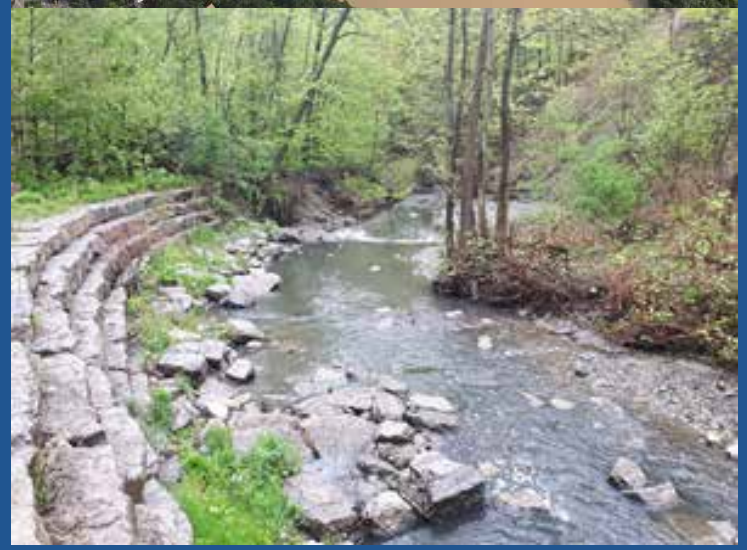

Understanding Streams

Photo Sources: Top – Humber River after large storm (Toronto and Region Conservation Authority TRCA) Bottom – Burke Brook armourstone wall (City of Toronto)

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Understanding Streams

Fluvial Geomorphology is the study of streams.

Streams are studied by

- **Form:** width, depth, length, slope
- **Function**: movement of water and sediment
- How these characteristics are **interrelated** and how they **change over time**

Photo Sources: Rod Anderton (Yellow Creek)

Water and stormwater infrastructure in Toronto works with our streams, rivers, lakes and watersheds.

High flows from past storms have caused substantial erosion damage to sewers and watermains located in and near the City's ravines and watercourses resulting in a need to Protect water and sewer infrastructure from further excessive erosion

Understanding streams helps us to develop solutions to

- Develop solutions to changing conditions such as excessive erosion, unprotected water and sewer infrastructure
- Work with the changes in the stream
- Enhance stream functions and habitats in the long term

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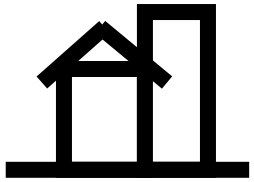
Understanding Streams

- Streams are **dynamic** and follow natural processes of erosion and laying sediment until a stable form is developed and maintained
- **Stressors** can destabilize the stream over the short or long-term causing changes in its shape, location and overall size. These stressors include:



Urbanization and “hard” impermeable surfaces decrease the infiltration and absorption of rain/snow into the ground

Climate change increases the frequency and intensity of large storm events which increases the flows in streams

Historically built controls or adjustments alter a stream’s form in ways that counter-act natural processes (ie. dams, culverts, weirs)

Photo Sources: Rod Anderton (Duncan Creek,)

Understanding Streams

How streams respond to stressors

Higher quantity of water (“peak” flows) start to enter the stream

The speed and volume of water within the stream rapidly increases

The stream adjusts and accommodates these peak flows

Excessive erosion “moves” the stream closer to the City’s water and sewer infrastructure

Photo Sources: Rod Anderton (Berry Creek)

