

Photo credit: Audra Melton, The Nature Conservancy

Coastal Streams and Habitat Initiative

A Conservation Action Plan for Nine Mississippi Coastal Streams

September 1, 2016

The Nature Conservancy

ACKNOWLEDGMENTS

Project Team

The Coastal Streams and Habitat Initiative is a project funded by the National Fish and Wildlife Foundation's Gulf Environmental Benefit Fund Project, awarded to the Mississippi Department of Environmental Quality, and implemented by The Nature Conservancy in partnership with the Pascagoula River Audubon Center and the Mississippi Department of Environmental Quality Basin Program.

Lead Authors

- Thomas Mohrman, Mississippi Marine Programs Director, The Nature Conservancy, Mississippi
- Mike Murphy, Mississippi Coastal Field Representative, The Nature Conservancy, Mississippi
- Amy Smith Kyle, Coastal Conservation Project Manager, The Nature Conservancy, Louisiana
- Leah Bray, Conservation Specialist, Anchor QEA, LLC

Project Implementation Team

- Coen Perrott, Coastal Streams Basin Coordinator, Mississippi Department of Environmental Quality
- Jill Andrews, GIS Technician, The Nature Conservancy, Louisiana
- Seth Blitch, Coastal Program Director, The Nature Conservancy, Louisiana
- Steve Herrington, Director of Freshwater Conservation, The Nature Conservancy, Missouri
- Thomas Mohrman, Director of Marine Programs, The Nature Conservancy, Mississippi
- Mike Murphy, Coastal Field Representative, The Nature Conservancy, Mississippi
- Amy Smith Kyle, Coastal Conservation Project Manager, The Nature Conservancy, Louisiana
- Mark LaSalle, Director, Pascagoula River Audubon Center
- Erin Parker, Outreach and Education Manager, Pascagoula River Audubon Center
- Leah Bray, Conservation Specialist, Anchor QEA, LLC
- Peggy Stowers, Planner, Anchor QEA, LLC

Technical Advisory Team

- Tom Strange, Senior Scientist, Covington Civil & Environmental, LLC
- Ayesha Gray, Director, Grand Bay National Estuarine Research Reserve
- Andrew Whitehurst, Assistant Director of Science and Water Policy, Gulf Restoration Network
- Judy Steckler, Executive Director, Land Trust for the Mississippi Coastal Plain
- Coen Perrott, Coastal Streams, Pascagoula, and Lower Pearl Basin Coordinator, Mississippi Department of Environmental Quality

- Doug Upton, Division Chief, Office of Pollution Control, Mississippi Department of Environmental Quality
- George Ramseur, Director of the Office of Coastal Restoration and Resilience, Mississippi Department of Marine Resources
- Andy Sanderson, Natural Heritage Program Coordinator, Mississippi Museum of Natural Science
- Steven Ashby, Associate Director of Northern Gulf Institute, Mississippi State University
- Kelsey Johnson, Community Planner, Gulf Coast Community Design Studio, Mississippi State University
- Mike Murphy, Coastal Field Representative, The Nature Conservancy, Mississippi
- Erin Parker, Outreach and Education Manager, Pascagoula River Audubon Center
- Patric Harper, Northern Gulf Program Coordinator, U.S. Fish and Wildlife Service
- Robert Leaf, Assistant Professor, Division of Coastal Sciences, University of Southern Mississippi
- Jake Schaffer, Professor, Department of Biological Sciences and Curator of Fishes, University of Southern Mississippi
- Robert Smith, Coastal Program Coordinator, Wildlife Mississippi

Contributors

This plan would not have been possible without the time, input, and support from the numerous individuals that participated in the Public Listening Sessions and Conservation Planning Workshops. We are appreciative of the knowledge and experience that was freely shared—it is the foundation of this plan.

We would also like to thank Beauvoir, Café Climb Career Development Center, Pascagoula River Audubon Center, Mississippi Gulf Coast Community College Estuarine Center, and the Waveland Public Library for donating the use of meeting locations.

We thank our Nature Conservancy colleagues who have assisted on this project in a variety of ways, including Jeff DeQuattro, Becky Easterling, Alex Littlejohn, Suzanne Mora, Keith Ouchley, Geoff Rich, and Emmy Wright.

