

Protection of Municipal Sewer and Water Assets Around Urban Watercourses

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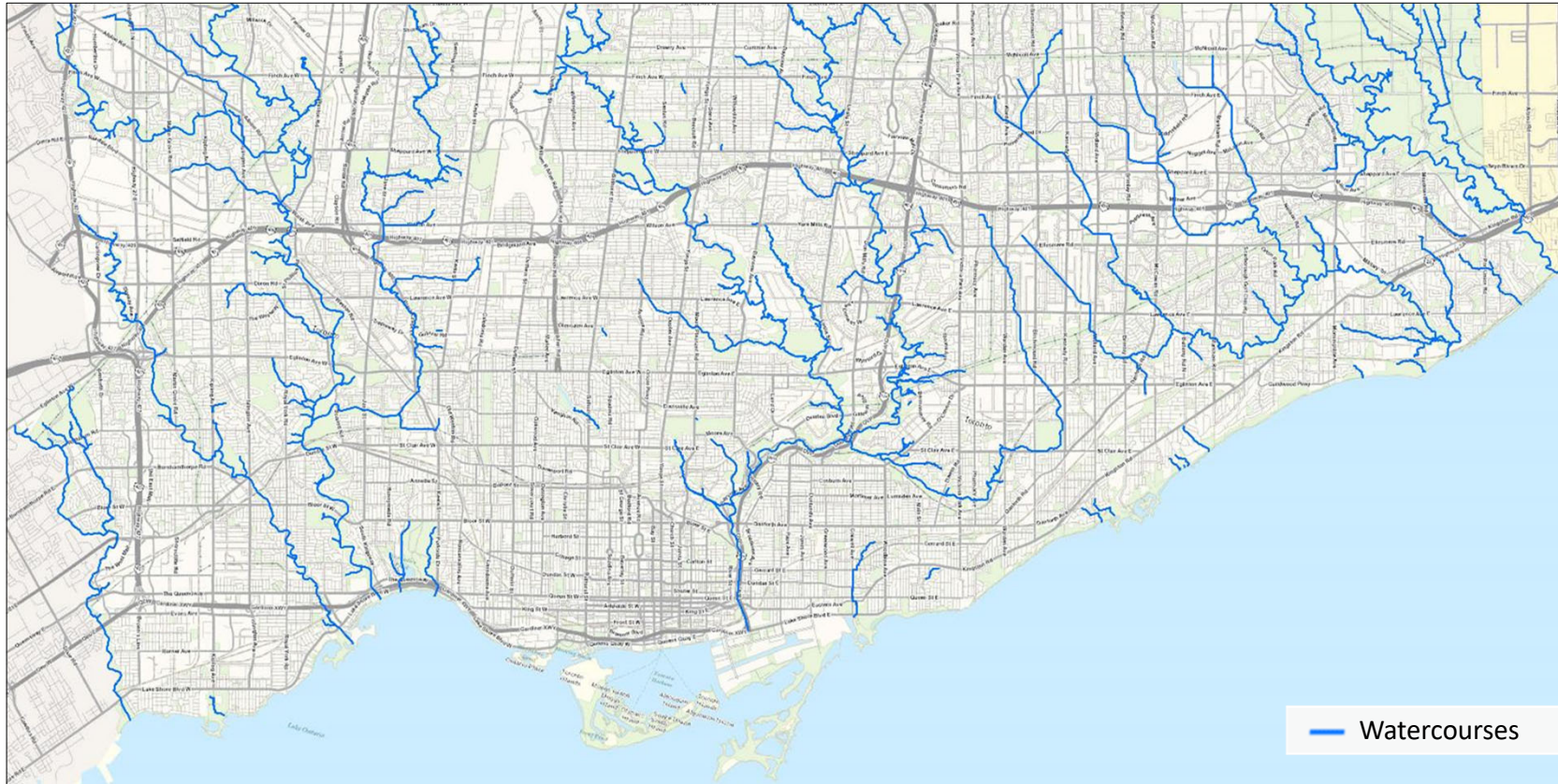


