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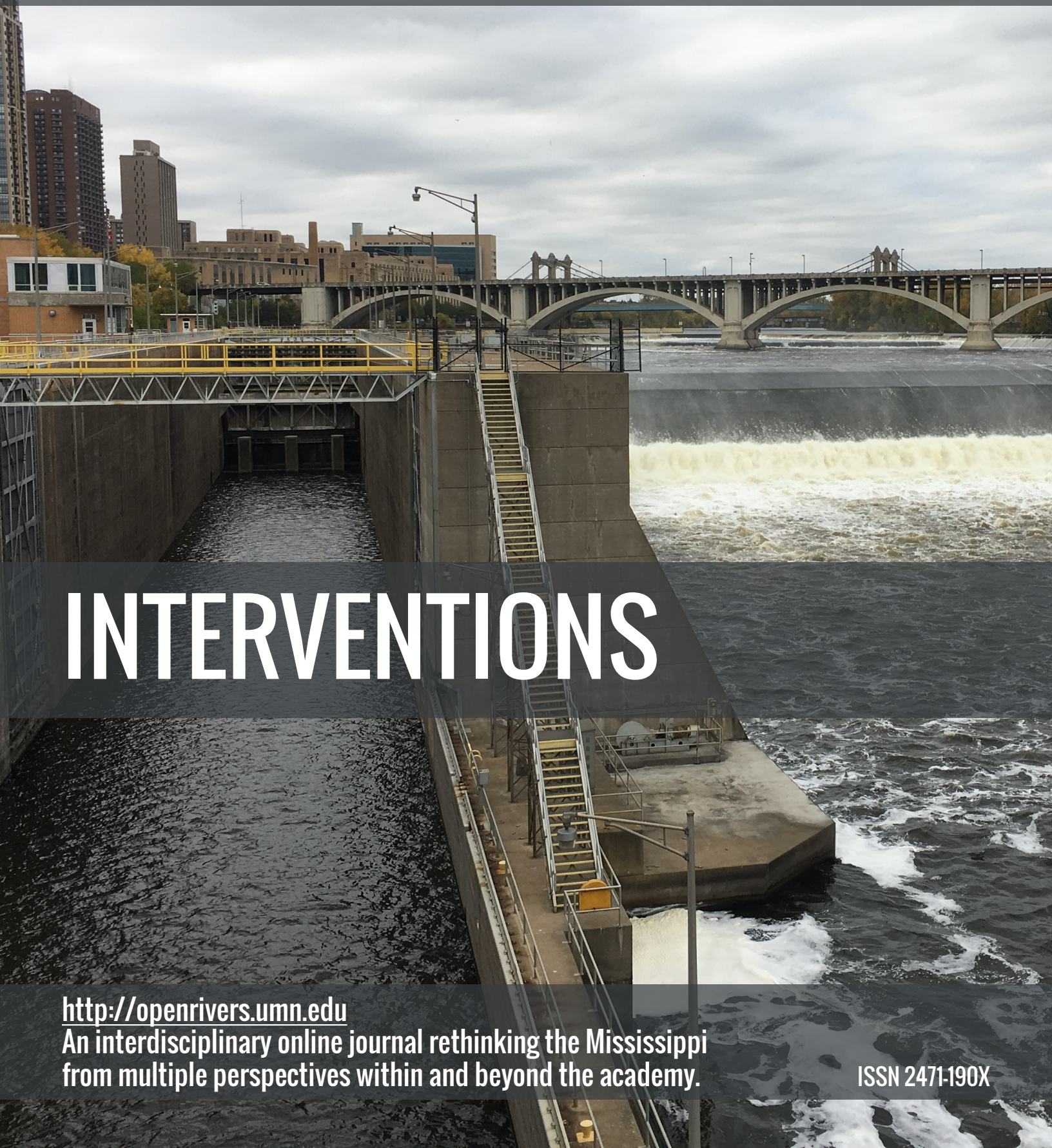
OPEN RIVERS : RETHINKING THE MISSISSIPPI



INTERVENTIONS

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The cover image is of St. Anthony Falls Lock, closed in June 2015. Image courtesy River Life, University of Minnesota.

