

Urban Flooding and Stormwater Initiatives in Thunder Bay



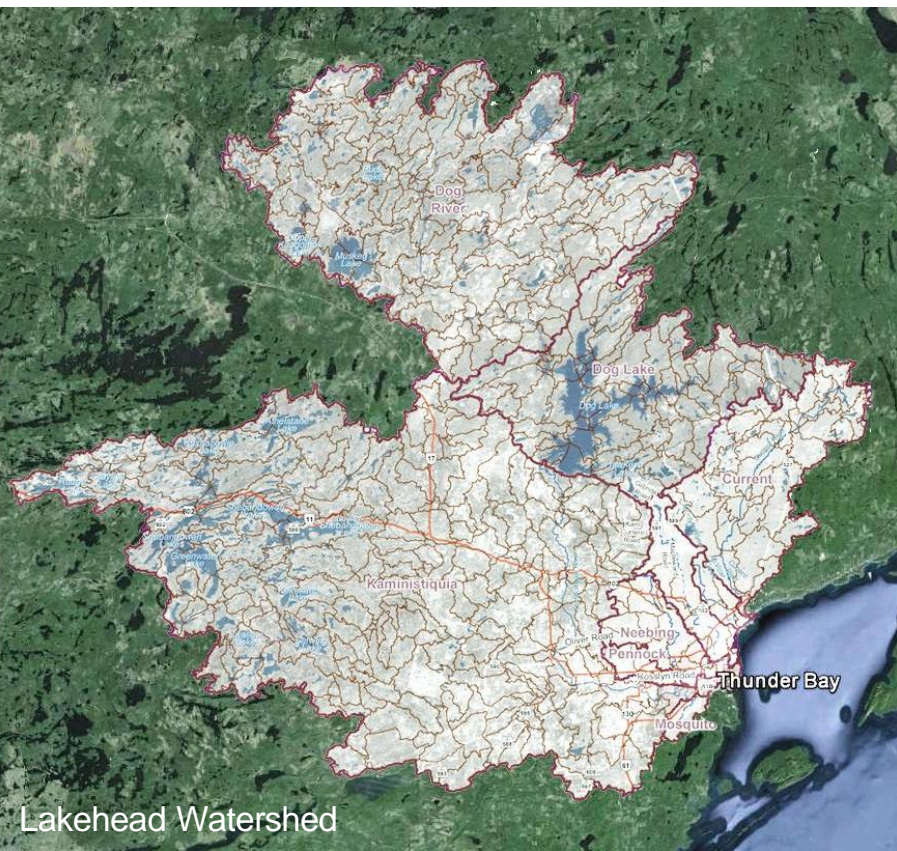
Municipal Engineers Association – Annual General Meeting

November 2018



Aaron Ward, P. Eng.
Project Engineer
Engineering & Operations Division

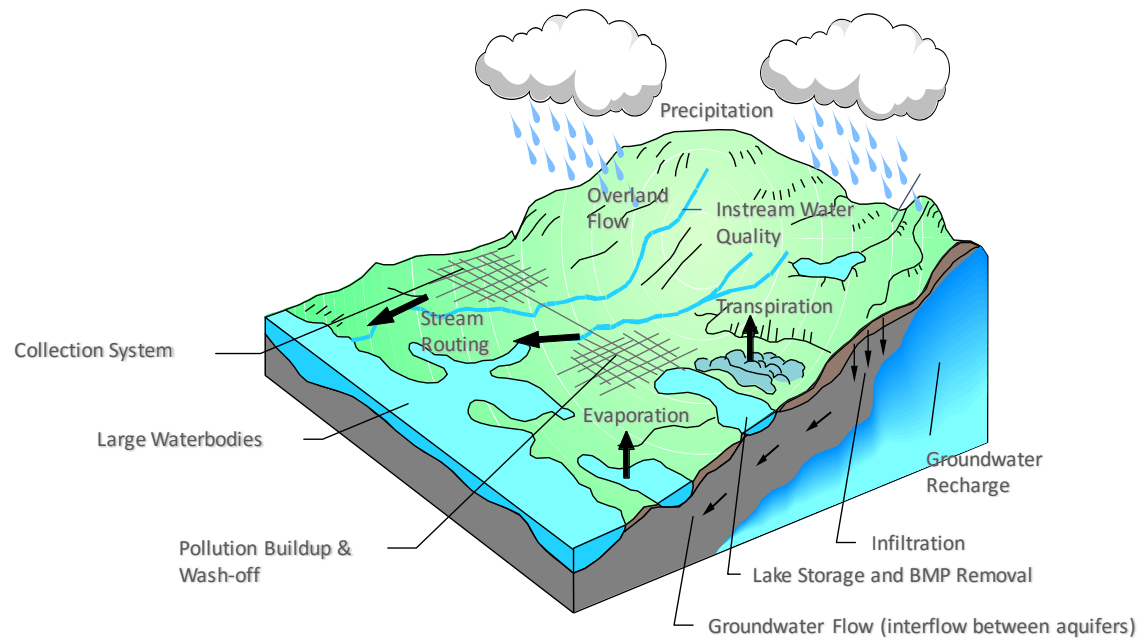
Thunder Bay - Overview



- 109,000 people (2011 census)
- 323km² total area & 130km² developed area
- Lakehead watershed – 8,930km²
- 8 sub-watersheds
 - Current River
 - Kaministiquia River
 - McVicar Creek
 - McIntyre River
 - Mosquito Creek
 - Neebing River
 - Pennock Creek
 - Waterfront Watershed
- 712mm annual precipitation
 - 559mm rainfall & 188cm snowfall

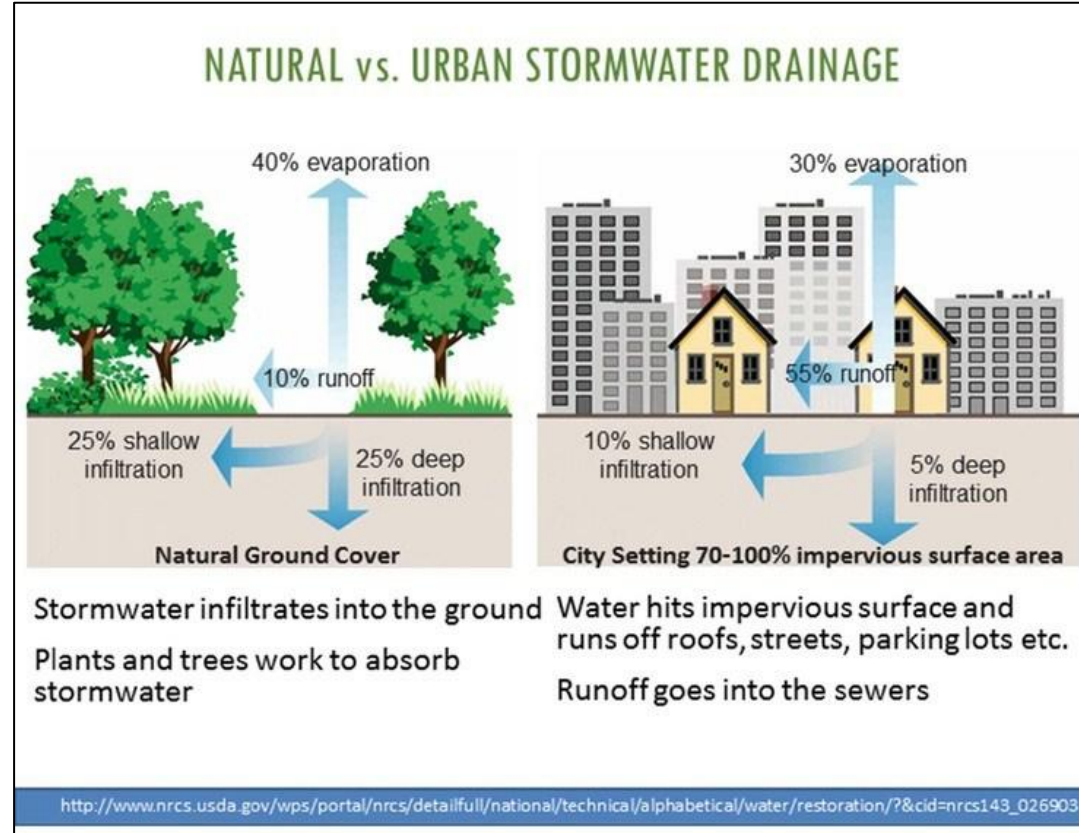
What is Stormwater Management?

- Capture/collection, storage/treatment and conveyance of water in response to rainfall and snowmelt
- Legislative requirements have evolved significantly from traditional “drainage”
 - Hazard protection
 - Quality treatment
 - Volume reduction
 - Watershed health



What is Stormwater Management?

- In general, urban development typically results in 5x more runoff (or more) – assuming no stormwater controls on-site
- Increased pollution and impacts to rivers & environment
- Increased downstream flooding



One Drop (Video)



Courtesy of: Green.AmericanRivers.org

<https://www.youtube.com/watch?v=vMallfLsfOc&feature=youtu.be>

Thunder Bay

- No stranger to flooding & urban flooding
- Impacts felt throughout City in a variety of forms
- Climate change compounding the severity and frequency of events



Hydrant! But
where's the road?

