Geosyntec consultants

# GREATER BONNE FEMME WATERSHED MANAGEMENT PLAN

*Prepared for*

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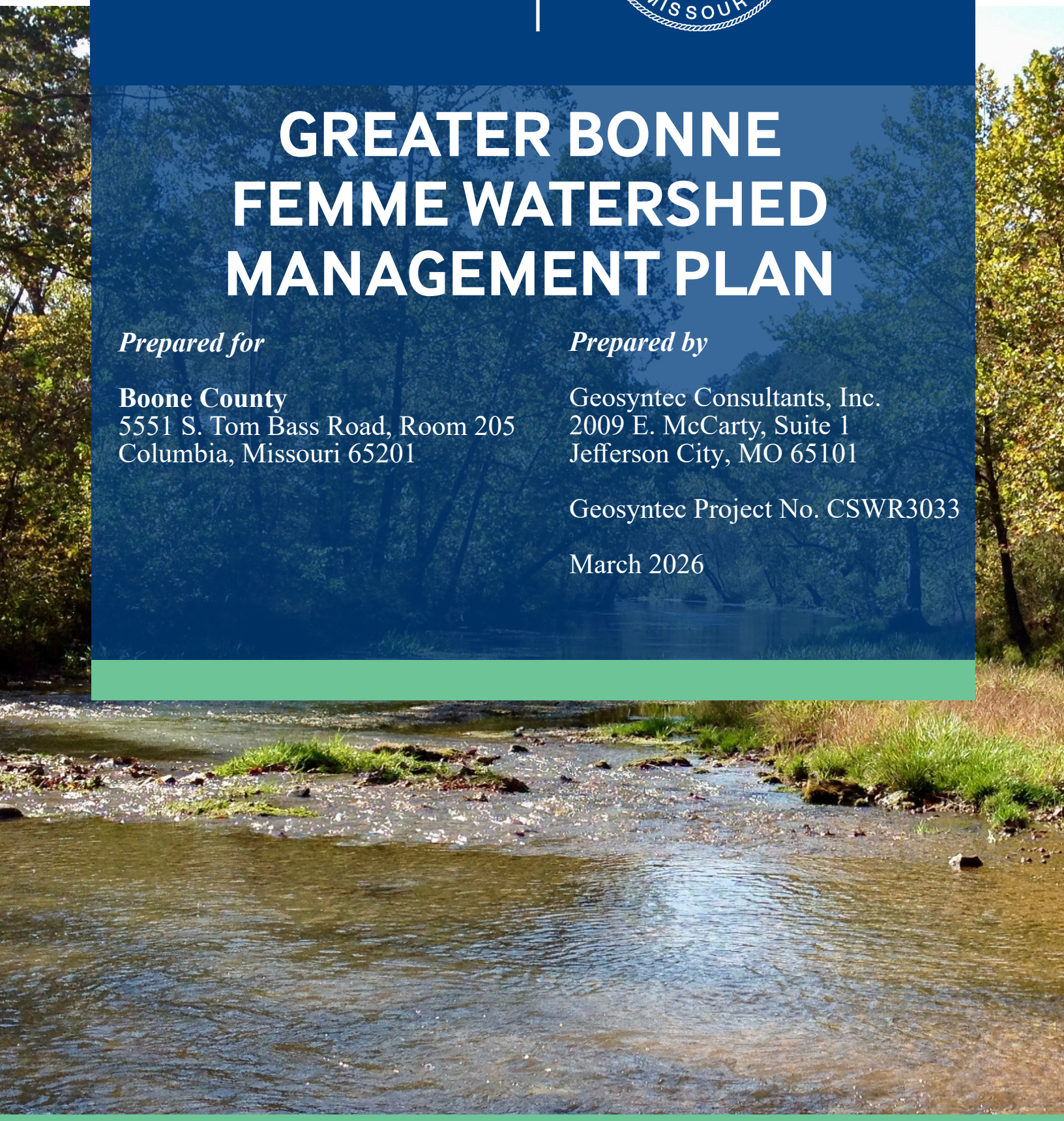

# EXECUTIVE SUMMARY

This document outlines the Watershed Management Plan (WMP) for improving water quality in the Greater Bonne Femme Watershed (GBFW), Boone County, MO.

## Introduction

The GBFW covers 92.4 square miles in Boone County and encompasses a variety of land uses, including agricultural, forested, urban, and other land uses. The watershed contains distinctive natural karst features—such as caves, springs, sinkholes, and losing streams—that facilitate direct connections between surface and groundwater systems. The area includes Outstanding State Resource Waters, several parks, and recreational areas, all providing the community with considerable benefits and economic value. However, the watershed faces growing challenges related to population growth, changing land use patterns, and persistent water quality concerns.

The most pressing water quality issues identified in the GBFW are E. coli, excessive nutrients, and sedimentation. These water quality issues have been linked to various aspects of watershed management and specific types of land use. For example, six stream segments are currently listed as impaired for E. coli, with contributing sources traced to livestock, failing septic systems, and urban runoff. Separately, elevated nitrogen and phosphorus levels in some waterbodies have led to nuisance algal blooms. And increased sediment loads in GBFW waterways continue to threaten sensitive habitats, particularly in karst recharge areas. These issues not only impact aquatic ecosystems and recreational opportunities but also pose public health risks and can be detrimental to local economies.

To combat these challenges, Boone County, along with other watershed stakeholders, established the Greater Bonne Femme Watershed Initiative (the Initiative) to develop a comprehensive Watershed Management Plan (WMP). The WMP's mission is to:

***Inspire a community of like-minded individuals to restore, conserve, and protect the resources of the GBFW, while having a mix of land uses and development , and maintaining thriving agricultural activities.***

This WMP builds upon previous planning efforts in the watershed, including the 2007 Bonne Femme Watershed Plan, Technical Advisory Team efforts, and 2023 Bonne Femme Nine-Element Watershed-Based Plan.

## Return on Environment Study

The WMP development included the first Return on Environment (ROE) study conducted in the Midwest. This study highlighted the importance of preserving, restoring, and protecting natural resources by quantifying the current economic value (in USD) of ecosystem services and natural resources. The

ROE Study captures a range of societal benefits directly connected to or that foster community well-being and overall economic stability. The qualitative and quantitative analysis identifies the economic value (in USD) across five benefit categories: 1) direct use benefits, 2) environmental (indirect use) benefits, 3) economic activity, 4) property value benefits, and 5) community cost savings. Significant community benefits within these categories were identified (**Figure ES-1**), which will assist and guide the County in future land use, development and economic growth, public safety, and public utilities cost discussions and decisions. More broadly, this study reveals and documents, specifically for the GBFW ecosystem, the often-unrecognized value of natural resources and their contribution to community well-being.


**Figure ES-1: Benefits Quantified by the Return on Environment Study**

## Greater Bonne Femme Watershed Initiative

The Initiative formed partnerships to support the development and implementation of the WMP, with the goal of restoring and protecting water quality through both an environmental and social lens. The WMP is based on four pillars, which are connected by these partnerships as shown in **Figure ES-2**.

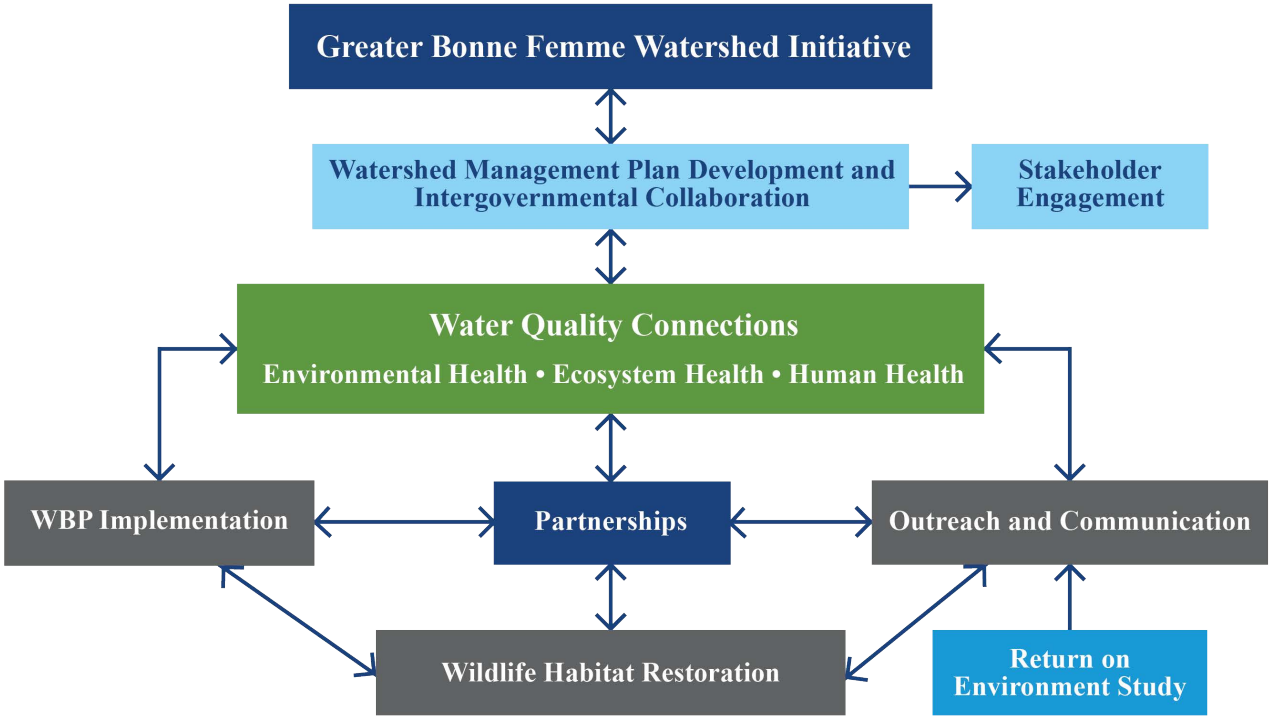


**Figure ES-2: Framework for the Greater Bonne Femme Watershed Initiative**

The four pillars of the WMP are summarized below:

**Pillar1: Implementation of the Watershed-Based Plan (WBP)**

The objective of Pillar 1 (Implementation of the WBP) is to promote and encourage agricultural landowners to voluntarily install demonstration Best Management Practices (BMPs), such as the use of cover crops. This objective would be accomplished through the following actions:

- Outreach and communication to distribute information and encourage adoption of the agricultural BMPs through planned events (e.g. Creek Week) and an on-site wastewater incentive program
- Cost share incentive program for agricultural landowners that would cover from 90 to 100 percent of total BMP costs
- Demonstration projects (e.g. at South Farm) to allow the public to view the BMPs in action
- Water quality and soil health monitoring to track improvements and guide adaptive management

**Pillar 2: Watershed-wide Wildlife Habitat Restoration Project**

The objective of Pillar 2 (Watershed-wide Wildlife Habitat Restoration Project) is to provide a framework to guide landowners in the watershed to improve wildlife habitat on their property. A wildlife habitat restoration plan was developed based on three principles: 1) minimizing habitat fragmentation, 2) habitat enhancement, and 3) removing barriers to reconnecting functional habitat areas. Water quality improvements are expected as a result of restoring wildlife habitat in the GBFW. Opportunities for each of these approaches were identified through geographic information system (GIS) spatial analysis that prioritized opportunity areas for prairie restoration, wetland/floodplain restoration, and stream buffer restoration (of shrubs or trees). The identified restoration opportunities are shown in **Figure ES-3**.