Agenda

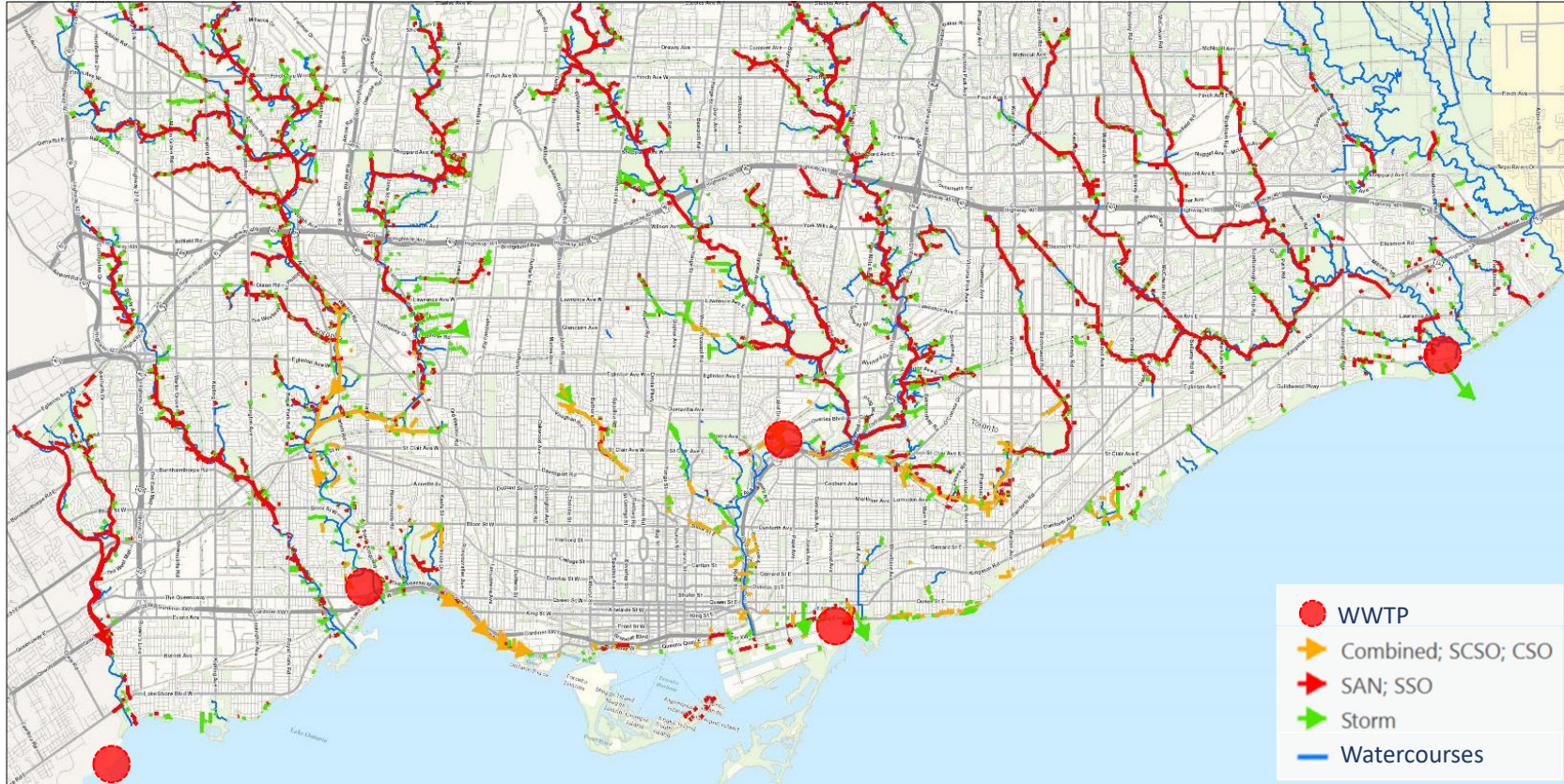
- Toronto's Watercourse Systems and Ravine Infrastructure
- Erosion Hazard Scoring and Tracking
- Erosion Control Asset Management
- Watercourse Capital Planning