Thunder Bay

- May 2012 – Disaster and State of Emergency Declared
- Approximately 40 mm of rain fell on May 24
- May 28 - Series of heavy thunderstorms formed and re-formed over City. Environment Canada rain gauges recorded between 91 and 97 mm, LRCA rain gauge exceeded 110 mm

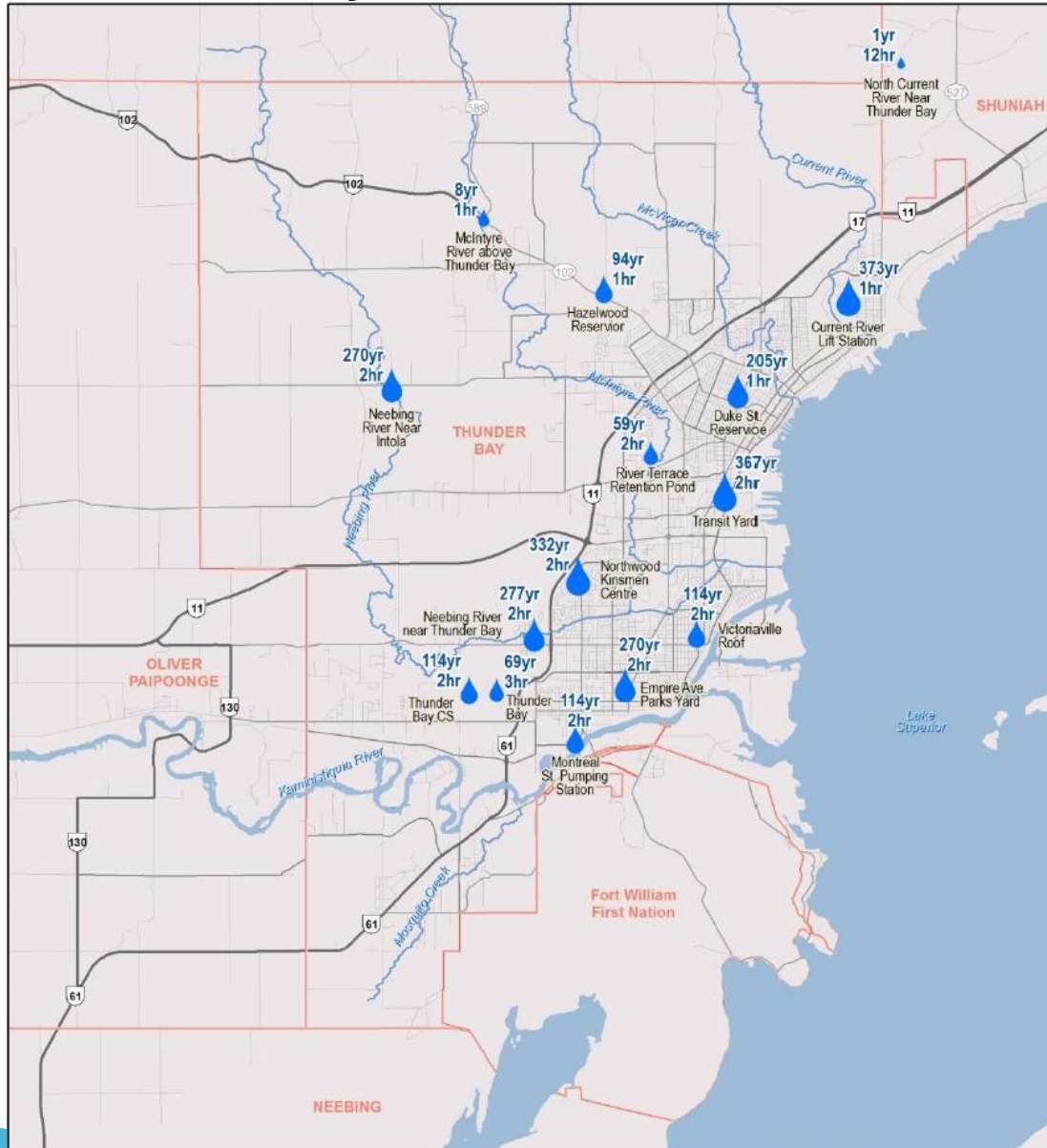


Thunder Bay

May 2012



Thunder Bay



June & November 2016

25mm to 90mm rain – varied widely throughout City

Majority within a 3-hour period

Late fall / winter rains becoming more common

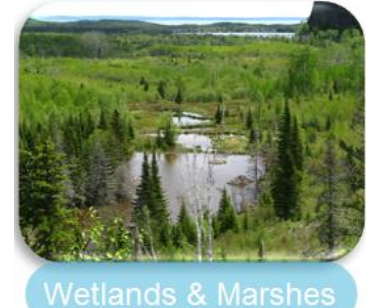
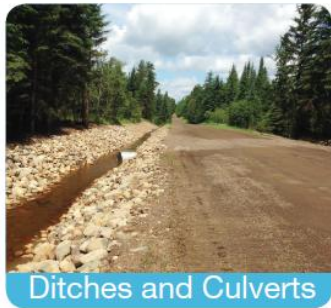
Thunder Bay



June 2016

Stormwater Management Infrastructure

– What is the City's Stormwater Infrastructure?



330km of sewers, 4,200 manholes, 11,000 catch basins, 486km ditches, 45 treatment facilities, 4 pumping stations

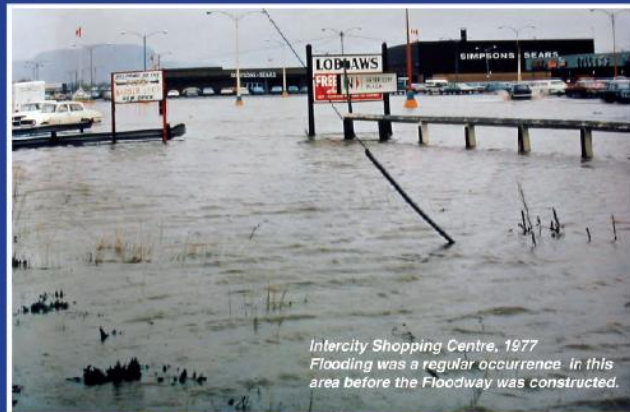
Stormwater Management Infrastructure

Neebing-McIntyre Floodway

1984 - 2009

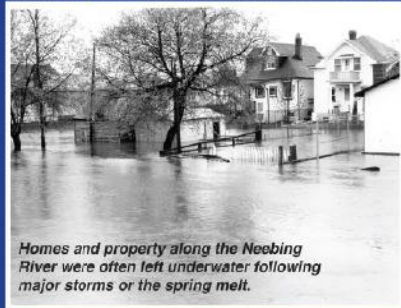
25 Years of Flood Protection

The Problem...



Intercity Shopping Centre, 1977
Flooding was a regular occurrence in this area before the Floodway was constructed.

Historically, flooding along the Neebing and McIntyre Rivers was a common occurrence in the spring when melting snow, runoff and spring rains would often cause the rivers to overflow their banks, damaging homes and businesses. Flooding also occurred after intense storms.



Homes and property along the Neebing River were often left underwater following major storms or the spring melt.

It was not uncommon for yards and parking lots to be under several feet of water. The presence of the Floodway has enabled significant development in the Intercity area.

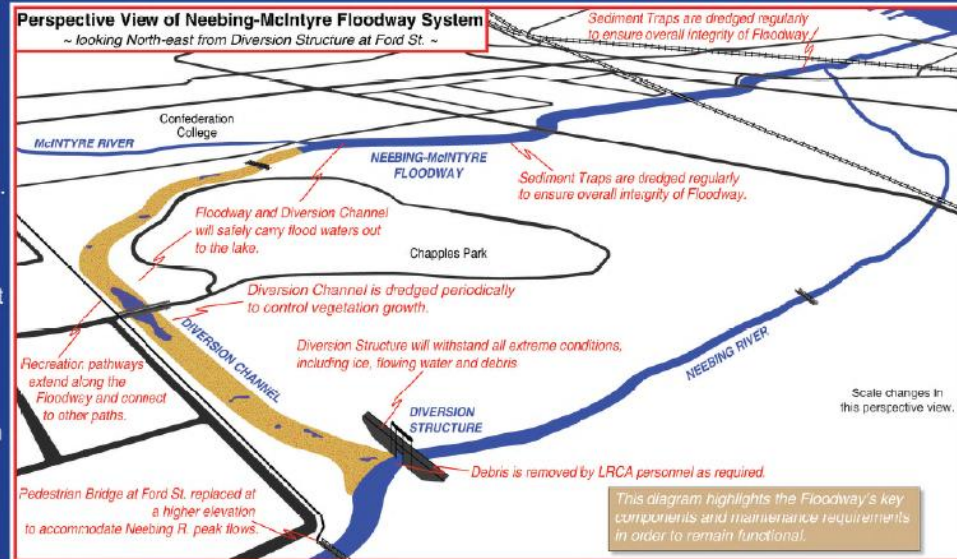
The Solution...

In the early 1970's the Lakehead Region Conservation Authority approached the engineering firm of Proctor and Redfern to come up with ideas to resolve the flooding problem.

Their plan called for a diversion structure, constructed near Ford Street and Parkway Drive, which would restrict water flow on the Neebing River east of Ford Street by diverting excess flows into a diversion channel around Chapple's Golf Course and into the McIntyre River. The plan called for widening three kilometres of the McIntyre River from William Street, near Confederation College, to Lake Superior.

The budget for the project was set at \$15-million. The City of Thunder Bay contributed \$3.75-million while the Provincial Government provided the balance of the funding.

Construction began in 1979 and the Floodway was completed in 1984, one year ahead of schedule and under budget!



