Testimony to the Lower Minnesota River Watershed District: Minnesota River Flooding Causes, Impacts and Amelioration

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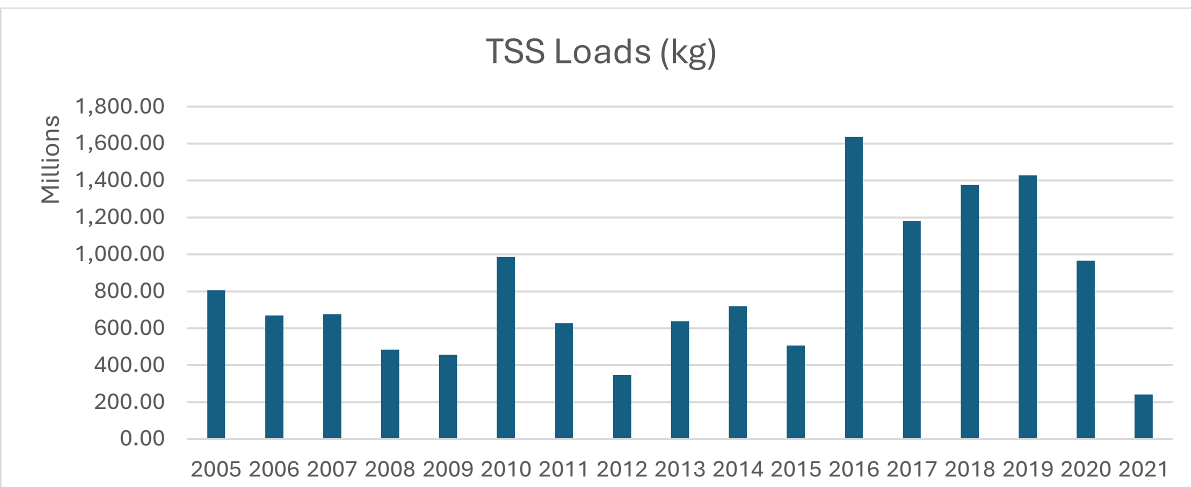
Problem

Its geologic history, beginning with the formation of the Glacial River Warren some 12,000-14,000 years ago, has made the Minnesota River and its tributaries "primed to erode", in the words of recent investigators. Today's Minnesota River occupies a narrow slit in the immense channel carved by Warren's raging meltwaters from Glacial Lake Agassiz. Tributaries descend several hundred feet down the sides of today's Minnesota River valley, carving their own valleys into the ancient escarpment. The innate tendency of the riverine landscape to erode has been exacerbated in recent times by the drainage of most wetlands in the basin, replacement of native prairie with cultivated fields and hard surfaces, and a warming, wetter climate. Average annual rainfall in Minnesota has increased by 3.4 inches, and rain events of six inches or more are four times more common since 2000 than in the previous three decades (Minnesota Department of Natural Resources).

Altogether, these forces have contributed to more frequent flooding and increased transport of sediment. Mean annual flow of the Lower Minnesota River has more than doubled since 1990. In a recent wet period, 2016-2020, total suspended solids (TSS) load near the mouth of the Minnesota River approached



