How Many Wetlands Does it Take to Clean A Watershed?

Determining the potential of wetlands in an agricultural basin.

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Introduction

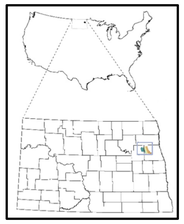
Wetlands are known to sequester nutrients and sediment, and are often built for that purpose, however it is less clear how many it would take to remediate an entire watershed using treatment wetlands alone.

One of the key variables inherent in this question is wetland spatial arrangement: To most efficiently remediate a watershed using wetlands, where should they be built?

Results will help to determine the limits and possibilities of treatment wetlands at the watershed scale.

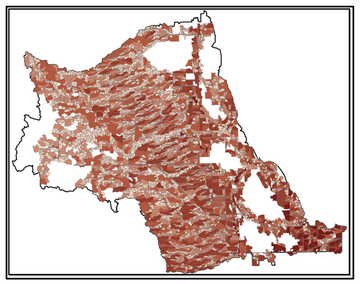
Methods

This study takes place in the heavily agricultural, 303(d)-listed Upper Turtle River watershed of North Dakota. The watershed area is 536 km^2



Modeling occurred via PTMApp, a watershed planning tool that can estimate the sources and loads of pollutants. It can also assess the impact of BMPs including wetlands.

Three distinct strategies of wetland construction were modeled.



Pollutant (TN + TP + Sediment) heat map of field-scale catchments within the UTR watershed.

All wetlands were sized to accommodate runoff from the 10-year 24-hour storm at 2 m depth.

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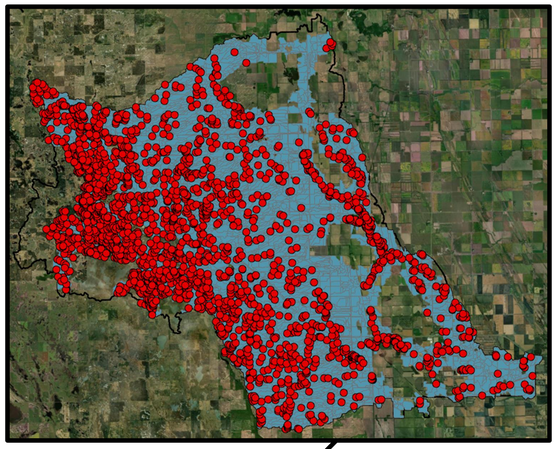
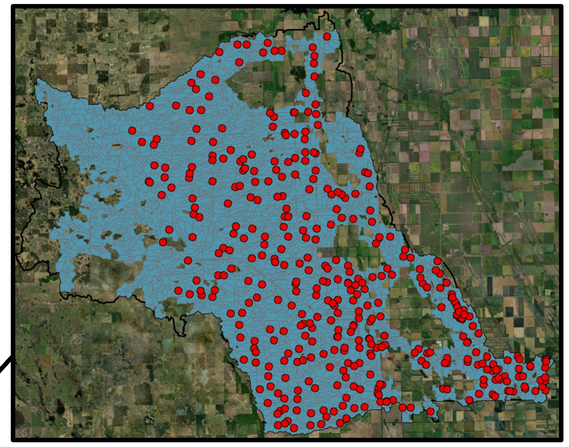
Results

Baseline: numerous wetlands, but most are upstream of target pollutant sources



Scenario A: Small wetlands added at the outlets of the most polluted catchments.

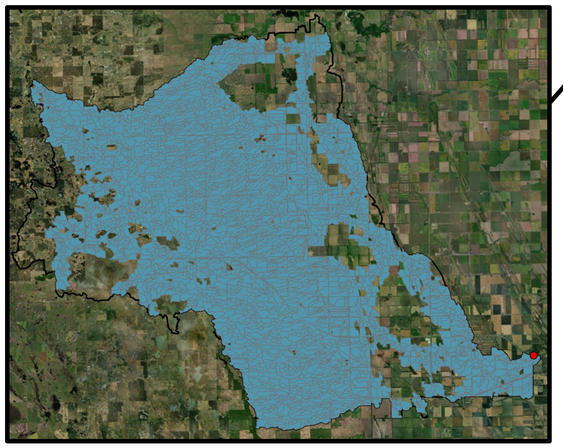


Baseline	
Wetlands (NWI)	2,546
Runoff Intercepted	12.3%
TN Intercepted	2.5%
TP Intercepted	2.3%
Sediment Intercepted	1.4%

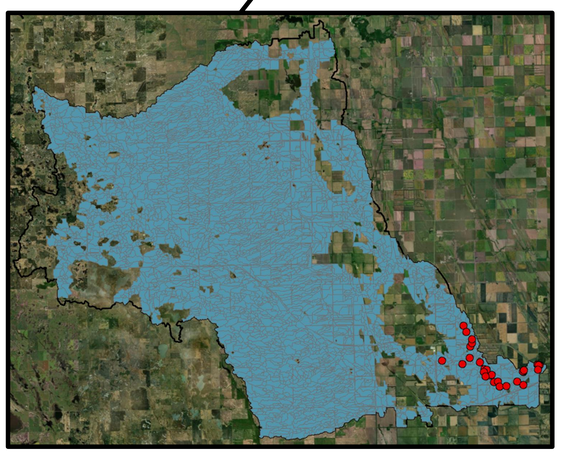
A	
Wetlands	+397
Wetland Area	+2.3 km^2
Wetlands (%)	+0.4%
Runoff Intercepted	27.6%
TN Intercepted	30.4%
TP Intercepted	30.3%
Sediment Intercepted	22.2%

B	
Wetlands	+1
Wetland Area	+8.2 km^2
Wetlands (%)	+1.5%
Runoff Intercepted	100%
TN Intercepted	100%
TP Intercepted	100%
Sediment Intercepted	100%

C	
Wetlands	+28
Wetland Area	+4.0 km^2
Wetlands (%)	+0.8%
Runoff Intercepted	89%
TN Intercepted	99.3%
TP Intercepted	99.2%
Sediment Intercepted	99.1%



Scenario B: One large wetland added at the watershed outlet.



Scenario C: Large wetlands on the two major forks, small wetlands downstream.

Assessments

Scenario A would involve many land owners and high construction costs for modest gains to water quality and habitat.

Scenario B treats all watershed outflows and would create valuable habitat, but at the expense of a riverside neighborhood.

Scenario C treats a high portion of the most polluted water without excessive sites or impacts to private property

Results indicate that UTR water quality could be remediated through strategic conversion of 1% of the watershed to wetlands.

Next Steps

Evaluate scenarios in ArcSWAT
This software operates at a daily time-step and incorporates groundwater flows.

Quantify ecosystem services
Comparing ecosystem services expected from each scenario, including biomass.

Explore feasibility
Look at the economic and legal aspects of scenarios. Are funding tools available?

Repeat the study in another watershed

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