City of Toronto Watercourses



Sewer Infrastructure by Watercourses



Sewer and Water Asset Inspections



Sewer and Water Asset Inspections





Project Status

- Planned
- Unplanned
- Restored
- Future Study

 > 128
 100
 80
 50
 < 30

Erosion Risk Score Calculation

$$\text{Risk Score} = \text{IC} * \text{EDP} * \text{COF}$$

Infrastructure Condition (IC)

- PACP Structural Rating
- Service Life
- Material and Construction method
- Deterioration



Erosion Damage Probability

- Time-to-contact / cover depth (unexposed)
- % Exposure (exposed)
- Current state of erosion / Erosion Potential
- Watercourse Energy

Consequence of Failure (COF)

- Impact to public safety, infrastructure, or environment
- Proximity of hazard
- Site accessibility

Erosion Risk Calculation

EROSION DAMAGE PROBABILITY

Factor	Descriptive Rating	Sanitary and Combined Sewer
1-2	Low	Unexposed. Cover above 1 m , or greater than 50 year Time to Contact (from GSMP)
3-4	Medium	Unexposed in medium or high energy watercourse. Cover below 1 m , or greater than 15 year Time to Contact (from GSMP). If cover unknown use rating of 3.
5-6	Medium-High	Exposed or near exposure (<=15cm depth of cover). Less than 20% depth of Pipe/encasement exposure . Moderate local watercourse erosion. Condition has not significantly worsened since last inspection. Unencased pipe is automatically a 6
7-8	High Risk	Exposed. Pipe/encased exposure above 20% depth of pipe and above pipe spring line . High local watercourse erosion. Condition has worsened since last inspection. Unencased pipe automatically a 8 . If channel is in bed rock (like parts of Mimico and Etobicoke) can consider dropping the rating to a 7. Assume average encasement depth of 15 cm.*
9-10	Very High Risk	Exposed. Pipe exposure below pipe spring line . If pipe exposure is near or below pipe invert use rating of 10. If channel is in bed rock (like parts of Mimico and Etobicoke) can consider dropping the rating to a 9.

	Descriptive Rating	Asset Type					
		Sanitary and Combined Sewer	Sanitary and Combined MH	Outfall	Storm sewer - beyond 5m from outfall	Storm sewer MH	Watermain
Infrastructure Condition	Very Good	1	1	1	1	1	1
	Good	1	1	1	1	1	1
	Fair	1	1	1	1	1	1
	Poor	1.1	1.1	1.05	1.1	1.1	1.1
	Very Poor	1.25	1.25	1.1	1.25	1.25	1.25
	Broken Pipe (applies to sanitary sewer and watermain only)	2	N/A	N/A	N/A	N/A	2
Erosion Damage Probability	Low	1-2	1-2	1-2	1-2	1-2	1-2
	Medium	3-4	3-4	3-4	3-4	3-4	3-4
	Medium-High	5-6	5-6	5-6	5-6	5-6	5-6
	High Risk	7-8	7-8	7-8	7-8	7-8	7-8
	Very High Risk	9-10	9-10	9-10	9-10	9-10	9-10
Consequence of Failure	Low	N/A	N/A	1-2	1-2	1-2	1-2
	Medium	N/A	N/A	3-4	3-4	3-4	3-4
	Medium-High	N/A	5-6	5-6	5-6	5-6	5-6
	High	7-8	7-8	7-8	7-8	7-8	7-8
	Very High	9-10	9-10	9-10	9-10	9-10	9-10

Erosion Risk Calculation - Example

1.1

Poor

Infrastructure Condition

- Moderate to major surface spalling
- PACP Structural Rating = 3
-wrinkled lining feature



9

Very High

Erosion Damage Probability

- % exposure= 53% (below spring line)
- No erosion control on both banks and midchannel



9

Very High

Consequence of Failure

- Trunk Sewer: Very High Impact
- Entire crossing is exposed
- Diameter < 900 mm



89

SL2204411

Trunk Sewer
Humber Creek– Lower Humber River
La Rush Drive



Erosion Control Asset Management Plan Development



Ontario Regulation 588/17 is a provincial regulation titled "Asset Management Planning for Municipal Infrastructure"

The law mandates all Ontario municipalities create and follow a standardized framework for managing infrastructure.