In 1954 the Neebing Valley Conservation Authority was created by an Order in Council to deal with flooding problems. At the time the Authority's area of jurisdiction was the Neebing River Watershed which extended 48 kilometres inland from Lake Superior and included the City's of Fort William and Port Arthur as well as the Townships of Neebing, Palpoonge, McIntyre and Oliver.

In 1963, under the Conservation Authorities Act and by an Order in Council, the name was changed to the Lakehead Region Conservation Authority and the area of jurisdiction was enlarged to include what are now known as the City of Thunder Bay, Municipalities of Shuniah, Neebing and Oliver, Palpoonge as well as the Townships of Dorion, Cormier, O'Connor and Gillies.

The Neebing-McIntyre Floodway is owned & maintained by:



LAKEHEAD REGION
CONSERVATION AUTHORITY

Stormwater Management Infrastructure

Neebing-McIntyre Floodway

1984 - 2009

25 Years of Flood Protection

The Mechanics...



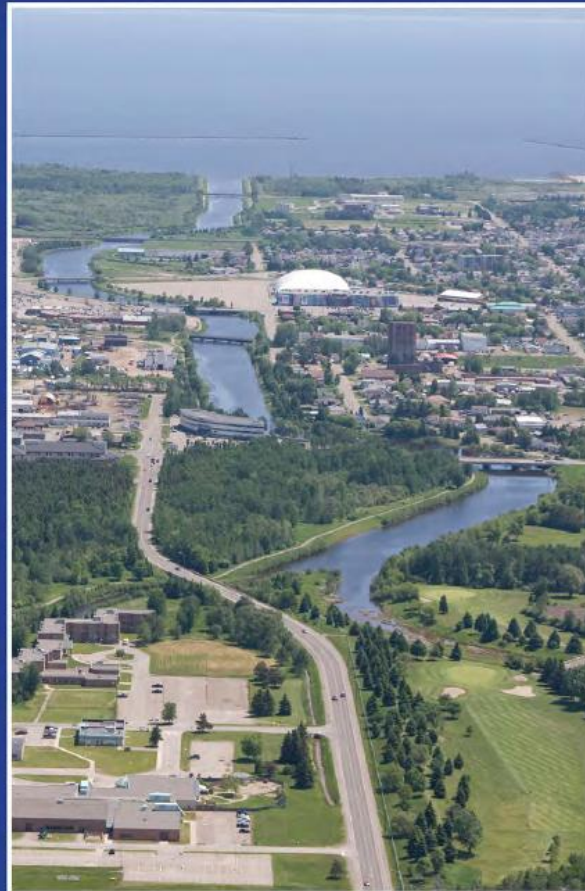
No decisions need to be made to activate the Neebing-McIntyre Floodway in the event of a flood.

The Diversion Structure, located on the Neebing River near Ford Street and Parkway Drive, has an opening which limits the flow on the Neebing River. When water levels exceed the design capacity of the opening, water is re-directed down the Diversion Channel and into the Floodway Channel/McIntyre River.

The Floodway is designed to handle a Regional Storm which would result in 193 mm/7.6 inches of rain in a 12-hour period.

Since 1984, the Floodway has experienced almost yearly demand, usually diverting in the spring as well as following intense storms. By reducing the risk of flooding in the Intercity area, significant development has been able to take place.

A Better Place to Live...



Construction of the Neebing-McIntyre Floodway has provided a valuable legacy to the City of Thunder Bay.

A vast green space was created along the Floodway.

In partnership with the City of Thunder Bay, the Lakehead Region Conservation Authority (LRCA) has constructed six kilometres of access pathways along the Floodway which connect to the City's network of Recreation Trails.



The budget for the project included funding for five new bridges which would not have been built at the time were it not for the Floodway. The bridges are located on Island Drive, Fort William Road, Memorial Avenue, William Street and Balmoral Street.

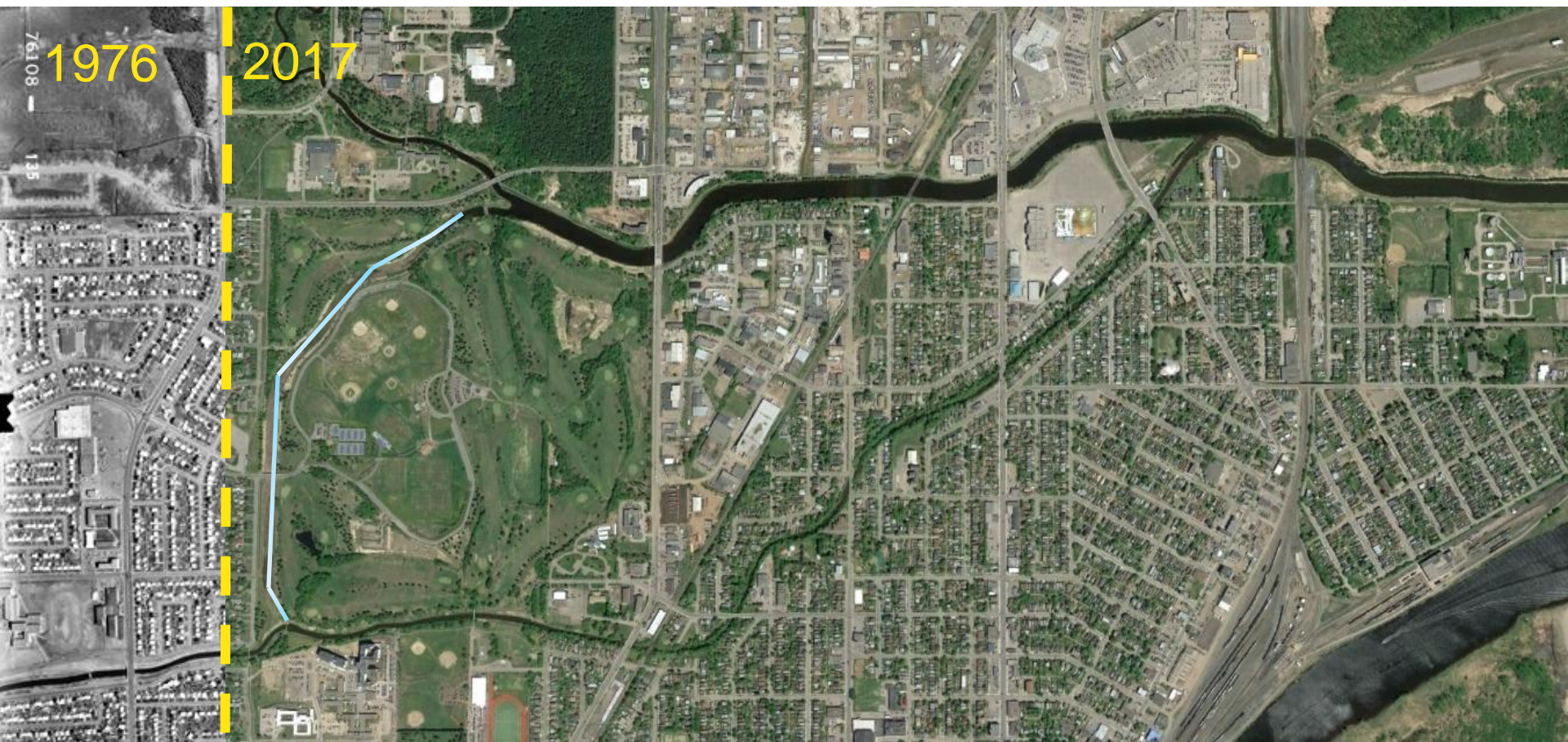
The Neebing-McIntyre Floodway continues to protect the City of Thunder Bay more than a quarter of a century after construction.

The Neebing-McIntyre Floodway is owned & maintained by:

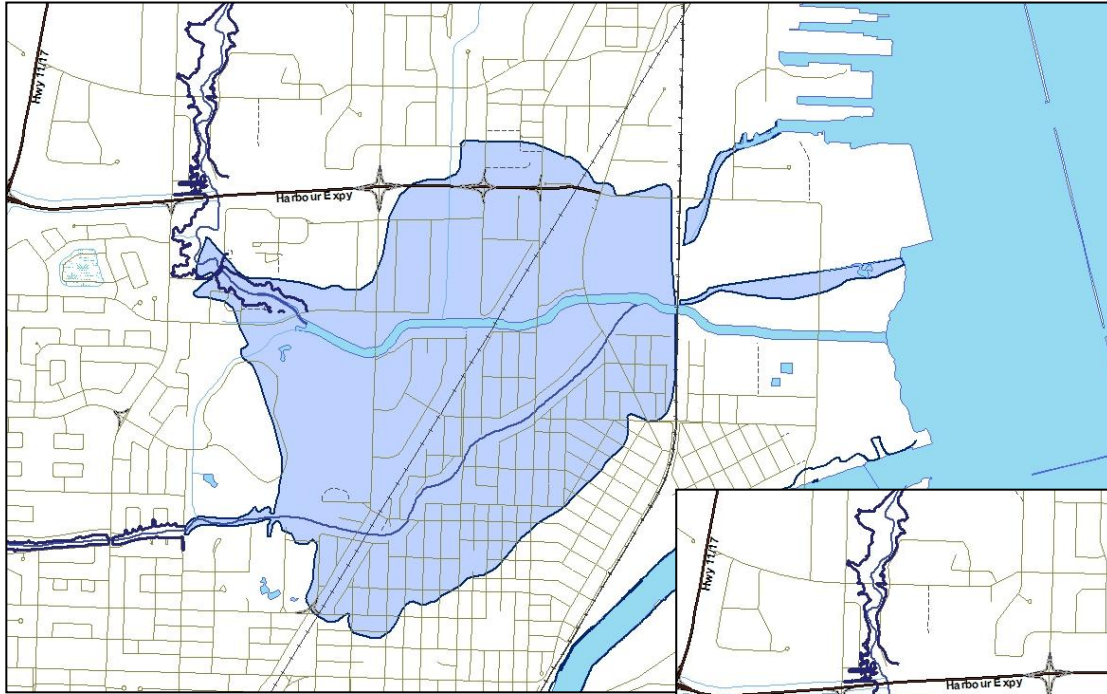


LAKEHEAD REGION
CONSERVATION AUTHORITY

Stormwater Management Infrastructure



Stormwater Management Infrastructure



Estimated Floodplain prior to the Floodway (pre-1984)



