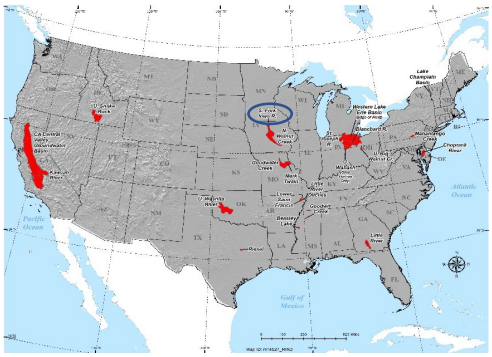
South Fork, Iowa River Watershed

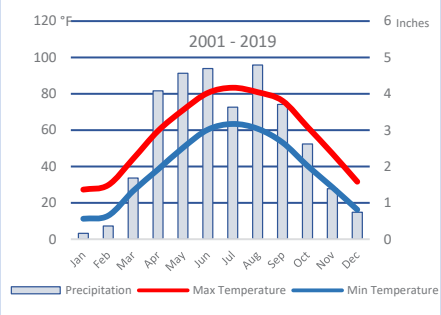


A Conservation Effects Assessment Project (CEAP) Watershed Assessment Study: A collaboration between the Agricultural Research Service and the Natural Resources Conservation Service

Location

The South Fork of the Iowa River drains 780 km^2 (193,000 acres) in Iowa. The watershed is an area of intensive production of row-crops and livestock.

Temperature and Precipitation



Major land uses

Cropland: Corn & Soybean production occurs on about 90% of the watershed. **Pasture, Livestock facilities, Farmsteads, Woodlands, Roadways, and Towns** comprise the remainder.

Data collection

Stream monitoring began in 1996 and was expanded to multiple stream gauges in 2001. Continuous discharge data are aggregated on 30-minute intervals. Automated samplers collect water samples during storm events with additional samples collected every week during the growing season. Water quality sondes have been in place since 2007 to collect continuous data on water temperature, dissolved oxygen, and nitrate concentrations.
Two meteorological stations measure precipitation, temperature, relative humidity, and solar radiation.

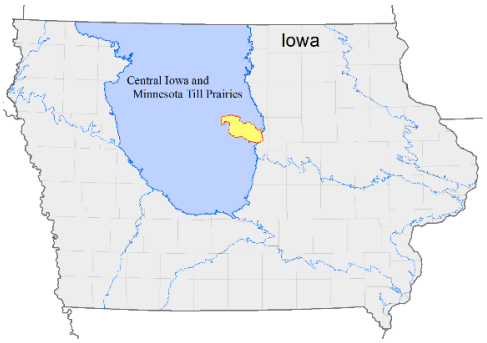
Concerns

The SFIR watershed is in the Des Moines Lobe of north central Iowa and southern Minnesota, an area of recent glaciation that exhibits limited stream development and poor soil drainage. The loam textured soils are high in organic matter, which, combined with a humid temperate climate, make the area one of the world's most productive agricultural regions. Hydric soils occupy 54% of the watershed. Artificial (tile) drainage systems were installed beginning in the early 1900s and are being updated on an ongoing basis. About 84% of the watershed is tile drained, and 2/3 of stream discharge originates via tiles.

The drainage water carries substantial nitrate loads, which have averaged around 30 kg ha^{-1} in recent years. Soil temperatures are cool in the spring, and farmers use tillage to help warm them for planting. The resulting poor residue cover increases soil erosion, especially in spring when periods of wet weather have delayed planting in recent years. There are >100 livestock facilities, most producing swine. Most manure is applied in fall, which challenges beneficial re-use of manure nutrients.

