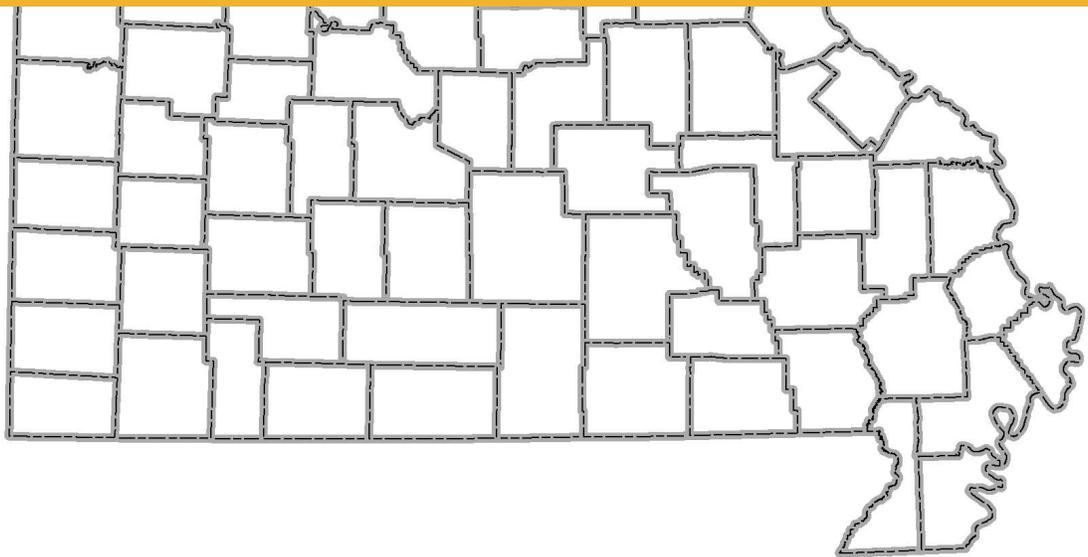


Healthy Watershed Plan

Lower Grand 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*.

Lower Grand River Watershed

Healthy Watershed Plan

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Lower Grand River Watershed

Healthy Watershed Plan

Purpose of Plan

The Lower Grand River Watershed Healthy Watershed Plan reflects the perspective, ideas, desires and vision of the participating stakeholders. The Healthy Watershed Plan has been created to help guide future efforts in maintaining and improving water quality in the Lower Grand.

Key Points

The Lower Grand River Healthy Watershed Plan is the result of hundreds of hours of work on the part of participants, presenters, and planners as part of the Our Missouri Waters collaborative. The Green Hills Regional Planning Commission, working with the Missouri Department of Natural Resources, created this document with input from local stakeholders with assistance and technical resources from a variety of agency partners and individuals.

Planning for the future of the Lower Grand River Watershed included planning for future activities and initiatives. Stakeholder involvement formed the foundation for the creation of the healthy watershed plan. Several hundred potential stakeholders were individually invited to participate in the meetings and approximately 71 stakeholders attended at least one of the meetings. Ultimately, the plan was presented to the stakeholders on September 8, 2016.

Five stakeholder meetings were held at the University of Missouri Forage Systems Research Center near Linneus, Missouri, which is located in the center of the watershed. At these meetings, technical presentations about pertinent topics were made and information concerning the desires and priorities of the participants were gathered. In this format information was shared with and gathered from stakeholders. Various tools for feedback were employed ranging from casual discussion to formal survey instruments.

This plan identifies issues and priorities for the watershed. Both the issues and priorities lists were created and ranked in importance by the stakeholders. Specific goals and recommendations resulted from brainstorming sessions around each issue. Goals and recommendations were developed with a consensus, not to imply they had unanimous support. Each recommendation was found to have merit by one or more of the stakeholders.

The continuation of a local watershed advisory committee was discussed at several meetings and particularly at the July and September meetings. The stakeholders that attended the July meeting were asked if the Lower Grand River Watershed should have an established local citizen advisory committee or team. Eighteen stakeholders voted on this question and 88 percent of the voting stakeholders voted "Yes", 12% voted "Maybe", and 0% voted "No". Thirty-nine percent voted that this committee should meet twice a year, 39% voted for a quarterly meeting, 6% voted for a yearly meeting, 6% voted for three meetings per year, and 11% voted for meeting more than 4 times per year. One idea is to continue the partnership with the Green Hills Regional Planning Commission to assist stakeholders in continuing their committee and supporting their recommendations.

Lower Grand River Watershed

Healthy Watershed Plan

Objectives and Opportunities

Purpose of Plan

It is the hope that this document will guide future outreach and education efforts in the watershed, improve collaboration between stakeholders in the watershed, and support applying for and competing for funding for projects based on the recommendations of local stakeholders.

The overall objective of this plan is to maintain or create a healthy watershed in the Lower Grand River basin of north central Missouri. Major concerns in the watershed that have been identified by local stakeholders include soil erosion (from both streambanks and fields), log jams, flooding, and stream impairment. To make improvements of these issues in the watershed, key areas that will need future focus in the watershed include education and outreach, soil health, obtaining funding for projects, and promoting and encouraging outdoor recreation and knowledge of nature in the watershed. For each of these major concerns and keys areas of focus, stakeholders developed specific goals and recommendations, listed later in this document, that can be used as guidance for future efforts in the watershed.

In the development of this healthy watershed plan, a diverse group of local stakeholders have come together to learn more about the watershed and participate in setting goals and recommendations for future actions. Participants have included county commissioners, local landowners, ranchers and farmers, soil and water conservation district boards and employees, local municipalities, University of Missouri Extension staff, state natural resource, conservation, and transportation departments, and federal research and natural resource agencies. By bringing together this diverse group, there are opportunities to partner together for education in the watershed and collaborate together on future projects.

