Muddy Bayou Watershed Plan
9 Key Element Plan
HUC 080302020403
MWS 9334
GY 22 Project Area
Version 0 (9/22/2022)

Element a: Identification of Causes and Sources of Impairment

The Muddy Bayou Watershed is located in the south-central portion of Quitman County and the northwestern part of Tallahatchie County in North Mississippi covering approximately 32,731 acres. From its headwaters east of Stover, Mississippi, Muddy Bayou meanders south from the northern areas of the watershed moving east along the boundary and finally draining into Opossum Bayou at the mouth of the watershed. The Muddy Bayou watershed (MWS 9334) is located in the Mississippi River Delta region within level III ecoregion (73) Mississippi Alluvial Plain and level IV (73b) Loess Plains. Most streams in the Muddy Bayou watershed are intermittent except for Muddy Bayou and several drainage canals. According to the 2019 National Land Cover Database (NLCD), the landuse within this watershed is comprised of approximately 76% cropland, 21% wetlands, and 3% other (water and urban) as depicted in Figure 1.

The water-use classification for all water bodies in this watershed, as established by *Regulations for Water Quality Criteria for Intrastate, Interstate, and Coastal Waters* (MDEQ, 2021)*, is Fish and Wildlife.* Waters with this classification are intended for fishing and propagation of fish, aquatic life, and wildlife. Waters that are classified as *Fish and Wildlife* should also be suitable for secondary contact recreation, which is defined as incidental contact with water including wading and occasional swimming.

While this watershed does not have an active listing on Mississippi's Section 303(d) List of Impaired Streams, Muddy Bayou serves as the mainstem drainage for the watershed which ultimately empties directly into Opossum Bayou. Opossum Bayou (MS TMDL segment MS269E) located east of Sumner, Mississippi was originally included as an "evaluated" assessment in Mississippi's Section 303(d) List in 1998. Assessments designated as "evaluated" were performed using anecdotal data and information from the watershed, but there was no actual monitoring data to support the determination. Based on the evaluated information provided, the entire Opossum Bayou watershed was listed as being impacted for a suite of causes: pesticides, nutrients, siltation, organic enrichment/low dissolved oxygen and pathogens. As such, Muddy Bayou is a contributing source to the nutrient and sediment TMDLs that have been developed for Opossum Bayou (MS269E).

