

Sediment Sources



Root River Watershed



Field to Stream Partnership

The Root River Field to Stream Partnership is a multi-organizational effort to evaluate agricultural practices and water quality at multiple scales and landscape settings. The strategic selection of these study watersheds allows the findings to be applied to similar areas across southeastern Minnesota.

Sources of Sediment in the Root

Scientists from multiple Universities completed a five-year study to identify sediment sources in the Root River Watershed using sediment fingerprinting techniques.

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Background

- Sediment is a natural part of river ecosystems. Yet, too much of it can be harmful to the quality and health of a river.
- It is important to understand all sediment sources and sinks in a river system when making land and water management decisions and setting water quality goals.
- The Root River watershed is nearly the size of Delaware, so determining sediment sources is complex and relies on advanced science and independent techniques.
- In 2016, scientists from multiple Universities completed a five-year study to identify sediment sources and sinks (sediment budget) in the Root River Watershed.
- This project was funded by the Minnesota Department of Agriculture's Clean Water Fund Research and Evaluation Program (Clean Water Fund).



Near channel sediment sources along the Root River south of Lanesboro. (Photo Kevin Kuehner)

Methods

- **Sediment fingerprinting** uses the unique geochemical characteristics of river sediment which are then compared with sediment from potential source areas.
- Sediment fingerprinting tracers used for this study included meteoric Beryllium-10, Lead-210 and Cesium-137.



Collecting sediment cores from a streambank erosion site along the Root River. (Photo Kevin Kuehner)

Results

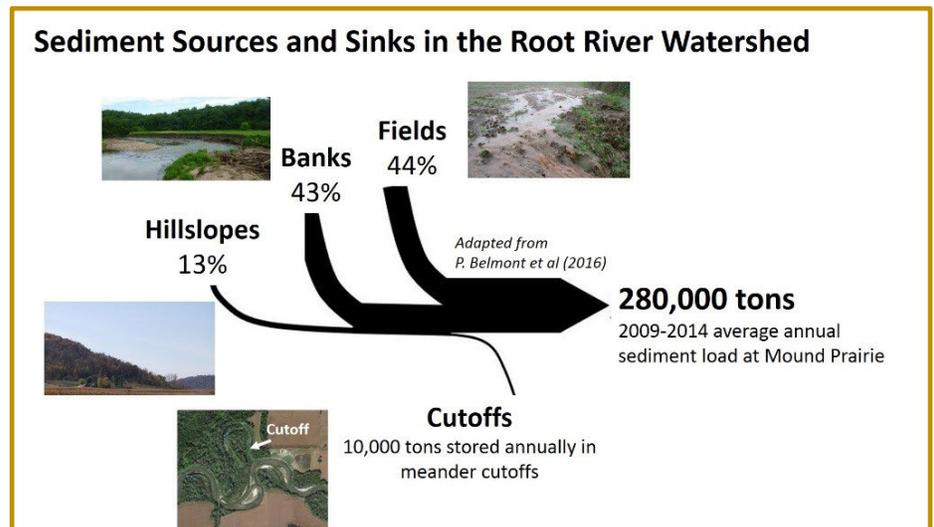


Figure 1. Sediment Sources and Sinks in the Root River Watershed. Adapted from Belmont et al, 2016.

Non-Field Sources

- An estimated, 56% of the sediment measured at the outlet of the Root River is from non-field sources.
- Non-field sources include soil derived from near-channel stream bank erosion and bluffland hill slopes.
- Streambank erosion- 43% of this non-field sediment, measured at the watershed outlet, is from near-channel stream bank sources.
 - The Root River and major tributaries are very active river channels with access to many large and easily erodible banks. **Sediment concentrations increase with river flow at a greater rate in the Root River than almost any other river in Minnesota.**
 - Near channel sediment sources are highly sensitive to flow in the mid to lower reaches of the Root River watershed.
 - Channel widening and lateral migration of channels into tall banks represents the dominant sediment source.
 - This soil appears to have been originally derived from agricultural fields, presumably within the past 150 years, but has been temporarily stored in, and reworked from modern and historical floodplains.
- Bluffland hill slopes and ravines- Other non-farm field sources of soil include bluffland hillslopes and forested ravines. These sources contribute an estimated 13% of the annual sediment exported from the watershed.



Streambank erosion along the Root River downstream of Lanesboro. (Photo Patrick Belmont)



Active erosion area in a forested ravine (Photo Kevin Kuehner)



Soil contained in field runoff (photo Kevin Kuehner)

Field Sources

- An estimated 44% of the annual sediment load measured at the outlet of the Root River near Mound Prairie is derived from agricultural fields within the past several decades (within the past 50-75 years).
- The percentage of sediment derived directly from agricultural fields can vary greatly throughout the watershed and by scale; from 60-70% at small watershed scales, to 25-30% for large sub-watersheds.

Sediment Movement and Storage (Sinks)

- A high percentage of sediment moves through the watershed system but not delivered to the Mississippi River.
- An estimated 500,000 tons of sediment is exchanged annually due to channel widening and migration processes within the floodplain channel system.
- About 10,000 tons of soil is stored in historical river cutoff areas (ox-bow lakes).



Summary of Findings (Belmont et al, 2016)

"The overarching implication of this sediment budget is that agricultural field management and best management practices are essential for reducing sediment loading, as agricultural sources contribute nearly half of the contemporary sediment load. At the same time, channel widening and meander migration are also important sources, also comprising nearly half of the sediment load at Mound Prairie. To some extent, bank erosion is a natural process and has been a net source of sediment in the Root River basin for thousands of years. At the same time, bank erosion has likely been exacerbated in recent years due to storage of legacy sediment that comprises the tall and pervasive alluvial terraces that we have mapped throughout the upper mainstem Root River and tributaries. In addition, bank erosion has likely been amplified in recent decades as human-exacerbated climate change and increased efficiency of agricultural drainage have resulted in significantly higher flows."

Full Report

Each sub-watershed within the Root River Watershed has its own sediment transport story. The full report can be found at the Minnesota Digital Water Research Library by searching: Belmont, P., Dogwiler, T. and Kumarasamy, K. (2016). *An integrated sediment budget for the Root River Watershed, southeastern Minnesota.*