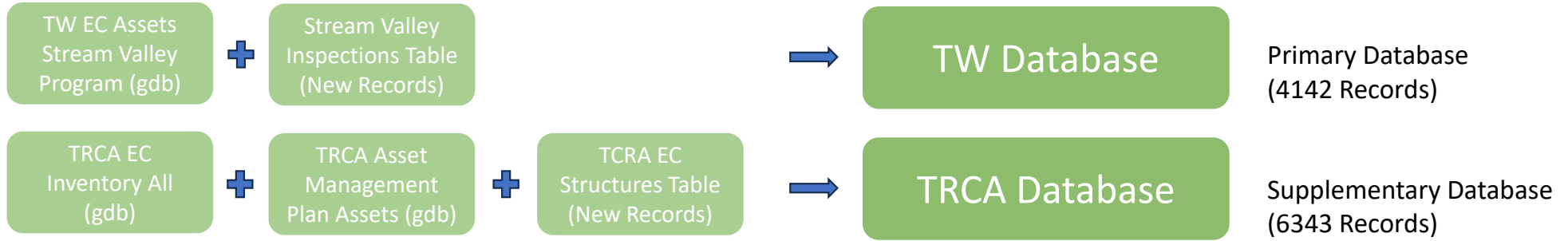
Core goal to guide governments toward financial sustainability by closing infrastructure funding gaps and making data-backed spending decisions for long-term management

O.Reg 588/17 - Asset Management Planning for Municipal Infrastructure (Erosion Control Structures)

In the City of Toronto, erosion control are managed using a split-responsibility model between the City of Toronto (Toronto Water) & the Toronto and Region Conservation Authority (TRCA).

Under the City's 2025 Corporate Asset Management Plan, Toronto Water is responsible for erosion control structures built specifically to safeguard buried linear infrastructure

Development of the EC Asset Inventory

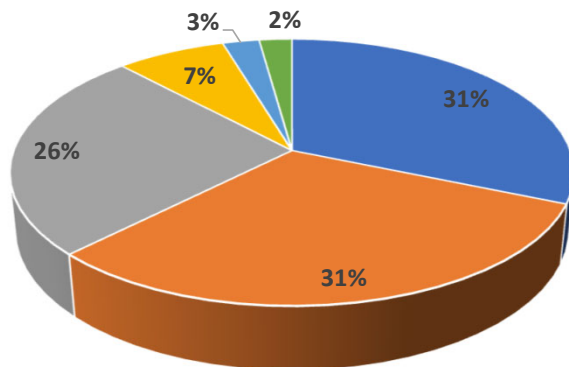


Clarification: TW Database is only supplemented with TRCA Database where there is no existing TW EC Structure, regardless of inspection date.



Development of the EC Asset Inventory

Processed TW Database



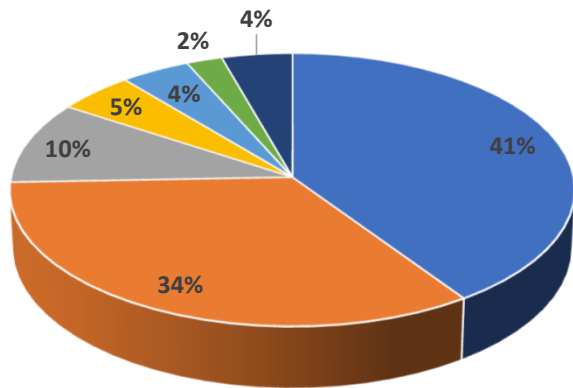
- Channel(ized)
- Retaining Wall
- Revetment
- Other
- Culvert
- Hardened/Concrete Bed