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FEATURE

WHY SO MUCH SAND IN THE LOWER MINNESOTA RIVER?

By Carrie E. Jennings

The Lower Minnesota River, from Carver Rapids to the confluence with the Mississippi, is a low-gradient, broad reach of the river. If you wade into the brown water you may be surprised to find that the bottom is actually sandy. Based on the yearly gaging data, about half an inch of sand would accumulate in the channel each year if it were not dredged. That is about six times

View of the Minnesota River near the I-35 bridge during high flows in summer 2016. Image by Carrie Jennings.

more than the average, pre-European-settlement accumulation rate.

So what? This stretch of river is meant to slowly fill in, or aggrade, with time. Why should we fight a natural process? Isn't the suspended sediment that is making the water muddy what everyone should be focused on?

The rapidity with which the sand is accumulating is affecting ecosystems and more immediately, it is inconvenient and costing taxpayers money. It has the potential to affect commercial barge traffic to the Port of Savage; it is using more taxpayer dollars as dredging tries to keep up with the river-filling sand; and it will spread sand on a proposed paved bike trail that would run along the levee from the Bloomington Ferry Bridge to Ft. Snelling. (Fat-tire bikers and mountain bikers may be happy to hear this. They would like to keep this part of the river wild.)

This summer, archaeological test pits were being dug along the proposed bike trail route to make sure it would not impact or pave over important archaeological sites. Most of the pits were turning up nothing, which seemed odd to the team contracted by the Department of Natural Resources (DNR) to do the work. I was contacted for an opinion when they finally did hit a couple

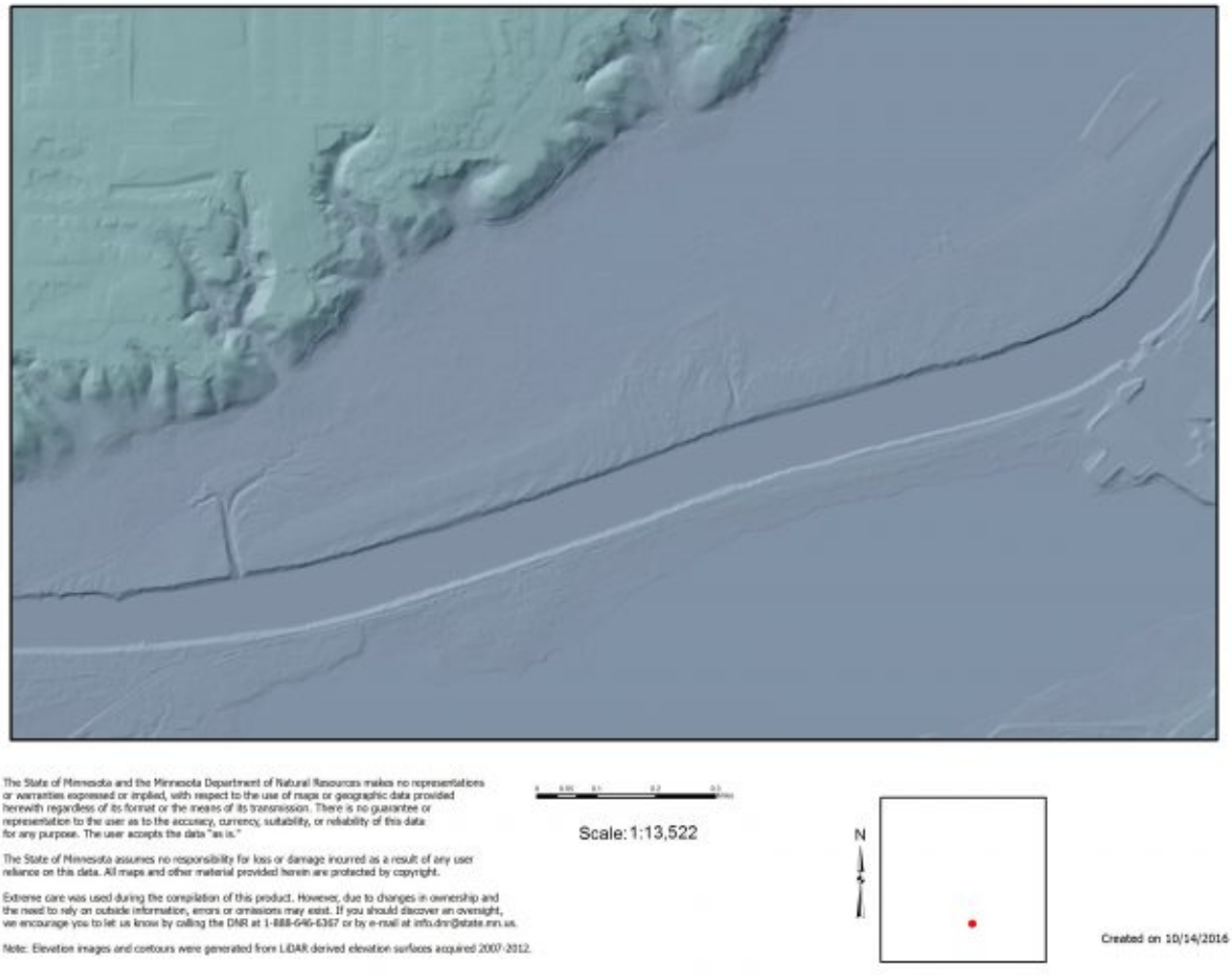
Excavation pit showing two layers with artifacts, at 10 and 20 inches deep. The white layer at 20 inches is mussel shells. Image by Carrie Jennings.