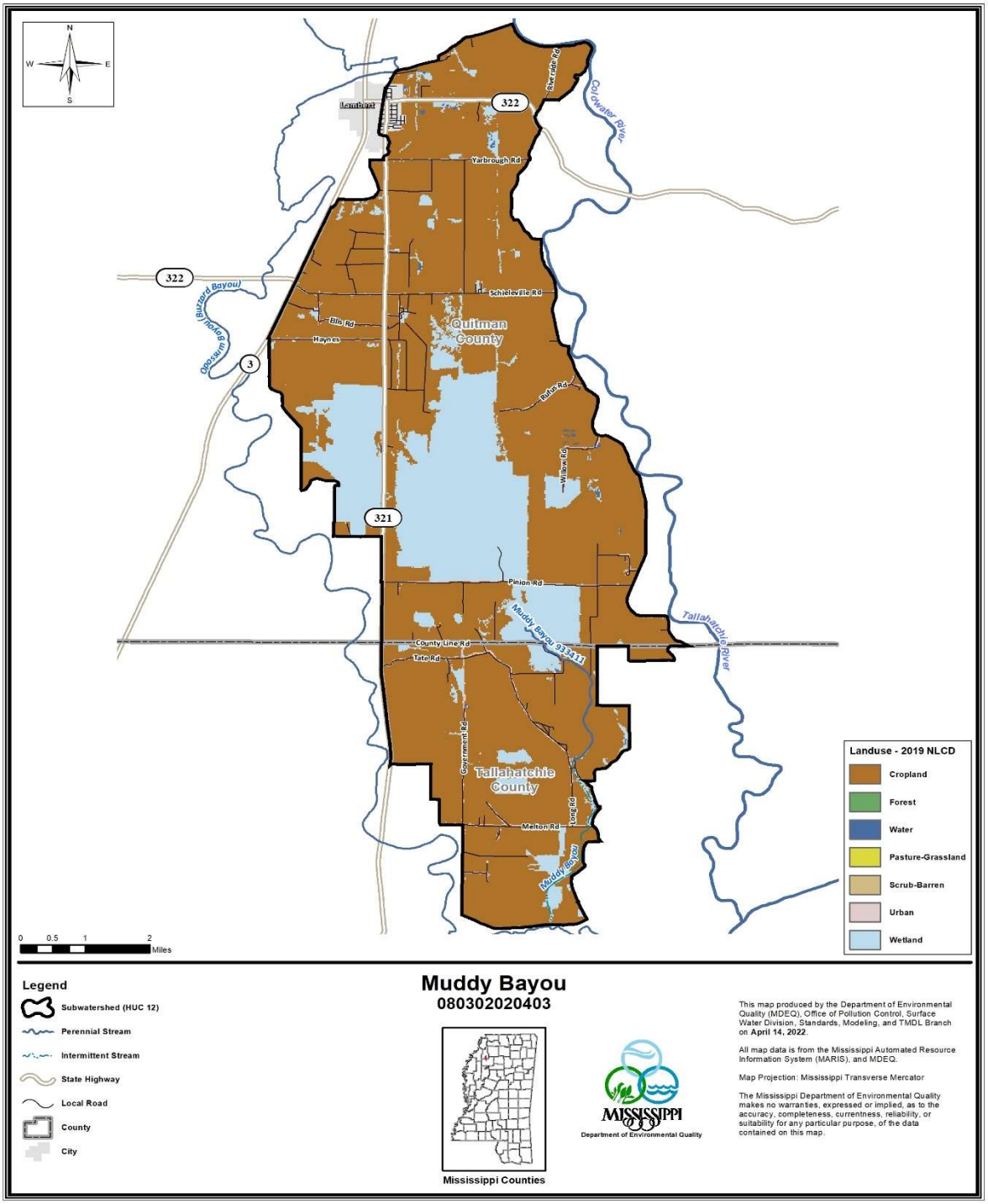

Figure 1: Landuse Distribution in the Muddy Bayou Watershed

Opossum Bayou (MS269E) is included in the regional sediment TMDL that was developed for the Yazoo River Basin: *Total Maximum Daily Load Yazoo River Basin Delta Region for the Delta Region* in 2008. There are only two facilities in the Muddy Bayou Watershed with

NPDES permits that include limits for Total Suspended Solids (TSS) which is used as an indicator of sediment contributions from permitted activities. These are the town of Lambert POTW and the Quitman County Correctional Facility located in the very upper part of the Muddy Bayou watershed. However, these two facilities are considered minor as these sources provide negligible loadings of suspended solids to the receiving waters compared to wet weather sources (e.g., NPDES regulated construction activities and nonpoint sources). Also, the TSS component of a NPDES permitted facility is different from the pollutant addressed within that sediment TMDL. The pollutant of concern for that TMDL is sediment from landuse runoff and in-channel processes. Certain contaminants may be associated with sediment such as pesticides and nutrients. These contaminants were not addressed directly within the sediment TMDL. However, these contaminants would also be controlled by the same best management practices (BMPs) that control the sediment from nonpoint sources of pollution. The TMDL calls for an 80-84% reduction in sediment. Nonpoint loading of sediment in a water body results from the transport of material into receiving waters by the processes of mass wasting, head cutting, gullying, and sheet and rill erosion. Sources of sediment include agriculture, silviculture, rangeland, construction sites, roads, urban areas, mass wasting areas, gullies, surface mining, in-channel and instream sources, and historical land use activities and channel alterations.

Opossum Bayou (MS269E) has an additional TMDL for nutrients: *Total Maximum Daily Load Total Nitrogen and Total Phosphorus for Opossum Bayou* (MDEQ, 2008). Mississippi does not have water quality standards for allowable nutrient concentrations. MDEQ currently has a Nutrient Task Force (NTF) working on the development of criteria for nutrients. The TMDL identified an annual concentration of 1.06 mg/l as an applicable target for Total Nitrogen (TN) and 0.16 mg/l for Total Phosphorus (TP) for water bodies located in the west side of the Delta Region in the Yazoo Basin. This TMDL calls for TP to be reduced by 84.7% and TN to be reduced by 94.4%. Non-point loading of nutrients and organic material in a water body results from the transport of the pollutants into receiving waters by overland surface runoff, groundwater infiltration, and atmospheric deposition. Unlike nitrogen, phosphorus is primarily transported in surface runoff when it has been sorbed by eroding sediment. These contaminants would also be controlled by the same best management practices (BMPs) that control the sediment from nonpoint sources of pollution.