Structure Type	Frequency
Channel(ized)	1297
Retaining Wall	1291
Revetment	1057
Other	304
Culvert	102
Hardened/Concrete Bed	91
Total	4142

Material	Frequency
Concrete	1256
Gabion Basket	1086
Rip Rap	613
Armourstone	559
Fieldstone	156
Other	112
Concrete Slabs	111
Concrete Rubble	78
Boulders	72
Null	38
Corrugated Metal Pipe	35
Sheet Piling	22
Coir Matting	2
Live Cribwall	2
Total	4142

Development of the EC Asset Inventory

Processed TRCA Database



- Revetment
- Retaining Wall
- Weir
- Bed Control
- Channel(ized)
- Spillway
- Other

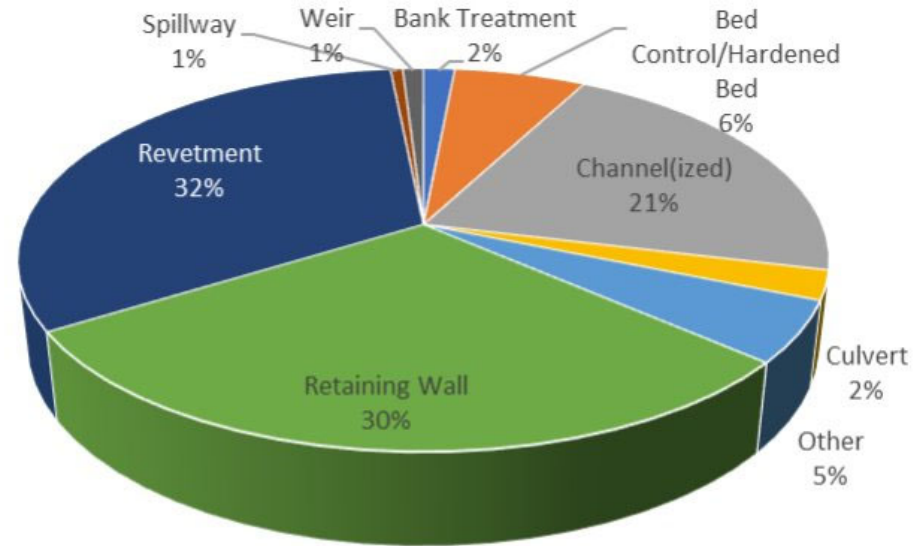
Structure Type	Frequency
Revetment	2568
Retaining Wall	2152
Weir	620
Bed Control	305
Channel(ized)	276
Spillway	142
Vane/Deflector	62
Flood Control Channel	58
Toe Protection	57
Buttress	28
Slope Treatment	23
Bank Treatment	22
Slope Stabilization	9
Drainage Swale	6
Ford	6
Null	3
Culvert	2
J-Hooks	2
Berm	1
Riser	1
Total	6343

Material	Frequency
Gabion Basket	2016
Rip Rap	1346
Armourstone	973
Concrete	625
Fieldstone	447
Concrete Slabs	250
Concrete Rubble	159
Miscellaneous Rock	113
Boulders	82
Live Cribwall	45
Steel	37
Vegetated Rip Rap	36
Sheet Piling	30
Other	27
Timber	27
Cobbles	21
Miscellaneous Construction Materials	20
Earth Fill	15
Shale	13
Vegetation (Unspecified)	11
Null	10
Corrugated Metal Pipe	6
Logs	5
Reinforced Earth Fill	5
Stakings	5

Material	Frequency
Brush Layers	3
Coir Matting	2
Corrugated Metal	2
Gravel	2
PVC	2
Sand	2
Turf Reinforcement Mat	2
Concrete Block Mat	1
Corrugated Plastic Pipe	1
Rootwads	1
Sienna Stone	1
Total	6343