Special thanks goes to the University of Florida, Center for Aquatic and Invasive Plants, for permission to reprint the invasive species guide for The Corps Network, and Dr. Stephen T. Ross of the University of New Mexico for permission to reprint fish photographs for The Corps Network.

Others who assisted in the project include Lee Trebotich, formerly of the Pascagoula River Audubon Center; John Hosey; The Corps Network for coordinating the Rapid Stream Assessments; The Nature Conservancy Gulf of Mexico Program; and Mississippi Department of Environmental Quality Field Services Program.

We thank the Mississippi State University, Gulf Coast Community Design Studio, and the Gulfport sixth graders, teachers, and administrators of Bayou View Middle School and Central Middle School for participating in the conservation planning of Brickyard Bayou.

We are grateful to the following people and organizations who assisted The Nature Conservancy with access to the stream sites:

- City of Pascagoula, Bayou Chicot
- Knights of Columbus, Council 1583, Brickyard Bayou
- Bay Waveland Yacht Club, Magnolia Bayou
- Albert Piazza, Magnolia Bayou
- Society of the Divine Word Seminary, Magnolia Bayou
- Greg Stewart, Beauvoir, Oyster Bayou
- Ali Leggett, Mississippi Department of Marine Resources, Coastal Preserves Program, Rhodes Bayou
- The Land Trust for the Mississippi Coastal Plain, Turkey Creek
- City of Gulfport, Brickyard Bayou, Turkey Creek and Coffee Creek
- Gulfport/Biloxi International Airport, Turkey Creek and Brickyard Bayou
- Mike Safari, Watts Bayou
- Randle Slade, Watts Bayou
- Paul Tinsley, Watts Bayou

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Photo credit: The Corps Network

1 PROJECT OVERVIEW

The Mississippi Gulf Coast is a large estuary between the marsh shoreline of Louisiana and the natural beach coastline of Alabama and Florida. Although the Mississippi Coast spans a relatively small area (approximately 70 miles of shoreline), it encompasses diverse habitats of great ecological significance. Upland pine forests, wet pine savannas, bottomland hardwoods, barrier islands, cypress swamps, freshwater and coastal marsh—along with important submerged habitats such as oyster reefs and seagrass beds—make the Mississippi Coast an area of exceptional biological productivity.

These important coastal habitats are home to an abundance of diverse wildlife and ecological connections. Located in the Mississippi Flyway, the Mississippi Coast encompasses significant bird habitat and is a particularly critical stopover site for neotropical migratory birds. Other migratory species of importance reside in Mississippi's coastal rivers and marine waters, including the state- and federally listed endangered Gulf sturgeon and other diadromous fish.

Eight major rivers and dozens of small natural streams drain the Mississippi Coast. The coastal streams represent a significant input of freshwater into the Mississippi Sound estuary. These small streams have historically been undervalued and severely impaired. In urban settings, many small streams are often highly altered for drainage and shoreline development. Typically channelized and restrained between steep concrete or riprapped banks, many of them no longer look or function as natural streams. Despite these challenges, Mississippi's coastal streams retain ecological, scenic, and historic value.





Gulf sturgeon research
Photo credit: Steve Herrington, TNC

Today's Mississippi Coast confronts many of the same challenges facing coastal areas throughout North America. Water pollution from upriver sources, rapid shoreline development, wetlands loss, increasing urbanization, invasive plants and animals, and significant natural hazards such as hurricanes have put a strain on natural resources.

To address some of these challenges, the **Coastal Streams and Habitat Initiative (CSHI)** project began in 2014 and was funded by a grant from the National Fish and Wildlife Foundation's Gulf Environmental Benefit Fund awarded to the Mississippi Department of Environmental Quality (MDEQ). The Nature Conservancy (TNC) has led the CSHI in partnership with the Pascagoula River Audubon Center, while working closely with MDEQ.