Figure 2 shows the location of the impaired segment along with the water quality monitoring location in the Muddy Bayou Watershed.

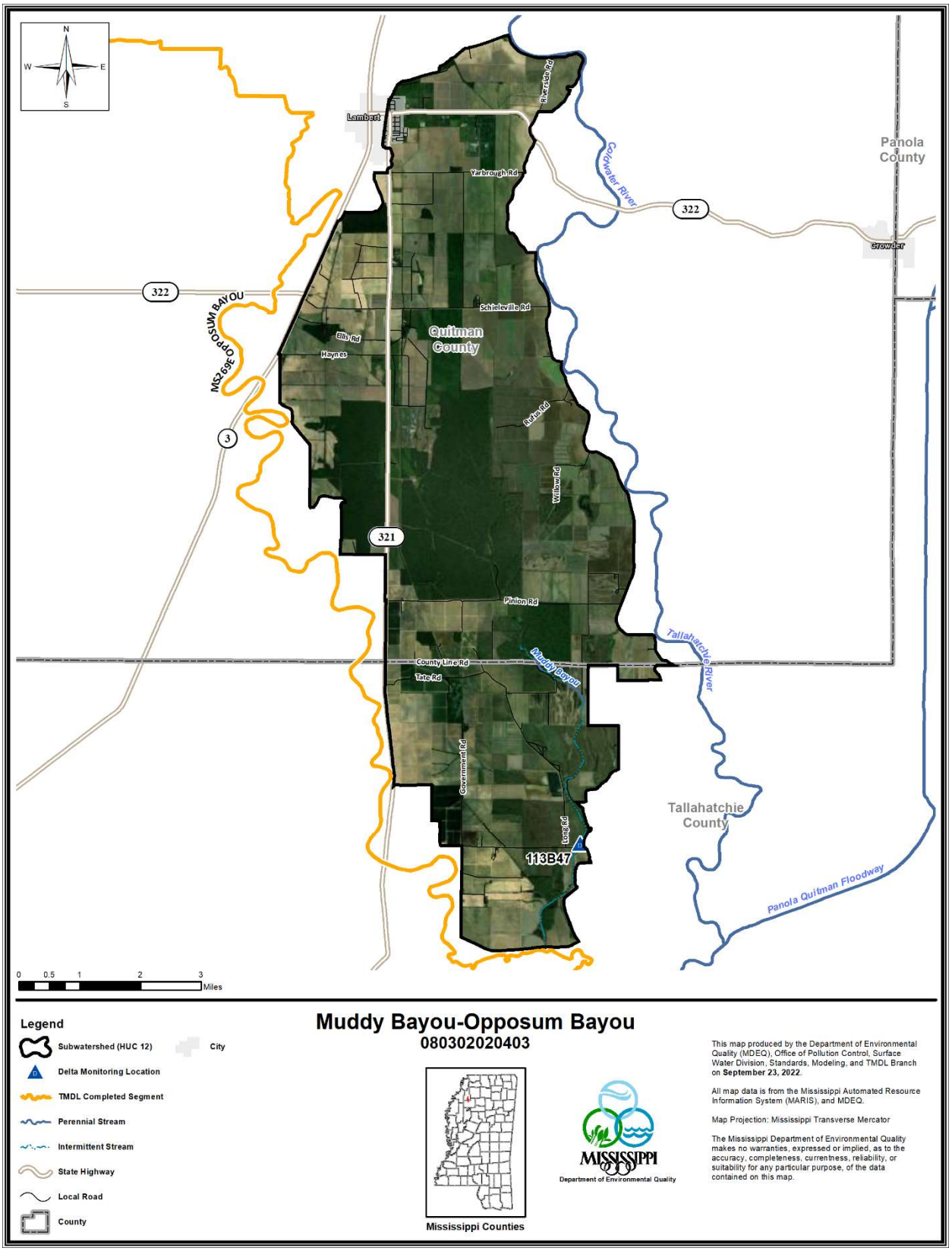

Figure 2: Muddy Bayou Watershed Monitoring Location and Opossum Bayou Segment MS269E