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Understanding Streams

Example of High Peak Flows

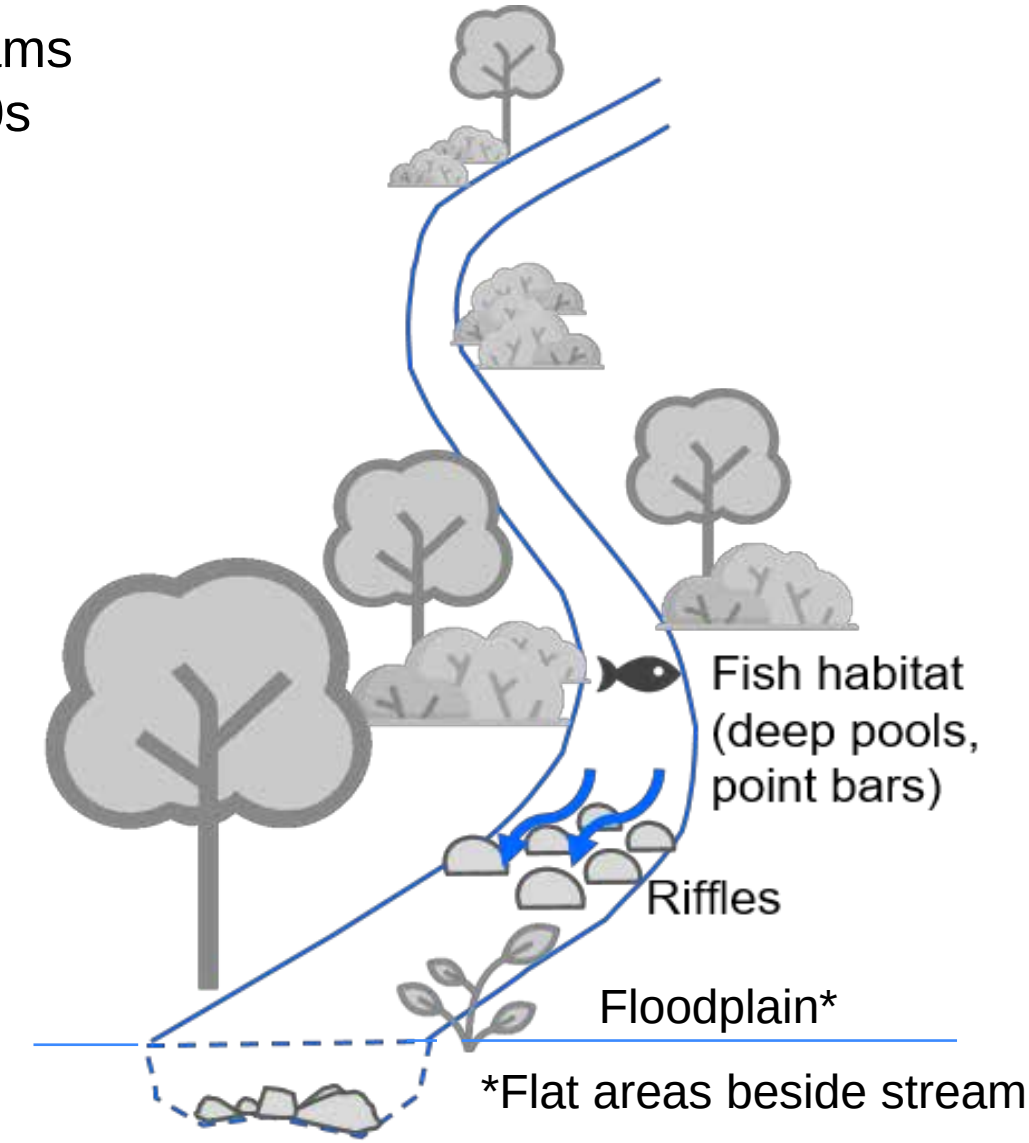
The photo on the left shows dry weather conditions in Yellow Creek near Yonge Street and St Clair Avenue. The photo below is in the same location with high flows on November 27, 2020 a few hours after a major storm.

Photo source: Rod Anderton (left) John Bossons (right)