Key goals identified in this plan include:

- Reduce streambank erosion and soil erosion from fields in the watershed by improving infiltration of water into soils and through appropriate use of non-structural and structural conservation practices.
- Reduce the adverse effects of log jams and prevent log jams when possible.
- Reduce flooding and resulting stream bank damage.
- Improve water quality and wildlife habitat (ecology) of streams.
- Reduce sediment and nutrient transport from the watershed.
- Reduce bacteria levels in impaired streams.

Key objectives in reaching these goals include:

- Reach residents of the watershed through education and outreach to improve awareness of the watershed and of practices that contribute to stewardship of water quality and water supply.
- Develop awareness of nature and the important natural features in the watershed.
- Improve soil health in the watershed by promoting a suite of soil health practices.
- Increase funding available for projects in the watershed and for funding voluntary best management practices.

The purpose of this document is to provide a description of the watershed, explain the process that led to the development of this healthy watershed plan, and document the specific recommendations for the watershed developed by local stakeholders.

Lower Grand River Watershed

Healthy Watershed Plan

Watershed Location

The Lower Grand River Watershed (HUC 10280103) is 2,358 square miles (1,510,400 acres) in size and includes parts of eight counties in north central Missouri, including Putnam, Mercer, Sullivan, Grundy, Linn, Livingston, Chariton and Carroll counties and two counties in Iowa, Wayne County and Appanoose County.

Communities of the Watershed

Communities that lie completely within the watershed include Powersville, Lucerne, Newtown, Harris, Osgood, Milan, Humphreys, Browning, Galt, Meadville, Purdin, Linneus, Laclede, Brookfield, Sumner, Rothville, Mendon, Triplett, Brunswick, Hale, Tina, and Bosworth. Communities that lie partially within the watershed include Chula, Laredo, Wheeling, Pollock, Bogard, Green City, Bucklin, Marceline, and Chillicothe, Missouri. Clio, Iowa and Allerton, Iowa are also partially located in the watershed.

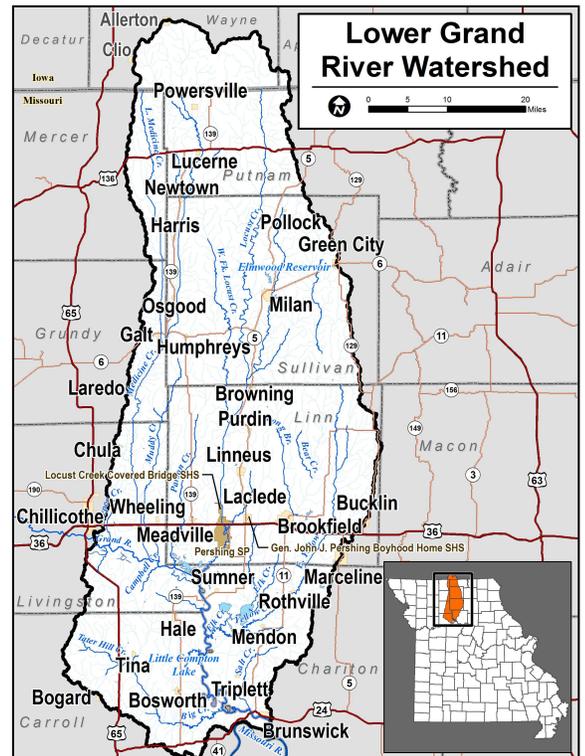
Location of the Watershed

The Lower Grand River Watershed composes 30 percent of the Grand River Basin. Proportionately 5.2% of the Lower Grand River Watershed is in Wayne County, IA, 0.1% in Appanoose County, IA, 3.6% in Mercer County, 9.4% in Putnam County, 3.2% in Grundy County, 22.9% in Sullivan County, 10% in Livingston County, 24.5% in Linn County, 11.3% in Carroll County, and 9.8% in Chariton County.

The West, Middle, and East Forks of Medicine Creek, Locust Creek, and their headwater tributaries originate in Wayne County, Iowa, where 123 square miles of the county are part of the watershed. Little Medicine Creek and West Fork Medicine Creek flow south into Mercer County, Missouri, where 86 square miles of the county are part of the watershed. Barber Creek also begins in Mercer County and flows southeast into Putnam County. Three square miles of Appanoose County, Iowa, contain headwater tributaries to Locust Creek. From Iowa, Medicine Creek and Locust Creek flow south into Putnam County.

Putnam County contains 222 square miles of the watershed and Medicine Creek, West Locust Creek, and Locust Creek flow south through the county. Tributaries to Medicine Creek in Putnam County include West Fork Medicine Creek, Buckworth Creek, Long Branch, Barber Creek, Hylan Branch and Elm Branch. Tributaries to West Locust Creek and Locust Creek in Putnam County include Badger Branch, Tanyard Branch, Brush Creek, Watkin's Creek, Hackett Branch and Johnson Branch. East Locust Creek originates in Putnam County and flows south into Sullivan County.

Almost half of the entire watershed is found in Sullivan and Linn counties. In Sullivan County, 540 square miles are within the watershed. West and East Yellow Creek watersheds originate in the northeast portion of Sullivan County, and West Locust Creek and Locust Creek continue south through the county. Locust Creek is joined by East Locust Creek and Little East Locust Creek in south central Sullivan County. Muddy Creek and Little Muddy Creek originate in southwestern Sullivan County and flow southwesterly into Linn County and then into Grundy and Livingston counties, respectively. Headwaters of Parson Creek sub-watershed begin in the southwest part of Sullivan County.



Lower Grand River Watershed

Healthy Watershed Plan

Land Use in the Watershed

Land use in the watershed is approximately 50 percent grassland, 25 percent cropland, 15 percent forest, 5 percent developed, 4 percent wetland and 1 percent water. Historically, the landscape of the Lower Grand basin was a diverse mix of prairie, savanna and forest plant communities with numerous small oxbows and bottomland lakes and sloughs. The northern part of the watershed is characterized by rolling hills and dominance of pasture, while the southern area has less steep terrain and is dominated more by row crop agriculture.

