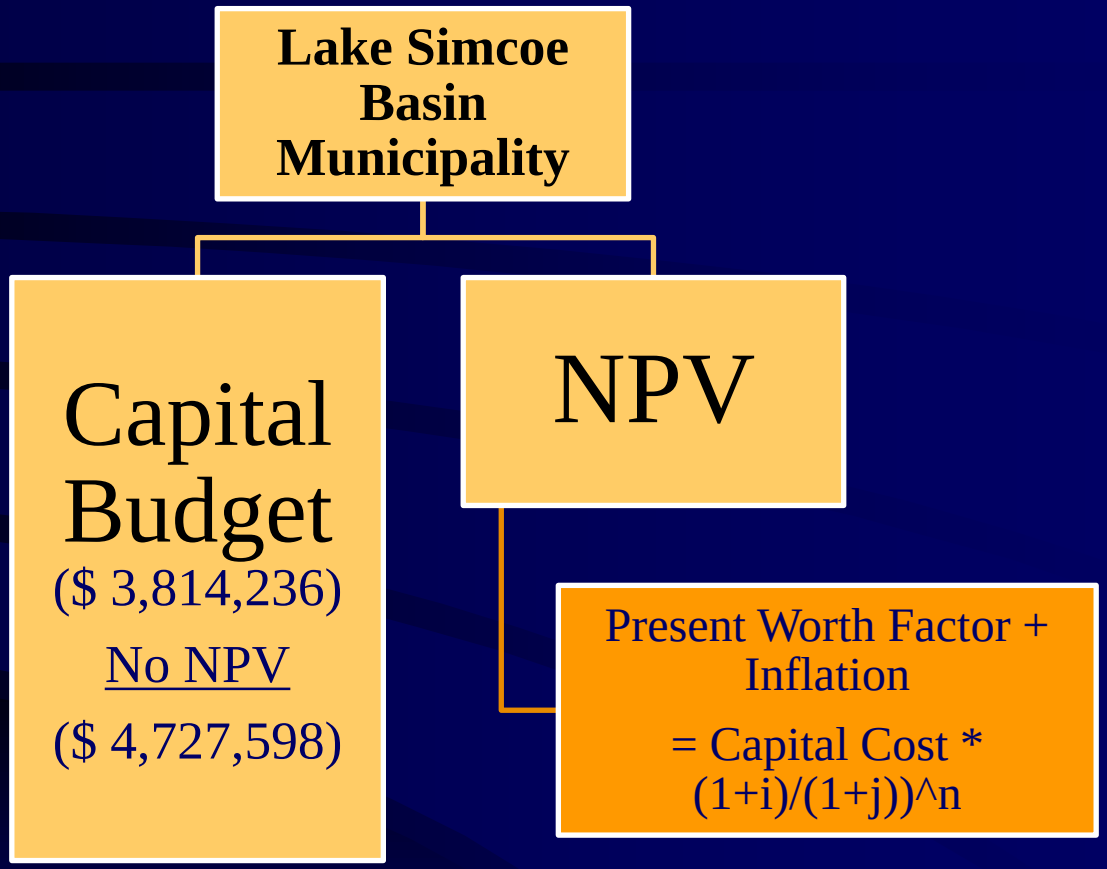
GREENLAND® Case Study to Utilize Phoslock for Example SWM Pond Asset Plan (cont'd)



*

i = 0.014

j = 0.06

Life Cycle Maintenance Alternatives

OPTION '1': 20 YEAR CYCLE

- Maintenance Cleanouts + Oil & Grit Separators + Maintenance Cost on ALL Wet Ponds

Note: Oil & Grit = 80% Removal of TSS = Less Sediment

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Option '1' - Financial Scenario

20 year Costing Projection – SWM Master Plan for Example Municipality in Lake Simcoe Basin

# of SWMFs	LID Retrofit Watershed Improvements	Grit Reduction (enhance) *	SWMF Treatment Upgrades (retrofit)	Cleanouts & Maintenance **	NPV Totals
9	$ 26,250.00	$ 180,000.00	$ -	$ 185,312.00	$ 185,312.00
9	$ 26,250.00	$ 60,000.00	$ 240,000.00	$ 441,466.83	$ 644,146.72
3	$ 15,750.00	$ 90,000.00	$ 240,000.00	$ 89,441.13	$ 376,043.93
9	$ 26,250.00	$ 60,000.00	$ 1,480,625.00	$ 573,117.41	$ 1,702,455.23
6	$ -	$ 30,000.00	$ -	$ 443,895.69	$ 906,278.77
36	**$ 94,500.00**	**$ 420,000.00**	**$ 1,960,625.00**	**$ 1,733,233.06**	**$ 3,814,236.66**

20 year Costing Projection – SWM Master Plan for Example Municipality in Lake Simcoe Basin
(with adjusted retrofit costs)