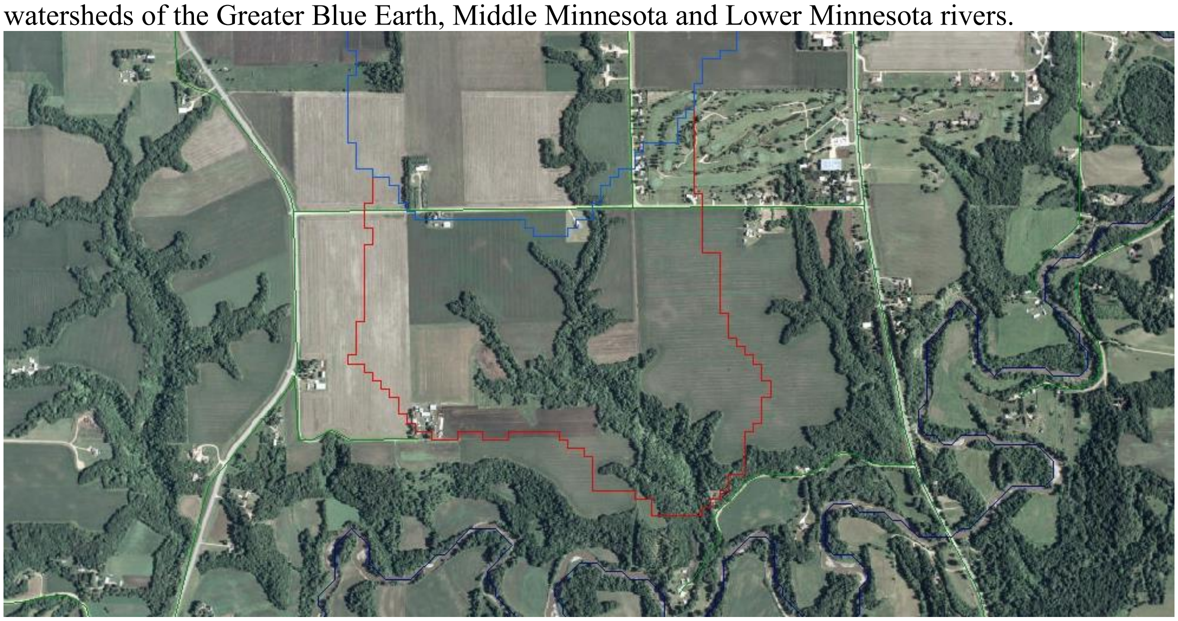
or exceeded one million metric tons per year, unprecedented for the period of record (Metropolitan Council Environmental Services). The coring of bed sediments in Lake Pepin has shown that rates of sediment deposition from the Minnesota River, which accounts for more than three-fourths of sediment loading to the lake, have increased 10-fold since European settlement (St. Croix Watershed Research Station).

River scientists of various specialties have learned much about the problem of sediment in recent years. It is now generally accepted that most of the suspended sediment load from the Minnesota River comes from "near-channel" sources – stream bluffs, banks and ravines. These kinds of erosion occur along the lower, steeper reaches of tributaries as they descend from the surrounding plateau down to the Minnesota River hundreds of feet below, deepening and extending their valleys by back cutting upstream. Episodes of higher stream flow, caused by more intense precipitation falling on a landscape largely devoid of wetland storage, erode and undermine riverbanks and bluffs at their base, or toe, whereupon they collapse into the stream and are carried away by powerful currents. Surface runoff from rainfall or snowmelt events form gullies and ravines (large gullies) down the steep valley walls of tributaries. Altogether, it is estimated that, on average, 60-85 percent of sediment transported down the Minnesota River comes from near-channel sources.

Solution

Different solutions are called for in controlling erosion from stream banks and bluffs, on the one hand, and gullies and ravines, on the other. In the case of the former, most emphasis has been on creating increased areas of water storage on the landscape, often through restoration of former wetlands previously drained and converted to crop production. A significant proportion of the landscape needs to be converted to water storage in order to reduce water runoff sufficiently to abate stream flow and the erosion of riverbanks and bluffs. With farmland prices at historic highs, averaging near $10,000 per acre, widespread restoration of converted wetlands has become a relatively costly solution. There is a need to identify priority sites for wetland restoration to ensure that scarce public funds produce the greatest possible benefit.

Ravine erosion is concentrated in areas downstream of “nick points”, or abrupt increases in stream gradient, where tributaries rush to their confluence with the main stem. Ravines are prevalent in the watersheds of the Greater Blue Earth, Middle Minnesota and Lower Minnesota rivers.