Location of the Watershed (Continued)

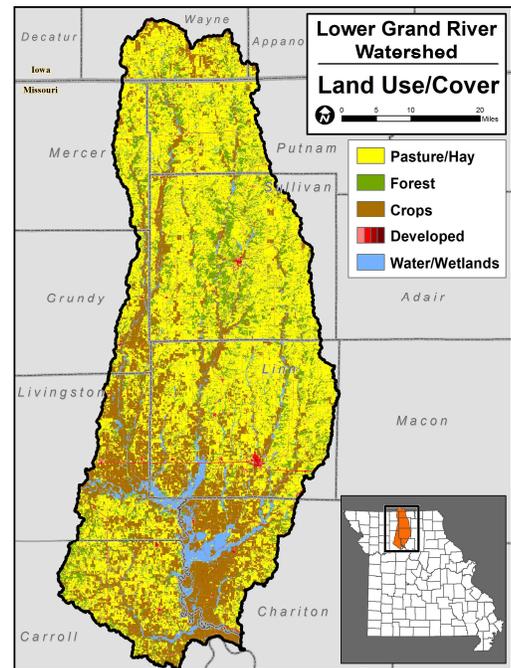
Grundy County has 76 square miles in the watershed, including Medicine Creek that flows from Sullivan County into Grundy County east of the town of Galt. In the extreme northeast corner of Grundy County, Little Medicine Creek flows into the county from Mercer County and flows south through the east side of the county and flows into Medicine Creek southeast of Galt. Muddy Creek enters the southwest corner of the county and both Medicine Creek and Muddy Creek flow south from Grundy County into Livingston County.

Linn County has 578 square miles within the watershed. East Yellow Creek flows south through the county and is joined by the sub-watersheds of Hamilton Branch, Winigan Creek, Long Branch, and Sights Branch. West Yellow Creek also flows south through Linn County and is joined by the Bear Creek and Long Branch sub-watersheds. Muddy Creek and Turkey Creek originate in the central part of the county. Turkey Creek is joined by Little Turkey Creek and flows south into Chariton County. West Locust Creek joins Locust Creek northwest of the town of Purdin and Muddy Creek joins Locust Creek south of Hwy 36 at Pershing State Park. Parson Creek flows south through the county, west of the town of Meadville, into Fountain Grove Conservation Area where it joins the Grand River. Hickory Branch flows west of Pershing State Park and joins Locust Creek in Fountain Grove Conservation Area.

In Livingston County, 236 square miles are within the watershed. Muddy Creek and Little Muddy Creek enter Livingston County in the northeast corner of the county and Muddy Creek flows south through the county west of Wheeling and joins the Grand River south of Bedford Station. Medicine Creek flows south through the county, east of Chula, and joins the Grand River southwest of Bedford Station.

Chariton County contributes 231 square miles to the watershed geography: Slater Branch, East Yellow Creek, and West Yellow Creek join to form Yellow Creek. Hickory Branch joins Yellow Creek, which skirts the southern boundary of Swan Lake National Wildlife Refuge and Yellow Creek joins the Grand River at the Yellow Creek Conservation Area. Turkey Creek and Elk Creek meet in the northeast part of Swan Lake National Wildlife Refuge, and Elk Creek flows through the refuge and joins Yellow Creek in the Yellow Creek Conservation Area. The Salt Creek sub-watershed originates southeast of Mendon and Salt Creek flows east of Triplett and then joins the Grand River west of Brunswick. Brunswick is located on the Grand River, just a few miles upstream from its confluence with the Missouri River.

In Carroll County 266 square miles are within the watershed, including the sub-watersheds of Hurricane Creek and Big Creek. The Grand River forms the boundary between Chariton County and Carroll County.



Lower Grand River Watershed

Healthy Watershed Plan

Uses of the Watershed

The Lower Grand River Watershed is part of the larger Missouri River and Mississippi River watersheds, which provide hundreds of miles of water for drinking water supply, aquatic habitat, irrigation, and navigation.

Uses of the Watershed

Drinking water supply sources in the watershed include Elmwood Lake, Milan City Lake, Marceline City Lake (New Reservoir), Brookfield Lake, Locust Creek, West Yellow Creek and several alluvial wells. Surface water sources in the watershed provide 3.5 million gallons per day to about 24,000 people.

There are 34 public drinking water systems in the watershed and 17 of these systems rely solely on surface water, two systems buy from both surface and groundwater sources, and 15 systems use only groundwater. There are 760 miles of major streams in the watershed. Some of the larger streams are Locust Creek, Medicine Creek, Yellow Creek and the Grand River.

Hunting for deer, turkey, and waterfowl are top recreational activities. Public areas including Pershing State Park, Fountain Grove, Locust Creek, and Yellow Creek Conservation Areas and Swan Lake National Wildlife Refuge provide habitat for wildlife and migrating waterfowl and various opportunities for people to enjoy the outdoors. Pershing State Park, Fountain Grove and Yellow Creek Conservation Areas, and Swan Lake National Wildlife Refuge make up the Lower Grand River Conservation Opportunity Area (COA), which is an area that has important natural resources and a rich diversity of native species. Each of these areas is known for restored wetlands and associated plants, insects, amphibians, reptiles, birds, and migrating waterfowl.

Portions of Locust Creek represent one of the last examples of an active meandering river system in northern Missouri. Two large reaches of Locust Creek have not been extensively channelized. The first is a 28.7 mile reach through Sullivan County, which was recognized in the 1982 National Park Service Nationwide Rivers Inventory as being one of the few remaining largely un-channelized reaches of stream in north Missouri. The second is a 17.4 mile reach from the confluence of Locust Creek and Grand River to the northern portion of Pershing State Park.

Previous Planning Efforts in the Watershed

Public water systems that have previously completed source water protection plans include Bosworth, Marceline, Meadville, Carroll PWSD #1, and Missouri American-Brunswick.

There are several watershed districts in the watershed that had programs under the NRCS PL-566 program. These include Big Creek and Hurricane Creek in Carroll and Livingston counties, East Yellow Creek in Linn and Sullivan counties, and Upper and East Locust Creek in Sullivan and Putnam counties. These local watersheds currently work to maintain impoundment structures built under this program.