Estimated Floodplain after Floodway (post-1984)

Report Card – Asset Management

- From the 2016 Asset Management Plan...
 - Average spending from 2011-2015 was \$2.9 million annually
 - Capital funding should amount to \$6.2 million annually

This equates to a **\$3.3 million annual funding gap and grade of D.**

Funding vs Need



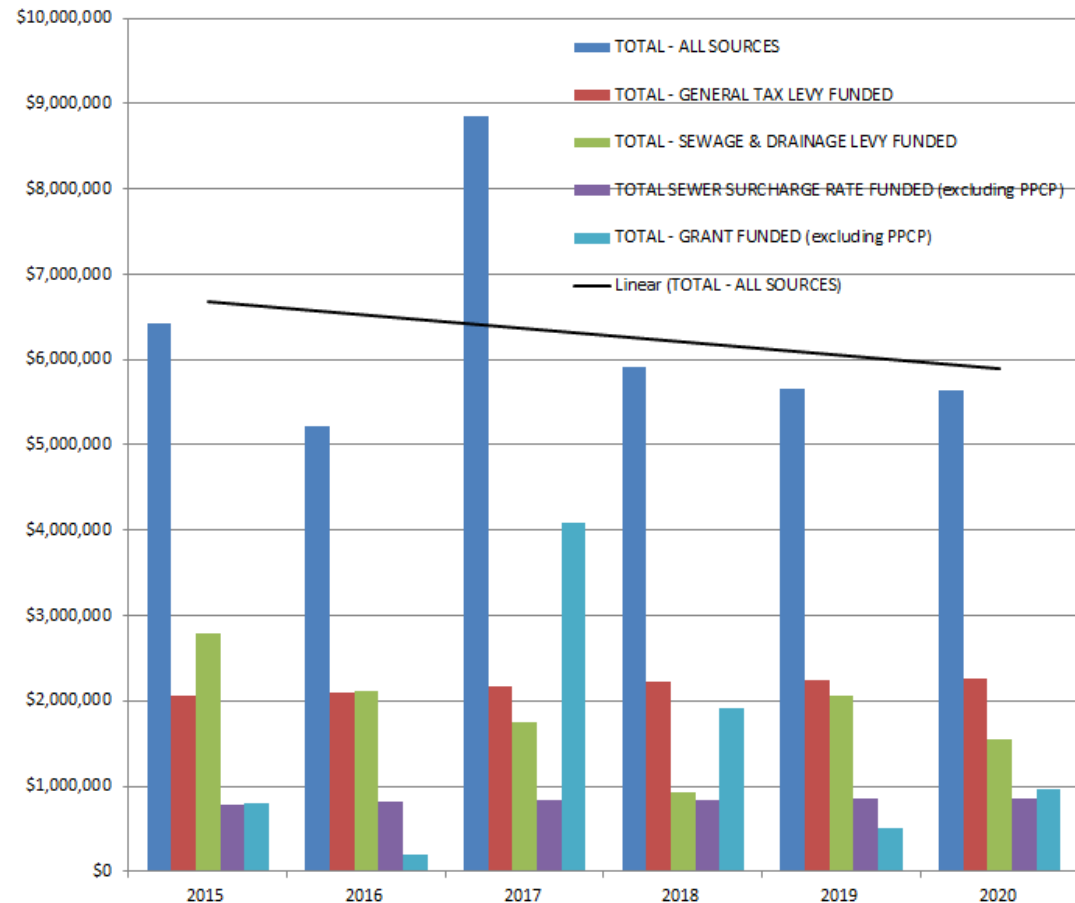
Note: Does not include:

- all current assets, such as ditches, culverts, and treatment facilities
- the construction of new, or larger, infrastructure and treatment facilities

Stormwater Expenditures & Financing

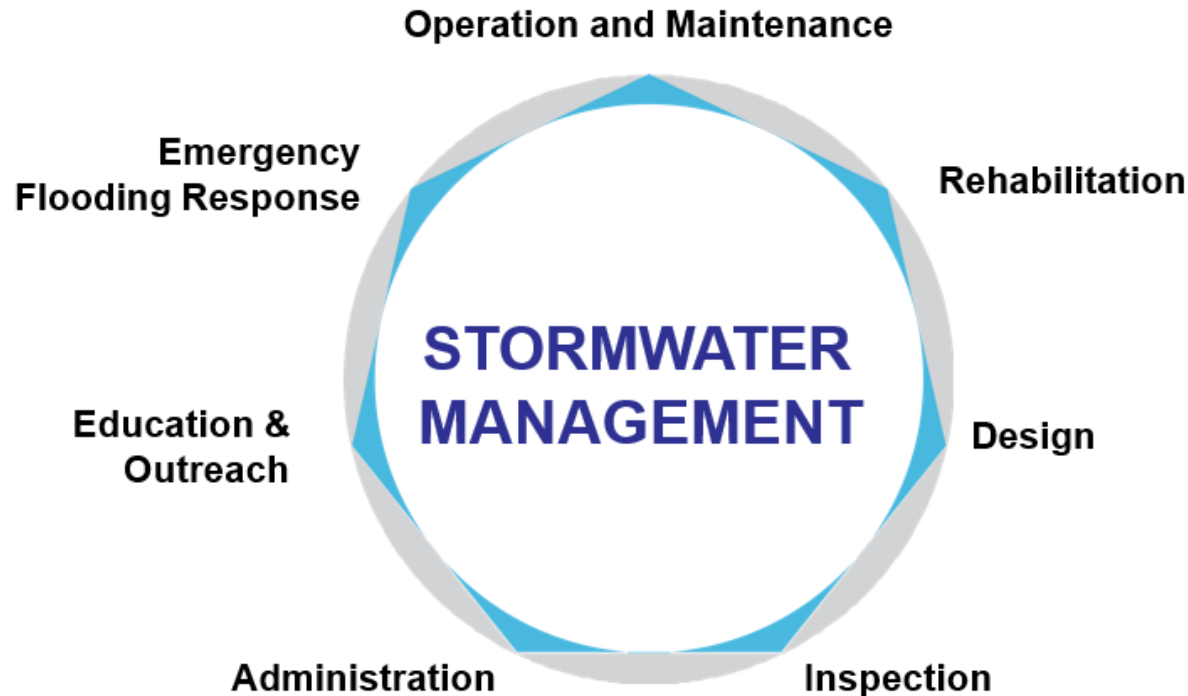
- Avg. \$6-million annual expenditures on stormwater works
- O&M - \$1.8M avg.
- Capital & Programs - \$3.2M avg.
- LRCA - \$1M avg.

(average from 2015 to 2018 actual & current budgets to 2020)



What is Thunder Bay Currently Doing?

- The City is responsible for protecting public health & safety as well as the environment by managing the quality and quantity of stormwater reaching our lakes and rivers