of layers with artifacts near the natural levee of the river, south of Nine Mile Creek.

The layers of interest were buried by 10 and 20 inches of sand. One layer contained a confusing mess of items that included: a white ceramic pipe stem from Paris that could have dated to the European contact period, some abraded and some sharp pot sherds, some metal, and a small triangular piece of blue plastic. That the layer included metal and plastic means that it dated to the modern time and was redeposited here with older materials, possibly by a large flood event. The deeper layer was a bed of mostly disarticulated mussel shells.

The question the archaeologists asked me was, "How old are the layers and how did they get buried?"

If the half inch of sand accumulating in the channel were spread evenly over this part of the river valley, this site could date to the 1960s and the archaeologists would have to dig another 6 to 10 feet to get back 200 years, to the European-contact period. This is a valley-wide average based on just a few years of gaging data, so is at best a ballpark figure. However, this rapid sedimentation did make sense to the archaeologists. Most of their pits were barren, even though they expected this to be a rich area.



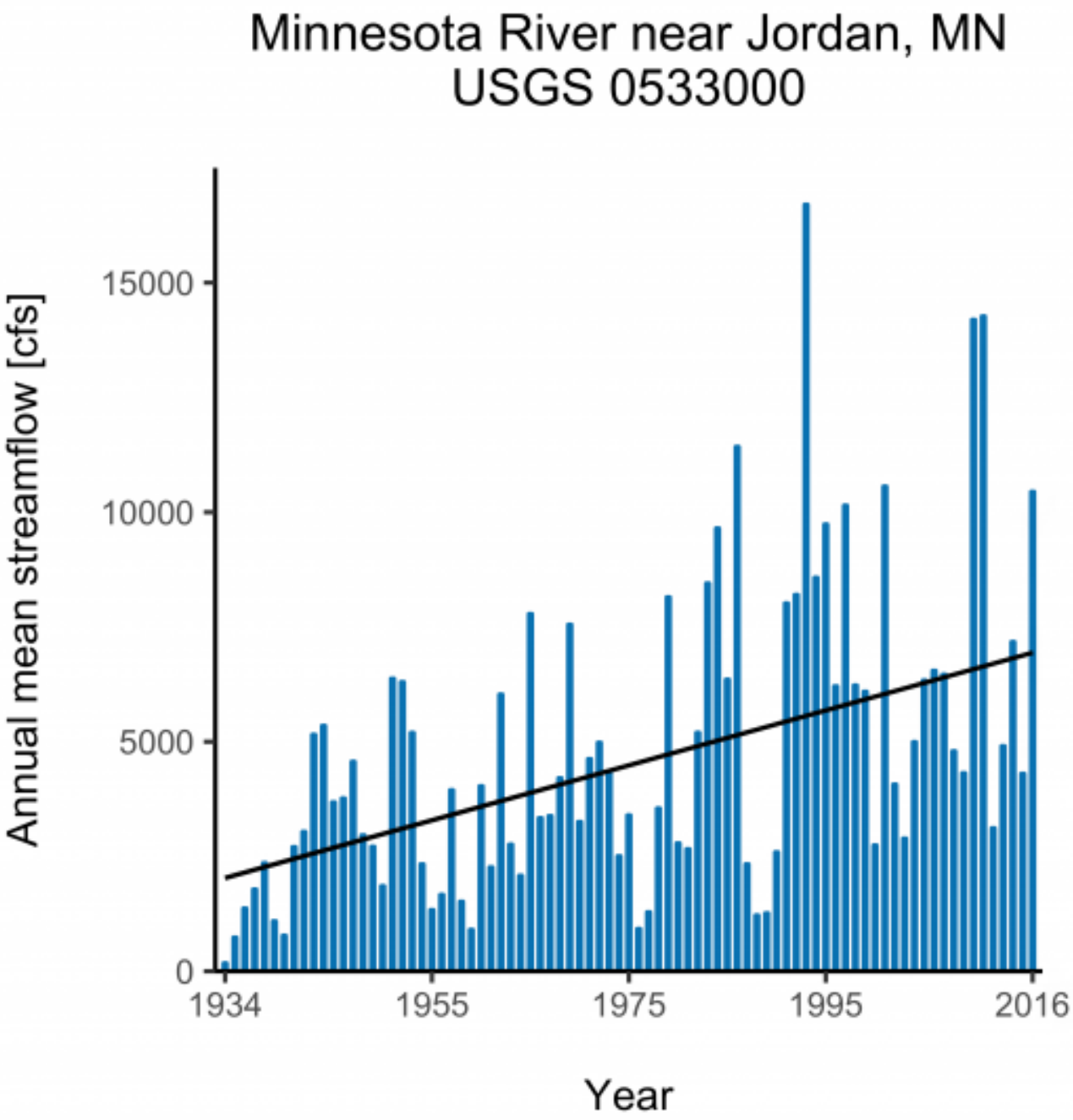
Sand is deposited on a levee during high flows of the Minnesota River and in some cases, breaches the levee and is deposited in a splay of sand farther back on the floodplain. Scale: 1:13,522, north is at the top of the image. Map created by the author from high resolution elevation data provided by the DNR, using the DNR tool MNTOPO

So we were probably only looking at decades of sediment burying the layers. The trash layer may even represent one of the big, historic floods in the valley such as the April 1965 flood—the flood of record until a 2010 fall flood surpassed it. With that recent of an event, it is even possible to review the flood history and Army Corps of Engineers photos to see when this portion of the valley was inundated.You can easily see on the shaded relief map (below) where splays of sandy sediment breach the levee and build up the level of the flood plain with each flood. Anything placed on the floodplain here will be slowly smothered with sand, as the buried root crowns of the floodplain trees attest.

One intact mussel was found in the shell layer and tentatively identified by photograph by Bernard Sietman, DNR. He said that it "appears to be Quadrula nobilis (Gulf mapleleaf). We just discovered this species in Minnesota a little over 10 years ago from old shell deposits in the lower Minnesota River at Carver and a few sites around the I-35 bridge.... We would be interested to know how those shells were deposited there; naturally, by humans, etc."