In the 1990's, the Missouri Department of Conservation wrote Watershed Inventory Assessments (WIAs) for Locust Creek watershed and the Grand River Basin. These WIAs provide information about the location, geology, fisheries, and water quality of the watersheds.

In November 2013, a Planning Assistance to States (PAS) study was completed for the Locust Creek Watershed, which looked at various alternatives for reducing sedimentation and improving hydrology in the Locust Creek watershed.

Lower Grand River Watershed

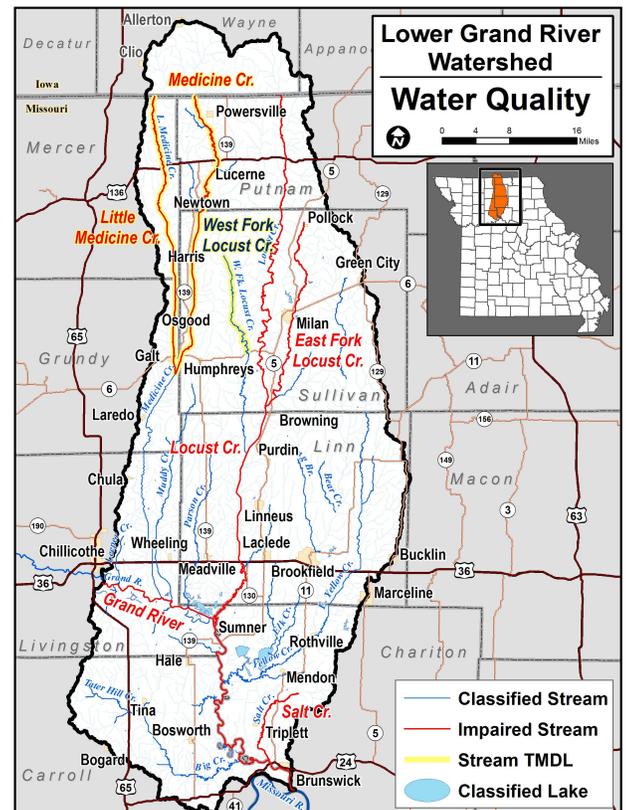
Healthy Watershed Plan

Impairments of the Watershed

Water quality monitoring indicates there are elevated *E.coli* levels, high suspended solids, high nutrients (nitrogen and phosphorus), and low dissolved oxygen in some streams. These water quality impairments can affect the designated beneficial uses of the streams.

Within the watershed, seven water bodies are currently on the state's 2014 303(d) list of impaired waters. The seven water bodies listed as impaired include 32.4 miles of East Fork Locust Creek (impairments include *E.coli* for 32.4 miles and low dissolved oxygen for 15.7 miles), 56.0 miles of the Grand River (impairment includes *E.coli*), 6.8 miles of Hickory Branch (impairment includes low dissolved oxygen), 39.8 miles of Little Medicine Creek (impairments include aquatic macroinvertebrates bioassessments and *E.coli*), 91.7 miles of Locust Creek (impairment includes *E.coli*), 43.8 miles of Medicine Creek (impairment includes *E.coli*), and 14.9 miles of Salt Creek (impairment includes low dissolved oxygen). East Fork Medicine Creek is listed as an impaired stream in Wayne County, Iowa (impairment is for low aquatic life).

In this watershed, two Total Maximum Daily Load studies were completed identifying sediment as an impairment to aquatic life in Medicine Creek (formerly East Fork Medicine Creek) and Little Medicine Creek. These TMDLs establish allocations of total suspended solids to both point and nonpoint sources, which should be implemented to protect and restore the designated aquatic life uses within the watersheds. A third TMDL, written for West Fork Locust Creek, addresses pollutant allocations for nutrients and suspended solids. Pollutant reduction recommendations in TMDLs are plans, for which actions still need to be taken, so the water bodies meet water quality standards.



Lower Grand River Watershed

Healthy Watershed Plan

Issues identified by stakeholders during the Pilot Project

Some of the issues identified by local stakeholders during the pilot phase include flooding, water supply for public systems, erosion/sedimentation, stewardship of rented acreage, outreach about soil and water conservation to absentee and land lessors, and the need for more public awareness about watersheds in general.

Pilot Phase Project 2011-2014

In November 2011, the Lower Grand River Watershed was announced by the Missouri Department of Natural Resources as one of the three pilot watersheds for the Our Missouri Waters effort. Throughout 2012, DNR's watershed coordinator contacted people in the watershed including the local Soil and Water Conservation District Boards, Chillicothe Young Farmers group, Stream Teams, Green Hills Regional Planning Commission, public water supply systems, Missouri Farm Bureau, several agri-businesses in the watershed, and state and federal agencies that work in the watershed. The regional watershed coordinator met personally with many of these groups to receive their input about water resource issues in the basin. A Facebook page, entitled "Our Missouri Waters Lower Grand River Watershed" was established for the watershed. The watershed coordinator posted news events, grant opportunities, and photos from the watershed on the Facebook page throughout the year. This Facebook page is now called "Our Missouri Waters Northeast Region" as it has expanded to include other watersheds in the region.

In July of 2012, a seminar was held in Chillicothe for state and federal natural resource agencies that work in the Lower Grand basin. This seminar provided an opportunity for agencies to present their current work in the watershed and to improve collaboration of efforts in the basin. During 2013, an advisory committee was formed to plan the Lower Grand River Water Summit which was held on September 10th, 2013, in Brunswick at the mouth of the Grand River. The Summit was attended by 115 people, which included 68 people from counties of the Lower Grand basin. Attendees of the Summit included a mix of county commissioners, local government, wastewater and drinking water operators, soil and water conservation district boards, public drinking water supply boards, agency partners and local MU-Extension staff. Presentations and group discussion during the Summit focused on water supply, watershed management, and wastewater infrastructure in the basin. Pre-summit and post-summit surveys were sent to the local audience of the Summit to receive additional feedback about issues and efforts in the watershed.