Element b: Expected Load Reduction

The MDEQ will work with agency resource partners to identify and implement BMPs to address pathogen and sediment concerns in the Muddy Bayou Watershed. Conservation practices that address sediment often provide an additional benefit in the reduction of nutrients as they attach to sediment particles in run-off. The United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) has a list of approved BMPs to address sediment issues and this list will be used to identify candidate BMPs in the watershed.

The *State of Mississippi Water Quality Criteria for Intrastate, Interstate, and Coastal Waters* (MDEQ, 2021) regulation does not include a numerical water quality standard for aquatic life protection due to sediment; however, a narrative standard for the protection of aquatic life was interpreted to determine an applicable target for the sediment TMDL in the Muddy Bayou watershed. The narrative standard states "…waters shall be free from materials attributable to municipal, industrial, agricultural, or other dischargers producing color, odor, taste, total suspended solids, or other conditions in such degree as to create a nuisance, render the waters injurious to public health, recreation, or to aquatic life and wildlife, or adversely affect the palatability of fish, aesthetic quality, or impair the waters for any designated use." The regional sediment TMDL for the Delta which includes the Opossum Bayou (MS269E) watershed concluded that sediment yields would need to be reduced by 80 to 84% in the watershed. All sediment yield reductions were developed from suspended sediment concentration data measured at stable streams in the same ecoregion(s). The targets were developed to reflect stable stream conditions using reference sediment yields. These reference conditions were established by the USDA's Channel and Watershed Processes Research Unit (CWPRU) at the National Sedimentation Laboratory (NSL).

MDEQ does not have numeric nutrient criteria. To develop the TN and TP targets included in the Opossum Bayou TMDL, a percentile approach was used following EPA recommendations. The Total Nitrogen and Total Phosphorus TMDL for Opossum Bayou (MS269E) recommended an 84.7% reduction in Total Phosphorus (TP) with a target annual concentration of 0.16 mg/L. The TMDL also recommended a 94.4% reduction in Total Nitrogen (TN) with an annual target concentration of 1.06 mg/L.

The MDEQ will work with agency resource partners to identify and implement BMPs to address sediment and nutrient concerns in the Muddy Bayou Watershed. The United States Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) has a list of approved BMPs to address water quality concerns. Conservation practices that address sediment often provide an additional benefit in the reduction of nutrients as they attach to sediment particles in run-off. Practices approved by NRCS will be used to identify candidate BMPs in the Muddy Bayou watershed.

Element c: Proposed Management Measures

Coordinating partners with MDEQ include the Mississippi Soil and Water Conservation Commission (MSWCC), the Natural Resource Conservation Service (NRCS), and the local Soil and Water Conservation Districts (SWCDs) throughout the state. These SWCDs are typically housed within USDA Service Centers co-located with NRCS offices. Routine work within these

offices includes regular communication with the local landowners and operators within the watershed as they work to support sign-ups for Farm Bill initiatives. Technical support staff in these offices routinely coordinate with local stakeholders to gauge landowner interest and based on their expertise, have identified a suite of BMPs that should be effective in addressing nonpoint source pollution sources in the Muddy Bayou Watershed.

Staff from MSWCC and the SWCD depend upon assistance from their NRCS partners in determining landowner interest in the watershed because they are on the farms and in the fields with the landowners, understand the needs at the local level, and have knowledge of unfunded applications for federal program assistance which meet Section 319 eligibility requirements. Based on their analysis, installation of the following BMPs would mitigate sediment issues in the Muddy Bayou watershed helping the stream recover: grade stabilization structures, streambank and shoreline protection, cover crops, and the instillation of dikes and other water control structures. Factors considered for determining specific locations for the placement of BMPs included the following attributes based upon best professional judgement of trained NRCS, SWCD and MDEQ Staff:

1. Likely water quality benefit;
2. Willingness of landowners to participate;
3. Implementation of the recommendations included in the TMDL(s);
4. Ease of measuring effectiveness of the BMP(s) through monitoring;
5. Shorter length of time for anticipated results (i.e., within the grant period);