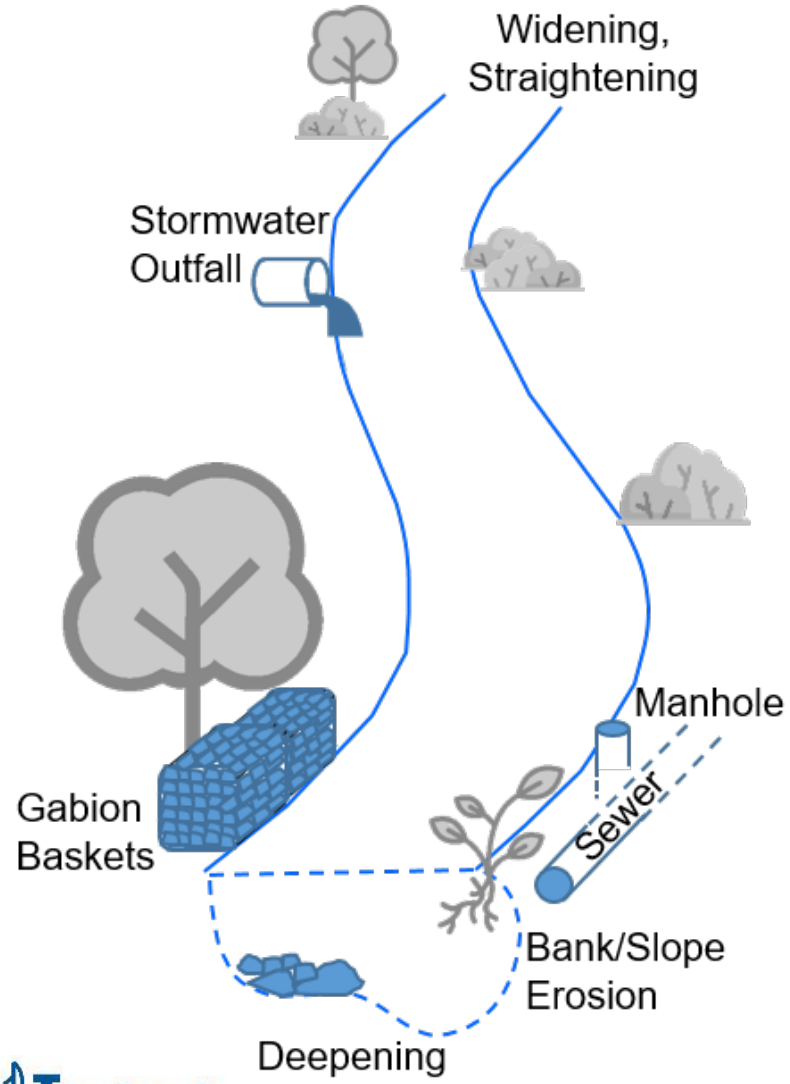
Understanding Streams

Pre-Urbanization - Common characteristics of streams prior to the City's significant growth in the 1970-1990s include:

- Stream meanders and curves
- Stream has varying depths
- Diverse stream features and habitats
  - Boulders, shallow riffles, fish spawning zones, deep pools and point bars
- Trees and vegetation provide
  - Stream bank stability
  - Aquatic habitat
  - Cover for fish from predators
  - Shade to cool/reduce over-heating of the stream's water temperature



Understanding Streams



Post-Urbanization – Common characteristics of streams today include:

- Stream widens and deepens due to erosion, causing "entrenchment" where flows no longer go out of the channel into adjacent floodplain areas
- Impeded or increased flows from City infrastructure: outfalls, bridges, culverts
- Fallen trees/less vegetation to stabilize stream slope/bank (undercutting)
- Reduced and degraded stream features and habitats (riffles, deep pools, point bars)
- Excessive flows, sediments and debris in the stream degrades aquatic habitats and shrinks deep pools
- Erosion controls methods: gabion baskets, stream straightening

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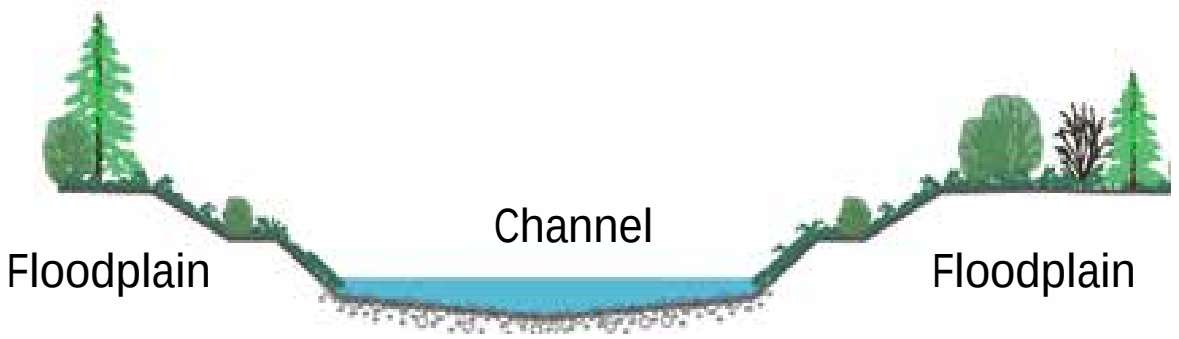
Understanding Streams

