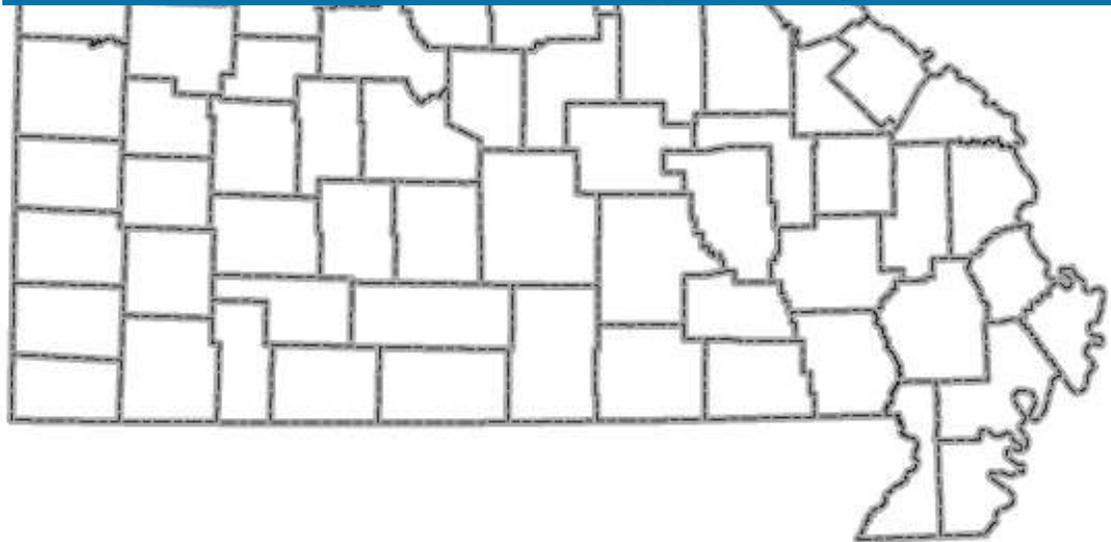


The State of *Our Missouri Waters*

North Fork Salt River Watershed



The Missouri Department of Natural Resources seeks to improve the availability of water resource information to communities where impact to these water resources is felt most.

The information presented in this summary is intended to increase awareness of how activities on land and in water have an influence on water resource quality and quantity. The department greatly values local input and engagement regarding the mission of ensuring safe and ample water resources, and will continue to seek local guidance to further focus department efforts and funding strategies for the betterment of *Our Missouri Waters*.



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December 2014

North Salt Fork River Watershed

The State of Our Missouri Waters

Importance of Water Quantity and Quality

Water shortages can have severe and expensive consequences. Adequate water supplies are vital not only to human health and safety, but also to the prosperity of our state. Whether it is for crop irrigation, industrial manufacturing or power generation, water is at the core of human existence and sustainability. A few decades ago, the supply of water in Missouri was considered virtually unlimited. As population and industry have increased, a need for statewide water planning has emerged.

Water quality impairments can also have severe impacts on human health and the environment and be extremely expensive. Unfortunately and more importantly, many water quality impairments are only discovered once the consequences of poor water quality have been realized. For this reason, it is important that locals are involved in the protection of their water quality and quantity so as to prevent irreversible consequences.

Key Points

The North Fork Salt River Watershed composes 32 percent of the Salt River Basin in northeast Missouri. It is one of three HUC 8 watersheds that drains into Mark Twain Lake. Mark Twain Lake was created when Clarence Cannon Dam was completed in 1984. The 18,600 acres of surface water and 285 miles of shoreline provides hydroelectric power, flood control, recreation, fish and wildlife conservation, water supply, and control of water levels for navigation downstream on the Mississippi River. The 1,940 foot dam is capable of producing up to 58,000 kilowatts of power, which is enough energy to power a town of 20,000 people.

The watershed serves as source water for the Clarence Cannon Wholesale Water Commission water treatment plant, which is located on the North Fork Salt River Arm of the lake near Florida. The water treatment plant is capable of treating 10 million gallons of water per day. The commission was established in 1983 and began selling water in 1992. The commission currently provides approximately 4.2 million gallons of clean drinking water each day to approximately 70,000 people in 14 counties in northeast Missouri, which includes 15 cities and nine rural water districts that are members.