Project Vision

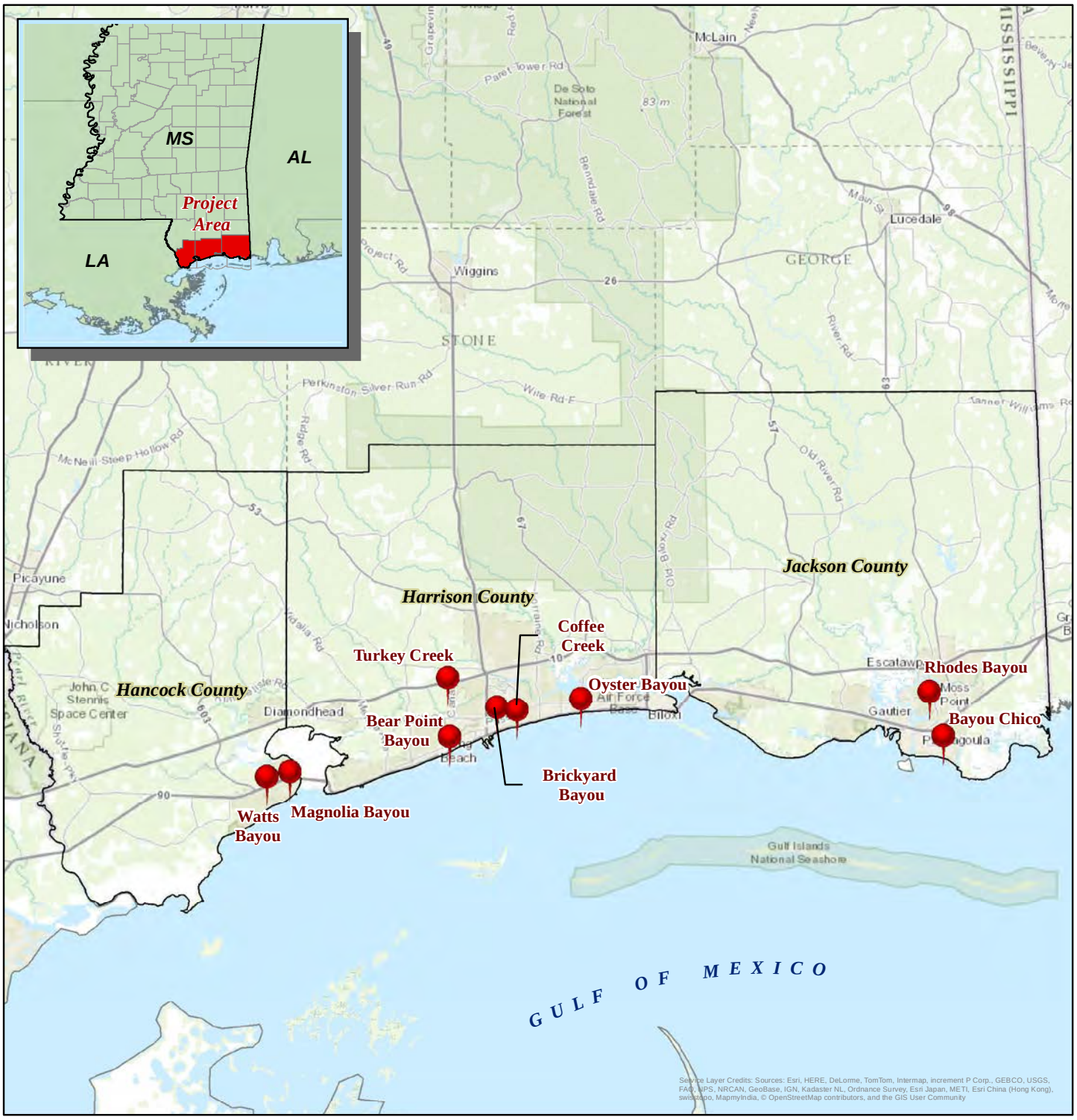
The unified vision for this project is to conserve key coastal streams in Mississippi by creating restoration opportunities to benefit nature and people with clean water and healthy habitats. In addition, the overarching goal is to evaluate the health of the streams and their restoration potential to develop a Conservation Action Plan with prioritized strategic actions based on these evaluations. Some of the conservation actions will result in engineered conceptual designs that will be available for completion by qualified agencies, organizations, and private companies.