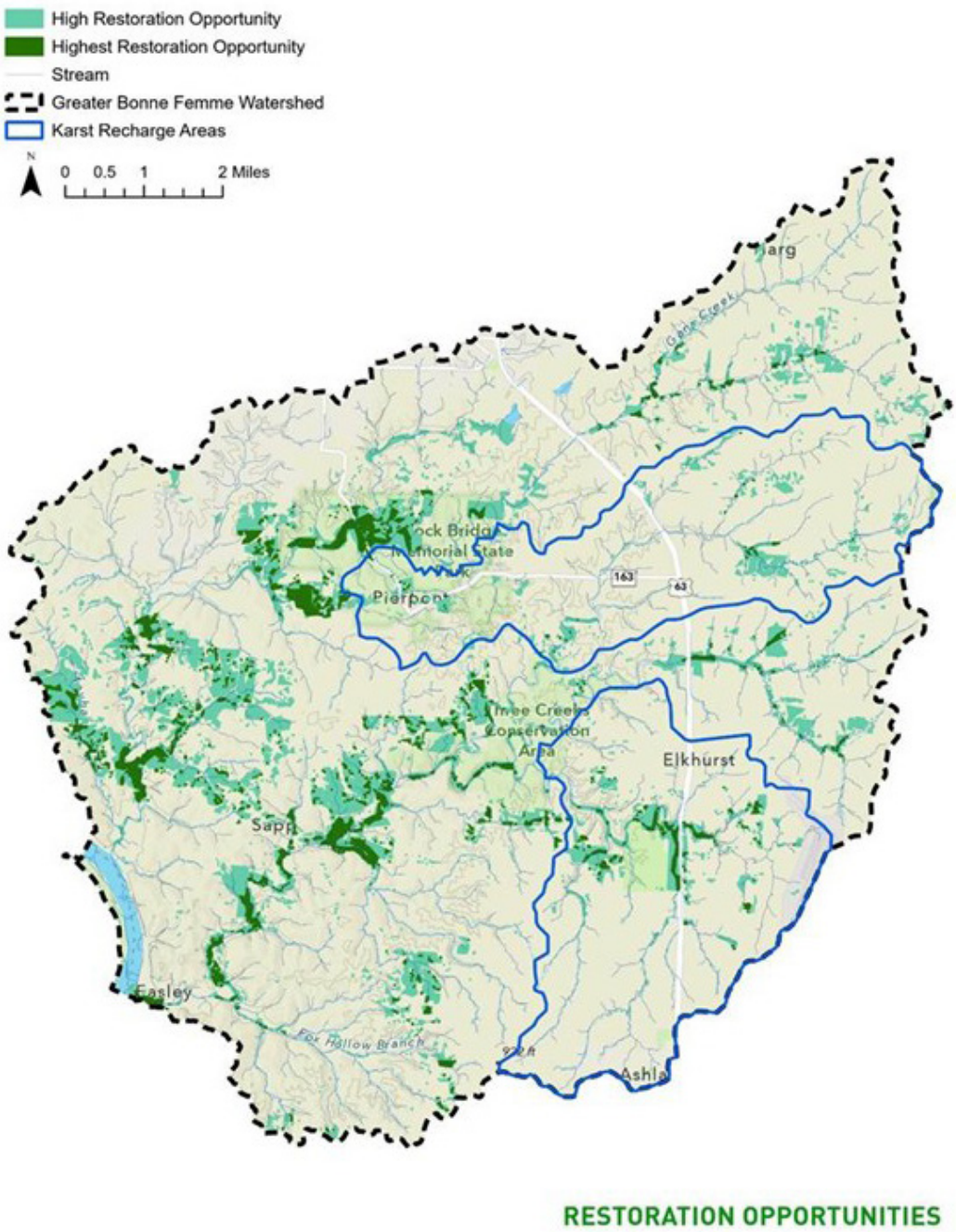


**Figure ES-3: Framework for the Greater Bonne Femme Watershed Initiative**


**Exhibit ES-4: GBFW Outreach and Communication Plan**

**Pillar 3: Outreach and Communication**

The objective of Pillar 3 of the Initiative (Outreach and Communication; O&C) is to develop a public information and marketing strategy that increases awareness about watershed and water quality issues and strengthens stakeholder understanding of the connection between land use activities and water quality. This pillar also aims to encourage the implementation of BMPs to protect and improve water quality throughout the GBFW. An O&C Plan was developed as part of WMP development that outlines a public information and marketing strategy, primary implementation parties, and key project partners. The O&C Plan consists of six key steps with corresponding action items, which are shown in **Exhibit ES-4**.

**Pillar 4: Water Quality Connections**

The objective of Pillar 4 (Water Quality Connections) is to highlight how water quality links human, environmental, and ecosystem health within the GBFW. Improved water quality is vital for maintaining the balance among these interrelated components. The development of this pillar was informed by a brainstorming charrette. The actions identified for establishing water quality connections are:

- Develop wide-reaching environmental education for homeowners, landowners, and developers.
- Develop messaging to homeowners, landowners, and developers.
- Promote conditions to limit environmental degradation.
- Utilize the ROE Study to increase awareness of the financial, environmental, and social incentives of maintaining clean water and a clean environment. Develop regulations to guide sustainable development and reduce impairments to water quality.
- Reduce fertilizer and chemical usage and promote the use of regenerative practices for all land uses.

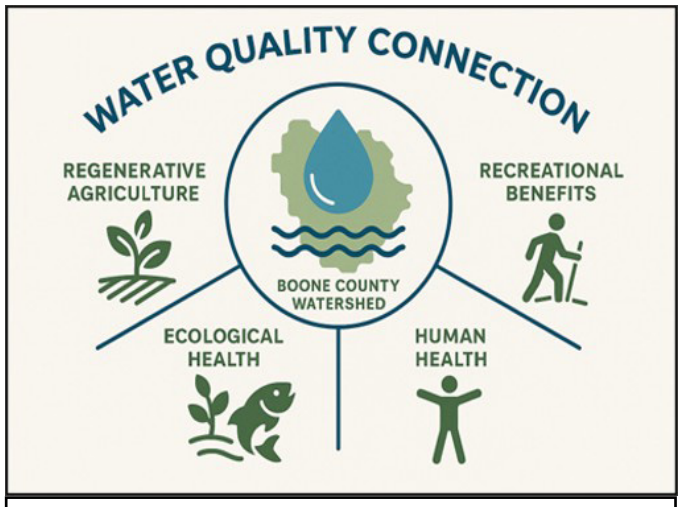


**Exhibit ES-2: Water Quality Connections**

### Stakeholder Engagement

The WMP development included robust stakeholder engagement to obtain input from local residents, farmers, businesses, and organizations. More than 4,700 individuals participated in various events, surveys, and workshops to help define the priorities of the plan. Notable events included Interpretive Programs at Rock Bridge Memorial State Park in 2023, 2024, and 2025; the Annual Water Festival in 2023, 2024, and 2025; and the Columbia Area Earth Day Festival in 2024 and 2025. Additionally, a Water Quality Connections Charrette and the ROE Study GBFW Initiative Community Survey were conducted to gather public input on natural resource concerns and priorities for the WMP. Several of these activities received coverage in local news media.

**Exhibit ES-3: GBFW Events Pictures**

## WMP Recommendations

The recommendations for this WMP have been organized primarily by implementation type, including outreach and communication, work on the ground, monitoring, and data management, and further associated with the relevant pillar(s) of the WMP and the ROE study. These recommendations for each implementation are provided below:

**Pillar 1: Implementation of Watershed Based Plan**

**Pillar 2: Wildlife Habitat Restoration Plan**

**Pillar 3: Outreach and Communication Plan**

**Pillar 4: Water Quality Connections**

**Return on Environment Study**

### Outreach and Communication

| Recommendation Description | Pillar 1 | Pillar 2 | Pillar 3 | Pillar 4 | ROE |
|---|---|---|---|---|---|
| Develop incentive programs, digital media, and a database of O&C distribution outlets specific to each O&C target audience. | | | ● | | |

| Recommendation Description | Pillar 1 | Pillar 2 | Pillar 3 | Pillar 4 | ROE |
|---|---|---|---|---|---|
| Develop and hold community events, BMP tours, & public meetings. | ● | | ● | | ● |
| Identify key partners for O&C activities and discuss opportunities for additional engagement and targeted outreach. | | | ● | | |
| Implement incentive programs, such as the Water Friendly Recognition Program and Onsite Wastewater Program, to drive adoption of BMPs. | ● | | | | ● |
| Promote and/or increase awareness of financial incentives for conservation and ecosystem projects. | | ● | | ● | ● |
| Encourage the use of native plantings in stormwater management areas to create a connected network of living infrastructure. | ● | ● | | | ● |
| Encourage the creation of continuity of habitat in privately-owned landscapes to benefit wildlife. | | ● | | | |
| Encourage a reduction in fertilizer and pesticide use by residential landowners highlighting their impact through social media and flyers. | ● | | ● | ● | ● |
| Develop and distribute educational materials on agricultural BMPs. | ● | | | | |
| Encourage voluntary installation of agricultural BMPs by increasing awareness of the availability of cost-share programs. | ● | ● | | | |
| Encourage regenerative agriculture practices that improve environmental and community health. | | | | ● | ● |
| Encourage the exclusion of cattle from streams to protect water quality. | ● | | | | ● |
| Encourage the adoption of green infrastructure practices in new developments that can benefit wildlife. | | ● | | | |
| Promote conservation easements to help facilitate conservation practices. | ● | | | | |
| Encourage developers to implement environmentally friendly practices and support conservation subdivisions and transfer of development rights. | ● | | | | |
| Emphasize the connection between a healthy natural environment and mental and physical health using signage at recreational places. | | | | ● | ● |

## Work on Ground

| Recommendation Description | Pillar 1 | Pillar 2 | Pillar 3 | Pillar 4 | ROE |
|---|---|---|---|---|---|
| Collaborate on projects to control invasive species. | | ● | | | |
| Establish or enhance riparian corridors to manage and protect waterways using the prioritization identified in Figure 8 of *Appendix C: Habitat Restoration Plan.* | ● | ● | | | ● |
| Enhance living infrastructure connectivity through areas developed for compatible species such as pollinators. | | ● | | | |
| Increase the diversity of flowering native shrubs and forbs that support pollinators and maintain undisturbed nesting sites, such as brush and leaf piles. | | ● | | ● | |
| Improve aquatic connectivity through culvert retrofits, dam or tile drain removal, or bridge repair for wildlife passage. | | ● | | | |
| Protect pollinator habitat from insecticide and most herbicide applications. Consider policy changes to eliminate the use of non-specific herbicides such as glyphosate in open spaces. | | ● | | ● | |
| Recruit new landowners for demonstration projects. | ● | | ● | ● | ● |
| Restore wetland and floodplain along the banks of streams and rivers to stabilize banks, filter pollutants, and provide habitat for wildlife. Prioritization of wetland and floodplain restoration is provided in Figure 7 of *Appendix C: Wildlife Habitat Restoration Plan.* | ● | ● | | | ● |
| Restore prairie habitat within priority areas as designated in Figure 6 of *Appendix C: Wildlife Habitat Restoration Plan.* | | ● | | | |

## Monitoring

| Recommendation Description | Pillar 1 | Pillar 2 | Pillar 3 | Pillar 4 | ROE |
|---|---|---|---|---|---|
| Conduct water quality monitoring to develop a baseline assessment and assess the impact of BMPs over time. | ● | ● | | | ● |
| Conduct soil health monitoring at demonstration projects sites to showcase improvements to landowners and the general public. | ● | | | | ● |