# of SWMFs	LID Retrofit Watershed Improvements	Grit Reduction (enhance) *	SWMF Treatment Upgrades (retrofit)	Cleanouts & Maintenance **	NPV Totals
9	$ 26,250.00	$ 180,000.00	$ -	$ 185,312.00	$ 185,312.00
9	$ 26,250.00	$ 60,000.00	$ 480,000.00	$ 441,466.83	$ 863,912.63
3	$ 15,750.00	$ 90,000.00	$ 480,000.00	$ 89,441.13	$ 595,809.84
9	$ 26,250.00	$ 60,000.00	$ 2,961,250.00	$ 573,117.41	$ 2,910,264.99
6	$ -	$ 30,000.00	$ -	$ 443,895.69	$ 1,126,044.68
36	**$ 94,500.00**	**$ 420,000.00**	**$ 3,921,250.00**	**$ 1,733,233.06**	**$ 5,681,344.14**

Life Cycle Maintenance Alternatives
(cont'd)

OPTION '2': Phoslock + 20 YEAR CYCLE

- Capital required for *Lake Simcoe Protection Plan* compliance
  - Manage SWM ponds with PHOSLOCK® through annual applications to ALL wet ponds scheduled for retrofitting (5 total from example SWM Master Plan).
  - Install additional Oil/Grit separators when appropriate for off-setting sediment cleanouts.

Note: Additional reductions in Total Phosphorus (TP) loadings for above wet ponds through Phoslock = 26 kg/year

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Option ‘2’ - Financial Scenario

20 year Costing Projection – SWM Master Plan for Example Municipality in Lake Simcoe Basin

# of SWMFs	LID Retrofit Watershed Improvements	Grit Reduction (enhance) *	SWMF Treatment Upgrades (retrofit)	Cleanouts & Maintenance **	NPV Totals
9	$ 25,083.33	$ 180,000.00	$ -	$ 185,312.00	$ 185,312.00
9	$ 23,333.33	$ 120,000.00	$ -	$ 195,818.99	$ 282,341.59
3	$ 15,750.00	$ 90,000.00	$ -	$ 149,724.56	$ 209,220.30
9	$ 26,250.00	$ 180,000.00	$ 990,468.75	$ 805,877.14	$ 1,596,613.93
6	$ -	$ 30,000.00	$ -	$ 401,562.21	$ 697,960.62
36	**$ 90,416.67**	**$ 600,000.00**	**$ 990,468.75**	**$ 1,738,294.90**	**$ 2,971,448.44**

20 year Costing Projection – SWM Master Plan for Example Municipality in Lake Simcoe Basin
(with adjusted retrofit costs)

# of SWMFs	LID Retrofit Watershed Improvements	Grit Reduction (enhance) *	SWMF Treatment Upgrades (retrofit)	Cleanouts & Maintenance **	NPV Totals
9	$ 25,083.33	$ 180,000.00	$ -	$ 185,312.00	$ 185,312.00
9	$ 23,333.33	$ 120,000.00	$ -	$ 195,818.99	$ 282,341.59
3	$ 15,750.00	$ 90,000.00	$ -	$ 149,724.56	$ 209,220.30
9	$ 26,250.00	$ 180,000.00	$ 1,980,937.50	$ 805,877.14	$ 2,392,588.29
6	$ -	$ 30,000.00	$ -	$ 401,562.21	$ 697,960.62
36	**$ 90,416.67**	**$ 600,000.00**	**$ 1,980,937.50**	**$ 1,738,294.90**	**$ 3,767,422.81**

GREENLAND® Case Study to Utilize Phoslock™ for Example SWM Pond Asset Management Plan (cont'd)

Option '1': NPV SWM Master Plan
= $3,814,236.66

= $5,681,344.14 *

Option '2': NPV with PHOSLOCK® Applications
= $2,971,448.44

= $3,767,422.81 *

* (with adjusted GREENLAND® tender - based retrofit costs)

Potential Savings "for" LID (Source Control) Re-investment!

= **$842,788.22**

Up to…

= **$1,913,921.33** *

* (with adjusted GREENLAND® tender - based retrofit costs)

Integrated Engineering & Landscape Architecture Design and Construction Management Services for LID Projects

Low Impact Development (LID) is a stormwater management and land development strategy applied at the parcel and subdivision scale. This strategy emphasizes **conservation** and use of on-site natural features, integrated with engineered, small-scale hydrologic controls to more closely **mimic** pre-development hydrology.

The goal of LID is to prevent measurable harm to streams, lakes, wetlands and other natural aquatic systems from commercial, residential or industrial sites. LID technologies and related design practices are used by Greenland's clients (and wherever feasible from functional perspectives) for land development projects.

A "Greenland-LID" strategy can include:

- Green Roofs and Living Walls;
- Rainwater Harvesting;
- Artificial Floating Islands;
- Permeable Pavement;
- Bio-swales; – (and more!).

Benefits of Better Site Designs Using a Low Impact Development (LID) Approach

- Reduce volume of storm water generated.
- Better water quality and recharge.
- Save $ on infrastructure (compared to conventional options).
- Enhances diversity in the housing market.
- Integrates with connectivity and pedestrian friendly goals.
- Marketable housing.

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"The famous balance of nature is the most extraordinary of all cybernetic systems. Left to itself, it is always self-regulated" – Joseph Wood Krutch