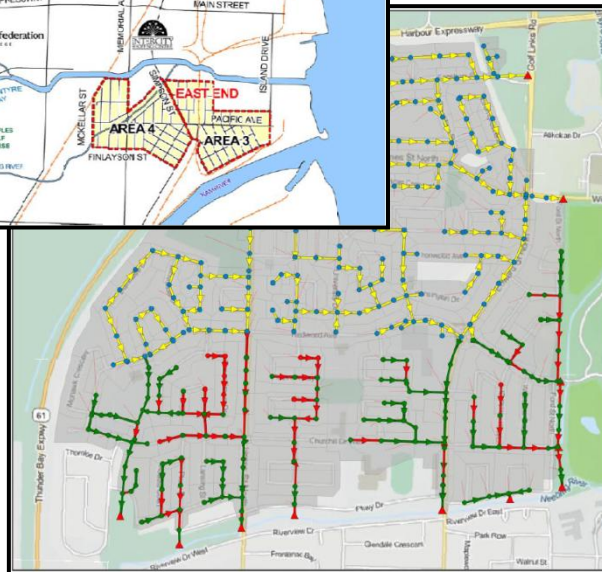
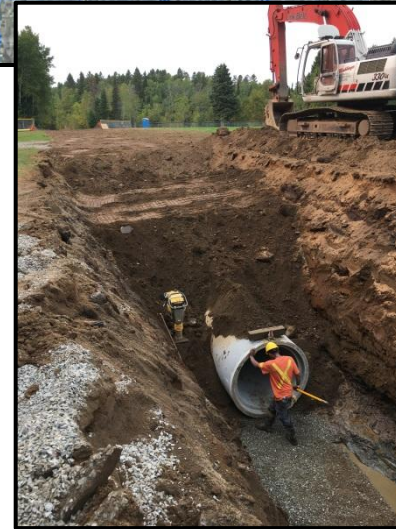
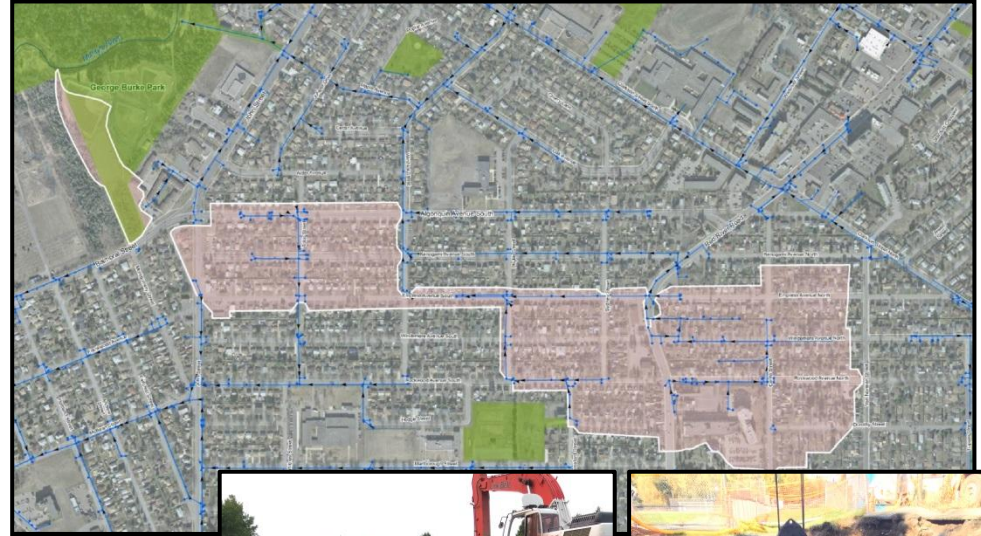
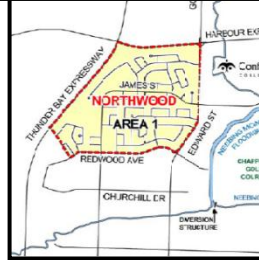
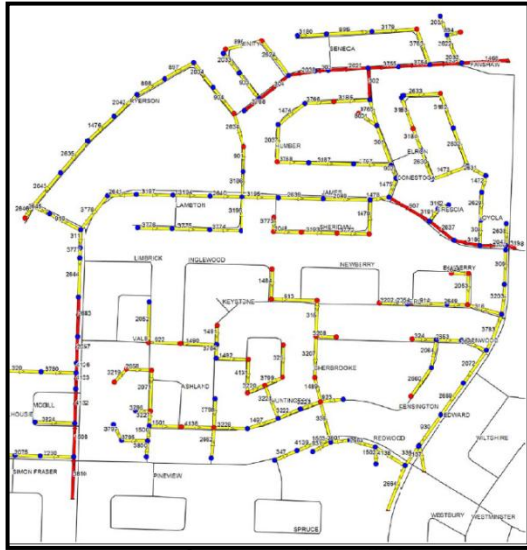


Design & Rehabilitation (Capital Replacement)



Design & Rehabilitation (Capital Replacement)

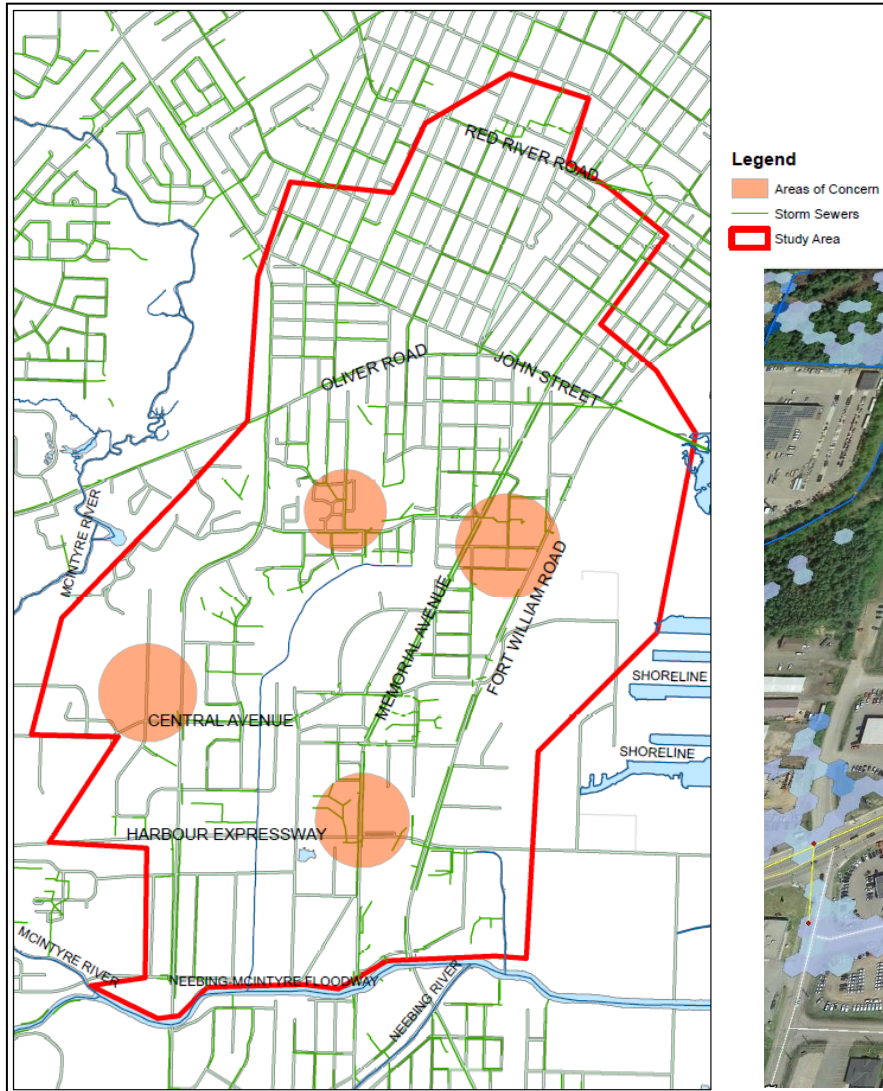
Empress Avenue – Storm Relief (2015)



Neighbourhood Master
Stormwater Drainage
Study (2014) &
Northwood Expanded
Limits (2015)

Design & Rehabilitation (Capital Replacement)

- Studies & enhanced modeling to better direct capital improvement efforts
- Sample below from InterCity Drainage Study currently underway



Operation & Maintenance

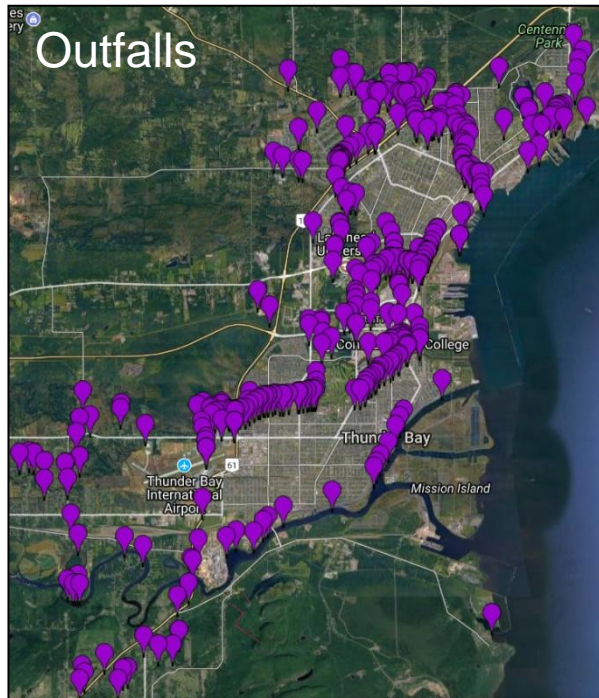


Operation & Maintenance

- Lyon Channel Trunk Ditch
Cleaning – Before & After



Inspections



Outfall Inspections



Treatment Facility Inspections



Education & Outreach



Assistance & Rebate Programs

2018 Residential Drainage Rebate Program

Protect your house from flooding!

Drainage rebates are available to non-profit organizations, such as churches or co-op housing. Homeowners who qualify for the City of Thunder Bay Property Tax and Water Credit Programs for Low-Income Seniors and Low-Income Persons with Disabilities are eligible for additional rebates up to 80% of the invoiced cost of the work completed.

Drainage Measure

Rebate

Sump Pump 50% of the invoiced cost up to a maximum of \$1,500.00 including labour, materials, permit and taxes

Backflow Prevention Valve 50% of the invoiced cost up to a maximum of \$1,750.00 including labour, materials, permit and taxes

Disconnect Weeping Tile 100% up to a maximum of \$500.00 including labour, materials, permit and taxes

Installation of new Storm Sewer Connection 50% of the invoiced cost up to a maximum of \$1,500.00 including labour, materials, permit and taxes

ecosuperior
ENVIRONMENTAL PROGRAMS
ecosuperior.org

Expanded in 2018 to include 50% up to \$1,500 for re-directing foundation drainage from sanitary sewer to storm sewer system.
Total rebates up to \$5,000.