The commission has completed a source water protection plan that identifies potential sources of pollutants within the watershed. Water quality concerns include high total organic carbons, turbidity spikes, nutrient and herbicide runoff, elevated atrazine levels, sedimentation, maintenance of water quality for recreational use and loss of forest, fish and wildlife resources.

Approximately 42 percent of the 119 miles of the North Fork Salt River has been channelized, which has led to high banks, steep sided channels, and stream bank erosion. Steep banks also limit public access to the river for recreation.

A Watershed Restoration Action Strategy was completed during 1999 to 2000 and a steering committee and technical resource panel existed as part of this work. This strategy identified the different roles and proposed actions for various partnering agencies/groups as they relate to public outreach and water quality improvement. Also, a nine element watershed plan for the Black Creek Watershed has recently been completed by a local steering committee. Black Creek in Shelby County is on the 303(d) list of impaired streams for elevated *E. coli* and low dissolved oxygen levels.

Opportunities

Community Involvement

- Communities, groups and individuals can help promote watershed improvement activities through education, advocacy and hands-on projects. Examples include, watershed education, litter control, tree planting, water quality monitoring and storm drain stenciling.

Education and Outreach

- Assistance is available for training and assistance regarding several topics such as source water protection, municipal drinking water loss, water main leak location, asset management, water conservation planning and implementation and I/I onsite assistance.
- Training is also available to livestock operations and landowners regarding the benefits of alternate watering sources for livestock, improvements to land application practices, best management practices and associated cost-share programs.

Financial Assistance

- **Clean Water and Drinking Water State Revolving Funds** are available to build or improve municipal wastewater and drinking water infrastructure and support agricultural and urban projects such as improvements to urban runoff, wet weather flow, stormwater and sewer overflow issues, water reuse and conservation and alternative treatment projects.
- **319 Nonpoint Source Funds** are available to assist organizations with implementation of on-the-ground practices that control, reduce or manage nonpoint source pollution such as riparian buffer strips, detention ponds, limitation of animal waste to stream and sinkholes.
- **Source Water Protection Grants** and **Well Plugging Grants** are available to public water systems to support safe well abandonment procedures and source water protection implementation and planning efforts.
- A full list of department funding sources is available at <http://dnr.mo.gov/financial.htm>.

North Salt Fork River Watershed

The State of Our Missouri Waters—Background

What is a Watershed?

A watershed is an area of land defined by ridges, from which waters flow into a particular lake, river or wetland.

North Fork Salt River Basin Characteristics

- Drainage area of 894 mi²
- Includes portions of six counties
- Part of the Salt River system
- Largest population cities include Queen City, Kirksville, La Plata, Clarence, Shelbina and Shelbyville.
- Estimated population 26,953 in 2000 and 27,588 in 2010.
- Estimated population from 2000 to 2030 in four counties (Adair, Schuyler, Knox and Shelby counties) projected to decline ranging from 0.3 to 15.2 percent, while Monroe and Macon counties are expected to increase by 3.0 and 12.7 percent, respectively.

Recreation

The watershed drains to Mark Twain Lake and provides 18,600 acres of water for boating and fishing. Mark Twain State Park and Historic Site and additional public land provide thousands of acres for camping, hiking, fishing, picnicking and hunting. Canoeing opportunities are available on the North Fork Salt River.



Water Resources

There are five lakes ranging in size from 50 to 8,940 acres, totaling 16,347 lake acres in the watershed. There are 1,300 miles of major streams. Some of the larger streams include North Fork Salt River, Ten Mile Creek, Otter Creek, Crooked Creek, Clear Creek, Black Creek and Bear Creek. Surface water sources including North Fork Salt River, Shelbina Lake and Mark Twain Lake provide 4.2 million gallons per day to about 70,000 people. Surface water sources outside the watershed including Rathbun Lake, Unionville Lake, Lake Thunderhead, Monroe City South Lake and J Lake, Forest Lake, Hazel Creek and Long Branch Lake also provide drinking water to people in this watershed.