The **CSHI Conservation Action Plan** (known throughout this document as CAP) is the result of 2 years of engaging over 250 stakeholders and conservation partners to develop a comprehensive plan for restoration projects in priority areas in coastal Mississippi. Using TNC's CAP process, the CAP identified target coastal streams for conservation, the current health and problems affecting these streams, the source of problems, and the best strategies to maximize their long-term protection and restoration.

TNC and partners selected nine streams from the three coastal counties in Mississippi for the CSHI. These streams included: Watts Bayou and Magnolia Bayou in Hancock County; Turkey Creek, Brickyard Bayou, Bear Point Bayou, Oyster Bayou, and Coffee Creek in Harrison County; and Rhodes Bayou and Bayou Chicot in Jackson County. Streams were chosen as focal ecosystem targets for the CAP because they represent the biodiversity and important ecological processes of coastal Mississippi. Stream locations are depicted in Figure 1-1.

To implement this CAP, conceptual designs were developed for projects within each of the nine watersheds. The intent of the conceptual designs is to add an incentive for project partners to implement the plan(s). These designs target the top threats identified for each stream, and will advance one or more priority strategies for each watershed. Project types include detailed surveys of stream degradation, conceptual designs for stream restoration, streambank stabilization, and channel improvements. Additional projects were drafted to address wetland loss and wildlife passage issues and will be available for future funding sources. For the CSHI, the project team made every effort to create uniformity across the watersheds for conceptual design projects.

Figure 1-1
Stream Locations



Map Created by: Baton Rouge, Louisiana Field Office (JA)
Date: 3 April 2015

Project Locations

County Boundaries

N
W E
S

10 5 0 10
Miles

1:633,600

Source: World Topo Map (ESRI,

The Nature Conservancy
Protecting nature. Preserving life.

1.1 Conservation Action Plan

In the past, TNC has successfully implemented a ten-step CAP process for defining the conservation projects, developing and executing strategies and measures, and using the results to adapt and improve conservation outcomes (TNC 2007). The process uses an adaptive management framework to help stakeholders focus natural resources conservation strategies on clearly defined elements of biodiversity and conservation targets (as well as the threats to these targets), and to measure their success in allowing for adaptation over time (TNC 2007). During the planning process, an Excel spreadsheet was used to input rankings from stakeholders, organize the information for prioritization, and define conservation strategies.

Ten-step CAP Process:

1. Identifying people involved in the project
2. Defining the project scope and focal conservation targets
3. Assessing the viability of focal conservation targets
4. Identifying critical stresses and threats
5. Completing a situational analysis
6. Developing strategies for conservation
7. Measuring results
8. Developing a work plan
9. Implementing actions and measures
10. Analyzing and learning from results, adapting, and sharing findings

The CAP contains a two-pronged approach for stakeholder engagement: facilitated discussions with the Technical Advisory Team and facilitated discussions with the public in separate Public Listening Sessions to identify conservation priorities, stresses and threats, and restoration and abatement strategies. Stakeholders included local citizens and representatives from municipal and county government; academic institutions; community organizations; state, local, and federal management agencies; and non-governmental organizations.

A facilitator led the CAP process with each watershed stakeholder group. Through a series of workshops and meetings, they worked together to identify conservation targets, analyze target threats, identify objectives and outcomes, develop strategic actions, and define indicators and measures to monitor success.

1.1.1 Public Listening Sessions

For all nine watersheds within the CSHI, TNC and facilitators worked together to create short forms to collect information as: 1) a reference for scope or places that are important within the watershed; 2) perceived and real environmental, habitat, historic, or cultural threats; and 3) strategies or solutions for the threats. These three components follow TNC's CAP process for the public to provide a robust picture of the issues that are important in a watershed conservation plan. Participants were solicited by direct mail postcard, a public service announcement broadcast via radio, and personal invitation.

The Public Listening Sessions were held from May through July of 2015. Stakeholders in attendance were knowledgeable of their watershed, its scope, and existing problems, and could easily identify potential solutions for future action plans. Through this series of Public Listening Sessions, the concerns of stakeholders were heard and recorded, and facilitators received excellent localized information for each watershed. The information provided during the meetings was integrated into the CAP process to help

prioritize actions. The TNC representatives made personal appointments with key stakeholders to collect specific information related to their work in the watershed. For example, the University of Southern Mississippi (USM) provided information related to a stream restoration grant that was recently awarded and will leverage funds from CSHI for project implementation.