## Data Management

| Recommendation Description | Pillar 1 | Pillar 2 | Pillar 3 | Pillar 4 | ROE |
|---|---|---|---|---|---|
| Develop an online dashboard to track voluntary adoption of BMPs and monitor water quality improvements over time to gauge the effectiveness of BMP implementation. | ✓ | | | | |
| Create a master repository for information & events accessible to the public (cavewatershed.org page or other digital community engagement platform). | | | ✓ | | |
| Develop appropriate methods and metrics for gauging plan efficacy by goal type and target audience, as applicable. | | | ✓ | | |
| Evaluate O&C plan efficacy with desktop-based metrics (engagement surveys, marketing interactions, Appendix K of the WBP) and grow and improve with an adaptive management framework as needed. | | | | ✓ | |
| Improve wildlife mapping to understand the presence and distribution of wildlife, particularly with regard to indicator species identified in Appendix C: Habitat Restoration Plan. | | ✓ | | | |

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# ACRONYMS AND **ABBREVIATIONS**

| | |
|---|---|
| Ashland | City of Ashland |
| BCSWCD | Boone County Soil and Water Conservation District |
| BFSC | Bonne Femme Stakeholder Committee |
| BMP | Best Management Practice |
| cfu/100mL | Colony Forming Units Per 100 Milliliters |
| CWA | Clean Water Act |
| GBFW | Greater Bonne Femme Watershed |
| GIS | Geographic Information System |
| MDC | Missouri Department of Conservation |
| MDNR | Missouri Department of Natural Resources |
| O&C | Outreach and Communication |
| ROE | Return on Environment |
| TAT | Technical Advisory Team |
| TMDL | Total Maximum Daily Load |
| TSS | Total Suspended Solids |
| USEPA | United States Environmental Protection Agency |
| WBID | Water Body Identification Number |
| WBP | Watershed-Based Plan |
| WMP | Watershed Management Plan |

# WATERSHED MANAGEMENT **OVERVIEW**

## 1. INTRODUCTION

### 1.1 What is a Watershed?

A watershed is an area of land that drains or "sheds" water into a specific waterbody. Every body of water has a watershed. Watersheds drain rainfall and snowmelt into streams and rivers. These smaller bodies of water flow into larger ones, forming a network of waterways. An illustration of a watershed is shown in Exhibit 1-1. The health of watersheds and water bodies is influenced by the complex interactions among soil, climate, hydrology, vegetation, human activities, and wildlife. A healthy watershed is characterized by good water quality in streams, limited flooding, available habitats for wildlife, recreational opportunities, and potential for economic development and improved quality of life. In developed watersheds, elements such as sewage, agricultural runoff, paved surfaces, and erosion may affect watershed conditions.

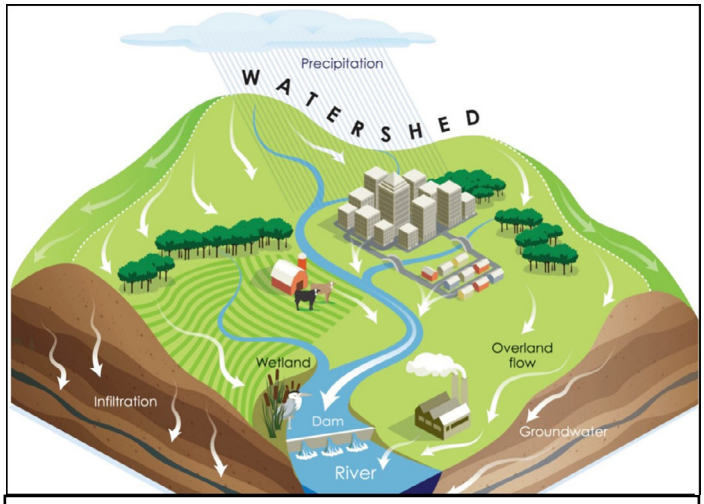



**Exhibit 1:**
**Watershed Diagram**

### 1.2 Why a Watershed Management Plan?

Water is our most precious resource. Over the millennia, great civilizations have both flourished and perished due to the availability of water. Today, industrialized societies are still, and possibly more so, dependent on reliable water supplies. In Missouri, each person uses about 75 gallons of water per day for household and other domestic uses. Even with more efficient use and other conservation efforts, as the population increases, so does the need for water.

*Did you know that the average person in Missouri uses about 75 gallons of water every day for household and domestic purposes?*

This watershed-management plan (WMP) is essential as it directly addresses water-related challenges faced by communities within the Greater Bonne Femme Watershed. The availability of clean and sufficient water, the maintenance of healthy streams and lakes, and protection from flooding are all vital to residents and businesses, significantly influencing community quality of life, public health, and economic sustainability. Healthy watersheds are valuable assets that enhance the appeal of communities for both residents and commercial enterprises. The region's streams serve as recreational resources for locals and visitors, reflecting the overall state of watershed health. These waterbodies sustain a wide range of aquatic plants and animal species and play an integral role in supporting local ecosystems. The specific mission of this WMP is provided below:

***To inspire a community of like-minded individuals to restore, conserve and protect the resources of the Greater Bonne Femme Watershed, while having a mix of land uses and development types, and maintaining thriving agricultural activities.***

## 1.3 Greater Bonne Femme Watershed

The Greater Bonne Femme Watershed (GBFW) encompasses the Bonne Femme and Little Bonne Femme subwatersheds as well as their tributaries. Both streams flow directly into the Missouri River near Easley, Missouri. The watershed spans approximately 92.4 square miles, which is approximately 13 percent (%) of the land area within Boone County (the County). The tributaries in the GBFW include Bass Creek, Turkey Creek, Fox Hollow Branch, Smith Branch, Devil's Icebox Spring Branch, Gans Creek, Clear Creek, and Mayhan Creek. The GBFW is located between the rapidly developing cities of Ashland (south) and Columbia (north), Missouri. Population growth over the last 10 years has increased at a rate of 40%, which is above the 34% population growth for all of the County from 2000 to 2021. Per the Boone County Master Plan (Boone County, 2025), population in the County is forecast to increase by 37.3% by 2050. A map of the watershed is shown in **Figure 1**.

The land use and land cover within the GBFW is mixed, with most of the land used for agricultural production. Table 1 provides a detailed breakdown of the existing land cover in GBFW (Boone County Resource Management and Project Partners 2023). The land use and land cover for the GBFW is illustrated in **Figure 1**.

**Table 1: Greater Bonne Femme Watershed Existing Land Use/Land Cover**

| Land Use/Cover | Percent Land Cover/Use |
|---|---|
| Forest | 43% |
| Pasture/Hay | 33% |
| Cultivated Crops | 13% |
| Urban | 9% |
| Other | 2% |

Sections of several streams in GBFW are classified as Outstanding State Resource Waters. This classification is awarded to streams that are high quality waters with a significant aesthetic, recreational, or scientific value as natural resources of the state. These streams are as follows:

- Bass Creek (1.0 mile in Three Creeks Conservation Area)
- Bonne Femme Creek (2.0 miles in Three Creeks Conservation Area)
- Turkey Creek (4.6 miles in Three Creeks Conservation Area)
- Gans Creek (3 miles in Rock Bridge Memorial State Park)
- Devil's Icebox Cave Branch (1.5 miles in Rock Bridge Memorial State Park)

The watershed exhibits unique karst hydrology features, primarily to the west of Highway 63. The karst features include caves, springs, sinkholes, and losing streams. The groundwater in karst areas is particularly sensitive to pollution since surface water bypasses any filtering of contaminants typically provided by soil. These karst features result in a hydrologic connection between the Bonne Femme and Little Bonne Femme watersheds.

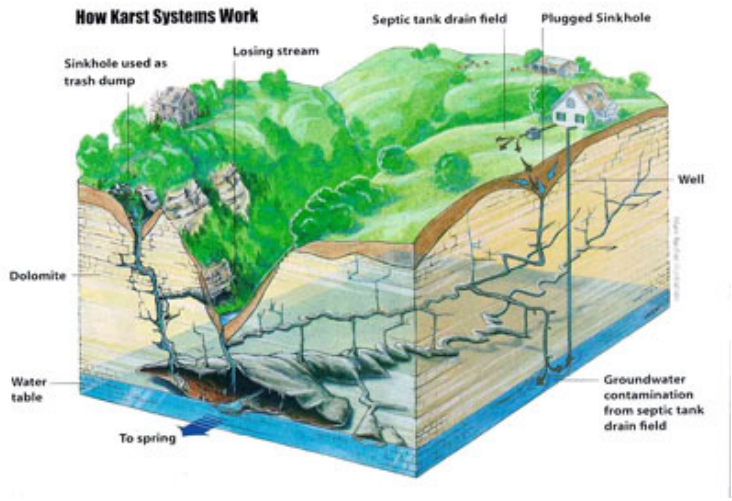



**Exhibit 2:**
**Karst Illustration**

The GBFW boasts diverse habitats and natural resources supporting wildlife, agriculture, and people. Parks and recreation areas in the GBFW include Rock Bridge Memorial State Park, Gans Creek Recreation Area, Gans Creek Wild Area, and Three Creeks Conservation Area. The Devil's Icebox Cave in Rock Bridge Memorial State Park and Hunter's Cave in Three Creeks Conservation Area are notable karst features. The unique features of the watershed provide wonderful recreational activities including caving, hunting, fishing, hiking, picnicking, horse-back riding, and rock-skipping. Thousands of visitors explore these unique features annually.

Urban and residential development to the north and south, and agricultural production to the east, have put pressure on the waters and ecosystem of the GBFW. These shifts result in greater runoff volumes, more erosion, and higher pollutant loads entering local streams, increasing the risk of flooding and impacting watershed health negatively. Comprehensive watershed management planning is essential to protect the Outstanding State Resource Waters and unique karst features and to address water quality challenges described below.