Glossary

Bank:	The sides of the creek, also part of the floodplain
Channel:	The water in the creek / river / stream
Confluence:	Where 2 or more watercourses meet
Erosion:	Gradual changes to the form (path a creek follows) and function (aquatic and terrestrial habitats the stream supports) of the creek and creek bed due to increased water flow and storms
Floodplain:	The area surrounding the channel which holds increased water flow when the width of the creek expands seasonally or due to storms and snowmelt
Substrate:	The material on bottom of the bed of the creek

Cross-section of stream channel and floodplain



Understanding Streams

How we develop a plan to work with a stream's geomorphology

Identity problems and causes

Identify historical context and existing stream conditions

- To determine how they influence the stream's current and future conditions
- Identify other ecological aspects such as habitats within stream and along the banks as these are indicators of stability or instability

Collect information and evaluate existing and future conditions

Evaluate the changes of the stream's form and function as a response to stressors

- How and at what rate a stream's form and function changes
- Evaluate how this is impacting water and sewer infrastructure

Develop Solutions

Develop and design an improved stream form that will:

- Protect water and sewer infrastructure
- Improve stream function, i.e. increase stream bank stability, reduce erosion, enhance stormwater flows, and improve aquatic habitats

Methods of infrastructure protection

Infrastructure protection and stream restoration work is constructed within the existing stream “footprint” at various stream segments and for differing lengths.