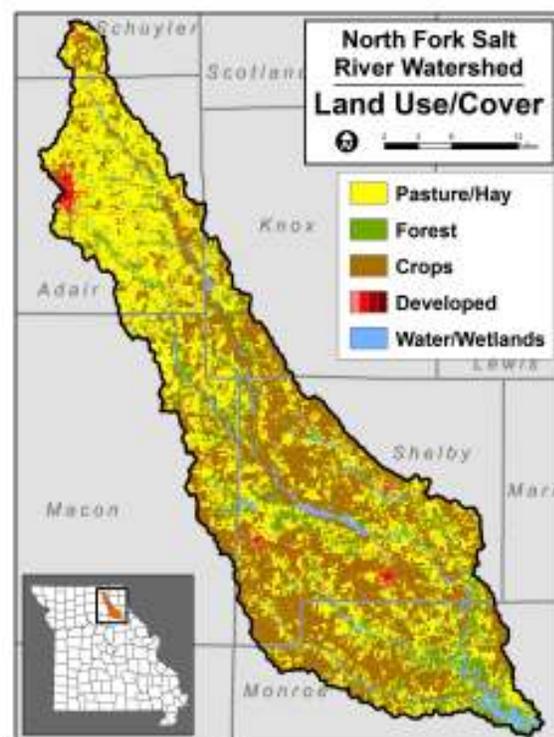
There are no high-yield, potable bedrock aquifers available. There are an estimated 93 private domestic wells that provide an estimated 26,300 gallons of water annually for domestic uses.

Geology/Hydrology

Surface features of the basin primarily consist of glacial till (generally < 200 feet in depth) overlain by loess (4 – 8 feet thick). The till is predominantly clay, with some rock and gravel intermixed with occasional sand lenses. Vertical movement of water is inhibited by the sequences of geologic strata, as the till contains much clay and many shale/coal beds are present. Water movement is predominantly through the surface stream network. There are no sizeable springs or losing streams documented, and stream baseflow is not well sustained in dry periods. One sinkhole has been documented. Bedrock groundwater is highly mineralized and not suitable for drinking-water supply.

Land Use

Land use is approximately 40 percent cropland, 37 percent grassland, 14 percent forest, 5 percent developed, 3 percent wetland, and 1 percent water. The northern portion is characterized by rolling hills and dominance of pasture, while the southern portion has less steep terrain and is dominated more by row crop agriculture. Claypan soils are predominant in the region and have very high runoff potential.



North Salt Fork River Watershed

The State of Our Missouri Waters—Current Conditions and Trends

Climate and Water Availability

Precipitation

Several wet periods have dominated since the early 1980s. This wet pattern has been accompanied by an increasing trend of heavy precipitation events. Severe drought occurred during 2012. This drought was brief compared to major multi-year droughts that occurred in the 1930s and 50's. Tree ring analyses conducted in Missouri and historic observation data show periods of multi-year severe droughts in Missouri's history, indicating that extended dry periods are likely to occur in the future.

Groundwater and Stream Levels

There is one groundwater monitoring well within the watershed, located near Shelbina, as part of the Missouri Observation Well Network. The hydrograph, shown to the right, represents water levels at the Shelbina monitoring well. This graph highlights how short periods of drought, such as the 2012 drought, can cause groundwater levels to quickly change. The graph also shows water levels at this well haven't recovered to pre-2012 conditions. There are currently four stream gauges in the watershed that measure average stream flow that varies from 0.8 to 99 million gallons per day.

Water Use Trends

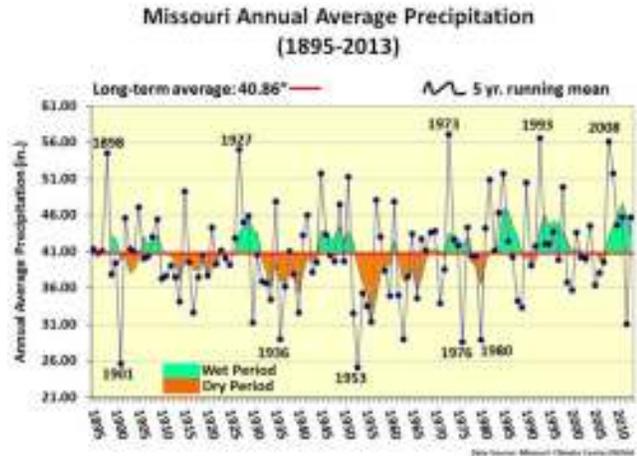
Two registered major water users, with at least a 100,000 gallons (70 gal per minute) per day withdrawal or diversion capacity, are present in the basin. The estimated annual water use of these major water users is 1.7 billion gallons, of which 100 percent is surface water for municipal uses. There are 12 community public water systems, all of which use surface water for their supply. Two of these systems, Kirksville and Shelbina, treat their own water from local city lakes and the remaining nine systems purchase treated surface water. Data of the amount of water withdrawn by major water users in the basin since 1996 show an overall increase in the gallons of water withdrawn over time. This increase likely corresponds with the increased number of public water supply systems that have decided to purchase water from a major water user rather than treating water from more local sources. Aging water treatment plants, aging of local city lakes, and the need to meet drinking water quality standards has led to fewer local drinking water treatment plants and more customers that buy water from a major water user in the watershed.