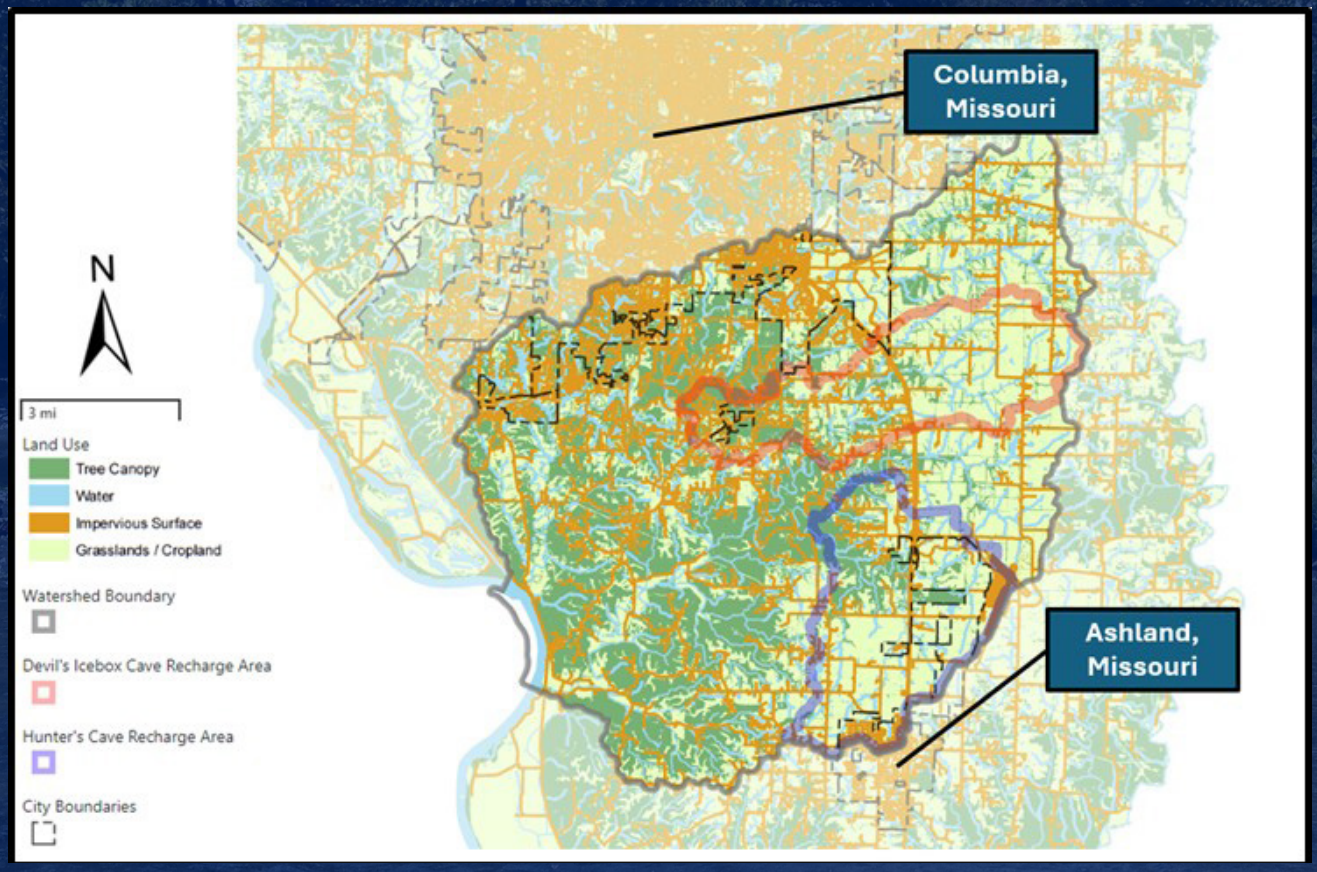



**Figure 1: Greater Bonne Femme Watershed Map (Boone County Resource Management and Project Partners 2023)**

## 1.4 Water Quality Challenges

Factors contributing to water quality decline in the GBFW include riparian area deforestation, failing on-site sewage systems, nutrients, pesticides, stormwater runoff from commercial and residential sites, and animal waste.

Water quality parameters of concern in the GBFW streams include Escherichia coli (*E. coli)*, nutrients (particularly nitrogen and phosphorus), and total suspended solids (TSS, including sediment). These water quality challenges are summarized below.

**Water Quality Parameters Description**

*E. coli*: Escherichia coli (abbreviated as *E. coli*) are bacteria found in the environment, foods, and intestines of people and animals. This bacteria is a preferred indicator for freshwater recreation and its presence provides direct evidence of fecal contamination from warm-blooded animals.

Total Phosphorus (TP): Sum of all forms of phosphorus in water, which can contribute algal blooms.

Total Nitrogen: Measure of all forms of nitrogen. High levels indicate potential pollution from wastewater treatment plants, manure and other sources.

Total Suspended Solids (TSS): Measure of particles (sediment, algae and organic material) that are suspended in water and can be trapped by a filter. TSS levels impact water clarity and high levels are harmful to aquatic life.

### 1.4.1 *E. coli*

Five streams in the GBFW have elevated levels of microbial contamination as measured by exceedance of the Missouri E. coli bacteria water quality standard. *E. coli* levels have exceeded the recreational season (April 1 through October 31) geometric mean  criterion for whole body contact “A” (126 colony forming units per 100 milliliters, cfu/100 mL) and whole-body contact “B” (206 cfu/100 mL). The Missouri Department of Natural Resources (MDNR) has listed six stream segments in the GBFW as being impaired for E. coli on the state’s 303(d) list of impaired waters. These six stream segments are as follows: Little Bonne Femme Creek: Water Body Identification number [WBID] 1003, Gans Creek: WBID 1004, Bonne Femme Creek: WBID 750 and 753, Turkey Creek: WBID 751, and Bass Creek WBID 752

The locations of impaired stream segments are shown in **Figure 2**. Under the Clean Water Act, the Missouri Department of Natural Resources is required to develop total maximum daily loads (TMDLs) for all impaired stream segments. TMDLs calculate the maximum amount of a specific pollutant, or load, a water body can absorb and still meet water quality standards. This calculated loading is then divided between the various pollutant sources in the watershed and becomes the goal, or loading target, to restore water quality. TMDLs have not been developed for these WBIDs.

[1] The geometric mean is a way to find the average of numbers that can vary a lot, like bacteria levels. Instead of just adding them up and dividing, you multiply all the numbers and then take a special root (like a square root). This helps give a fairer idea of the usual level, even if some numbers are much higher or lower than others.

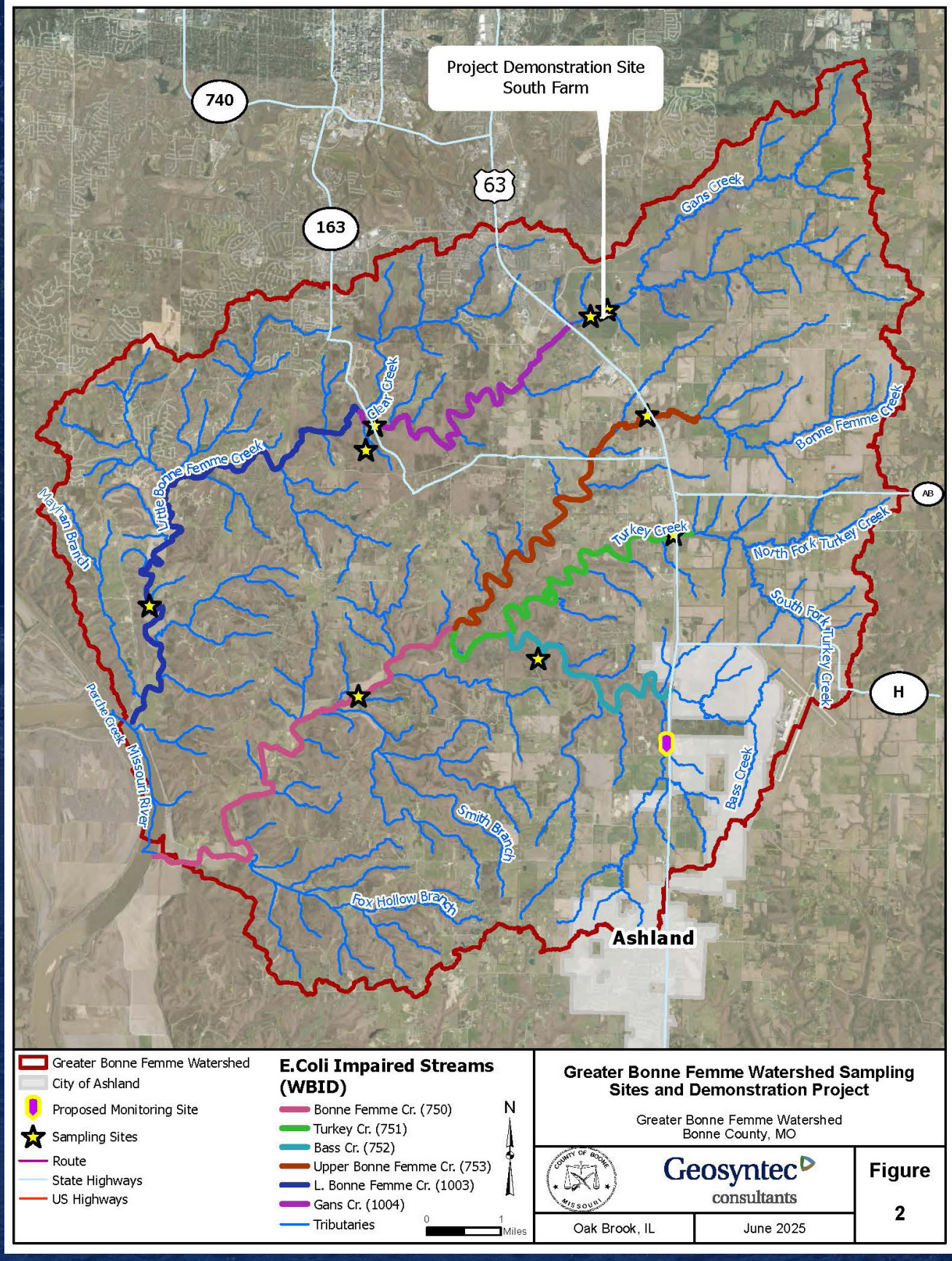



**Figure 2: Greater Bonne Femme Impaired Stream Segments, Proposed Sampling Sites and South Farm Demonstration Project**

### 1.4.2 Nutrients

Excessive nutrient concentrations, particularly those for nitrogen and phosphorus, can affect stream ecology in a variety of ways, including increasing the likelihood of algal blooms, which can harm water quality, food resources, habitats and, decrease the oxygen that fish and other aquatic life need to survive.

Water quality monitoring data over the years show elevated nutrient levels including total nitrogen and total phosphorus in multiple GBFW streams. These elevated nutrient levels have resulted in nuisance algae and algal blooms in GBFW such as the algal bloom in Gans Creek in 2018, shown in the adjoining picture (Exhibit 1).

**Exhibit 3:**
**2018 Algae bloom in Gans Creek**

### 1.4.3 Sediment

Sediment in streams, often measured as TSS (total suspended solids), can affect stream water quality by smothering critical habitat and food sources at the bottom of the streams or making it more difficult for sight-feeding fish to locate prey. Sediment can also transport other pollutants into the stream. High turbidity levels have been reported in GBFW streams during wet weather, indicating sediment loss from land (Bonne Femme Stakeholder Committee [BFSC] 2007). Sedimentation in the Devil's Icebox Cave system was previously correlated to a decreased abundance of pink planarians, a species that is unique to the cave, as they feed on invertebrates that live on the stream bed. Fate and transport of sediment is therefore of particular concern in the Devil's Icebox Recharge Area.


**Exhibit 4:**
**Pink Planarian Found in Devil's Ice Box (Source: MDC)**

## 1.5 History of Watershed Planning

Several watershed plans and actions have been implemented over the years to protect the valuable natural resources of the watershed and address the water quality challenges described above. Previous watershed planning and implementation efforts are summarized below.

### 1.5.1 2007 Bonne Femme Watershed Plan

The Bonne Femme Stakeholder Committee (BFSC) developed a watershed plan through a stakeholder-driven process with financial assistance from a Missouri Section 319 Nonpoint Source grant from 2003 to 2007 (BFSC 2007). Water quality monitoring data from 2001 to 2006 as part of this plan indicated that total nitrogen and nitrate concentrations were elevated in several streams. The plan's primary goal was to maintain stream health through policy recommendations that address land use, stormwater management, and public education. It emphasized balancing environmental protection with economic vitality. The plan recommended strategies to prevent floodplain development, protect karst recharge areas, promote low-impact development (LID), and ensure the equitable implementation of best management practices (BMPs) The plan also encouraged zoning reforms, economic incentives, and public outreach to support sustainable growth. Special attention was given to preserving agricultural.

viability, enhancing parks and green spaces, and mitigating the downstream impacts of urbanization. Overall, the plan reflected a collaborative vision for a watershed that supports both environmental integrity and community prosperity through 2030. The plan was ratified by the County, the City of Columbia, and the City of Ashland.