Appendix A contains the *Public Listening Sessions Final Report*, which summarizes the public's input on the scope of the watersheds, perceived problems or threats, and identified solutions to the problems.



Harrison County project meeting



Coffee Creek Public Listening Session



Watts and Magnolia Bayou Public Listening Session

1.1.2 Technical Advisory Team

The Technical Advisory Team is a group of stakeholders consisting of natural resource professionals from agencies, academia, and nonprofit partners who understand the local watersheds from a scientific and planning perspective. The Technical Advisory Team met in sessions that paralleled the process of the Public Listening Sessions. This team also compiled scope, threats, and strategies from a narrower perspective than the public stakeholders—focusing on site-specific locations for each of the nine coastal watersheds. These sessions were held throughout 2015.

1.2 Stream Scope

The scope of the physical and geographic area considered for the CAP is referred to as a target. However, the scope is not limited to this geographic boundary and includes those components that are critical to the health of the drainage, or are considered valuable for the natural benefits provided to people and nature. These components are referred to as nested targets and can include the stream's habitats, functions, services, species, or values.

1.2.1 Establishment of Watershed Boundaries

Watershed boundaries were defined using methodologies based on the Watershed and Drainage Delineation by Pour Point in ArcMap 10 and Watershed Delineation with ArcGIS 10. A series of watershed maps were generated using a variety of data such as shapefiles, raster datasets, aerial photography, and ESRI web map services (see Appendix B).

1.2.2 Nested Targets

Embedded or nested targets within the watersheds include a variety of biological and functional components, as well as human values, for conservation. These targets can be found in the actual stream, riparian corridor, watershed, and tidal zone. Biological components include habitats that are representative of the watershed, valued for ecological significance, or valued for other intrinsic reasons. Plant and animal species of conservation concern are also considered biological targets. Upland native vegetation, forest habitat, and wetlands, as well as species assemblages of native fishes, stream invertebrates, and migratory bird species, are considered. Functional components include those services naturally provided by a functioning stream, such as water infiltration and water transport. Values for conservation were considered during the Public Listening Sessions for each watershed. Participants were asked to rank their top conservation values and include other values (if considered important) from the list. The top conservation values are listed within the chapters for each watershed.

1.3 Habitat Assessment: Stream Health

1.3.1 Rapid Stream Assessments

The Rapid Stream Assessment (RSA) is a field habitat evaluation tool that was used to provide an initial snapshot of stream health and inform the subsequent viability analysis (see Appendix C). The methodology used is the Stream Visual Assessment Protocol, version 2 (SVAPv2) from the U.S. Department of Agriculture, Natural Resources Conservation Service. Field conservationists are encouraged to use SVAPv2 in those situations where more detail is needed to critically score characteristics (identified as elements) and their relative contribution to the condition of the stream. This version lends itself to tracking trends in stream conditions over time, as well as identifying resource concerns and their potential causes. The sample data sheet used in the RSAs is included in Appendix C.

The SVAPv2 included the following 16 elements, of which 14 were used for the initial stream assessment:

- Channel Condition
- Hydrologic Alteration
- Bank Condition
- Riparian Area Quantity
- Riparian Area Quality
- Canopy Cover
- Water Appearance
- Nutrient Enrichments
- Manure/Human Waste
- Pools
- Barriers to Movement
- Fish Habitat Complexity
- Aquatic Invertebrate Habitat
- Aquatic Invertebrate Community
- *Riffle Embeddedness (not used)*
- *Salinity (not used)*

Assessments were conducted in fall 2014, spring 2015, and summer 2016, in partnership with The Corps Network, a youth development program that provides participants with job training, academic studies, leadership skills, and other support while they work in service to help local communities and the environment. Other partners included Café Climb Career Development Center and TNC's Gulf of Mexico Program.