Mussels are filter feeders that need rocky substrates and clearer water to exist. Something changed in this reach of the river to make them unable to survive.

An intact mussel, found in the shell layer, was tentatively identified by Bernard Sietman as Quadrula nobilis (Gulf mapleleaf). Image by Carrie Jennings.



Annual mean streamflow on the Minnesota River near Jordan, MN, 1934-2016. Graph provided by the author.

What do we, as a society, collectively decide to do with the Minnesota River?

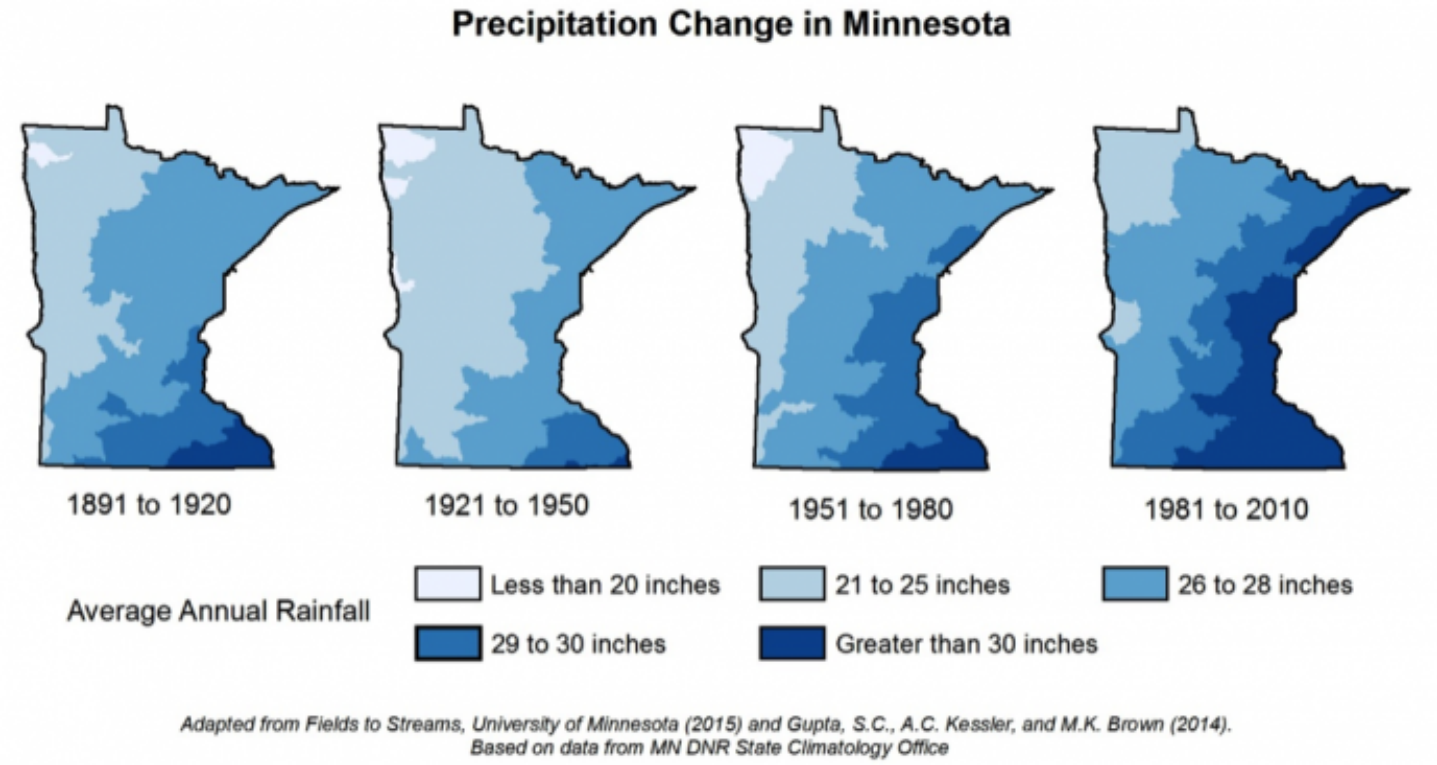
- Stop trying to navigate this reach of the river or pay more and more to dredge it?
- Abandon the trail idea or shovel it after every flood?
- Forget that mussels used to thrive here or return to a water quality that they can live in?