### 1.5.2 Technical Advisory Team Efforts

The 2007 Bonne Femme Watershed Plan implementation was largely dormant until 2015. The County initiated the formation of the Technical Advisory Team (TAT) in late 2015 to advance the implementation of the 2007 plan. The TAT consisted of representatives from local government, state and federal agencies, nongovernmental organizations, and local landowner partners.

The TAT recommended water quality monitoring to assess changes in GBFW streams since the earlier data collection efforts. Quarterly water quality monitoring was conducted at 10 sites from late 2016 through 2019, and the results were compared to water quality data from 2003 to 2007 that was collected as part of the 2007 plan. The comparison showed minor changes in levels for E. coli, nutrients, and herbicides from 2003 to 2007 to 2016 to 2019. Reported E. coli levels from 2016 to 2019 exceeded water quality standards at multiple sites, with a statistically significant increase observed at one site compared to 2003 to 2007 data. Microbial source tracking studies conducted from 2016 to 2019 indicated that elevated E. coli levels were associated with the genetic markers for humans, cattle, and ruminants. Nutrient levels, particularly nitrate and phosphate, remained low at most sites but were elevated in agriculturally intensive areas like Devils Icebox Cave Branch (agriculture in the recharge area, see Figure 1) and Upper Bonne Femme Creek.

The TAT also recommended the development of the USEPA's nine-element watershed plan to guide future implementation efforts for improving water quality in the GBFW.

### 1.5.3 2023 Bonne Femme Nine-Element Watershed-Based Plan

Boone County Resource Management and their Project Partners developed a nine-element watershed-based plan (WBP) with financial assistance from a Missouri Section 319 Nonpoint Source grant (Boone County Resource Management and Project Partners 2023).

The WBP incorporated the United States Environmental Protection Agency's (USEPA's) nine critical planning elements and emphasized adaptive management, stakeholder engagement, and integrating WBP elements into the existing Municipal Separate Storm Sewer System (MS4) permit [2] to address the E. coli impairments in GBFW streams (restoration goal) and reduce nutrient and sediment loading (protection goal). Based on the microbial source tracking data, the WBP identified cattle as the primary source of E. coli and recommended implementation of agricultural BMPs, such as livestock exclusion, increased vegetation on agricultural lands, and grazing management. Increased vegetation on the landscape slows down stormwater runoff, allowing more infiltration and treatment of pollutants by soil microbes. Implementation of the recommended BMPs was structured over a 21-year timeline in three phases (30%, 60%, and 90% BMP adoption), with estimated costs exceeding $1.2 million. It also recommended quarterly monitoring at seven sites to assess the recommended BMP effectiveness and guide adaptive management strategies. Public outreach, education, and stakeholder involvement were identified as being crucial to the plan's implementation, aiming to foster a culture of watershed stewardship across diverse community groups.

[2] The MS4 permit in the watershed is held jointly by Boone County, the City of Columbia, and the University of Missouri

The WBP recommendations will be integrated into the Boone County, City of Columbia, and University of Missouri MS4 permit through incorporation into all six Minimum Control Measures (MCMs) required by the permit. The MS4 Stormwater Management Plan (SWMP) will be updated to reflect actions taken under the WBP, and annual MS4 reports will track progress on implementation milestones. Projects for WBP implementation funded through the MDNR 319 Program will supplement, not replace, MS4 permit requirements. The WBP was approved by USEPA on June 12, 2023, for both future Section 319 funding and as an alternative restoration plan in place of total maximum daily loads (TMDLs) for a period of five years.

After USEPA approval of the WBP, the County and Project Partners realized that it was unlikely that the recommended agricultural BMPs would be implemented/adopted at the rate necessary to achieve the water quality goals of the WBP. Based upon this realization, the County and project partners launched the Greater Bonne Femme Watershed Initiative (the Initiative), which is described in Section 2. The County and project partners will continue to implement the WBP as a part of the Initiative.

## 1.6 Plan Development Process

The County and Project Partners established the Initiative with the goal of creating a watershed management plan (WMP) that will ultimately be adopted by the County and the cities of Columbia and Ashland. The Implementation Committee and several subcommittees consisting of state and local agencies and private entities were formed under the Initiative. The subcommittees formed are for agricultural BMPs, monitoring, outreach and communication, wildlife habitat restoration and water quality connections (https://www.cavewatershed.org/committees.asp). There is also a planning subcommittee which explores integrating watershed management goals with local policy. The Implementation Committee identified the four pillars shown in Exhibit 2 for incorporation into the WMP. These four pillars are described in **Section 3**.


**Exhibit 5: Four pillars for incorporation into the WMP**

The County hired a project team (called the WMP team), which consists of Geosyntec Consultants Inc. (Geosyntec, principal consultant) and Biohabitats Inc. (Biohabitats) to develop the WMP. The WMP team collaborated closely with the Implementation Committee and subcommittees on each of the four pillars. Geosyntec was also commissioned by the County to develop a return on environment (ROE) study, aimed at identifying and assessing the environmental, societal, and economic benefits of water resources and ecosystems within the GBFW and assigning a dollar value to those benefits (Geosyntec 2025). The findings of the ROE study and its importance to the WMP are outlined in Section 2. Section 3 of this plan provides a description of each pillar and how each connects to the WMP. Additionally, the WMP team undertook extensive stakeholder engagement efforts (detailed in Section 3). Lastly, Section 5 of the report describes the recommended actions for the WMP based on the four pillars.


## 2. RETURN ON ENVIRONMENT STUDY

The County initiated a Return on Environment (ROE) study (Geosyntec, 2025) under WMP Pillar 3 Outreach and Communication. The purpose of the ROE study was to identify and measure the environmental, societal, and economic benefits of natural resources within GBFW. The ROE study did not intend to replace the intrinsic, non-monetary values associated with natural resources. Instead, its purpose was to bridge the connection between nature and the community's quality of life and well-being by translating the substantial benefits provided by natural resources in GBFW into universally understood terms—specifically, monetary values for ecosystem services. This approach helps make the importance of conservation more accessible and compelling to a broader audience, supporting informed decision-making and community engagement for WMP implementation.

The ROE study identified five benefit categories for review: direct use, indirect environmental benefits, economic activity, property value impacts, and community cost savings. These benefit categories were quantitatively evaluated using a variety of tools and techniques and a range of data pertinent to the GBFW and the surrounding cities, towns and residents. The estimated benefits value for each of these categories is provided below, followed by a brief description of each of the categories. This section ends with prioritized recommendations from ROE study to inform the WMP.

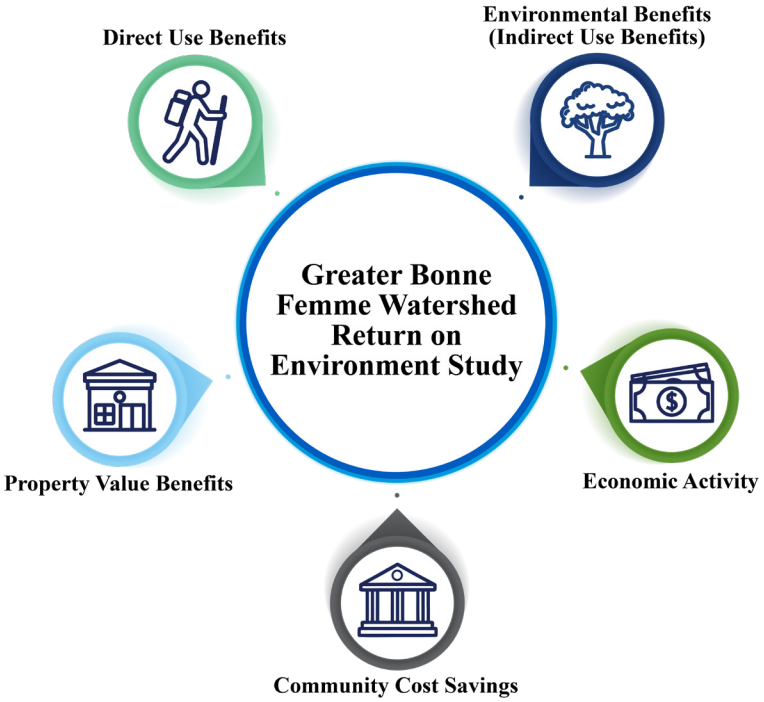



**Exhibit 6: Conceptual Overview of Return on Environment Study Benefit Categories**

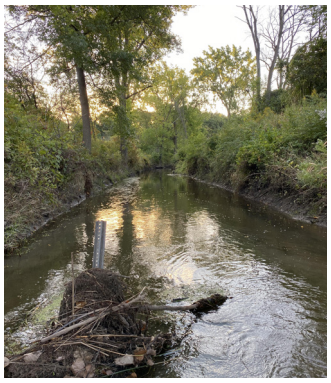
**The ROE study found the current value of ecosystem services across the five categories—direct use, indirect environmental benefits, economic activity, property value, and community cost savings—to be:**

| | |
|---|---|
| $363M to $548M | in annual recreation benefits |
| $460M to $1B+ | in avoided healthcare and workplace costs (e.g., physical activity related to recreation) |
| $765M | in prevented flood damage via stormwater retention |
| $11M | of annual economic tourism spending supported by activities in the GBFW |
| $2M | in annual tax revenues captured by tourism-related spending |
| $100M+ jobs | supported by tourism-related activities in the watershed |
| $23,000 - 30,000 | in added property value for structures located near open spaces |

## 2.1 Direct Use Benefits

The ROE study quantified the direct benefits of recreating in the GBFW, and the costs avoided from related physical activity. Recreational activities such as hiking, fishing, and wildlife viewing generate an estimated $363 million to $548 million annually. Additionally, physical activity associated with these activities provides significant health and economic advantages, including $197 million to $620 million in avoided healthcare costs, $261 million to $510 million in productivity gains, and $2 million to $16 million in workers' compensation savings each year. These results show that free access to forests, trails, and open space is a major community asset—not only in quality-of-life terms but also in reduced healthcare burden and improved workforce outcomes.

## 2.2 Environmental Benefits



Environmental benefits, or indirect benefits, further demonstrate the economic value of conservation practices in GBFW. Implementing best management practices (BMPs) such as cover crops and riparian buffers can prevent nutrient and sediment pollution, resulting in $4,000 to $5 million in annual nutrient removal cost savings and $38,000 to $2 million in sediment-related savings. Natural infrastructure also provides critical flood protection, retaining approximately 32% of runoff during a 100-year storm event and avoiding an estimated $765 million in maximum potential damages. Additional benefits include reducing pesticide-related risks, valued at $364,000 to $884,000 annually, and improving water quality to support recreation and public health.

## 2.3 Economic Activity Benefits

The GBFW's natural capital drives local spending, jobs, and tax receipts linked to outdoor recreation and tourism. The ROE study estimates roughly $11 million in total annual economic activity, supporting 100+ jobs (≈139) across hospitality, retail, recreation services, and supply chains, and generating approximately $2 million in combined federal, state, and local tax revenues each year. Beyond these quantified effects, high-quality open space strengthens business and talent attraction by enhancing quality of life, which can compound benefits over time through employer retention, workforce productivity, and place branding.