Element d: Technical and Financial Assistance

As part of any Section 319 funded project, MDEQ requires a 40% match in project areas. This match may be in the form of actual dollars or may be provided as "in-kind" to project activities. Partners in this project who may contribute match include MSWCC, Quitman and Tallahatchie County Soil and Water Conservation Districts, NRCS, and/or local landowners and operators. For project implementation, administration, management, and watershed plan revision, as well as hosting and facilitating team meetings, MDEQ plans to work under a memorandum of agreement (MOA) with the MSWCC to implement this project. Project partners provided the funding amounts used to estimate costs for BMP installation. Below is summary of estimated costs for potential BMPs and overall project implementation:

Cost Estimate: Full Project Implementation

BMPs	Size/Amount	Estimated Cost
Grade Stabilization Structure (low flow)	15 each	$52,329
Grade Stabilization Structure (med. flow)	20 each	$263,123
Grade Stabilization Structure (high flow)	10 each	$205,373
Grade Stabilization Structure (very high flow)	10 each	$330,332
Cover Crops	1,132 acres	$79,705
Dikes	130,000 CuYd	$544,700
Structure for Water Control	24,216 Inft	$91,536
Streambank and Shoreline Protection	1,135 ft	$730,385
Technical Assistance*	N/A	$45,000
Education and Outreach*	N/A	$28,000
Monitoring*	N/A	$25,000
Project Management, Implementation, Coordination, Plan Revision*		$135,000
Total Estimated Cost		**$2,530,483**

NOTE: Conservation Best Management Practices provide a 40% match at a minimum
* Denotes fields that are estimated upon three incremental funding cycles of the project

Due to the magnitude of BMP needs, this project will need to be funded incrementally using multiple sources of funds. To fully address all suggested conservation needs in the watershed, this plan recommends funding be provided in 3 increments. To maximize education and outreach activities and monitoring efforts, MDEQ plans to leverage with existing programs already allocated for funding where possible. Below is the estimated budget for the first incremental funding (Phase 1) of this project:

Cost Estimate: Phase 1 Implementation:

BMPs	Amount	Estimated Cost
Grade Stabilization Structure (low flow)	15 ea	$52,329
Dikes	30,000 cy	$125,700
Structure for Water Control	4,216 Inft	$15,935
Cover Crops	107 ac	$8,195
Streambank & Shoreline Protection	135 ft.	$95,477
Technical Assistance	N/A	$15,000
Education and Outreach	N/A	$12,000
Monitoring	N/A	$16,000
Project Management, Implementation, Coordination, Plan Revision		$55,000
Total Estimated Phase 1 Cost		**$395,636**

NOTE: Conservation Best Management Practices provide a 40% match at a minimum.

Element e: Information and Education

The MDEQ, in cooperation with numerous federal, state, and local stakeholders has developed diversified information/education programs, best management practices manuals, literature, books, videos, and public service announcements that address pollutants from the seven (7) major landuse categories of nonpoint source pollution: agriculture, construction, forestry, on-site wastewater disposal, surface mining, urban storm water runoff, and hydrologic modification. Audiences from pre-school to adults throughout the state are reached with a variety of mature, well-designed programs each year. These programs, events, manuals, and literature can be used in the watershed project by tailoring them to address pollutants of concern. A positive approach is used to reach the full diversity of people in the community with projects that foster a "sense of place", a "sense of pride in community", and a sense of the native plants, animals, and general ecology of their region. Stakeholders and coordinators work together to participate in problem-solving, brainstorming, plan development, training workshops, soil and water conservation field days and other activities that promote collaboration and ownership of the watershed, as well as solutions to its problems. The ultimate goal is to bring about behavior changes and the use of "best management practices" that will improve water quality and the overall quality of life in the watershed. Evaluation forms, pre-test/post-test, surveys, and reporting of the number of people who attend workshops, trainings and events are among the methods used to measure the success of education/information programs. A partial list of MDEQ's programs that could be used in the Muddy Bayou watershed are listed below:

- **Water Model Presentations** - Enviroscapes and groundwater aquifer models distributed statewide with training and related interactive lesson plans.