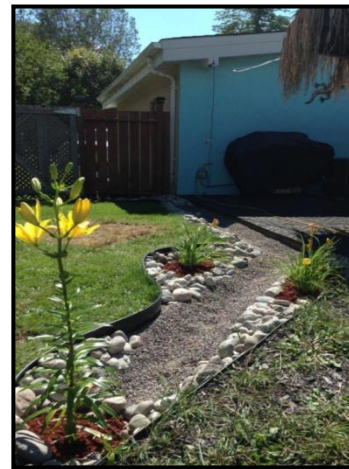


THUNDER BAY
TREE STEWARDSHIP PROGRAM

Street tree (boulevard) planting for \$175 (1/3 of cost).

Rain Garden Rebate Program

Rebates up to \$500
(open to businesses as well)



Understanding and Improving Your Residential Drainage

ecosuperior ENVIRONMENTAL PROGRAMS
CITY OF Thunder Bay Superior by Nature

Rain Barrel Rebate Program

\$20 discount



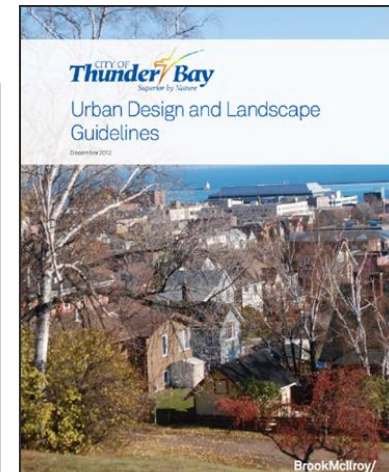
CITY OF
Thunder Bay
Superior by Nature

Plans / Strategies / Policy / Guidelines / Standards

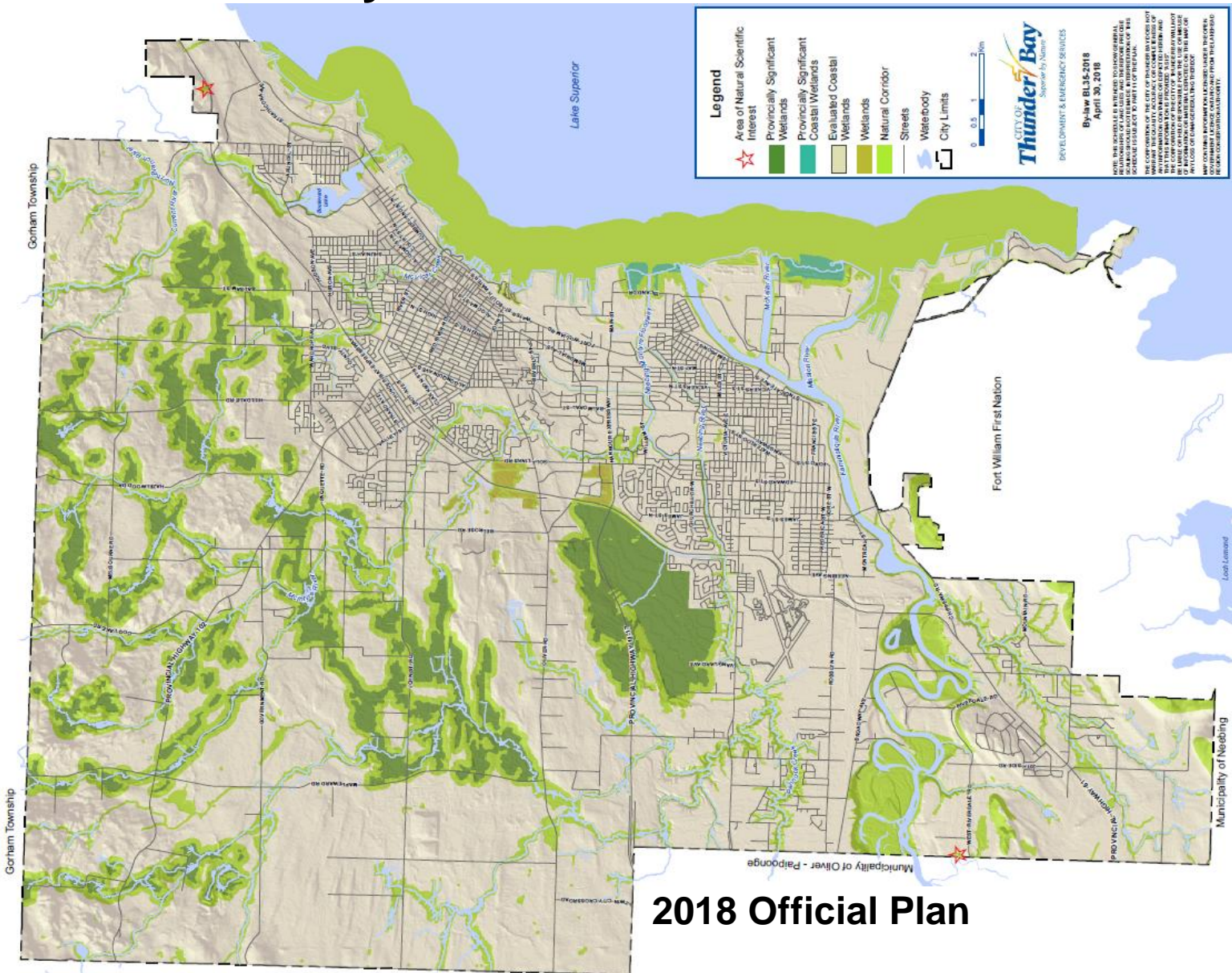
CORPORATION OF THE CITY OF THUNDER BAY

CITY OF Thunder Bay
Superior by Nature

ENGINEERING
AND
DEVELOPMENT
STANDARDS



Thunder Bay Official Plan



- Protected wetlands now cover 4,620ha within the City.
- Additional wetland evaluations underway (LRCA)
- Estimated 13,860,000m³ of stormwater storage in wetlands.

2018 Official Plan

Urban Forest Management Plan (2011)

- \$552,362
- Reduction of 78,606 cubic meters of runoff

Stormwater



- \$455,908
- Electric and gas savings of 2383 megawatts, and 319,000 Therms

Energy Conservation



- \$403,056
- Increased property values
- Increased wildlife
- Increased Social Experiences and Quality of Life

Aesthetics/ Social



- \$77,383
- Absorption of 13,525kg of pollutants
- Oxygen released where citizens live and breathe
- Interception of particulates and other pollutants

Air Quality



- \$67,718
- Reduction of 2,500,000kg of CO2
- Reduce City's contribution to issues such as climate change, heat zones and island effects

CO2

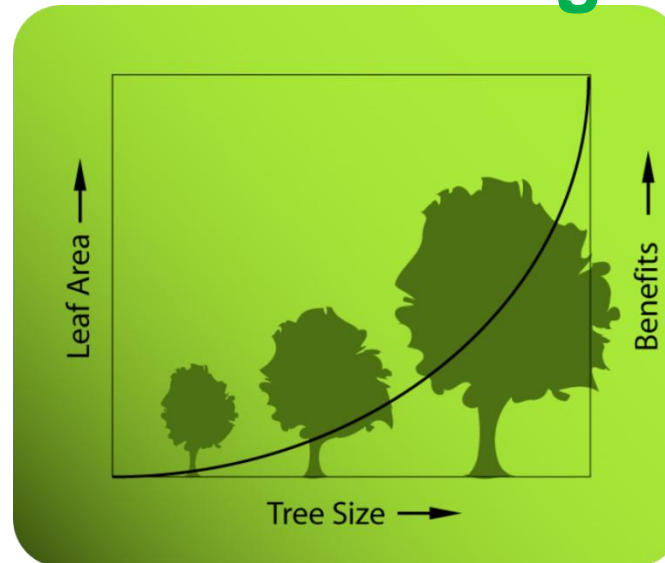


- \$1.6M benefits from urban street trees / year



30,000 street trees

Better with age



Urban Forest Management Plan (2011)



Citizen Pruner Program &
Young Tree Pruning



Tree Watering Bags
(75l / 20 usg bags for 2-years)

Public & Private Initiatives

- Arbor Day
- Tree Stewardship Program
- Community Group Initiatives
- Commemorative Trees
- Private Tree Planting Program



2016 Stormwater Management Plan

- Adopted by Council in 2016, this plan will guide the City's stormwater management actions for the next 20 years, based on the following goals:



ECOSYSTEM HEALTH



WATERSHED QUALITY



WATER QUANTITY



OPERATIONS and MAINTENANCE



MONITORING and DATA ASSESSMENT



FUNDING and ORGANIZATION



CLIMATE CHANGE

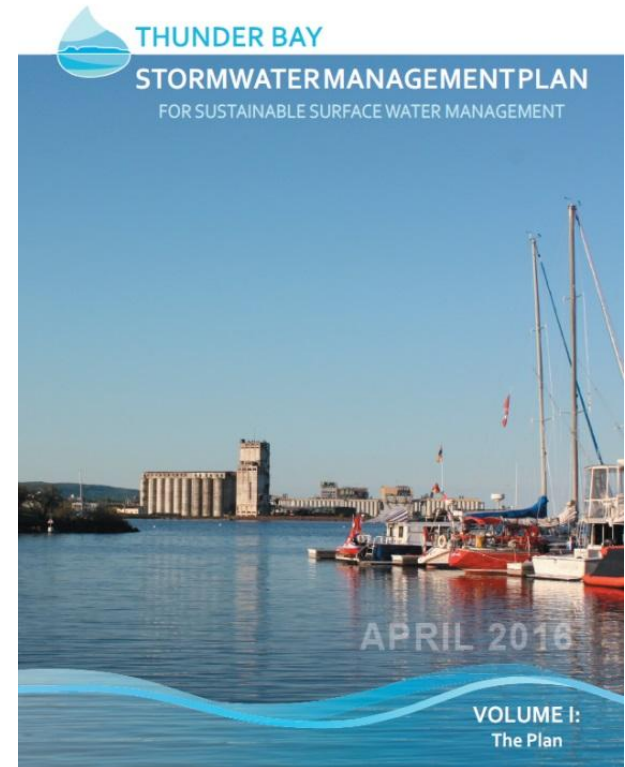


REGULATION and ENFORCEMENT



EDUCATION and OUTREACH

- Stormwater Financing Study currently underway



New Green Infrastructure & Stormwater Facilities

McIntyre Watershed- BMP Map,

BMP Types shown:

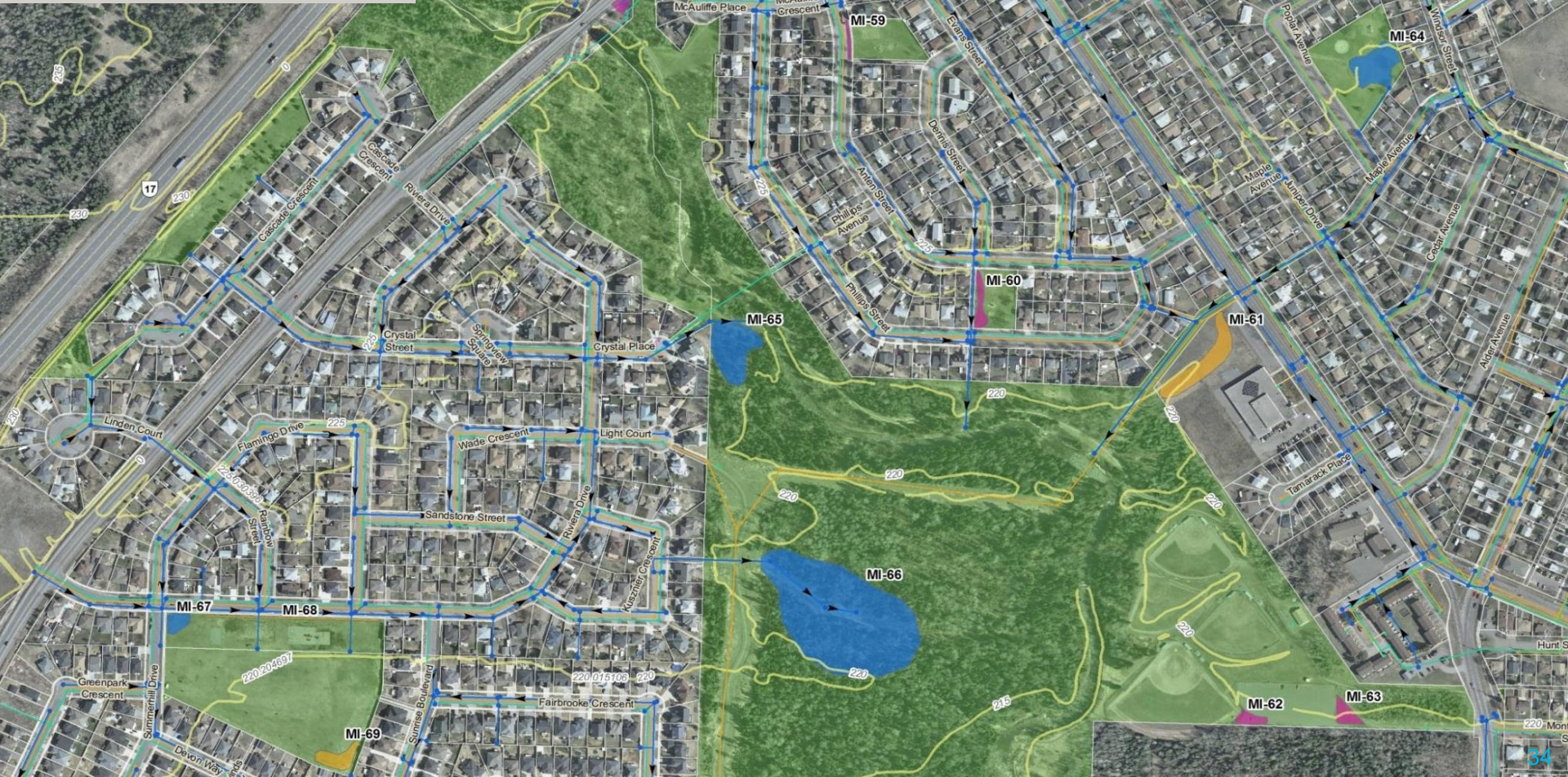
- Detention
- Filtration
- Infiltration

- Detention
- Filtration
- Infiltration

Filtration

Infiltration

Infiltration



New Green Infrastructure & Stormwater Facilities

Watershed	Total # of BMPs	Benefits		
		Total TP Removal (kg/yr)	Total TSS Removal (kg/yr)	Total Volume Reduction (m ³ /yr)
Current	83	233	81,780	260,100
Kaministiquia	62	716	803,700	691,700
McIntyre	136	968	647,400	656,000
McVicar	27	17	4,922	19,350
Mosquito	17	5	1,359	12,590
Neebing	161	513	338,400	779,000
Pennock	9	3	1,273	8,347
Waterfront	57	311	169,200	355,800
Total	552	2,765	2,048,034	2,782,887

Range in Total Present Cost (CAD)	Number of BMPs
\$0 – 10,000	39
\$10,000 - \$50,000	117
\$50,000 - \$100,000	108
\$100,000 - \$500,000	236
\$500,000 - \$1,000,000	36
\$1,000,000 - \$3,000,000	16

- By end of 2018, +/-30 stormwater facilities built (excludes OGS's), majority within last 5-years.
- For Green Infrastructure facilities, +/-18.4ha (45 acres) drain through these facilities.
- In 2017 / 2018, +/-20,000m³ treated annually in 13 new Green Infrastructure facilities.

New Green Infrastructure & Stormwater Facilities

Edward & Parkway



Victoria & Walnut



Victoria & Tarbutt



George Burke Park



New Green Infrastructure & Stormwater Facilities



New Green Infrastructure & Stormwater Facilities



New Green Infrastructure & Stormwater Facilities



New Green Infrastructure & Stormwater Facilities



New Green Infrastructure & Stormwater Facilities



Winnipeg Street

New Green Infrastructure & Stormwater Facilities



- Need for on-going erosion control during construction
- Need for full-time inspection

Lessons Learned

- Keep facility off-line until complete
- Contractor & sub-contractor engagement



- Consistent soil testing before installation & after installation.
- Infiltration rate testing after installation, before planting.
- Stronger & clearer contract documents

Residential Drainage Rebate Program

2018 Residential Drainage Rebate Program

Protect your house from flooding!

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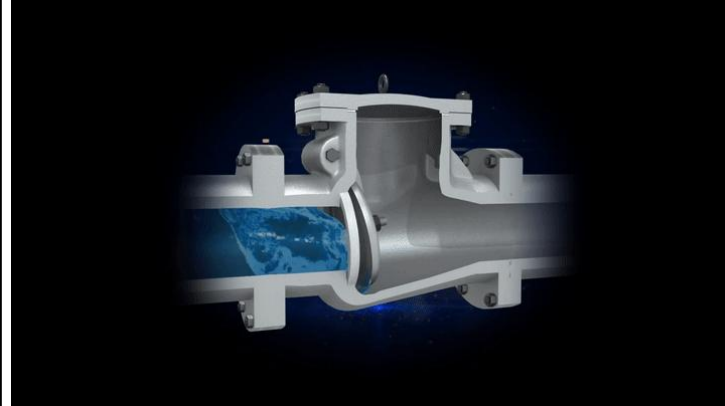
Drainage rebates are available to non-profit organizations, such as churches or co-op housing. Homeowners who qualify for the City of Thunder Bay Property Tax and Water Credit Programs for Low-Income Seniors and Low-Income Persons with Disabilities are eligible for additional rebates up to 80% of the invoiced cost of the work completed.