1.3.2 Water Quality Data

Little water quality data previously existed for many of the nine coastal streams. Therefore, in collaboration with MDEQ, 18 parameters were measured from March 2016 to August 2016 to establish stream baselines. Additionally, measurements of dissolved oxygen, nitrite, nitrate, and phosphorous were used as water quality parameters as components of stream viability assessments. These samples were collected by MDEQ Field Services Department staff and followed MDEQ's Quality Assurance/Quality Control standards.

A summary of each stream's water quality results is listed in the corresponding watershed chapter. Of the four measurements used in the viability assessment, potential impairments to dissolved oxygen were detected in Magnolia Bayou, Bear Point Bayou, Turkey Creek, and Oyster Bayou, and possible nutrient enrichment was detected in Oyster Bayou. Data were compared to Mississippi's Water Quality Standards to determine the existence of potential impairments; if confirmed, the waterbody would then be placed on Mississippi's List of Impaired Water Bodies.



Stream water testing

Photo credit: Elizabeth Gray



Bluegill found in Magnolia Bayou sampling

1.3.3 Biological Sampling of Fishes

Fish data were sparse or nonexistent for all coastal streams except Turkey Creek and a few few data sets for Brickyard Bayou. This was confirmed by an online search of all available U.S. museum fish collections. TNC is currently working on baseline fish samples in all streams and will have data upon request after the final draft of this report. Specimens captured will be preserved at the Mississippi Museum of Natural Science. This work is permitted under a Mississippi Department of Marine Resources Scientific Research Permit (#SRP-019-16) and a Mississippi Museum of Natural Science scientific collection permit (#0413161).

1.3.4 Viability Assessment

Stream health was evaluated using a viability assessment, which is an objective assessment of the current health of a conservation target. The viability assessment also measures the stream's health over time and identifies what a healthy state might look like in the future. This assessment may be based on specific expert analysis or best assumptions using available data. This portion of the CAP process was key to knowing which targets are most in need of immediate

Words to Know

Viability assessment: an objective assessment of the current health of a conservation target; also measures a stream's health over time and identifies what a healthy state might look like in the future

attention. Metrics developed from the viability assessments will form the basis of measurement for success over time.

The first step in the viability assessment was to identify Key Ecological Attributes and corresponding indicators. Key Ecological Attributes (KEAs) are aspects of a target's biology or ecology that, if missing or altered, could lead to the loss of that target over time. KEAs define the most critical components of biological composition, structure, interactions and processes, environmental regimes, and landscape configuration that sustain a target's viability or ecological integrity over space and time. These KEAs were based on peer-reviewed scientific literature and measures currently used by the State of Mississippi and federal conservation agencies. Table 1-1 contains the KEAs used for this CAP, along with their definitions.

Table 1-1
Key Ecological Attributes

KEY ECOLOGICAL ATTRIBUTE	DEFINITION
Connectivity	Connectivity includes floodplain access between the stream and watershed as well as passage vertical within the stream
Hydrology	Flow regime of water through the watershed and stream
Landscape Pattern (mosaic and structure)	Watershed land cover, types of habitat, and non-habitat footprint
Stream Geomorphology	The physical geology and shape of the stream channel
Riparian Corridor	Immediate adjacent terrestrial stream component
Invasive Species	Non-native or noxious plant and animal species affecting native habitat assemblages
Water Quality	The chemical conduction of stream water including dissolved oxygen, phosphorous, nitrogen
Pollution	Trash and debris that has potential to affect the stream and other KEAs
Riparian Corridor Size	Size of the vegetative vertical corridor associated with the stream channel
Finfish Species Assemblage and Condition	Diversity and desirability of finfish species identified in the stream (only data for Turkey Creek was available at the time of this analysis)

Indicators, or measures, can determine the viability of a conservation target. Ten indicators were selected to measure the full range of viability for targets in the watersheds. The ten indicators (see Table 1-2) were selected for practical purposes; many are currently used by conservation managers to measure resource health. In a viability assessment, indicators for at least one landscape context, condition, and size are ranked for each target. Anecdotal knowledge, and even rough estimates, may be used to rank target viability, which in turn can help identify areas for future research on the health of the target. Efforts were made to identify and rank a minimum number of KEAs and indicators that most comprehensively measure viability.