Estimated Major Water Use by Sector for North Fork Salt River Watershed

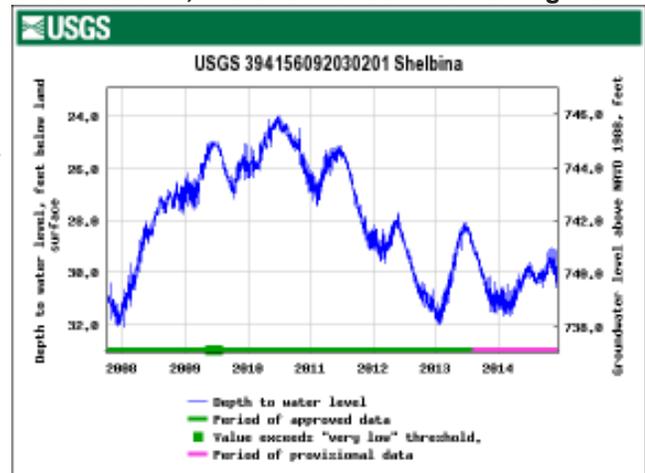


Drinking water supply sources in the watershed include Shelbina Lake, North Fork Salt River, and Mark Twain Lake.

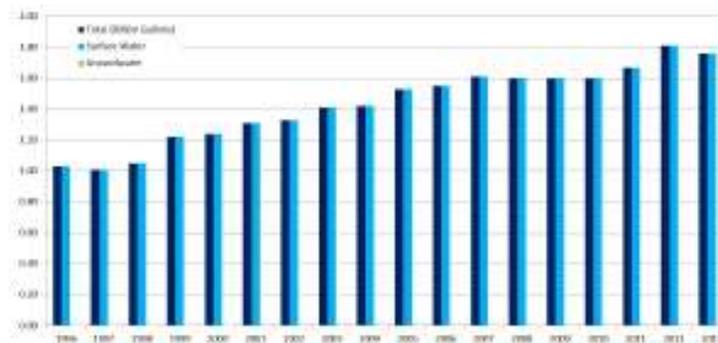
Estimated Major Water Use by Source



USGS Shelbina, MO Groundwater Monitoring Point



Historical Water Use North Fork Salt River Watershed



North Salt Fork River Watershed

The State of Our Missouri Waters—Current Conditions and Trends

Watershed Protection

Protection of Our Natural Resources

The department exercises authority under Missouri's Clean Water Law to regulate point sources of pollution. When point sources are known or discovered, the department issues permits for these sources to limit the amount of certain water contaminants that may be discharged into the water body.

The department also has resources to help people proactively plan to protect water resources, such as:

- Source Water Protection Plans for drinking water sources
- Section 319 funding for watershed planning and projects
- Funding to plan for source water protection
- Soil and Water Conservation funding
- State Revolving Fund grants and loans for community drinking water and wastewater improvements

A full list of department funding sources is available at dnr.mo.gov/financial.htm

It is important to note that resources are limited and local involvement, in determining most critical and effective focus areas, is invaluable.

Water Quality Impairments

Section 303(d) of the federal Clean Water Act requires each state identify waters that do not meet water quality standards and for which adequate water pollution controls are not in place. These identified waters are considered impaired. Water quality standards protect beneficial uses of water such as whole body contact (e.g. swimming), maintaining fish and other aquatic life, and providing drinking water for people, livestock and wildlife.

The following lake and streams within the watershed are listed on the State's 2014 list of impaired waterways and are presented on the adjacent map: 19.4 miles of Black Creek (impairments include elevated *E. coli* and low dissolved oxygen) and Mark Twain Lake (impairment includes mercury in fish tissue from atmospheric deposition).

Impairments can be caused by known sources like point or nonpoint source pollution, or may be unknown; however, identifying activities near impaired water bodies can provide key information in determining the sources of contamination as well as developing solutions for impaired waters.