Inventory & Condition Assessment

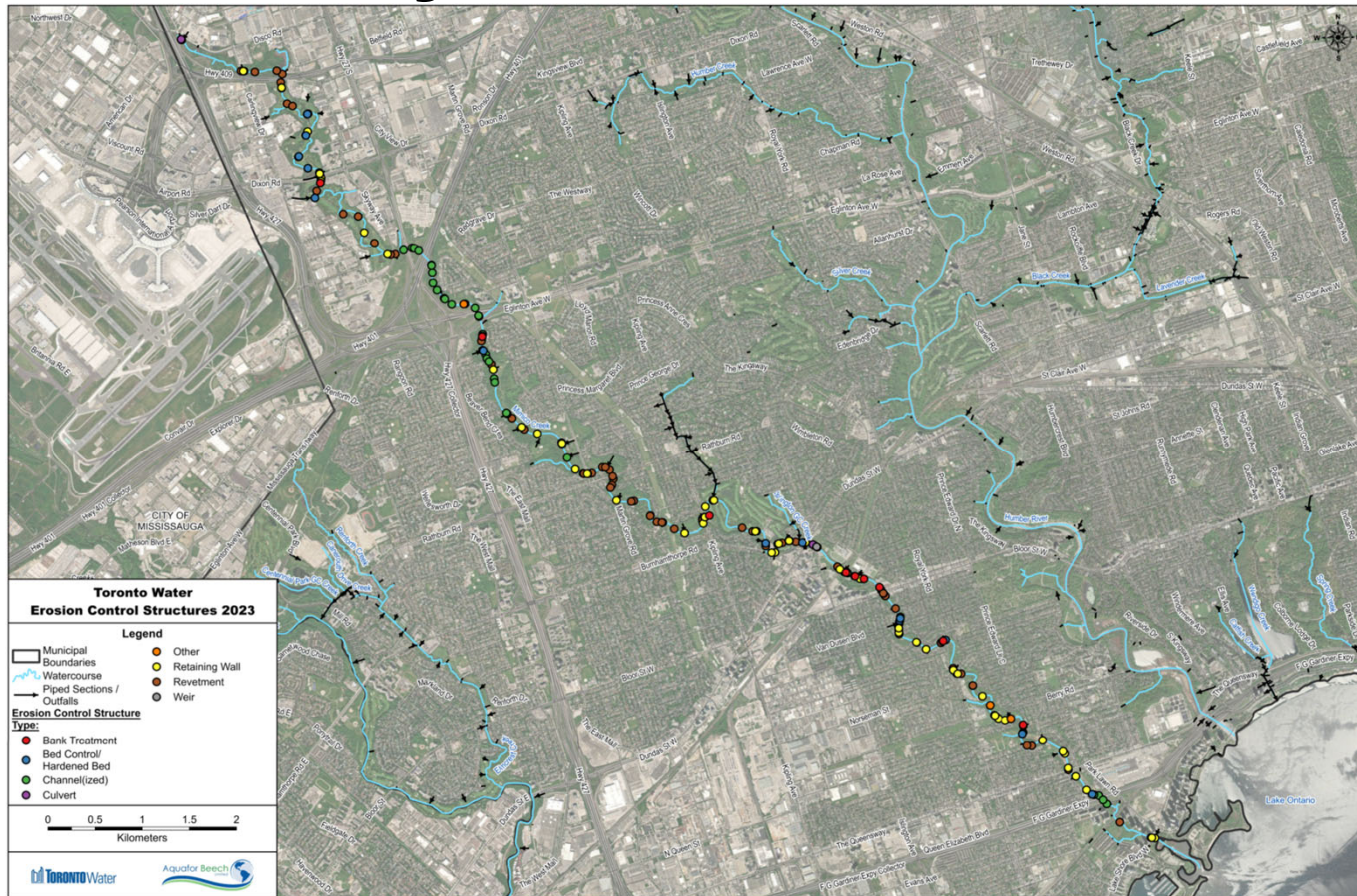
- Built a consolidated EC asset inventory of 3,959 structures, with standardized IDs and watercourse linkages.