In 2013, the regional watershed coordinator continued to receive input from local Soil and Water districts in the watershed about cost-share practices available in the county and ideas for projects. In 2014, the regional watershed coordinator visited each Soil and Water District board and each MU Extension council in the watershed, and a regional water supply workshop was held in Milan in April 2014. A Project WET (Water Education for Teachers) workshop was held in Brookfield in 2014 for teachers to learn about the Project WET curriculum. Two watershed e-newsletters were distributed yearly since 2013 through GovDelivery. Currently, there are over 800 people subscribed to receive updates from the coordinator for the Lower Grand River Watershed.

A second seminar for state and federal agency partners was held in October 2014. Presentations were given by state and federal natural resource agencies working in the watershed and there was group discussion about partnering and outreach/education efforts. Themes expressed at the 2012 and 2014 agency partner meetings were the need to take a watershed approach to natural resource issues, receive input and leadership from local stakeholders, define natural resource goals and develop information about watershed best management practices that can be presented to the public, and have continued collaboration between local, state, and federal agencies.

During the pilot period, the University of Missouri Extension, in cooperation with the Missouri Department of Natural Resources' 319 Program hosted an annual watershed/non-point source workshop at Lake of the Ozarks during 2012, 2014, 2015, and 2016. Local stakeholders from the Lower Grand River Watershed were invited to these workshops and several attended each year.

Lower Grand River Watershed

Healthy Watershed Plan

Healthy Watershed Meetings

Healthy Watershed Meetings

Five public meetings were held in the watershed between November 2015 and September 2016. All five meetings were held at the University of Missouri Forage Systems Research Center near Linneus, Missouri. Each meeting began at 10 am and concluded at approximately 3 pm. Lunch was provided to all attendees at each meeting. Following each meeting, presentations from each meeting were posted on the Green Hills Regional Planning Commission's website at <http://www.ghrpc.org/>. At each meeting, verbal or written techniques were used to gather opinions and ideas from the attendees for the development of the Healthy Watershed Plan and these methods are listed separately in the next section under "Healthy Watershed Planning Process".

The initial public meeting was held on November 12, 2015. Approximately 192 invitations were sent by mail from the Green Hills Regional Planning Commission to identified possible stakeholders, and a press release was sent to eight local newspapers and four radio stations in the area. There were 52 attendees at the first meeting. Presentations included an introduction to the Our Missouri Waters partnership project by Randy Railsback, Executive Director of the Green Hills Regional Planning Commission, and Mary Culler, DNR Regional Watershed Coordinator, and a Watershed 101 training by Bob Broz, Water Quality Specialist with MU Extension. Greg Pitchford, Fisheries Biologist with the Missouri Department of Conservation, presented about the fisheries of the Lower Grand River watershed, and highlighted that sedimentation and erosion is impacting downstream aquatic habitats in the watershed.

The attendees of the first meeting were given a written survey that asked them if they would like to come to future meetings or be on the watershed committee, and if so, what time or date of the week was most convenient for them. The survey asked attendees what information they would like to know more about for the watershed, what people should know about the watershed, and if there were other people that they would suggest be involved in the meetings. The survey asked attendees if they wanted to participate in the future in some other way (outreach events, have a demonstration site on their property, etc.).

The second meeting was held on January 21, 2016. Approximately 220 invitations were sent by regular mail, including attendees of the first meeting. Email reminders were sent out followed by phone calls and text messages. Also, a press release was sent to eight local newspapers and four radio stations in the area. There were forty-four in attendance. Presentations were made by Pat Guinan, MU Extension State Climatologist, regarding temperature and precipitation trends in the state and by Robert Lerch, Soil Scientist with the USDA Agriculture Research Service, about water quality studies in northern Missouri streams.

Pat Guinan's presentation shared that 2015 was the warmest year on record globally and that December 2015 was the warmest December on record for the state of Missouri. He pointed out that Missouri has been in a wet period since the early 1980's, and a multi-decadal drought is possible in the future. Extended dry and wet patterns can change abruptly in Missouri, so management of extreme wetness and extreme dryness will be important in watershed management. Robert Lerch's presentation highlighted that in his study watersheds the majority of contaminant runoff (specifically of atrazine and nitrate) occurs during the 2nd quarter of the year and that more sediment is being lost from bank erosion compared to overland (field erosion). His presentation highlighted the effectiveness of buffers in reducing volume of runoff and sediment, nutrient, and herbicide loads. Robert also briefly discussed the idea of targeting conservation practices to the most critical areas of the landscape to receive a greater environmental benefit, and he discussed some of the social and political views on each side of this issue.

After the presentations, Mary Culler gave a brief update on upcoming events, which included an invitation to the group to attend the MU Extension Nonpoint Source Management Workshop at Lake of the Ozarks on February 18-19, 2016, a March 12th Introductory Stream Team workshop in Shelbina, and an April 16, 2016, litter pick-up event in Linn and Sullivan counties. Mary also reminded the group about the available on-line communications for the watershed, including the department's website and the regional planning commission's website, the GovDelivery bulletin/newsletter service, and the northeast region watershed Facebook page.



Lower Grand River Watershed

Healthy Watershed Plan

Healthy Watershed Meetings (Continued)

Survey Results from the First Meeting

Thirty-three attendees of the first meeting completed a written survey. Of these 33 completed surveys, 27 (82%) were interested in attending future meetings, 4 (12%) were maybe interested in future meetings and 2 (6%) said they were not interested in attending future meetings. Of the 33 completed surveys, 9 people replied that they did not want to participate on the local watershed advisory committee; three left this question blank, and 21 people responded that they were or might be interested in participating on the local watershed advisory committee. Attendees were also asked to provide their contact information (mailing address, phone number, and email) so they could be contacted for future meetings.

The third meeting was held on March 14, 2016. Approximately 220 invitations were sent by regular mail, and included attendees of the first two meetings. Email reminders were sent out followed by phone calls and text messages. There were 37 people in attendance. At this meeting, Randy Railsback provided an introduction and Mary Culler provided a recap of meetings #1 and #2 for the benefit of past and new attendees at the meeting. Mary also reminded the group to visit the regional planning commission's website and she announced two upcoming events in the area, a soil health workshop in Macon on March 17, 2016, and the Locust Creek litter pick-up event on April 16, 2016.