Examples of **point sources** of pollution include municipal wastewater treatment plants, land disturbance sites, large confined animal operations, and treated industrial wastewater discharges. Common challenges for wastewater treatment include the limited contaminant removal capacity of certain types of treatment. When facilities experiences difficulty in providing the proper level of treatment and contaminant removal, the department often works with them to improve the treatment process and quality of the discharge. In the case that point source emitters are unwilling to improve the quality of their discharge, the department has regulatory authority to ensure that inappropriate discharges are discontinued in a timely manner.

Nonpoint pollution sources refer to contaminants that do not come from specific conveyances and may come from multiple sources, such as failing septic systems and contaminants carried in stormwater runoff from rural, urban and agriculture lands. Other causes of water body impairments include natural causes like precipitation, climate and drought which can alter stream flow and channel characteristics leading to changes in water quality.



North Salt Fork River Watershed

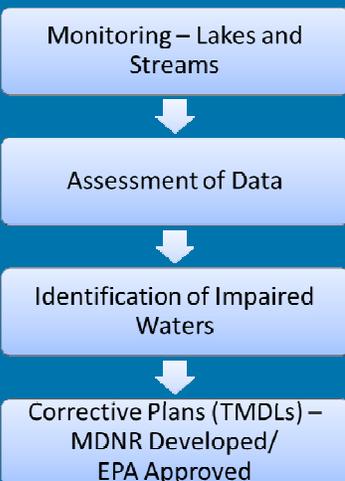
The State of Our Missouri Waters—Current Conditions and Trends

Watershed Protection

General Water Quality Criteria

A water body is considered impaired if it does not meet water quality standards that specifically protect its beneficial uses, such as drinking water, recreational uses and fish or other aquatic life health.

Missouri's Process to Improve Water Quality



NPDES:

National Pollutant Discharge Elimination System. In Missouri, NPDES permits are also known as Missouri State Operating (MSOP) permits.

Total Maximum Daily Loads (TMDL)

A TMDL is a mathematical calculation of the maximum amount of a pollutant that a water body can absorb and still meet water quality standards. A TMDL study identifies the potential or suspected pollutant sources in the watershed and allocates the allowable pollutant load among these sources. It also includes an implementation plan to identify how the load will be reduced to a level that will protect water quality. In this watershed, a TMDL has been established for Bear Creek near the city of Kirksville to address an impairment to the protection of aquatic life.

Bear Creek was first listed on the 2002 303(d) list of impaired streams for violations of Missouri's general water quality criteria that address protection of aquatic life and biological aquatic communities. Fisheries surveys indicated impairment of the fish community and low dissolved oxygen readings have been measured in the stream. This TMDL establishes pollutant allocations and recommended load reductions for sediment, nutrients and biochemical oxygen demand that should be implemented in order to protect and restore the aquatic life designated use within Bear Creek. Also, a TMDL for *E. coli* impairment in Black Creek in Shelby County is currently being developed. Pollutant reduction recommendations in TMDLs are plans, for which actions still need to be taken so that water bodies meet the water quality standards for their designated beneficial uses.

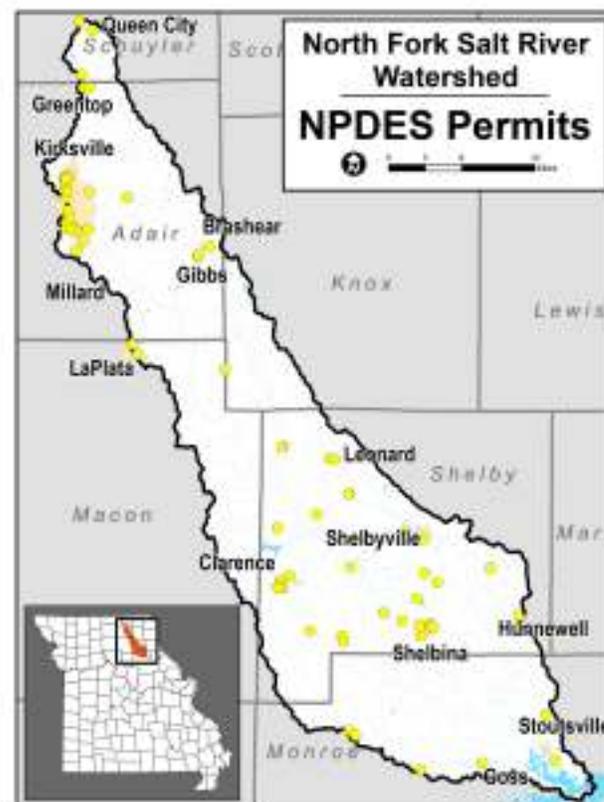
For more information regarding the Bear Creek TMDL, visit the following link.

