



Saturated Buffers

Saturated buffers are a conservation drainage practice designed to remove nitrate from agricultural tile water by modifying the outlet to allow flow to be diverted through the soil profile of a vegetated buffer. The outlet is modified by using a control structure which directs a portion of the flow to a distribution line that runs parallel to the stream.

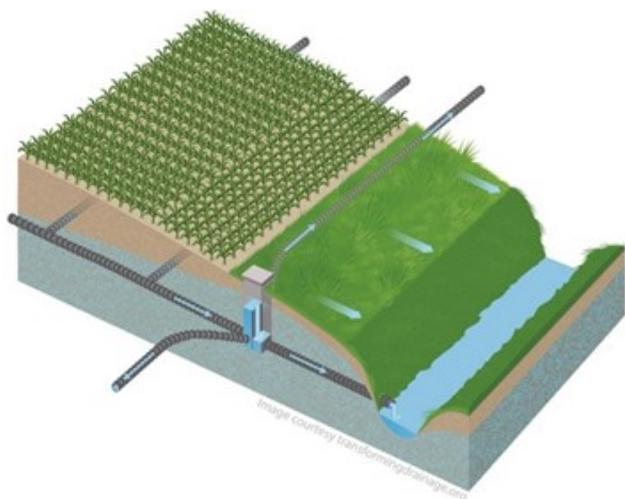


Figure 1 Saturated buffer schematic by transformingdrainage.org.

Project

ADMC worked with FSA to monitor 7 Midwest sites from October 2017- August 2018.

- Site average nitrate concentration reductions ranged from **41% - 98%**
- Nitrate load reductions ranged from **10 – 194 pounds**

Table 1 ADMC monitored saturated buffer performance, Oct. 17—Aug. 18.

Site	Nitrate-N	
	Concentration Reduction	Load Removed, pounds
IA-1	97%	87
IA-2	74%	194
IA-3	98%	10
IL-2	79%	NA
IL-5	69%	177
MN-2	41%	16
MN-4	73%	41

Sites



Figure 2 ADMC monitoring locations.

The 7 sites were distributed among IA, IL, and MN. Each of the sites had three transects of wells. The transects consisted of a stream side well and then 2 additional wells distributed evenly between the stream side well and the distribution line. Figure 3 displays the monitoring layout of IL 5.



Figure 3 IL 5 site overview.

Costs

\$3,584 was the average installation cost of the 7 monitored saturated buffers, and they have operated at an efficiency of **\$1.22/pound of N removed** over the 20 collective site years of monitoring.

Site Suitability

- 30 feet of perennial vegetation
- < 1.2% soil organic matter
- No sand lenses or gravel layers
- Stable stream banks



Scalability

Researchers from the Department of Crop Sciences at the University of Illinois, Urbana-Champaign developed a decision support tool to determine the extent of feasible sites in the Midwest. To do so, they implemented a stepwise GIS model to eliminate stream miles with surrounding conditions not conducive to saturated buffer installation.

Stream length elimination steps

If a stream length met the following criteria, it was eliminated as a possible site.

- 1) Lengths identified as a major river or intermittent stream in the National Hydrography Dataset
- 2) 330 ft around streams with soil organic matter <2.5%
- 3) 980 ft zone around streams without poorly drained soils
- 4) <50% of area within the 980 ft in corn or soybean production

Model results

23,460 miles of stream or 46,920 miles of stream bank were shown to be suitable sites for installation.

IA (6,660 miles), IL (6,580 miles), and OH (4,050 miles) have the greatest potential for suitable sites.



Figure 4 Miles of potential saturated buffers in the Midwest, acres in ().

Impact

How many Midwest acres can be treated with a saturated buffer?

9.5 million acres, or 22% of the estimated drained area in the Midwest can possibly be treated with a saturated buffer. Acres were determined based upon previous ADMC work that established that a typical saturated buffer is 690 to 1,000 ft long, and that it takes 26 linear feet to treat 1 acre of drainage.

How much nitrogen can be removed with full-scale implementation in the Midwest?

22,000— 43,000 tons of N can be removed assuming a N load removal rate of 23-44% load from the field tile, and that an average acre of drained land generates 20.5 lbs of N.

Enhancing existing CP21 and CP22 buffers

According to USDA fact sheets, CP21 and CP22 buffers hold back 6.4 pounds of N per acre. Over 20 site years of monitoring by ADMC, the 7 saturated buffers averaged 117 pounds of N removal per year and have a typical footprint of 1.4 acres. Enhancing a current CP21 filter strip or CP22 riparian buffer with a saturated buffer will remove 13 times the amount of N and by 6 to 10 times more cost effective.

Table 2 Efficiency gained by enhancing a standard buffer with a saturated buffer.

Practice	\$/lb. of N removed*	\$/lb. of N removed with a SB [†]
CP21**	\$16.6	\$2.61
CP22***	\$44.3	\$4.58

* Assuming a 1.4-acre area of a typical saturated buffer and an average of 6.4 pounds of N retained by buffer.

** Assumes average payment rate of \$148.3.

*** Assumes average payment rate of \$396.6.

† Assumes an average saturated buffer removal rate of 117.02 lbs of N per year and an equivalent annual cost of \$181.06 with a 40-year lifespan and a 4% real discount rate.

For a detailed version of how calculations were made, please refer to full report found at:

www.admcoalition.com