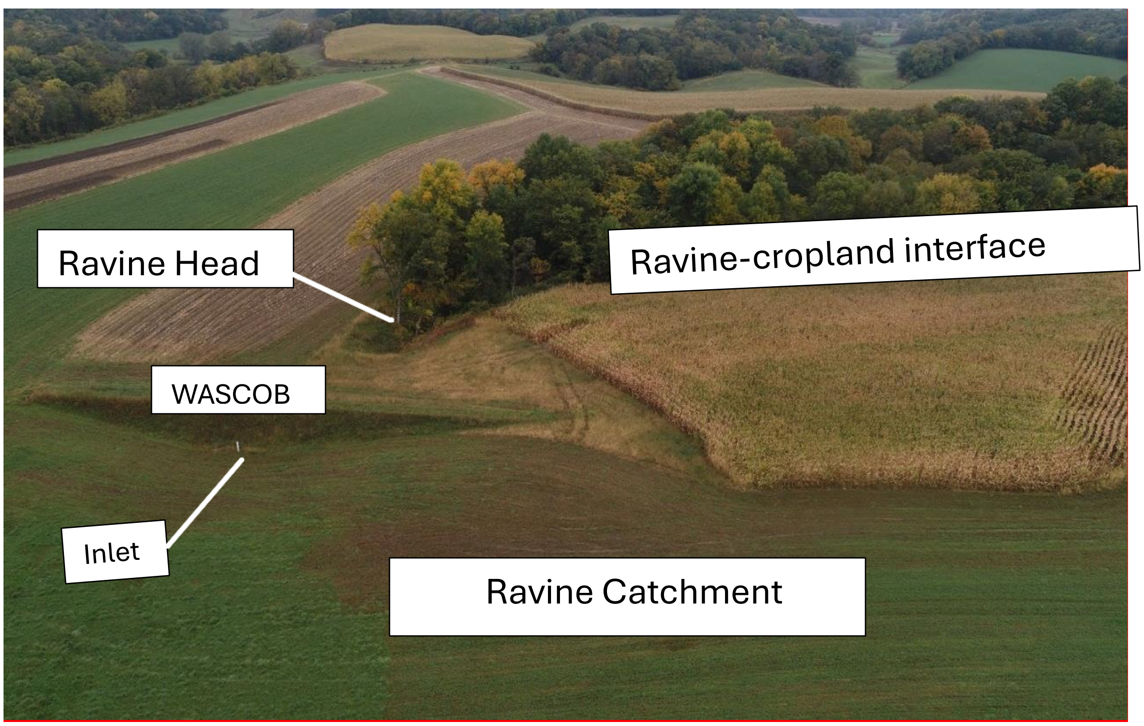


Thousands of ravines spread into the landscape of Minnesota River tributaries such as south of Mankato near the mouth of the Blue Earth River, shown here.

Surface runoff erodes gullies at field edge. Ravines can form further downhill. -

Tile drainage outlets can form plunge pools at the head of ravines.

To control water runoff and soil erosion from gullies and ravines requires examining ways of reducing and containing runoff at multiple locations: the area that drains to the ravine, called the catchment; the ravine head; the interface between cropland and a high-gradient slope with potential for gully and ravine formation; and the walls and bed of the ravine itself. The following potential interventions for each of these areas likely need to be applied in combinations to effectively control runoff from the high-precipitation events that are more common today:



- <u>Catchment:</u> Two practices which can significantly improve water storage and infiltration in the area draining to a ravine are cover crops and restored wetlands. **Cover crops** such as winter rye are seeded in the fall and produce a living ground cover early in the spring. The cover crop must be killed with herbicide or crimping prior to planting a row crop such as corn or soybeans. No-till or strip-till seeding of soybeans or corn preserves the enhanced infiltration capacity of the desiccated cover crop. A second option for the catchment, **restored wetlands**, will increase water storage and infiltration, thereby reducing runoff to the ravine head, the downstream tributary, and the main stem Minnesota River.

Drilling soybeans no-till into standing cover crop.
Nicollet County SWCD

Emerged soybeans in cover crop residue.
Nicollet County SWCD

- Ravine Head: A conservation structure typically used at this location is the **Water and Sediment Control Basin (WASCOB)**, designated CP-638 in the Field Office Technical Guide of the Natural Resources Conservation Service. WASCOBs are dams designed to effectively contain, and gradually release through a protected outlet, runoff from a rainfall event of up to one in ten-year frequency (3.4 inches) in a 24-hour period. A U.S. Army Corps of Engineering modeling study of Seven Mile Creek watershed found that WASCOBs contained runoff from moderate floods, but that additional measures were needed for higher-runoff events. WASCOBs combined with cover crops provided the greatest degree of runoff control of the options studied.