David Heimann, hydrologist with the United States Geological Survey, gave a presentation about the USGS stream flow gage trends in the watershed. David's presentation specifically focused on two of the 16 stream gages in the watershed, the gage on Locust Creek near Linneus, MO, and the gage on the Grand River near Sumner. Historic data for both gage stations, dating back to the 1930's, indicate that annual mean flow on both Locust Creek and the Grand River have had an upward trend over the decades, even when the flow data is adjusted to consider precipitation amounts. Peak flows in both streams also have an increasing trend. This indicates that some factor other than precipitation, perhaps land use changes, are contributing to greater stream flows in these streams when compared to historic data. David also provided information about the USGS study of re-distribution techniques of large woody debris in Locust Creek.

Scott Couchman, Wayne County, Iowa Soil and Water Conservation District, and Gary Applegate, District Conservationist with the USDA Natural Resources Conservation Service in Iowa, provided a presentation about Wayne County, Iowa, which includes the headwaters of Locust and Medicine Creeks. Gary described the land use, resource concerns, and conservation practices in the county. Alexea Neisen and Abe Smith with Dow Agro Sciences gave a presentation about how temperature and precipitation trends may affect nutrient cycles and transport, and discussed several areas of the United States that have been negatively affected by nutrient runoff. They discussed the Four "R's" for nutrient stewardship and discussed different methods and products that have been shown to curb nutrient loss.

The fourth meeting was held on July 14, 2016, at the MU Forage Systems Research Center. Invitations were sent by mail, followed by email and/or text message to all people that had attended at least one of the previous three watershed meetings. The group went over the draft Lower Grand River Watershed Healthy Watershed Plan. Heather Krempa, USGS hydrologist, and Colleen Meredith, DNR Soil and Water Program Director, provided a presentation about the benefit of long term monitoring in a watershed. There were 31 people in attendance.

The fifth meeting was held on September 8, 2016, at the MU Forage Systems Research Center. Invitations were sent by mail, followed by email and/or text message to all people that had attended at least one of the previous four watershed meetings. The group reviewed the final draft of the Healthy Watershed Plan. NRCS provided a rainfall simulator demonstration that illustrated runoff and infiltration from various land management types. Missouri Stream Team Program provided a presentation about the Stream Team Program and Stream Teams in the watershed. Michael Snyder, Environmental Resource Specialist with the Army Corps of Engineers Kansas City District, provided information about an upcoming feasibility study in the watershed and answered questions regarding the project. There were 36 people in attendance.

Lower Grand River Watershed

Healthy Watershed Plan

Initial ideas about the watershed

At the meeting held in November 2015, attendees were given three index cards each, and were asked to write a word, phrase, or sentence that is something they think of when they think of the Lower Grand River Watershed. This was done to help understand the initial thoughts and opinions of the attendees at the beginning of the series of meetings. The ideas expressed on these cards included descriptions of the watershed, concerns about the watershed, ideas on actions needed in the watershed, and questions or comments about the watershed meeting.

Healthy Watershed Planning Process

Descriptions of the watershed from the first meeting included the following paraphrased comments:

- My livelihood
- A wonderful place to raise cattle
- Goose hunting
- Yellow Creek
- Habitat
- Long and narrow
- Rural low population
- Log jams, Locust Creek log jam at Hwy 36
- Missouri River tributary
- Diverse agriculture land use and topography
- MRBI (Mississippi River Basin Initiative)
- Water supply to City of Bucklin
- Sediment, soil erosion, erosion, erosion (erosion was listed multiple times by several stakeholders)
- The Lower Grand watershed is a disturbed basin in that land use changes and channelization has resulted in an altered stream system carrying an abnormally high level of sediment, nutrients, and large woody debris.
- High nutrient loads

Potential concerns identified at the first meeting included the following ideas:

- Flooding farmland, Flood control, flooding of very productive crop-land! (flooding was listed multiple times by several different stakeholders)
- Runoff – drainage
- Water Quality
- Sediment, soil erosion, soil erosion, erosion, erosion (soil erosion was listed multiple times by several different stakeholders)
- Ditches along gravel roads trashy
- Freedom of access to water to sustain a viable agriculture endeavor during variable seasonal stress
- Foreign landowner use of groundwater to raise crops and livestock that are all exported, how do we control this use and make the application of rules equal? Specifically during drought.
- Erosion control practices causing offsite damages (interpreted by the committee as a tile outlet impacting downstream areas)
- To control erosion, water quality and floods, pollution

Potential ideas identified at the first meeting included the following ideas:

- Need to have a plan to remove log jams
- Soil Health
- A nice recreational lake?; East Locust Reservoir?
- Projects - Funding

Questions provided by the group

- How to get landowner participation?
- Causes of sediment in our area?
- How much soil erosion is natural?

Lower Grand River Watershed

Healthy Watershed Plan

Identification of Issues and Priorities

At the first meeting in November, topic ideas were assigned to different tables for small group discussions. Topic ideas were based on feedback from stakeholders received during the pilot phase and also from additional ideas provided by the group at the November meeting. Topics included the following: flooding, soil health, soil erosion, log jams, bacteria, stream impairment, recreation/tourism, outreach/education, and funding. After the technical presentations had concluded, attendees chose a table to sit at based on their interest in a particular topic. Worksheets were provided that asked each group to answer the following questions: 1.) Is this an issue or concern in the watershed that residents in the watershed feel is a concern?, 2.) How is it a concern? Or if it is not a concern, why is this not a concern to residents in the watershed?, 3.) What are some potential solutions to this issue?, and 4.) What are some ways that outreach and education could be done to reach these solutions? Participants recorded their ideas on large pieces of paper. There were several rounds of this exercise, so attendees had the opportunity to work on several topics of their choice. At the end of the day, each table reported out to the whole group about what was written for their table's topic.