Drainage Measure

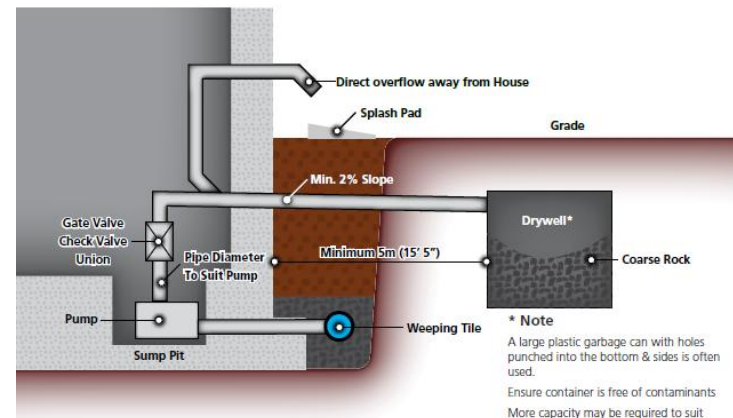
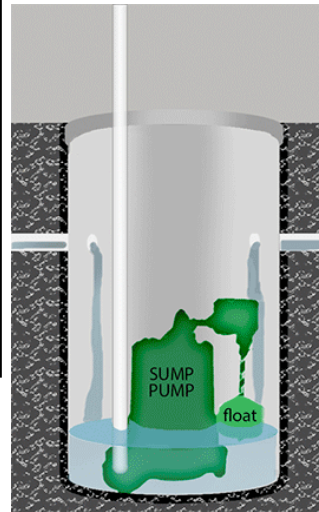
Rebate

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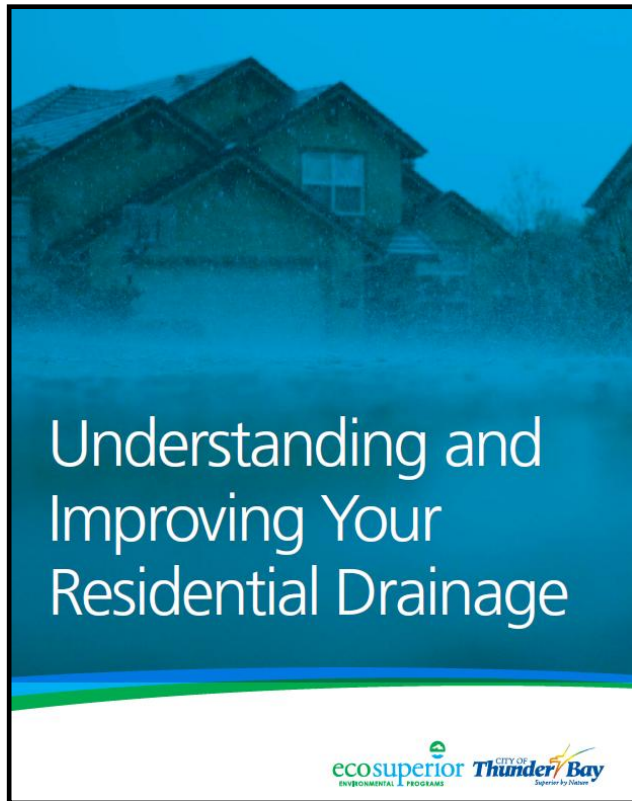
Backflow Prevention Valve



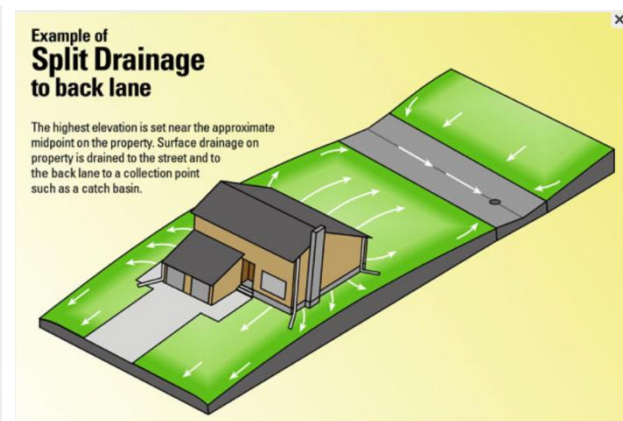
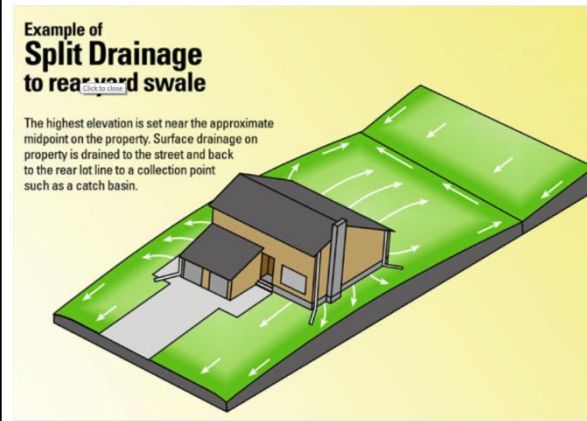
Sump Pump



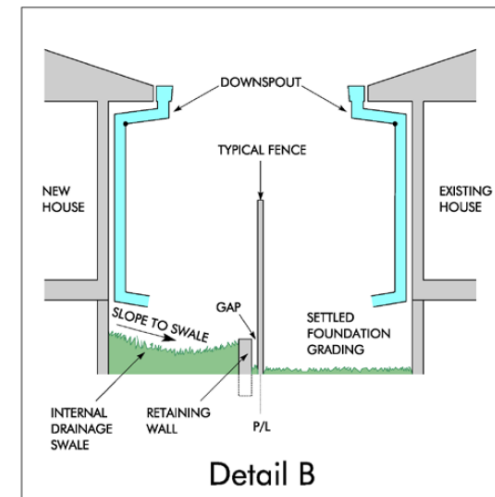
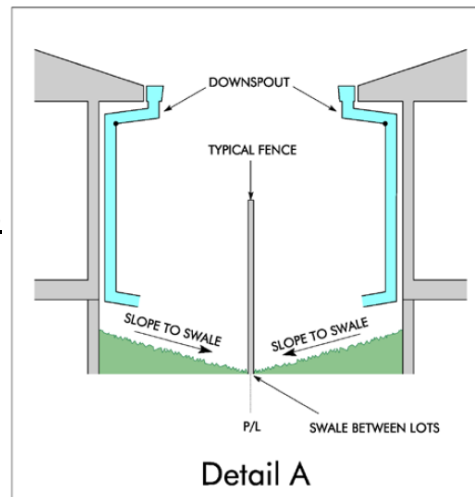
Improving Drainage Within Your Property



Typical Lot Grading



Typical Swale Between Properties



Improvement & Maintenance Tips

Eaves-troughs & downspouts, Backflow valves, lot grading, sump pumps, landscaping, etc.

Improving Drainage Within Your Property

Rain Garden Rebate Program

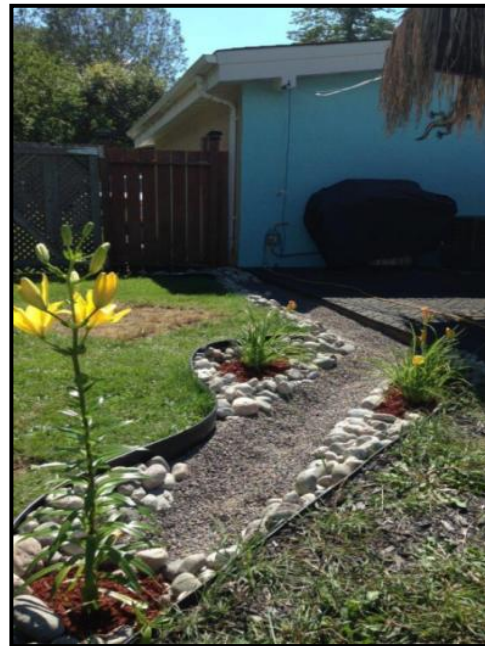
- Rebates up to **\$500** – matching funds not required.
- +/- 70 installed in Thunder Bay under program

What is a rain garden?

A rain garden is a landscaped depression that will soak up rainwater runoff from the roof of a house or garage, or other hard surface like a parking area. The rainwater is absorbed into the soil instead of flowing into a storm drain that empties into our local streams. Rain gardens are often planted with wildflowers or other plants that provide homes and food for birds and insects.

Rain gardens absorb rainwater, so they can help:

- recharge our groundwater
- protect neighbourhoods from flooding and drainage problems
- keep our streams clean by reducing the amount of polluted stormwater that goes into streams from storm drains
- provide habitat for birds, butterflies and insects.

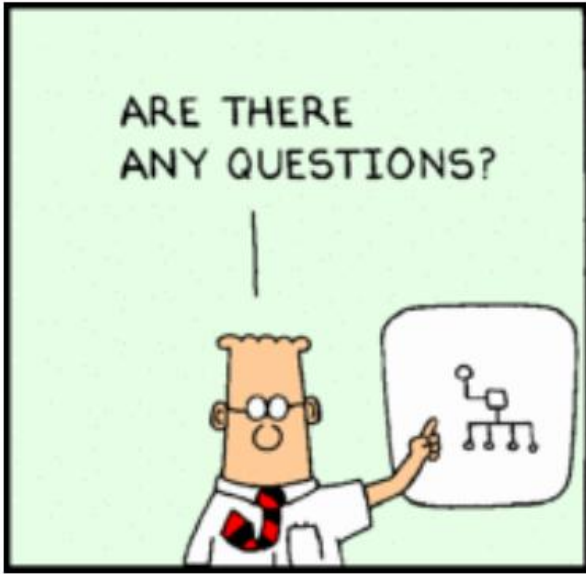


<http://www.ecosuperior.org/raingardenrebate> or check-out Eco-Superior's Facebook page for Thunder Bay examples

Additional Funding Sources for Programs

Funding Program Name / Agency	
Clean Water and Wastewater Fund	Great Lakes Sustainability Fund
MNRF Great Lakes Protection Funding	Eco-Action Community Funding Program
Great Lakes Guardian Community Fund	CN Eco-Connexions From the Ground Up
Lake Superior Lakewide Action and Management Plan	Tree Canada
Canada-Ontario Great Lakes Agreement	TD Friends of the Environment Fund
Ontario Great Lakes Strategies	RBC Blue Water Project Community Action Grants
Federation of Canadian – Municipalities Green Municipal Fund	Federation of Canadian – Municipalities for Climate Innovation Program
National Disaster Mitigation Program	Lake Simcoe Region Conservation Authority – Phosphorus Offset Program
Ontario Trillium Foundation	

Questions & Discussion



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