Main conservation practices used

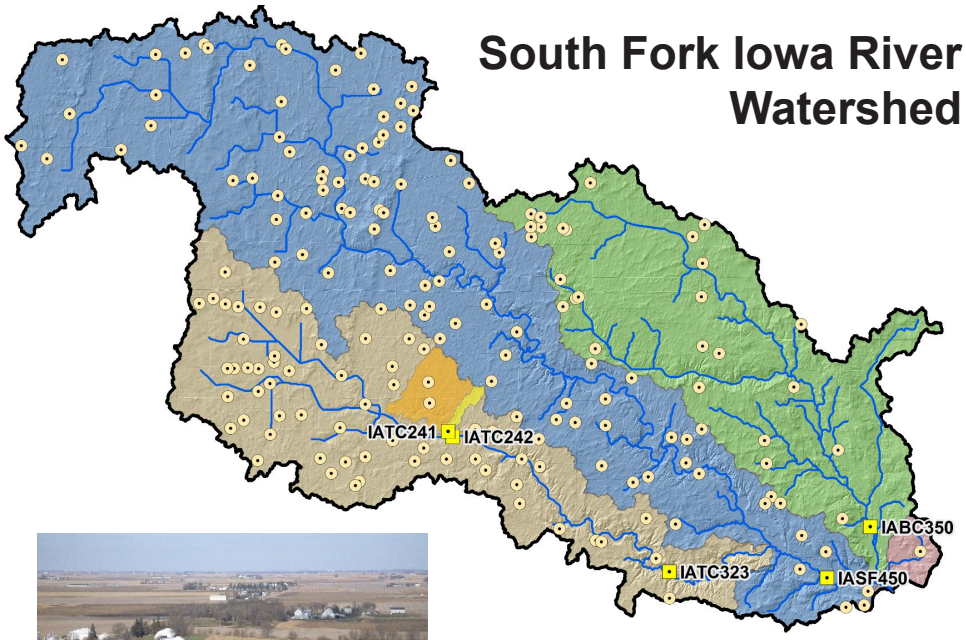
Most producers address water quality risks by managing timing and rate of fertilizer and pesticide applications. But wet weather can reduce flexibility of operations. Producers are being encouraged to implement practices to reduce nitrates in tile drainage, including controlled drainage, bioreactors, saturated buffers, and wetlands. Locations suited for placement of these and other practices have been identified using the Agricultural Conservation Planning Framework (ACPF), and farmers can view suggested practice placements, by field, on a story map website. Surface inlets found in glacial depressions can have filter practices installed, but only in fields where tillage is restricted.



Outcomes/Findings

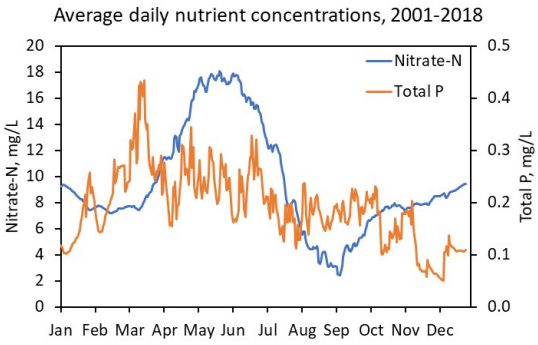
Plot and field scale

- Existing conservation practices (grassed waterways, WASCOBs, terraces) were mapped from1930 to 2016. Distribution of these conservation practices are related to erosion. Grassed waterways were the predominate conservation practice. In recent decades installation of new conservation practices tends to balance loss of conservation practices.
- Existing conservation practices are ineffective for reducing nitrate and *E. coli* in this tile-drained and manured watershed. Sources of nitrate are fertilizer, animal manure, and soil organic matter.
- Monitoring of this watershed showed that annual nitrate loss ranges from 8.4 to 58.9 kg/ha, which varies with rainfall. Streamflow varies seasonally with about 50% of the annual nitrate loss occurring during spring and early summer. Phosphorus losses are episodic; peak losses come from snowmelt in some years (see chart at right).
- The watershed would benefit from implementation of saturated buffers and wood-chip bioreactors. Wood – chip bioreactors host bacteria that convert nitrate in water to nitrogen gas in the atmosphere. Bioreactors occupy only 0.3% of a treated field's area and can reduce annual nitrate loads by 20%.
- Concentrations of two antibiotics used in swine production were detected in 69% of the water samples from streams and tile drains.
- Monitoring data has been used to test and calibrate watershed simulation models. Research has focused on testing tile drainage routines and evaluating benefits of perennial bioenergy crops.



The watershed has many confined animal feeding operations (circles), most producing swine. Drainage areas above gage stations (labeled) include streams and tile outlets.

Typical farmlands after harvest.



Watershed scale

- Practices to treat tile drainage can be used to reduce nitrate loads. Using the ACPF, we estimate that saturated buffers could treat drainage from 101,736 acres, bioreactors could treat drainage from 24,194 acres, and controlled drainage could be used on 44,933 acres in the watershed.
- Glacial depressions (prairie potholes) are common. The watershed has 4,775 potholes covering 19,710 acres, which could store 25,820 acre-ft of water if all were filled. In some years potholes are highly productive and not visible.

Restored prairie pothole wetland.

Collaborators and Stakeholders

Southfork Watershed Alliance Inc.
Iowa Soybean Association
Iowa Department of Agriculture & Land Stewardship
Antares Group Incorporated
USGS science for a changing world
DNR Iowa Department of Natural Resources
Agricultural Conservation Planning Framework

More Information

CEAP Site Lead: Rob Malone, rob.malone@usda.gov
ARS website: ars.usda.gov NRCS website: nrcs.usda.gov
CEAP website: nrcs.usda.gov/wps/portal/nrcs/main/national/technical/nra/ceap/