Asset Inventory – Toronto Water



Asset Inventory – Mimico Creek



Methodology – Estimated Service Life

Armourstone Retaining Wall

Condition: Good



Condition: Needs Repair



Condition: Failed



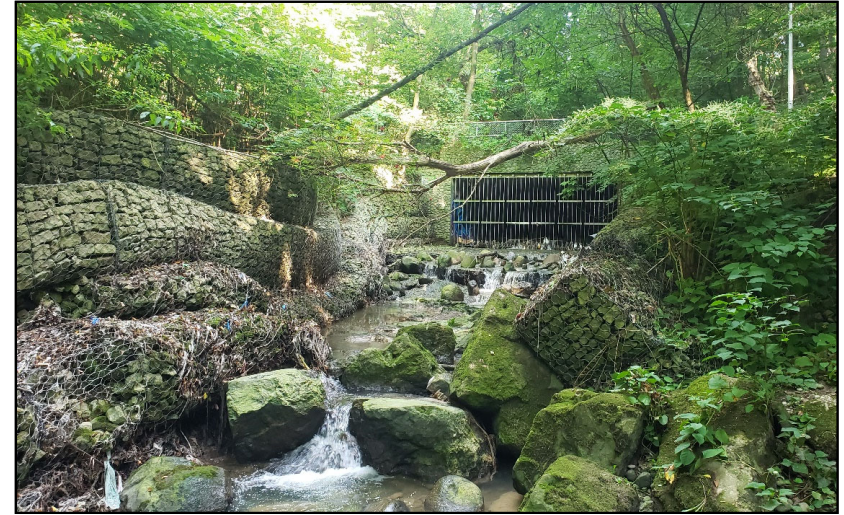
Methodology – Estimated Service Life

Gabion Basket Retaining Wall

Condition: Acceptable



Condition: Needs Repair



Improvements to Asset Awareness, Condition Tracking & Data Accessibility

TW Condition Rating

EC Condition	Score	Infrastructure Condition	Bump Up Order
Good	1	Not found / N/A	0
Acceptable	2	No visible risk	0
Needs repair	3	Visible risk	1
Failed	4	Exposed	2

TRCA Condition Rating

EC Condition	Score	Infrastructure Condition	Bump Up Order
Excellent	1	Not found / N/A	0
Good	2	No visible risk	0
Fair	3	Visible risk	1
Poor	4	Exposed	2

Numerical Rating	Descriptive Rating	Definition
1	Very Good	No deficiencies were observed. No observed risk to infrastructure that erosion control structure is protecting. Unfound infrastructure is assumed to have no observed risk.
2	Good	The erosion control structure is in overall good condition and no observed risk to infrastructure that erosion control structure is protecting; or No deficiencies were observed but visible risk to the infrastructure is observed.
3	Fair	No deficiencies were observed but the infrastructure that the erosion control structure protects is at high risk. Some areas of the structure may require preventative actions; The erosion control structure is in overall good condition and visible risk to the infrastructure is observed. Some areas of the structure may require preventative actions; or The erosion control structure needs minor repair but no observed risk to infrastructure that erosion control structure is protecting.
4	Poor	The erosion control structure is in overall good condition but the infrastructure that the erosion control structure is protecting is in high risk. The site may require further attention. The erosion control structure needs minor repair and visible risk to the infrastructure is observed. Some areas of the structure may require preventative actions;
5	Very Poor	The erosion control structure has failed or may imminently fail; the structure is no longer performing its constructed purpose. Visible risk to the infrastructure is observed; or The erosion control structure needs minor repair but the infrastructure protected by the erosion control structure is exposed and at high risk.

Levels of Service & Risk Framework

- Framework developed using Condition, Service Life, and Risk.
- Analysis shows there are failed assets contributing to elevated risk exposure.
- Implementation will guide prioritization of rehabilitation and capital planning.