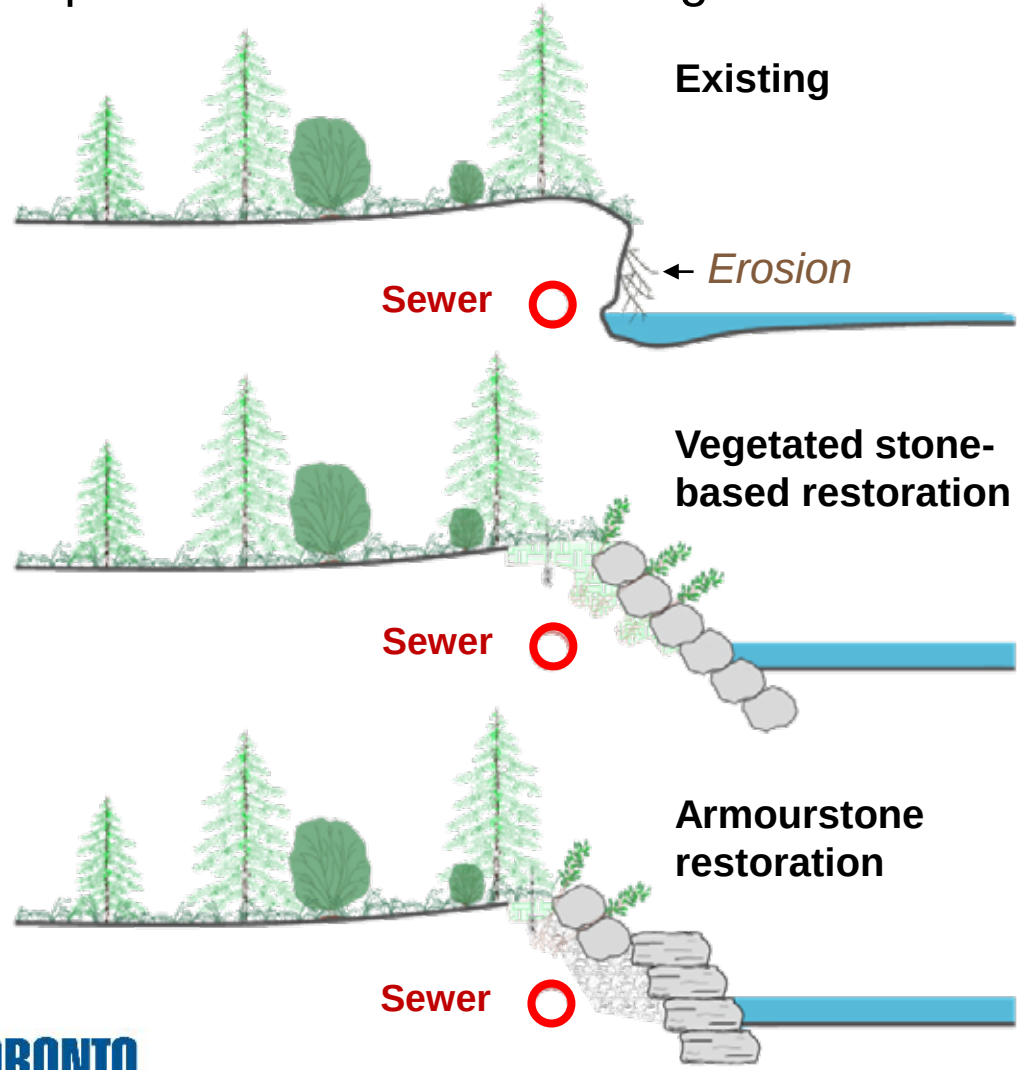
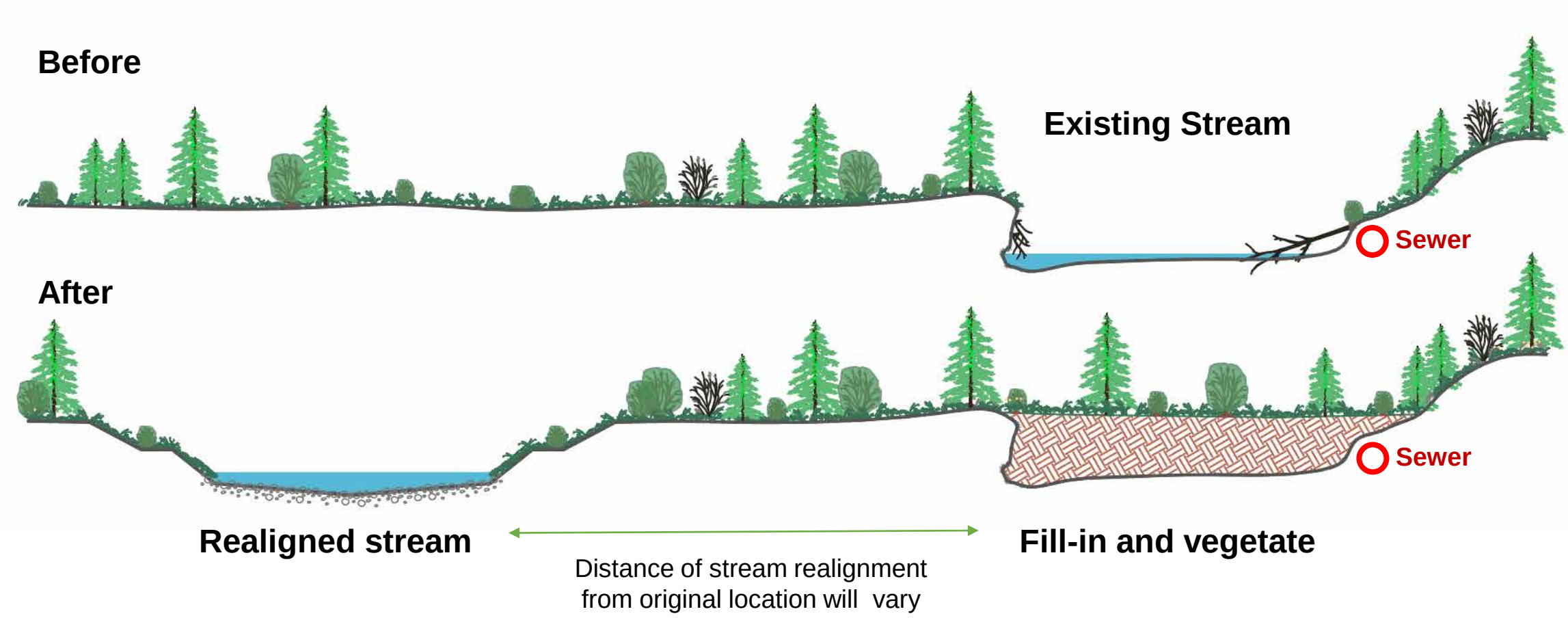


Photo of armourstone bank and vegetated stone treatment at the water’s edge along the north stream bank of Burke Brook.