Bear Creek TMDL: <http://dnr.mo.gov/env/wpp/tmdl/0115u-01-bear-ck-record.htm>

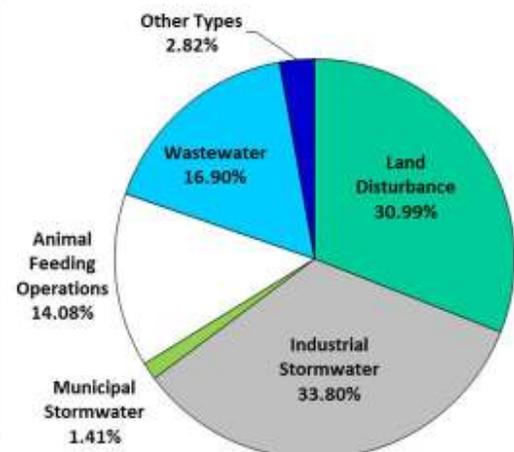
Regulated Point Sources

The department regulates point sources by issuing permits that prescribe conditions of operating the point discharge and limit the discharge of water contaminants. In addition, the department inspects regulated facilities and analyzes water samples to ensure the facilities are not polluting waters. It's also important that communities look to the future for watershed planning, in order to maintain awareness of wastewater treatment types, their impacts and upcoming regulations.

The following graphics illustrate the type and distribution of permitted sites in the watershed.



Distribution of Permit Types



North Salt Fork River Watershed

The State of Our Missouri Waters—Current Conditions and Trends

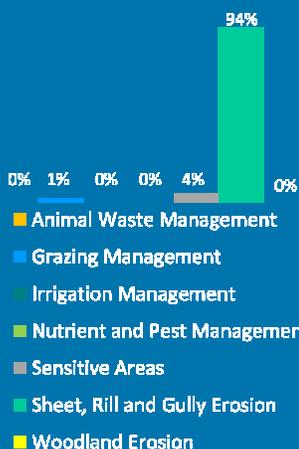
Local Watershed Improvements

Local Awareness

Is it safe to fish or swim in the nearby stream? Does the stream provide habitat suitable for fish? What does it cost to make this water potable? Will I have enough water during a drought?

Impacts to water quality and quantity are most critical to local communities; however, impacts are often not realized until a dire situation arises as a result of poor water quality or quantity. Local awareness and involvement can lead to pollution prevention and reduction, water supply sustainability and can give communities the upper hand in protecting, preserving and enhancing local water supplies for generations to come.

2009-2014 Implemented Conservation Practices



Missouri Stream Team and Volunteer Water Quality Monitoring

Missouri Stream Teams strive to gain and share knowledge regarding the state's stream systems and the problems and opportunities they face. The Missouri Stream Team Program is a partnership between the departments of Natural Resources and Conservation as well as the Conservation Federation of Missouri and the citizens of Missouri. Besides improving stream conditions, Stream Teams often provide useful data in targeting areas that should be monitored more closely for impairments. The Missouri Stream Team Watershed Coalition has compiled and reported monitoring data which demonstrates the importance of watershed protection, preservation and enhancement by local communities. (image from <http://mstwc.org/who-we-are/vision-mission-goals/>)



The Volunteer Water Quality Monitoring Program is one of the most popular activities of the Missouri Stream Team Program.

Soil and Water Conservation and Nonpoint Source Grants (319 Grants)

Over the last 13 years, the department has provided several watershed project grants to local communities to conduct outreach, implement and measure effectiveness of conservation practices and conduct watershed planning. These grant projects include: Stewardship Implementation Project to support implementation of agricultural conservation practices in the watershed; Habitat for Community project to fund outreach, interactive displays, demonstrations and field days in Schuyler County; Underground Outlet Demonstration project to measure the effectiveness of buffers treating runoff from underground terrace outlets; and writing the Black Creek Watershed Management Plan.

Source Water Protection Projects and Grants

This voluntary program is designed to assist public water systems and the communities they serve with developing local voluntary source water protection plans to protect their source of drinking water from existing or additional contamination sources. Participating public water systems include: City of Shelbina and Clarence Cannon Wholesale Water Commission. The City of Shelbina has an active source water protection plan for Shelbina Lake and CCWWC has an active source water protection plan for its intake on the North Fork Salt River Arm of Mark Twain Lake. Learn more at <http://dnr.mo.gov/env/wpp/pdwb/swpp.htm>.