Major Materials	Lifespan (yrs)	Estimated Remaining Lifespan under Various Conditions (yrs)				
		Excellent - 1	Good - 2	Acceptable - 3	Needs Repair - 4	Failed - 5
Remaining Lifespan Factor		80%	70%	50%	30%	0%
Sheet Piling	100	80	70	50	30	0
PVC	75	60	53	38	23	0
Vegetation	70	56	49	35	21	0
Steel	70	56	49	35	21	0
Corrugated Metal Pipe	65	52	46	33	20	0
Concrete Rubble	50	40	35	25	15	0
Armourstone	50	40	35	25	15	0
Boulders	50	40	35	25	15	0
Concrete	50	40	35	25	15	0
Concrete Rubble	50	40	35	25	15	0
Concrete Slabs	50	40	35	25	15	0
Other	45	36	32	23	14	0
Cobbles	40	32	28	20	12	0
Fieldstone	40	32	28	20	12	0
Rip Rap	30	24	21	15	9	0
Gabion Basket	30	24	21	15	9	0
Shale	30	24	21	15	9	0
Miscellaneous Rock	30	24	21	15	9	0
Live Cribwall	20	16	14	10	6	0
Earth Fill	20	16	14	10	6	0
Coir Matting	4	3	3	2	1	0

Lifecycle Management Activities & Cost Considerations

- Developed asset valuation and lifecycle costing using unit rates, condition and material-based costs.



- Identified long-term capital needs emphasizing proactive replacement and maintenance to reduce lifecycle risk and infrastructure deficit.



Watercourse Capital Planning

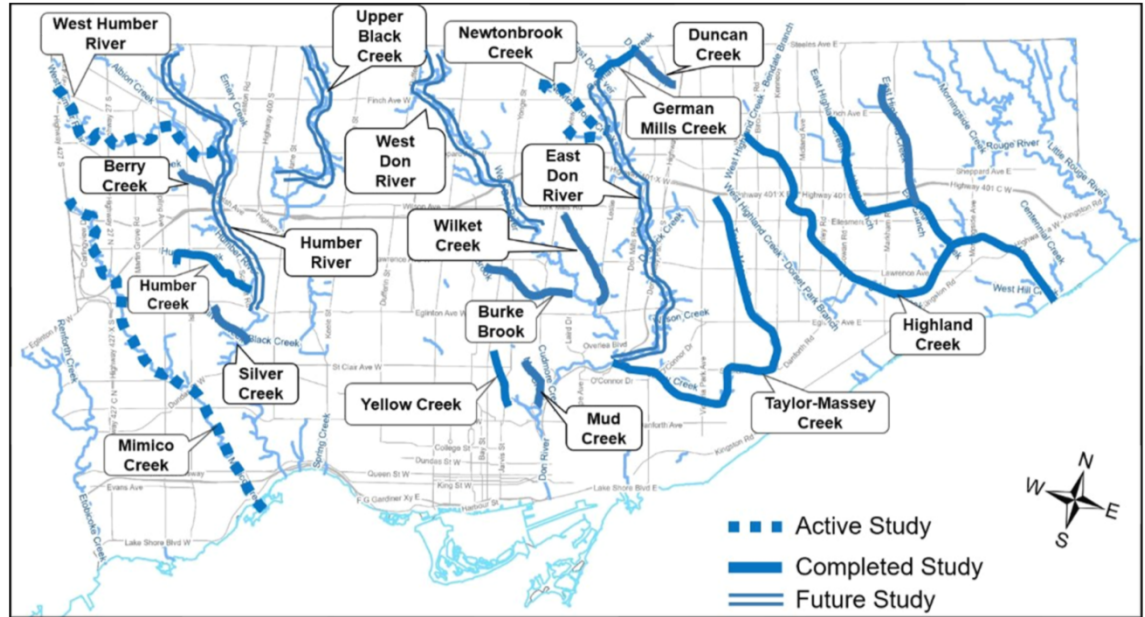
Project Identification and Prioritization

Project Sources

- Geomorphic studies
- Regular inspections
- Opportunistic projects with TRCA or other City divisions
- Other

Project Prioritization

- Degree of risk to sewer and water assets
- Consequence of failure of asset
- Cost sharing opportunities
- Other factors e.g. avoid community construction fatigue



Capital Plan and Future Initiatives