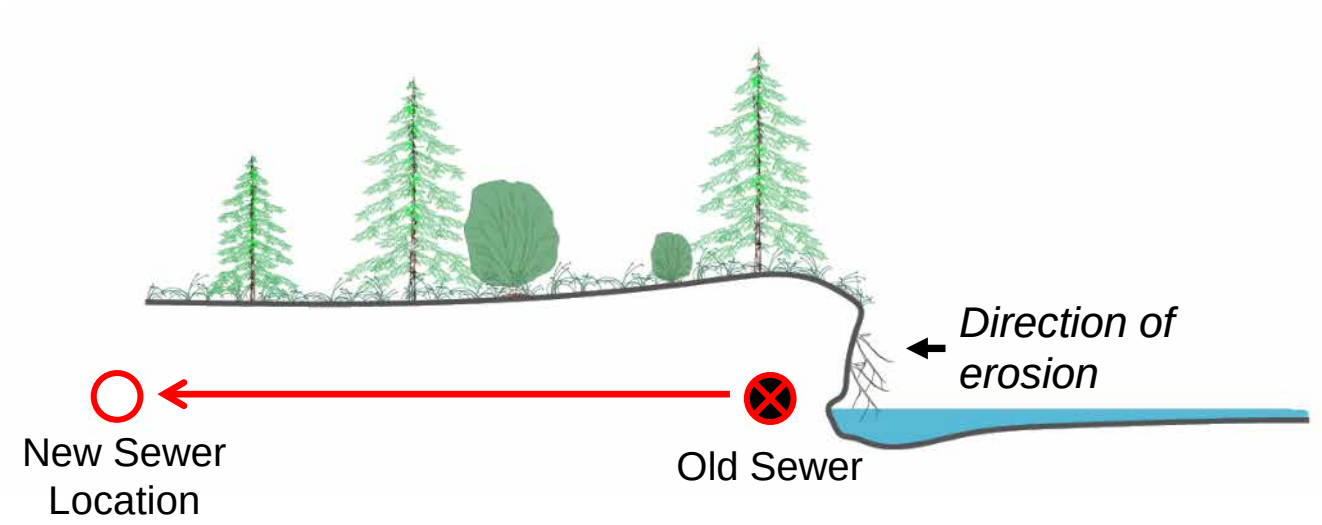
Methods of infrastructure protection

Realignment of the stream away from water and sewer infrastructure.



Methods of infrastructure protection

Move Water & Sewer Infrastructure



New water or sewer infrastructure is constructed in a new location further from the stream but within the ravine/valley. The original infrastructure is removed or abandoned in place, which is typically less disruptive and less costly.

Geomorphic Systems Master Plans (GSMPs)

There are five ongoing GSMPs across the City in creeks and rivers to identify and assess water and stormwater infrastructure at risk of erosion from high flows due to storms and snow melt runoff.

GSMPs are initiated with a study to observe how the City's storm sewer and watermain infrastructure can be protected within the creek / river along with an evaluation of recommended solutions to help reduce or prevent future impact. This ensures the City's infrastructure continues to operate and service residents and businesses. The solutions are part of a Geomorphic Systems Master Plan (GSMP) for each water body that will be implemented over a multi-year period.

Purpose of a GSMP study:

- To identify concerns related to erosion that may damage the City's water and stormwater infrastructure
- To develop solutions that protect the City's water and stormwater infrastructure from excessive erosion processes within the stream
- To improve stream functions, such as increasing stream bank stability, reducing erosion, enhancing stormwater conveyance, and improving habitats