By ignoring the question, we are making some of these the default decisions. By ignoring the cause, we may be locked in to a Sisyphean shoveling and dredging exercise because we didn't address the root cause of the increased sediment loads.

One tiny watershed district is trying to address the sedimentation problem. The Lower Minnesota River Watershed District (LMRWD) manages a 65-square-mile area that encompasses the lower 35 miles of the Minnesota River. Their narrow reach is the bottom of a funnel that bears the brunt of what happens upstream in 90 percent of the rest of this primarily agricultural watershed. The district is responsible for maintaining a navigable channel up to the ports in Savage from which agricultural products are delivered to market and bulk materials needed for farming are delivered to those in the watershed. The LMRWD is running out of places to put dredge spoil and is looking for a more holistic, watershed-wide solution. They don't have the money or political clout to tell the rest of the watershed what to do.

One approach they are trying is to document the change that has happened. We know that southern Minnesota rivers have exhibited a significant increase in annual flows over the last several decades owing to a combination of changes in climate, ground cover, and artificial drainage.

As a result, rivers have been widening throughout the watershed and are consuming on average,



Precipitation change in Minnesota showing average annual rainfall, 1891-2010. Image adapted by Freshwater Society, based on data from MN DNR State Climatology Office.

80 acres of land per year, affecting over 10,000 properties in the Minnesota River and its tributaries. The eroded sediment ends up clogging the low-gradient reaches of the lower Minnesota River, before the confluence with the Mississippi. Some makes its way to Lake Pepin further downstream.

In 2016, LMRWD engaged Freshwater Society to synthesize and communicate with stakeholders what was known about changes in flow and to demonstrate how increased sedimentation in this reach has been the unintended result of land management practices. Ultimately, they are interested in facilitating the creation of more upstream water storage to reduce sedimentation, but recognize that existing organizations and structures are of insufficient scale to address the problem.

Modeled projections are for more intense April-June storms and an overall increase in annual precipitation. The precipitation patterns are shifting, too, with more rain falling in the Minnesota River basin. So even if we do nothing, the flows in the river will continue to increase, resulting in increased flooding, erosion, and sediment transport.

Water storage is a likely way to slow the erosion of crop land and reduce the downstream impacts of sediment and flooding. The cumulative effect of each landowner helping a little bit, parcel by parcel, adds up. Importantly, we don't have to recreate the original lake, wetland, and river network to benefit from storage. We can store water in a variety of places, including by planting perennial plant cover that takes water up through its roots and evaporates it during key early spring times of year.

We know we don't have control over the weather, but sometimes it feels like we have even less control over what goes on in a watershed as large as the Minnesota. But this little watershed at the end of the pipe is attempting to find a solution to their sedimentation problems.

The science is pretty clear; it is the politics and policy that are holding us back now. If we pool resources to address the underlying cause of watershed change, then we will reap multiple benefits both upstream and down.

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About the Author

Carrie Jennings is director of research and policy at Freshwater Society. She was a field geologist for 24 years, most of those with the Minnesota Geological Survey at the U of Minnesota. She maintains a strong connection with the U of M where she did her MS and PhD, is adjunct faculty in Earth Sciences, a member of the faculty in Water Resources and the Natural Resources Science and Management Graduate Program. She has taught a field-oriented glacial geology course for the last 22 years and mentors graduate students across the U.