## 2.4 Property Value Benefits

Proximity to open space in the GBFW confers a measurable, one-time premium on homes, reflecting both market desirability and the lifestyle value of access to trails, parks, and conserved landscapes. Based on the ROE analysis and regional housing data, most properties adjacent to open space realize an estimated $23,000–$30,000 increase in value, with higher-value homes capturing proportionally larger premiums. While not an annual flow like recreation or health savings, this equity gain strengthens household balance sheets, improves resale outcomes, and can expand borrowing capacity—reinforcing that conservation investments yield private as well as public benefits.

## 2.5 Community Cost Savings

Cost of Community Services (COCS) findings indicate that land-use mix materially affects local fiscal stability. On average, residential land uses require $1.02–$1.67 in public services for every $1 of revenue, whereas commercial/industrial land uses typically require $0.17–$1.04, and working/open lands require $0.05–$0.77 per $1 of revenue. These ratios underscore that maintaining and restoring open lands, while balancing targeted commercial activity, can help offset the structural service demands of residential growth, reduce pressure on municipal budgets, and sustain the tax base—making conservation and strategic development complements rather than competitors.

## 2.6 Recommendations from ROE

These ROE findings demonstrate the economic relevance of conserving and restoring natural resources in the GBFW for community well-being and long-term stability. The ROE study included stakeholder engagement through a public survey and focus group discussions. This process provided opportunities for community education and the involvement of community members as supporters.

The ROE findings together with stakeholder feedback were used to develop three priority recommendations for the WMP:

- Restore wildlife habitat and advocate for water quality connections
- Improve water quality, implement BMPs, and conduct education and outreach
- Pursue efforts related to long-term water quality goals and conduct community engagement and encourage participation

# GREATER BONNE FEMME WATERSHED INITIATIVE

## 3. GREATER BONNE FEMME WATERSHED INITIATIVE

The Initiative takes a broad approach to restoration and protection of water quality in the GBFW. This effort includes implementation of the current WBP and extends beyond the WBP to a larger social and environmental context.

*The Greater Bonne Watershed Initiative formed partnerships for restoring and protecting water quality, incorporating both social and environmental contexts.*

The Initiative has greatly expanded the community of potential stakeholders and the opportunities for restoration and protection of streams in the GBFW by adding several pillars to the initial WBP approach (**Figure 3**). The Initiative partners are provided in Appendix A. Central to the Initiative is the concept of partnerships, which connects the four pillars and encourages collaboration among different stakeholder groups and subcommittees of the Initiative.

These four pillars include:

- Pillar 1: Implementation of the Watershed Based Plan (WBP)
- Pillar 2: Watershed-wide Wildlife Habitat Restoration Project
- Pillar 3: Outreach and Communication (O&C)
- Pillar 4: Water Quality Connections

The four pillars are described in further detail below.

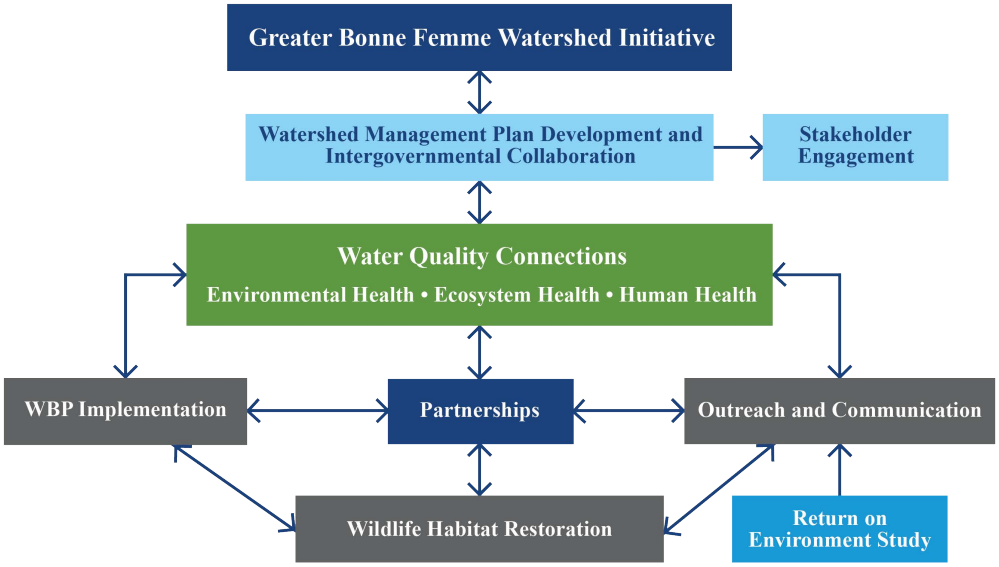



**Figure 3: Framework for the Greater Bonne Femme Watershed Initiative**

## 3.1 Pillar 1: Implementation of the WBP

The objectives of Pillar 1 (Implementation of the WBP) are to promote and encourage agricultural landowners to voluntarily install Best Management Practices (BMPs), such as cover crops, in the watershed and to install BMP demonstration projects. These BMPs will increase the amount of native vegetation cover on the ground to help slow, spread, and infiltrate stormwater runoff, resulting in reduced pollution and improved water quality in GBFW streams. Demonstration projects will also allow stakeholders, the public, and other agricultural landowners to view the BMPs in action.

The County was awarded an implementation grant by the United States Environmental Protection Agency and the Missouri Department of Natural Resources on March 13, 2026. The grant period is from April 1, 2026, to March 31, 2029. The implementation approach aims to encourage the adoption of approved BMPs by agricultural landowners throughout the GBFW. The implementation approach includes outreach and communication to agricultural landowners, supplemental funding for cost-share practices, a demonstration project at South Farm, and water quality and soil health monitoring. These four components are described briefly below.

### 3.1.1 Outreach and Communication

Several events and activities are planned to distribute information and encourage adoption of the agricultural BMPs. These include Creek Week, a week of water-themed activities leading up to the Water Festival, scavenger hunts for children, and land management workshops. The workshops will feature presentations from local agricultural landowners discussing their experiences with BMPs. Additionally, the County will launch an on-site wastewater incentive program in early 2026, which will provide training and financial incentives for proper maintenance of on-site wastewater systems.

### 3.1.2 Supplemental Funding for Cost-Share Practices

The implementation grant includes funding to support a cost-share incentive program as a part of the implementation approach. This program will be available to agricultural landowners-or operators in the case of cover crops-within the GBFW who are approved for cost share by the Missouri Department of Conservation or the Boone County Soil and Water District. The incentive will provide funding that exceeds standard cost-share percentages, covering up to 90 percent of the total cost for BMPs. For riparian corridor enhancement and restoration projects, which are considered the most effective methods for improving water quality in GBFW streams, the program may cover up to 100 percent of BMP costs. The maximum incentive per parcel is determined by the anticipated benefit of the BMP to overall water quality.

The County will work with project partners, including Missouri Department of Conservation (MDC) and Boone County Soil and Water Conservation District (BCSWCD), to enhance outreach and engage the agricultural community to increase awareness among agricultural landowners (and/or operator if the landowner is not local) about the availability of cost-share programs for implementation of approved BMPs. The increased awareness is anticipated to lead to voluntary adoption of BMPs approved under the WBP or any subsequent updates to the WBP.

### 3.1.3 Demonstration Project at South Farm

The County has partnered with the University of Missouri to design and implement a comprehensive demonstration project at South Farm's Beef Research and Teaching Farm showcasing various BMPs recommended in the WBP (Appendix B). The location of the demonstration project is shown in **Figure 2**. The selected BMPs are as follows:

- Pollinator habitat strip
- Warm-season native grasses plot
- Edible hedgerow
- Retention basin upgrade
- Riparian corridor restoration

These practices aim to stabilize erosion areas and encourage the establishment of native species, resulting in improved water quality. The estimated annual reduction in pollutant load due to the demonstration project is 112 pounds of total nitrogen, 22 pounds of total phosphorus, and 12 pounds of TSS. These BMPs will also reduce E. coli loading into Gans Creek, although the reduction could not be quantified based on existing data.

**Exhibit 7:**
**Picture of Pollinator Habitat Strip**

The project will also include monitoring water quality at locations upstream and downstream of the demonstration site (**Figure 2**). The demonstration project is designed to increase participation and engagement among agricultural landowners, with success measured by farm day event attendance, feedback, and surveys as well as water quality and soil health benefits.

### 3.1.4 Water Quality and Soil Health Monitoring

In 2025, the County began conducting monthly sampling at eight sites in the GBFW recreation season from April 1 to October 31 to re-establish a baseline for water quality in the GBFW streams. The locations of monitoring stations are shown in Figure 2. During the grant cycle, a quality assurance project plan will be developed to ensure the data meet MDNR standards. The samples are being analyzed for key parameters such as E. coli, total nitrogen, total phosphorus, and TSS. Soil health parameters will also be monitored at 10 sites within the footprint of the warm-season native grasses plot at the South Farm, aiming to demonstrate soil health benefits and encourage adoption of approved BMPs. The soil health parameters include organic matter, water holding capacity and soil microbial diversity and activity, which relate to climate resilience and improved production. Ultimately, pollutant load reductions from BMP installation will be monitored and reported, although it could take time for these benefits to fully establish.

## 3.2 Pillar 2: Creation of a Watershed-wide Wildlife Habitat Restoration Project

This objective of Pillar 2 (Watershed-wide Wildlife Habitat Restoration Project) is to provide a framework to guide landowners in the watershed to improve wildlife habitat on their property. Therefore, this pillar is intended to be a resource for landowners and Project Partners as well as decision-makers and practitioners. The wildlife restoration plan includes key concepts, spatial priorities, and technical resources for habitat restoration. Wildlife habitat restoration is anticipated to have water quality benefits similar to the installation of agricultural BMPs as it aims to restore native vegetation on the landscape, reduce erosion, and promote soil health. The Project Team worked with the Wildlife Habitat Restoration Subcommittee consisting of land managers and conservationists to develop the wildlife habitat restoration plan. The Wildlife Habitat Restoration Plan is included in Appendix C and is summarized further below.

### 3.2.1 Development of Wildlife Habitat Restoration Plan

Using a lens of habitat restoration in a watershed means shifting from a purely water quality perspective to one that prioritizes the needs of wildlife, especially habitat connectivity, food, and shelter. The major habitat types in the GBFW are headwater prairie and meadow, rolling hills and karst transitional, and bottomland woodlands and floodplain. Large contiguous plots of land were prioritized, as the larger the area of contiguous habitat, the more species that habitat can support. Accordingly, the plan was developed based on three principles: minimizing fragmentation, habitat enhancement, and removing barriers to reconnect functional habitat areas. Water quality improvements are expected as a result of restoring wildlife habitat in the GBFW.

Opportunities for each of these approaches were identified through geographic information system (GIS) spatial analysis that prioritized opportunity areas for prairie restoration, wetland/floodplain restoration, and stream buffer restoration (of shrubs or trees). Areas that reflect the highest priorities for each approach are shown in **Figure 4**.