Well Plugging Grants

As part of Source Water Protection, the department offers grants to plug abandoned wells. Inactive wells can act as a direct conduit for pollutants to enter our water sources. Safely closing these wells is another layer of protection for pollution prevention.

Soil and Water Conservation Cost Share Programs

Soil and Water Conservation Districts set goals for conservation issue concerns. These practices are funded and implemented to help districts meet their resource conservation goals, which conserves soil and improves water quality by reducing sedimentation in our rivers and streams. The chart to the left illustrates the number of practices implemented for each concern in the watershed from 2009 to 2014, relative to the total number of practices for this watershed. No animal waste management, irrigation management, nutrient and pest management, and woodland erosion practices were implemented during this time. District funding requests for FY15 show that sheet, rill and gully practices are most prevalent.

North Salt Fork River Watershed

The State of Our Missouri Waters

Resources

Education and Outreach Resources include:

Missouri Department of Natural Resources' Our Missouri Waters dnr.mo.gov/omw

Missouri Department of Natural Resources Financial Assistance Opportunities <http://dnr.mo.gov/pubs/financial-asst-brochure-2014.pdf>

Natural Resources Conservation Service (NRCS) <http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/technical/>

Missouri Rural Water Association (MRWA) <http://www.moruralwater.org/training.php>; <http://www.moruralwater.org/tools.php>; <http://www.moruralwater.org/dlcenter/>

Missouri Public Utilities Alliance (MPUA) <http://www.mpu.org/Training.php>; http://www.mpu.org/Untitled_Page_4.php

EPA Region 7 Environmental Finance Center (EFC) http://webs.wichita.edu/?u=HUGOWALL&p=/Centers_Research/Environmental_Finance_Center/

Funding Resources include:

Natural Resources Conservation Service (NRCS) <http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/financial/>

United States Department of Agriculture Rural Development (USDA-RD) <http://www.rurdev.usda.gov/ProgramsAndOpportunities.html>

Missouri Department of Economic Development (DED) <http://www.ded.mo.gov/BCS%20Programs/BCSProgramDetails.aspx?BCSProgramID=10>; <http://www.ded.mo.gov/Community/InfrastructureAssistance.aspx>

References

2010 Census data (<http://www.census.gov/>)

Center for Applied Research and Environmental Systems (<http://www.cares.missouri.edu/>)

Department of Natural Resources

- Groundwater Level Observation Well Network Page (<http://dnr.mo.gov/env/wrc/groundwater/gwnetwork.htm>)
- Missouri State Water Plan Series, Surface Water Resources of Missouri, 1995, Groundwater Resources of Missouri, 1996. (<http://dnr.mo.gov/env/wrc/statewaterplanMain.htm>)
- Source Water Protection Program Page (<http://dnr.mo.gov/env/wpp/pdwb/swpp.htm>)
- Major Water Users Page (<http://dnr.mo.gov/env/wrc/mwu-forms.htm>)

Missouri Stream Team Program (<http://www.mostreamteam.org/aboutTeams.asp>)

Missouri Stream Team Watershed Coalition Website, (<http://mstwc.org/>)

Multi-Resolution Land Characteristics Consortium, 2011 and 2001 National Land Cover Database, (<http://www.mrlc.gov>)

Missouri Climate Center, (<http://climate.missouri.edu/modata.php>)

U.S. Army Corps of Engineers, Southwest Missouri Water Resource Study—Phase I. Sept. 2012 (http://tristatewater.org/?page_id=12)

Guinan, Pat, State Climatologist, MU Extension, Missouri Climate Center, (<http://climate.missouri.edu/modata.php>)

The North Fork Project. Watershed Education and Information for Decision Makers. Watershed Restoration Action Strategies (WRAS) for the North Fork Salt River. (<http://www.mowin.org/Training/WQMP/pdf/nfsaltwrass.pdf>)

Source Water Protection Plan for Clarence Cannon Wholesale Water Commission, Sept. 2011.

Salt River Watershed Inventory and Assessment. Missouri Department of Conservation. <http://mdc.mo.gov/your-property/greener-communities/missouri-watershed-inventory-and-assessment/salt-river>