BEDLOAD TRANSPORT IN URBANIZED STREAMS WITH AND WITHOUT STORMWATER MANAGEMENT

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INTRODUCTION

Sediment (bedload) transport?
INTRODUCTION

• River restoration projects do not explicitly design for sediment transport: focus is on sediment *stability* rather than sediment *mobility*.

• This approach becomes a problem when designing with ecological needs in mind.

• Ultimately leads to project failure.

…but in natural systems sediment moves…
Why don’t we design for bedload transport?

• Lack of understanding of how urbanization, SWM and restoration projects affect bedload transport.

• Lack of data on bedload transport in urban settings.
INTRODUCTION

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Project Objectives

• Monitor bedload transport in streams in the Greater Toronto Area (GTA) with varying SWM and restoration projects.

• Understand the effect of these SWM and restoration projects on bedload transport and stream stability.
STUDY SITES

Morningside Creek
- Urbanized (suburbs)
- SWM ponds
- 1 study reach
- 3 flow gauges

Wilket Creek
- Heavily urbanized
- Minimal SWM
- 2 study reaches: restored and non-restored
- 5 flow gauges

Ganatsikaigon Creek (Ganny)
- Undeveloped: abandoned farmland and forest
- Plans for development in watershed
- 2 study reaches
- 5 flow gauges
METHODS

HYDROLOGY

• 2-minute interval stage measurements during field season.
• 5-7 minute interval stage measurements during winter season.
• 5-minute interval precipitation data from TRCA from 12 nearby precipitation stations.
METHODS

USING TRACERS TO MEASURE SEDIMENT TRANSPORT

- 300 RFID tagged stones per site with size distribution matching reach.
- Seeded in riffles.
- Recovery rates 85 – 100 %
RESULTS

FALL FLOODS

1) 12-Aug to 20-Oct 2015: Multiple short floods with high peaks.
RESULTS

FALL FLOODS

2) **28-OCT to 02-NOV**: One long and high magnitude flood.

![Graph showing water surface elevation above baseflow for Wilket Creek, Morningside Creek, and Ganny Creek from 28-Oct-2015 to 02-Nov-2015.](image)
RESULTS

FALL FLOODS – WILKET CREEK

Stone Tracking
- 03-NOV-2015
- 20-OCT-2015
- 01-AUG-2015 (seeding)

Gauges
Thalweg

FLOW

0 25 50 75 m

N
RESULTS

FALL FLOODS – MORNINGSIDE CREEK

Stone Tracking
- 10-NOV-2015
- 25-OCT-2015
- 09-AUG-2015 (seeding)

Gauges
Thalweg
RESULTS

FALL FLOODS – GANNY CREEK

Stone Tracking
- 11-NOV-2015
- 26-OCT-2015
- 12-AUG-2015 (seeding)
- Gauges
- Thalweg
Urban Restored  
Wilket (Restored)

Urban Non-Restored  
Wilket (Upstream)

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### 1st flood

- $D$ (mm)
- $P_m$

- $\times$ Urban
- $+$ Restored

### 2nd flood

- $D$ (mm)
- $P_m$

- $\times$ Urban
- $+$ Restored
Urban with SWM  Urban without SWM

1st flood

2nd flood

D (mm)

$p^e$ vs. $D (\phi)$

- $X$ Urban
- $O$ SWM

$D (\phi)$
DISCUSSION

FIRST PERIOD HYDROGRAPHS

Wilket Creek
Morningside Creek
DISCUSSION

FIRST PERIOD HYDROGRAPHS

Wilket Creek
Morningside Creek
DISCUSSION

FIRST PERIOD HYDROGRAPHS

Wilket Creek
Morningside Creek
SECOND PERIOD HYDROGRAPHS

Wilket Creek
Morningside Creek
DISCUSSION

SECOND PERIOD HYDROGRAPHS

Water Surface Elevation Above Baseflow (m)

Wilket Creek
Morningside Creek
CONCLUSIONS

As expected, differences in bedload transport between:

- Urban and non-urban streams,
- Restored and non-restored streams, and
- Between streams with and without SWM
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- Urban and non-urban streams,
- Restored and non-restored streams, and
- *Between streams with and without SWM*

**HYPOTHESIS:** Duration of transport events matters

- *Multiple short-duration* events more significant for bedload transport in urban stream *without SWM*
- *Single long-duration* event more significant for bedload transport in urban stream *with SWM*
FUTURE WORK

• Continue monitoring bedload transport.
• Quantify hydrographs through various cumulative metrics and relate to transport observed.
FUTURE WORK

- Continue monitoring bedload transport.
- Quantify hydrographs through various cumulative metrics and relate to transport observed.
- Link to precipitation data.
THANK YOU