At the second Healthy Watershed meeting held in January, attendees were provided with a summary of the comments received from the index cards, written survey, and small group sessions from the November meeting. Randy Railsback facilitated a group discussion about ideas that could address the main topics discussed at the November meeting. On a large piece of paper for each topic, action items from the group were recorded under each topic. Participants then used colored dots to individually vote on the topics list, to indicate which topics were of greatest importance to them, and to vote on the action item lists, again to show which ideas they thought were most important.

Most Important Issues and Priorities voted on by the local watershed advisory group

Issues (Problems or something that needs to be improved in the watershed)

- Soil Erosion (12 votes)
- Log Jams (8 votes)
- Flooding (7 votes)
- Stream Impairment (3 votes)
- Bacteria (1 vote)

Priorities (something to focus on as important in the watershed)

- Education and Outreach (9 votes)
- Soil Health and Practices (8 votes)
- Funding (7 votes)
- Outdoor Recreation (6 votes)

Lower Grand River Watershed

Healthy Watershed Plan

Identification of Goals and Recommendations

At the third Healthy Watershed meeting in March, the attendees were provided a handout that had the voting results from meeting #2 of the group's voting on the topics and action ideas for the watershed. After the series of technical presentations, the voting results from meeting #2 were reviewed. The group was provided with definitions of the following terms: Issues, Priorities, Goals, and Recommendations. Issues were defined as "a problem, something that needs to be improved in the watershed" and priorities were defined as "something to focus on as important in the watershed". Goals were defined as something that you desired but which has not yet been achieved. Recommendation was defined as a specific action which could help accomplish the goal under which it is listed.

The group was asked if it was appropriate to list their identified topics of Soil Erosion, Log Jams, Flooding, Stream Impairment, and Bacteria as Issues (aka problem, something that needs to be improved in the watershed) and their topics of Education and Outreach, Soil Health and Cover Crops, Funding, and Outdoor Recreation as Priorities (aka something to focus on as important in the watershed). The group felt that it was appropriate, and one attendee suggested that under the topic of Soil Erosion, that topic be sub-divided as streambank erosion and field erosion. The attendees were then provided with blank worksheets to develop Goals and Recommendations and the table groups were each labeled with one Issue or Priority. Individuals then chose an Issue or Priority to work on for goal/recommendation development, and attendees worked independently to write goals/recommendations on their worksheets, and then they shared their ideas with the others at their table. Several rounds were done to allow individuals the opportunity to switch tables and work on another Issue or Priority. All worksheets were collected and ideas were compiled to be presented to the group at the July meeting as part of the Healthy Watershed draft plan.

At the fourth Healthy Watershed Meeting in July, the group reviewed the draft Healthy Watershed Plan and provided comments for specific edits to the document. Attendees also used Turning Point voting software to vote on the continuation of a local citizen advisory committee/team and the preferred frequency of meetings for a committee.

Goals and Recommendations for Priorities

Because the priorities developed by the group will be the foundation for guiding activities to address issues in the watershed, the goals and recommendations for the priorities will be presented first.

Priority

1. Education and Outreach

Overarching Goal: Reach residents of the watershed to improve awareness of the watershed and of practices that contribute to stewardship of water quality and water supply.

Recommendations for this Goal:

- Identify education resources that can be shared between various groups/agencies including both hard copy and electronic/internet resources
- Continue to expand outreach to schools, including FFA & 4-H service projects
- Education programs such as an Earth Day Program
- Revive the No More Trash effort through MoDOT, MDC, and communities to do litter pick-up days
- Educate at adult/ landowner level

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Goals and Recommendations for Priorities (Continued)

Recommendations for the Goal of Education and Outreach (Continued):

- Education at local county fairs
- Information signage at public water access and when entering the watershed
- Field day with local farmers
- Farm walks hosted by local landowners where producers share what they are doing on their farm and share a potluck meal
- Hands on demonstrations
- Newsletters/ Email monthly newsletters
- Landowners that have experience should talk to school board, church boards, rural electric companies, rural water districts
- Reach out to Missouri Farm Bureau, MU Extension, city councils, rural water districts, Soil and Water Conservation Districts, Commodity groups
- Partner with Kirksville Livestock Symposium
- Partner with Soil and Water Districts for education of elementary grades
- A regulatory workshop to explain existing regulations
- Have the University teach about soil health at the cattleman's college
- Education about cover crops, and specifically grazing cover crops
- Educate about summer grazing options
- Make water testing readily available
- Re-energize Stream Teams for water quality monitoring, especially in the natural portion of Locust Creek

2. Soil Health and Practices

Overarching Goal: Improve soil health and control erosion with cover crops, crop rotation, and no-till.

Recommendations for this Goal:

- Use cover crops (living roots) to improve soil health, control weeds, increase organic matter, and reduce soil compaction
- Rotate crops and cover crops over 10 year span
- Use cover crops as pasture for livestock
- Use no-till to increase soil health
- Split nitrogen applications
- Research and development of different cover crops, including which cover crops can become invasive and which can be used as feed. Not much is known, and what is known isn't shared publicly
- Share research about cover crops publicly
- Provide assistance for what cover crop will work without a large expense
- Offer supplements/incentives to get farmers interested
- Make programs less restrictive and more realistic
- Reach out to seed companies, Young Farmers Groups, Green Hills Farm Project
- Help groups to share what works
- An Extension cover crop meeting
- Host speakers such as Dr. Randy Miles, associate professor of soil science at the University of Missouri-Columbia, or Harry Cope, farmer from Montgomery County

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Goals and Recommendations for Priorities (Continued)

3. Funding

Overarching Goal: Increase funding available for projects in the watershed and funding for voluntary best management practices.

Recommendations for this Goal:

- Target the funding to the highest priority
- Piggy back funding sources to pool dollars to make a bigger impact
- Funding to clean out PL-566 structures
- Communicating issues effectively to media and legislators
- Create a clearinghouse of what is available – all the agencies, what projects are on-going, what grants are available, what match is needed
- Inter-Agency communication and coordination
- Investigate opportunities through the Howard G Buffett Foundation
- Develop a good plan
- Identify where funds could come from (ie: tax, grants etc.)