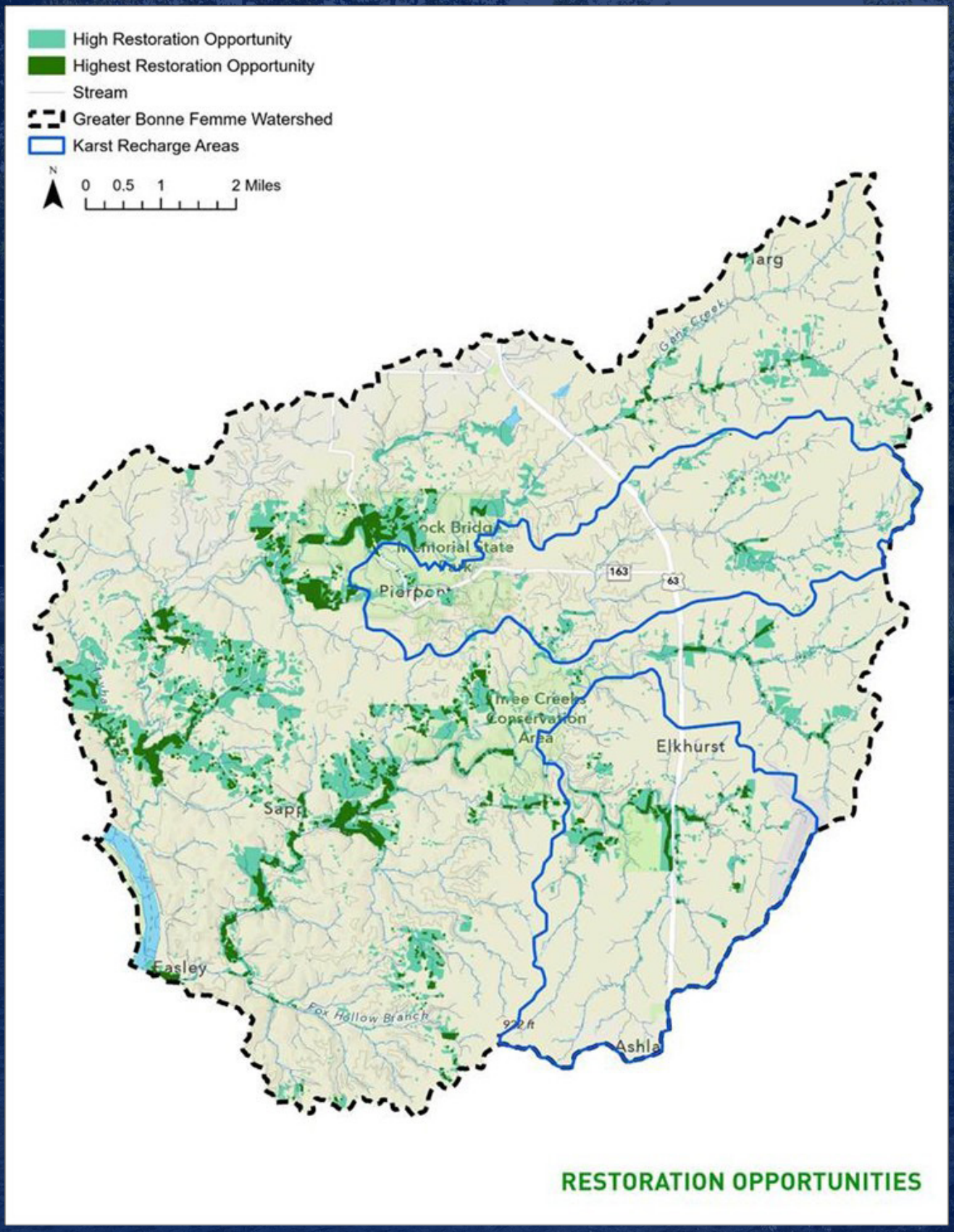



**Figure 4: Identified Wildlife Habitat Restoration Opportunities**

### 3.2.2 Implementation of Wildlife Habitat Restoration Plan

Implementing the wildlife restoration plan will require data and monitoring, internal planning, development of conservation policies, and restoration projects that may be funded by cost-share programs. A summary of recommendations is provided below.

- Citizen science and improved wildlife mapping should be used to understand the presence and distribution of wildlife, particularly with regard to indicator species (see Table 2 for identified indicator species in watershed).
- The County, the City of Columbia, and the City of Ashland should create and maintain a map of ecologically sensitive areas for prioritization of habitat protection and restoration, even if these areas are not regulated in any special way. Waterway systems, such as riparian buffers, wetlands, and floodplains, as well as habitat connectivity considerations, should be used to target outreach. Through outreach and communication, the goal is to inform future land use, land management, and project planning decisions.
- If code revisions are considered, the Initiative partners may find valuable resources at the Sustainable Development Code website. Example resources include Design Standards for Wildlife, Ordinance-Enabled Conservation Tools, Buffer Regulations for Wildlife Habitat, Vegetation Protection Areas along Stream Corridors, and Stormwater Green Infrastructure.
- Partnerships and private landowner incentives include several cost-share opportunities that can assist landowners with incorporating restoration strategies into their land management. These opportunities are described in Appendix C.

**Table 2: Greater Bonne Femme Watershed Candidate Indicator Species**

| Habitat Area[1] | Bird Indicator Species | Mammal Indicator Species |
|---|---|---|
| Headwater Prairie and Meadow | Dickcissel | Red Fox |
| Rolling Hills and Karst Transitional | Coopers Hawk | American Mink |
| Bottomland Woodlands and Floodplain | Long-legged Waders Such as Heron | River Otter |

[1]See Figure 3 of Appendix C for a map of habitat areas in the GBFW

[3] https://sustainablecitycode.org/about

## 3.3 Pillar 3: Outreach and Communication

The objective of Pillar 3 of the Initiative (Outreach and Communication; O&C) is to develop a public information and marketing strategy that increases awareness about watershed and water quality issues and strengthens stakeholders' understanding of the connection between land use activities and water quality. This pillar also aims to encourage the implementation of BMPs to protect and improve water quality in the GBFW. The O&C program should effectively convey information regarding current and potential water quality issues and benefits of watershed restoration and should generally market the Initiative as a whole.

An O&C Plan was developed in 2024 that outlines a public information and marketing strategy, primary implementation parties, and key project partners (Appendix D). As part of O&C Plan development, quarterly meetings were held with the County, Implementation Committee, and an O&C subcommittee to discuss plan implementation and obtain feedback.

The O&C Plan consists of six key steps with corresponding action items:

1. Identify Target Audiences
2. Develop O&C Programs for Each Audience
3. Implement O&C Programs for Each Audience
4. Develop Methods/Metrics for Gauging Plan Efficacy
5. Evaluate Plan Efficacy
6. Grow and Improve Programs via Adaptive Management Framework


**Exhibit 8:**
**GBFW Outreach & Communication Plan**

The first step of any effective O&C program is identifying a target audience and the desired goals or outcomes of the program on that audience. The Initiative has identified six audiences for targeted program efforts that include row crop agricultural producers, livestock producers, homeowners/developers/homeowners associations, the general public (children and adults), and watershed visitors. The next steps will include developing appropriate programs for each audience, such as community events, education materials, incentive programs, and media as well as implementing and distributing programs to engage with the public. For the remaining steps, an adaptive management framework will be used to develop methods/metrics for gauging plan efficacy in meeting goals and outcomes for target audiences, and then the programs will be evaluated and maintained, improved, or discontinued according to the results of the evaluation.

A comprehensive list of programs, action items, and other details are provided in Appendix D, and event statistics for major events and milestones related to O&C are provided in Section 4. In addition, the importance of a structured and well implemented O&C program is further supported by the findings of the Initiative's Return on Environment (ROE) study, which valuated ecosystem services and natural

resources in economic terms (Geosyntec 2025). A major finding of the ROE study was that residents of the GBFW accrue substantial environmental, societal, and economic benefit from the ecosystem in the GBFW across multiple benefit categories. The continued O&C efforts will keep protection of water quality and these ecosystem services a priority for the duration of the Initiative.

## 3.4 Pillar 4: Water Quality Connections

The objective of Pillar 4 (Water Quality Connections) is to highlight how water quality links human, environmental, and ecosystem health within the GBFW. Improved water quality is vital for maintaining the balance among these interrelated components.

*Human Health*: Clean water protects public health during contact recreation and everyday use, lowering exposure to pathogens and contaminants and enabling safe, meaningful time outdoors. In the GBFW, fewer high-bacteria days would translate to more reliable access to creeks and greenways, with associated mental- and physical-health benefits. Conversely, degraded water quality can increase illness risk, reduce outdoor activity, and create avoid-use advisories in lakes and streams that diminish quality of life.

*Environmental Health*: Watershed water quality reflects the condition of soils, vegetation, and land stewardship. Practices that build soil structure and increase infiltration (e.g., native plantings, cover crops, reduced tillage) reduce stormwater runoff and pollutant delivery, buffering droughts and floods and improving stream baseflow. In the GBFW, promoting locally adapted, regeneratively grown food would support soil and water resilience while lowering transport of bacteria and nutrients to streams, improving water quality.

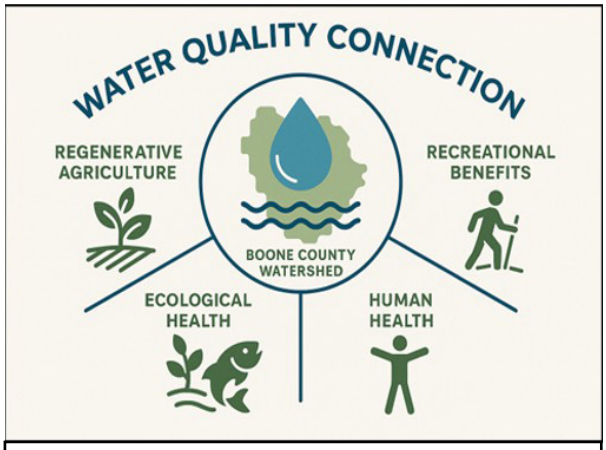



**Exhibit 9: Water Quality Connections**

*Ecosystem Health*: Habitat quality for aquatic and riparian communities depends on water quality in GBFW streams. Reduced pathogens, nutrients, and sediment improve conditions for native fish, amphibians, and plants, while connected, vegetated riparian corridors limit stream heating and provide refuge. In the GBFW, integrated habitat actions (riparian buffers, exclusion from sensitive reaches) work with pollutant reductions to restore ecological function.

**Exhibit 10: GBFW Charrette**

The development of this pillar was informed by a brainstorming charrette. A charette is a tool commonly used in the design world to elicit innovative design approaches. The goal of the GBFW charrette was to bring about ideas from the community on their water quality goals, how to achieve these goals by promoting interactions, and then develop action items to achieve these goals. Geosyntec organized the community-based charrette with support from the County staff on the evening of December 9, 2024, at the Boone County Electric Building in Columbia, Missouri. The charrette participants were divided into two groups, and each group discussed the three (human, environmental, and ecological)

connection topics, yielding discussion and notes from six sessions. The charrette agenda and discussions from the six sessions is included in Appendix E.

The goals for enhancing water quality connections are as follows:

- Improve water quality for recreational uses
- Improve landscape connectivity and recreation
- Improve landscape function to reduce flood mitigation
- Promote environmental and ecological education
- Promote ethics and personal accountability
- Promote connections between urban and rural citizens
- Promote connections between government and citizens

The actions for developing water quality connections to meet the identified goals were as follows:

- Develop wide-reaching environmental education
- Develop messaging to homeowners, landowners, and developers
- Promote conditions to limit environmental degradation
- Provide and/or increase awareness of financial incentives to promote a clean environment
- Develop regulations to guide development and reduce pollutant discharge
- Reduce fertilizer and chemical usage and promote use of regenerative practices for all land uses

> *"Seeking common ground for common good is just common sense."*
>
> *- Gabe Brown*

[4] A charrette differs from a survey in that it is an unscripted, bottom-up approach. The advantage of a charrette is to encourage out-of-the-box ideas and complement the more structured approach of a survey. The disadvantage of a charrette is that it only taps the knowledge and ideas of the attendees in the room, while a survey can potentially reach a larger audience, especially for people who have time constraints for participating in time limited events. The two approaches can complement each other and provide the best way to collect as many new ideas and approaches as possible.