- **Teacher workshops –** train educators in proximity to the watershed about NPS pollution and provide materials and information that can be used in their classrooms.
- **Adopt A Stream -** workshops and training venues for citizens, teachers, and students in the Muddy Bayou Watershed.
- **Mobile Classroom Education and Outreach Events** - for school ages kindergarten –5th grade students.
- **"Waste Pesticide Disposal Event" -** The primary goal of this program is to help Mississippi farmers and property owners minimize the environmental risks associated with the disposal of waste-pesticide products by disposing of products in a safe and efficient manner.

As part of the education outreach efforts, the stakeholder group forming the Muddy Bayou Watershed Implementation Team (WIT) will participate in collaborative meetings. The purpose of the meetings will be to identify partners, update the watershed plan, and host field days to showcase the implemented BMPs for the public. In concert with these WIT meetings, and to incentivize stakeholder participation, project funding will be used to purchase food and other refreshments for the WIT along with providing support for renting facilities in which to host those events. In accordance with 41 CFR § 301-74.11, light refreshments, meals, and/or beverages are an allowable expense under CWA Section 319, provided a description of the agenda, purpose, location, costs, etc., are outlined in an approved 319 grant workplan. At this time the exact number of participants and locations are not known therefore costs have been estimated for the purposes of this plan and will be updated.

Element f: Implementation Schedule

The following schedule describes the approaches and tasks that the grantee shall collaboratively perform with project partners to advance and implement this watershed-based plan. During this effort, resource agency partners will work with the Watershed Implementation Team and MDEQ Project Manager (where applicable), to perform the tasks identified below:

1. Work to develop, execute, and implement a Subgrant Agreement that specifies the roles, tasks, requirements, and milestones for project implementation. (Month 1)

2. Facilitate, in coordination with MDEQ and other partners, meetings, media and social media promotion of the project, and coordinate activities to fully implement this plan. (Months 1-36)

3. Work with the Quitman and Tallahatchie County SWCDs, MSWCC, NRCS, and MDEQ to inform landowners and operators within the watershed about the project and work to secure commitments from priority area landowners and operators who are willing to participate in the project. (Months 1-6)

4. Work with the local SWCDs, MSWCC, NRCS, and MDEQ to determine through GIS applications and intensive site surveys the priority areas within the sub-watershed that are contributing significant pollutant loads. All BMPs shall be installed in

accordance with the guidelines developed in the latest edition of the NRCS Technical Field Manual, or other approved guidelines. (Months 1-36)

5. Facilitate, in cooperation with MDEQ and other monitoring partners, the completion and implementation of an effective and efficient plan to monitor baseline water quality conditions in the watershed and track changes in water quality over time resulting from the BMPs implemented through this project. (Months 3-36)

6. Submit blank copies of standard maintenance agreements to MDEQ. (Months 3-36)

7. Conduct inspections of BMPs during construction (Months 3-36)

8. Coordinate with and support the local SWCD, MSWCC and NRCS in the collection of relevant GPS coordinates of all installed BMPs and incorporate this information into a GIS format. All geospatial data shall be collected in a manner consistent with the Federal Geographic Data committee-endorsed standards. (Months 3-36)

9. Collect adequate photo documentation before, during, and after installation of the approved BMPs. (Months 3-36)

10. Report measured, or estimated, nonpoint source pollutant load reduction, acreage affected, pre-and post- site conditions, and GIS data. (1-36)

Element g: Milestones and Outcomes

Milestone	**Outcome**	**Probable Completion Date**
Coordinate with the MDEQ, NRCS, MSWCC, and the Quitman and Tallahatchie Co. Soil and Water Conservation Districts to determine priority areas that are contributing significant pollutant loads to Muddy Bayou	Target priority areas for BMPs	Month 1-36
Establish Watershed Implementation Team.	Establish WIT	Month 1-2
Initiate watershed monitoring	Baseline Condition Monitoring	Months 1-12
Meet with landowners and cooperators to secure commitments to install BMPs in priority areas	Landowner Commitment	Months 1-36
Establish routine meeting schedule for WIT to support WBP revision	WIT Meetings	Months 1-36
Implement BMPs	BMP Instillation	Months 6-36

Coordinate with Landowners to inspect BMPs that were installed using Section 319 funds	BMP Inspection	Months 6-36
Begin monitoring to collect data on post-BMP water quality	Post-BMP Monitoring	Months 40-48
Implement education and outreach plan	Education/Outreach events scheduled	Months 8-36
Finalize revised WBP	Final Revised WBP	Months 30-36

Goal: Reduce sediment and nutrient loads entering waters in the Muddy Creek Watershed that could contribute to impairment in Opossum Bayou.