4. Outdoor Recreation

Overarching Goal: Develop awareness of nature and the important natural features in the watershed.

Recommendations for this Goal:

- Look at wildlife benefits in practices
- Maintain soil and water tax
- Establish walking trails
- Identify county conservation departments (with signage on roads)
- Partner with state and national Audubon society
- Partner with the National Wild Turkey Federation
- Have National Geographic do a historical focus of the watershed area
- School field trips
- Form more Stream Teams
- Reach out to absentee landowners

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Goals and Recommendations for Issues

1. Soil Erosion (Separate as Streambank and Field Erosion)

Streambank Erosion

Overarching Goal: Reduce streambank erosion.

Recommendations for this Goal:

- Manage log jams; they are causing some of the severe bank erosion
- Keep water on fields first, so less water is getting to stream in the first place
- No till to increase residue and water absorption
- Cover crops to help with sheet and rill erosion in winter months and water absorbing ability
- Slow water as far up the hill as possible
- Make it a local issue instead of state or federal
- Leave farmers alone and let them clean out brush and stabilize their own banks
- Get experts to come look at the watershed and make recommendations on several locations
- Event to educate about gully erosion/stream banks

Field Erosion

Overarching Goal: Increase soil water infiltration to reduce water runoff and soil erosion.

Recommendations for this Goal:

- Increase soil health through no-till and cover crops (cost share on these items)
- Seed more land to grasses
- Seeding down highly erodible ground
- Use more filter strips
- Water control structures and education about the benefits of structures for sediment and flood control
- Add silt basin to slow water at terrace outlet
- Improve coordination and consistency among soil and water conservation districts

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Goals and Recommendations for Issues (Continued)

2. Log Jams

Overarching Goal: Reduce the adverse effects of log jams and prevent log jam issues when possible.

Recommendations for this Goal:

- Permitting to treat log jams when they start before they become a major problem
- Determine where logs are coming from to help look for solutions upstream in the watershed, reduce the amount of debris coming down stream
- Management plan to include a long term fix
- Start at the top of the watershed and clean out logs, then develop a maintenance plan to keep it cleaned out
- Address stream bank erosion to reduce woody materials entering stream
- Slow down high velocity water upstream
- Remove the log jams from the channel into an area where they will not move back into the channel. When left untreated there is a tremendous amount of bank erosion as the channel changes to bypass the log jam
- Pursue alternatives for returning stream flow of Locust Creek instead of jam removal
- Identify “good” logging practices
- Continue the USGS research
- Examine/study impact of current jam

3.) Flooding

Overarching Goal: Reduce flooding and stream bank damage.

Recommendations for this Goal:

- Apply flood damage reduction funds where they will do the most good
- Develop accurate flood maps and make them available
- Discourage development in flood areas through active participation in flood regulations
- Assess and prioritize infrastructure needs relative to flooding
- Develop wetland flood control structures that also reduce nutrients
- Develop road structures that serve as catch basins and grade control structures
- More contact with road and bridge crews about troublesome sites
- When planting in flood prone areas, understand the risk in terms of frequency, duration, and depth of flooding
- More ground cover
- More responsibility or ability to let landowners manage streams
- Grade stabilization structures and dry structures
- Funding to clean out PL-566 structures
- Obtain money for structures, Revisit PL-566
- Work with local emergency planning commissions
- Swell reduction terraces

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Benchmarks for Measuring Watershed Health

How will we know if the health of the watershed is improving? The local watershed advisory committee discussed this concept at the September 2016 meeting. Some ideas for benchmarks include knowledge of the number of acres where conservation plans have and have not been implemented; the number of farms participating in the ASAP (Agricultural Stewardship Assurance Program); trends in long term water quality monitoring; intensity and duration of flood events; and ecosystem improvement.

Goals and Recommendations for Issues (Continued)

4. Stream Impairment

Overarching Goal: Improve water quality and wildlife habitat (ecology) of streams within the Lower Grand River Basin and reduce sediment and nutrient transport from the watershed.

Recommendations for this Goal:

- Cover crops to reduce nutrient levels in water
- No till incentive to help soil health and water absorption
- Variable rate application
- PL-566 and smaller water retention basins with slow let down for sediment retention
- Filter strips along streams to help absorption of water and nutrients
- Forested buffer strips to help stabilize stream banks against increased stream flows
- More wetlands
- Education of how buffers and wetlands can provide long term financial benefits to landowners by reducing flooding and bank erosion, and reduce the loss of agricultural land over time
- Monitor/quantify losses of ag land due to bank erosion and compare to losses with buffer strips
- Monitor ecological effects of conservation practices to better understand benefits and improvements
- Determine primary sources of pollutants
- Quantify flow-adjusted loads of pollutants
- Have picture/explanation of current conditions to establish baseline to measure against to determine if improvements are effective

5. Bacteria

Overarching Goal: Reduce bacteria levels in impaired streams.

Recommendations for this Goal (from meeting #1 and #2):

- Vegetative buffers
- Improve wastewater treatment infrastructure
- Identify point vs. non-point sources
- Informative signage at public waters
- Make water testing readily available
- Demonstrations
- Waste/nutrient management plans
- Composting
- Public meetings/Town hall meetings
- Septic Tank and Lagoon Education/loan Grants
- Comply with county ordinances
- Small lagoons education/promotion

A Living Document - Status and Changes to this Plan

The local watershed advisory committee intends for this Healthy Watershed Plan to be a living document, meaning that it can be updated and revised as needed to reflect new information and ideas for the watershed. The local watershed advisory committee recognizes that this document will likely require periodic review in order for it to adequately reflect current issues, priorities, and recommendations for the watershed.

For Additional Information

If you would like additional information regarding this document, please contact the Green Hills Regional Planning Commission at (660) 359-5636 or the Department of Natural Resources at (660) 835-8000.

Information about the watershed and presentations from the planning process can be found online at <http://www.ghrpc.org/> or dnr.mo.gov/omw



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