# STAKEHOLDER ENGAGEMENT

## 4. STAKEHOLDER ENGAGEMENT

Effective watershed management relies on the active involvement of a diverse range of stakeholders, including local governments, community members, nonprofit organizations, and universities. These stakeholders contribute to the planning, implementation, and evaluation of watershed initiatives, ensuring that environmental, social, cultural, and economic dimensions are holistically addressed. Community members offer firsthand insights into local conditions and concerns, while nonprofits, universities, and local governments act as conveners, advocates, and technical resources. Through participatory mechanisms such as advisory committees, workshops, and stakeholder forums, engagement ensures that planning processes incorporate multiple perspectives, build consensus, and identify shared priorities. A list of stakeholders, target audiences, and key project partners for the WMP can be found in Appendix D.

### 4.1 Engagement Process

Engagement with stakeholders in the GBFW has been ongoing for decades and includes a variety of education, marketing, community events, and partnerships with local organizations to promote water quality protection. Since the adoption of the WBP in 2023, the following major events and milestones have occurred:

- Rock Bridge Memorial State Park Interpretive Program
- Water Quality Monitoring Blitzes in and around Rock Bridge Memorial State Park
- Annual Water Festival
- Booths at various events including the Columbia Area Earth Day Festival
- Water Quality Connections Charrette
- ROE Study GBFW Initiative Community Survey
- Development of On-Site Wastewater System Fact Sheets
- Annual Creek Week

In addition to the listed major events and milestones above, there have also been dozens of other smaller engagement events led by key project partners with a focus on conservation, agriculture, and water quality. The above underscore robust stakeholder engagement that was undertaken for the WMP.

**Exhibit 11:**
**GBFW Events Pictures**

## 4.2 Engagement Metrics

Between January 2023 and May of 2025, over 4,750 individuals have been engaged through community outreach and education events across nearly 20 programs (not all programs were tracked). A brief summary and engagement statistics for the major events and milestones listed in Section 3.1 are provided below.

**Rock Bridge Memorial State Park Interpretive Programs**: Rock Bridge Memorial State Park's interpretive programming focuses on the cave system, stream water quality, life in a pond, and ecosystems, and connects students to the park. The attendees numbered 1,227 in 2023, 910 in 2024, and 905 in 2025.

**Annual Water Festival**: Held at Rock Bridge Memorial State Park, the Annual Water Festival brings together local governments and nonprofit organizations to celebrate the natural resources of Boone County and Missouri. Guided cave tours, wildlife demonstrations, and interactive models were offered during the festival. The festival attendees numbered approximately 450 in 2023, 170 in 2024, and 250 in 2025.


**Exhibit 12:**
**2025 Annual Water Festival Flyer**

**Columbia Area Earth Day Festival**: The Earth Day Festival occurs every Earth Day to celebrate the national holiday and gives local governments, nonprofit organizations, and vendors an opportunity to promote sustainability. The festival included 260 interactions with the Boone County Stormwater booth in 2024 and 75 interactions in 2025.

**Water Quality Connections Charrette**: The community-based charrette was held for 2 hours on the evening of December 9, 2024, at the Boone Electric Building in order to solicit community feedback regarding natural resources concerns and priorities to guide the WMP. Twenty people participated in the charrette, and it was also televised on a local news station.

**ROE Study GBFW Initiative Community Survey**: The ROE Community Survey was open for 46 days in 2024 (October 17 to December 2) and was used to solicit community feedback regarding water quality knowledge, perception of watershed concerns, and personal habits and priorities related to natural resources over a total of 17 questions. A total of 190 responses were received for the ROE study survey.

**On-Site Wastewater System Fact Sheets**: The County developed the On-Site Wastewater System Fact Sheets to help homeowners operate and maintain common home wastewater systems, such as septic, drip dispersal, lagoons, constructed wetlands, and others. The fact sheets are available on the Boone County Government website (www.boonemo.gov).

**Annual Creek Week**: In 2025, the inaugural Annual Creek Week was held in the GBFW region, convening diverse stakeholder groups to participate in a series of coordinated activities aimed at benefiting the community. The events of the 2025 Creek Week included a litter clean-up at Nifong Park (Monday), a fishing night at Boone County Nature School (Tuesday), a native plant exhibit at Southern Boone County Public Library (Wednesday), a movie night and panel discussion at Ragtag Cinema (Thursday), a sunset watershed hike at Three Creeks Conservation area (Friday) and concluded with the annual Water Festival (Saturday). The event was highlighted in a local news article.

*"Creek Week is a series of really fun events aimed at raising awareness of the Greater Bonne Femme Watershed. We want to raise awareness of the watershed and all of the exceptional recreational activities that are out there."*

*- Boone County Stormwater Coordinator Nicki Rinehart*

# WMP RECOMMENDATIONS

## 5. WMP RECOMMENDATIONS

This section provides recommendations for addressing GBFW issues that have been developed through stakeholder input, public workshops and surveys, and input from the Implementation Committee and other subcommittees. The recommendations for this WMP have been organized primarily by implementation type (outreach and communication, work on the ground, monitoring, and data management) and further associated with the relevant pillar(s) of the WMP or ROE study using the legend below.

**Pillar 1: Implementation of Watershed Based Plan**

**Pillar 2: Wildlife Habitat Restoration Plan**

**Pillar 3: Outreach and Communication Plan**

**Pillar 4: Water Quality Connections**

**Return on Environment Study**

### 5.1 Outreach & Communication

A significant number of the recommendations outlined in this Watershed Management Plan emphasize ongoing engagement with the community, project partners, and stakeholders throughout the watershed. These efforts aim to enhance the visibility of the GBFWI and to strengthen stewardship practices related to natural resources. These include development and implementation of new resources and events, promotion of existing resources and events, and encouragement of healthy watershed practices, including but not limited to:

| Recommendation Description | Pillar 1 | Pillar 2 | Pillar 3 | Pillar 4 | ROE |
|---|---|---|---|---|---|
| Develop incentive programs, digital media, and a database of O&C distribution outlets specific to each O&C target audience. | | | ✓ | | |
| Develop and hold community events, BMP tours, & public meetings. | ✓ | | ✓ | | ✓ |

| Recommendation Description | Pillar 1 | Pillar 2 | Pillar 3 | Pillar 4 | ROE |
|---|---|---|---|---|---|
| Identify key partners for O&C activities and discuss opportunities for additional engagement and targeted outreach. | | | ● | | |
| Implement incentive programs, such as the Water Friendly Recognition Program and Onsite Wastewater Program, to drive adoption of BMPs. | ● | | | | ● |
| Promote and/or increase awareness of financial incentives for conservation and ecosystem projects. | | ● | | ● | ● |
| Encourage the use of native plantings in stormwater management areas to create a connected network of living infrastructure. | ● | ● | | | ● |
| Encourage creation of continuity of habitat in privately-owned landscapes to benefit wildlife. | | ● | | | |
| Encourage a reduction in fertilizer and pesticide use by residential landowners highlighting their impact through social media and flyers. | ● | | ● | ● | ● |
| Develop and distribute educational materials on agricultural BMPs. | ● | | | | |
| Encourage voluntary installation of agricultural BMPs by increasing awareness of availability of cost-share programs. | ● | ● | | | |
| Encourage regenerative agriculture practices that improve environmental and community health. | | | | ● | ● |
| Encourage the exclusion of cattle from streams to protect water quality. | ● | | | | ● |
| Encourage adoption of green infrastructure practices in new developments that can benefit wildlife. | | ● | | | |
| Promote conservation easements to help facilitate conservation practices. | ● | | | | ● |
| Encourage developers to implement environmentally friendly practices and support conservation subdivisions and transfer of development rights. | ● | | | | |
| Emphasize the connection between a healthy natural environment and mental and physical health using signage at recreational places. | | | | ● | ● |

## 5.2 Work on the Ground

Improvements to watershed health will also need to come from projects on the ground, implemented by the County, private landowners, farmers, project partners as well as the cooperation of visitors to the watershed. Through a combination of ecosystem restoration, residential landscape management shifts, and the cumulative effects of many small projects, soil and water quality should improve throughout the GBFWI and benefit people, the environment, and the economy. Recommendations for work on the ground include:

| Recommendation Description | Pillar 1 | Pillar 2 | Pillar 3 | Pillar 4 | ROE |
|---|---|---|---|---|---|
| Collaborate on projects to control invasive species. | | ● | | | |
| Establish or enhance riparian corridors to manage and protect waterways using the prioritization identified in Figure 8 of *Appendix C: Habitat Restoration Plan.* | ● | ● | | | ● |
| Enhance living infrastructure connectivity through areas developed for compatible species such as pollinators. | | ● | | | |
| Increase diversity of flowering native shrubs and forbs that support pollinators and maintain undisturbed nesting sites, such as brush and leaf piles. | | ● | | ● | |
| Improve aquatic connectivity through culvert retrofits, dam or tile drain removal, or bridge repair for wildlife passage. | | ● | | | |
| Protect pollinator habitat from insecticide and most herbicide applications. Consider policy changes to eliminate the use of non-specific herbicides such as glyphosate in open spaces. | | ● | | ● | |
| Recruit new landowners for demonstration projects. | ● | | ● | ● | ● |
| Restore wetland and floodplain along the banks of streams and rivers to stabilize banks, filter pollutants, and provide habitat for wildlife. Prioritization of wetland and floodplain restoration is provided in Figure 7 of *Appendix C: Wildlife Habitat Restoration Plan.* | ● | ● | | | ● |
| Restore prairie habitat within priority areas as designated in Figure 6 of *Appendix C: Wildlife Habitat Restoration Plan.* | | ● | | | |

## 5.3 Monitoring

To effectively gauge the efficacy of outreach and communication and work on the ground efforts in improving watershed health, ongoing monitoring of natural resources in the GBFW will be necessary. Recommendations for monitoring include:

| Recommendation Description | Pillar 1 | Pillar 2 | Pillar 3 | Pillar 4 | ROE |
|---|---|---|---|---|---|
| Conduct water quality monitoring to develop a baseline assessment and assess the impact of BMPs over time. | ● | ● | | | ● |
| Conduct soil health monitoring at demonstration projects sites to showcase improvements to landowners and general public. | ● | | | | ● |

## 5.4 Data Management

Lastly, data management is a critical component for implementing a successful WMP. By systematically organizing and analyzing data, Boone County can more accurately understand which catchments are improving, which need further intervention, and allowing for adaptive management over time. Recommendations for data management include:

| Recommendation Description | Pillar 1 | Pillar 2 | Pillar 3 | Pillar 4 | ROE |
|---|---|---|---|---|---|
| Develop an online dashboard to track voluntary adoption of BMPs and monitor water quality improvements over time to gauge effectiveness of BMP implementation. | ● | | | | |
| Create a master repository for information & events accessible to the public (cavewatershed.org page or other digital community engagement platform). | | | ● | | |
| Develop appropriate methods and metrics for gauging plan efficacy by goal type and target audience, as applicable. | | | ● | | |
| Evaluate O&C plan efficacy with desktop-based metrics (engagement surveys, marketing interactions, Appendix K of the WBP) and grow and improve with an adaptive management framework as needed. | | | | ● | |
| Improve wildlife mapping to understand the presence and distribution of wildlife. | | ● | | | |

# 6. REFERENCES

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