Constructed WASCOB at head of ravine, Goodhue County SWCD

- Ravine-Cropland Interface: In this zone, **a buffer of perennial vegetation** can be used to convert concentrated flow at the field edge to sheet flow which more readily infiltrates into the soil. Such buffers can prevent the formation of new gullies and reduce the volume of runoff into existing gullies and ravines. A conservation practice called Minnesota CP-38E, developed by technicians for the Seven Mile Creek watershed in Nicollet County, is available throughout the state to enroll ravine/cropland interface areas in the Conservation Reserve Program. Farmers use this practice to "square the field" along irregular edges bordering ravines.

- In-Ravine: Within ravines, well-placed logs or wood beams or well-managed vegetative ground cover on side slopes can reduce erosion. The Corps of Engineers study found that **ground cover vegetation** could reduce sediment load and promote savannah restoration in south- and west-facing walls with less than 20-degree slopes. Vegetation had little effect on steeper ravine sidewall erosion driven by undercutting and mass wasting.

Proposal: Reduce Ravine Runoff:

Based on this analysis, it is suggested that the Lower Minnesota River Watershed District work with partners to advance a legislative agenda focused on reduction of runoff and soil erosion from ravines. Not only are ravines a major source of runoff to the main channel; most of the solutions do not entail removal of significant acreage from crop production. This proposal promotes a "treatment train" approach to deal with high-rainfall events by implementing a set of practices within the ravine catchment, ravine head, ravine/cropland interface and in the ravine itself. Local technicians should design the treatment train to control runoff and ravine erosion from events which exceed the current WASCOB design standard. The goal is to integrate multiple conservation efforts to keep pace with the trend of higher, more intense, rainfall events.

The Minnesota Legislature should support the following incentives to encourage adoption of a treatment train approach to ravine erosion control:

- Catchment incentives.
  - Identify wetlands within ravine catchments as **priorities for restoration** with state and federal funding.
  - Create a **Conservation Reserve Enhancement Program (CREP)** for wetland restoration within ravine catchments. CREP combines state funding from the Reinvest in Minnesota (RIM) program with the federal CRP to purchase permanent easements from participating landowners.
  - Fund **incentives for cover crops** followed by no-till or strip-till planting of row crops within ravine catchments.

- Cropland/Ravine interface incentives.
  - Based on experience in the Seven Mile Creek watershed, promote implementation of **perennial vegetation buffers** to square off fields along the ravine/cropland interface. Dedicate state CRP acreage and funds to implementation of Minnesota CP-38E from the CRP continuous signup program.

- Ravine Head incentives.
  - Establish ravine heads as a priority location for WASCOB (CP-638) structures.

    - Use state funds to cover part of federal cost-share requirements.
    - Provide **additional technical assistance** to One Watershed/One Plan joint powers organizations and soil and water conservation districts to implement WASCOBs and related best management practices. Consider providing such support through existing regional Soil and Water Conservation District technical joint powers boards.

- In-Ravine incentives.
    - Where establishment of ground cover on ravine side slopes appears practical, provide technical assistance and cost-share to establish perennial vegetation.

In addition to these incentives, the legislative program should fund educational and promotional resources for use by local units of government, as well as a regional information-education campaign to raise awareness of the importance of controlling ravine erosion, and resources available to landowners.

Impact

Ravine erosion has not received the attention proportionate to its impact locally and downstream in the Minnesota River basin. Addressing this widespread but largely hidden problem needs to be considered on the same level as the related issue of wetland restoration as a means of reducing runoff and abating flooding problems. This proposal, if adequately funded, would begin to treat ravine erosion as a serious environmental concern with downstream ramifications as well as local impacts. It would provide economic incentives for a menu of options to fit each individual situation. If successful, it would begin to normalize the practice of controlling runoff from ravines, reducing erosion of farmland at field edges, with often minimal need to use up cropland to implement conservation practices. For example, six acres of land would provide a mile-long 50-foot-wide buffer strip at the ravine/cropland interface, far more than most projects require. WASCOBs often take up little or no farmland. While cumulative impacts are difficult to estimate, each project by design would contain runoff from events of a once in ten years frequency, and often of more extreme events, based on the treatment train approach. A focus on regions of high ravine density, such as the Greater Blue Earth, Middle Minnesota and Lower Minnesota watersheds would expedite achievement of measurable results in stream flow and sediment loss.