Element h: Load Reduction Evaluation

Mississippi's water quality criteria do not include a water quality standard applicable to aquatic life protection due to sediment or nutrients. However, a narrative standard for the protection of aquatic life was interpreted to determine an applicable target for Opossum Bayou (TMDL MS269E) which serves as the receiving stream for the drainage from the Muddy Bayou Watershed. The narrative standard is that waters shall be free from materials attributable to municipal, industrial, agricultural, or other dischargers producing color, odor, taste, total suspended solids, or other conditions in such degree as to create a nuisance, render the waters injurious to public health, recreation, or to aquatic life and wildlife, or adversely affect the palatability of fish, aesthetic quality, or impair the waters for any designated uses. In lieu of numeric criteria for sediment, monitoring will be conducted to collect data on parameters that are considered surrogates for sediment concentrations and may include measurements for Total Suspended Solids, Total Suspended Sediment, and turbidity along with conventional parameters generally measured to determine aquatic health (e.g. Dissolved Oxygen, pH, Temperature, Conductivity). Water quality samples will be taken to measure total nitrogen and total phosphorus as well. The following thresholds will be used to measure compliance with water quality criteria and/or target thresholds:

Success Measurement Thresholds:

Parameter	**Threshold**
Dissolved Oxygen	Daily Average of 5.0 mg/L; Instantaneous threshold of 4.0 mg/L
Dissolved Oxygen % Sat.	$\geq$ 70% - $\leq$ 125%
pH	6.0-9.0
Temperature	Not to exceed 90°F
Specific Conductance	Less Than 1000 micromhos/cm
Dissolved Solids	Monthly average less than 750 mg/L; instantaneous threshold less than 1500 mg/L
Chemical Oxygen Demand	<50 mg/l
Turbidity	<100 NTU

Total Suspended Solids	<80 mg/l
Total Nitrogen	1.05 mg/L
Total Phosphorus	0.16 mg/L

It should be noted that recovery time of a stream is variable and may extend beyond the timeframe identified in the workplan. At the end of the project, data will be analyzed to determine if the data indicate improvements to water quality in Muddy Bayou. In the event data indicate little or no positive change, a Stressor Analysis will be conducted to determine if any new or additional stressors are preventing improvements to water quality. If any new stressors are identified, the Watershed Implementation Team will identify future actions/activities to address those stressors.

Element i: Monitoring

Prior to BMP installation, pre-implementation water quality chemical monitoring will be collected to serve as baseline data for the project along with any historical data available in Muddy Bayou. Water quality monitoring will include water chemistry data (nutrients, suspended solids, oxygen demand, chlorides, etc.), in-situ field measurements for such parameters as dissolved oxygen, pH, temperature, specific conductance, and turbidity, datalogger (sonde) deployment for continuous in-situ field measurement data. A list of this historical water quality monitoring in the Muddy Bayou watershed is provided in the table below and the sample locations are shown in Figure 2.

Station ID	Water Body	Sample Year(s)	Collecting Agency	Project	Water Chem	In-Situ	Sonde	Benthics
113B47	Muddy Bayou	2012	MDEQ	D-BISQ	X	X		X

Monitoring locations will be selected using best professional judgment and will be targeted to reflect water quality downstream of BMP activity. Once BMP installation is complete, and there has been sufficient time for the stream to stabilize, post BMP monitoring will be initiated. Post BMP monitoring will be conducted in a way that allows for comparison with the pre-implementation data. Because recovery periods of streams can be dependent on type and amount of BMPs installed, more than 1 year of post BMP data may be needed to observe a change in water quality. In some cases, it may take 5 or more years to see full benefits of BMPs. All data collection efforts will be conducted using trained personnel following established Standard Operating Procedures and adhering to agency Quality Assurance protocols.