Table 1-2
Viability Indicators

CATEGORY	INDICATOR
Landscape Context	Floodplain Accessibility
	Number of Aquatic Passage Barriers
	Percentage of Floodplain and Wetland Conversion
	Percentage of Impervious Surfaces
	Channel Alteration
Condition	Bank Stability
	Invasive Species
	Water Quality (Nitrogen, Dissolved Oxygen, Phosphorus)
	Solid Waste and Litter
Size	Riparian Vegetative Zone Width

The goal for improving long-term resource viability is to implement conservation strategies that improve viability rankings by one level (e.g., from "Fair" to "Good") over a 10-year period. Although this goal may be impractical given the project timeframe and the scale of these targets, stakeholders should consider efforts to improve certain KEAs that can reasonably be expected to increase by one level, and to maintain KEAs currently ranked "Good" or "Very Good" in order to keep and improve target viability across the basin. A summary of the viability results is included in Table 1-3.

Table 1-3
Viability Results Summary

WATERSHED	LANDSCAPE CONTEXT	CONDITION	SIZE	VIABILITY RANK
Magnolia Bayou	Fair	Fair	Fair	Fair
Watts Bayou	Fair	Fair	Fair	Fair
Bear Point Bayou	Fair	Fair	Fair	Fair
Turkey Creek	Fair	Fair	Good	Fair
Coffee Creek	Fair	Fair	Fair	Fair
Brickyard Bayou	Fair	Fair	Poor	Fair
Oyster Bayou	Fair	Fair	Fair	Fair
Rhodes Bayou	Good	Fair	Very Good	Good
Bayou Chicot	Fair	Fair	Poor	Fair

TNC populated much of the assessment with information collected during the spring and summer of 2015. Specifically, water quality data were collected and analyzed by MDEQ's Field Services Unit, RSAs were conducted using SVAPv2, and GIS analysis was conducted by TNC project staff. At the time of this document's publication, TNC is working on an inventory of fish species in all streams. Results will be available as an addendum, and fish specimens deposited in the Mississippi Museum of Natural Science.

1.4 Factors of Stream Degradation: Stresses and Threats

A practical challenge in conservation science is developing a standard lexicon for communication. A given stress or threat may be referred to by various names, often restricting comparisons, causing confusion, inhibiting communication, and limiting collaborative conservation actions among partners. Efforts were made to classify stresses and threats according to the most commonly used or formally accepted terminology in aquatic and conservation science and management. The hope is that this will optimize communication and understanding across all stakeholders, allow transferability to other aquatic conservation planning efforts, and best position the use of this CAP for collaboratively implementing the strategies described.

Stresses: impaired aspects of targets that result directly or indirectly from human activities; the actual problems degrading a target

Threats: proximate activities or processes that have directly caused, are causing, or may cause a stress (also known as the *sources of stress* or *direct threats*)

Many factors may contribute to the degradation of conservation targets. Stresses are impaired aspects of targets that result directly or indirectly from human activities. Simply put, stresses are the actual problems degrading a target. For example, altered riparian vegetation is a problem that degrades rivers and streams. Stresses can also be considered degraded KEAs.

Threats, also known as the "sources of stress" or "direct threats," are the proximate activities or processes that have directly caused, are causing, or may cause a stress. Multiple threats are frequently responsible for causing a given stress, often in different degrees. For example, landscaping and retail development are two threats responsible for altered riparian vegetation that degrade rivers and streams.

Analyzing stresses and threats helps identify the various factors that affect the targets. Ranking the threats prioritizes conservation actions where they are most needed. Criteria-based ranking provides an objective analysis of the degree to which certain problems are degrading a target, the sources of those problems, and which sources are the most critical. It also helps document assumptions so that they can be revisited—perhaps during a monitoring event.

1.4.1 Primary Stresses

Primary stresses were identified for the watersheds during the CAP process. Definitions for these stresses are provided here and are described for each watershed within its specific chapter.

Altered Connectivity describes the alteration in the transport of water within the stream channel onto the floodplain, commonly resulting in the reduction in size and/or scope of hydrologic and/or biological connection to floodplains (lateral connectivity), up- and/or downstream reaches (longitudinal connectivity), and hyporheic zones (vertical connectivity).



Altered Connectivity

Examples include channel incision that reduces floodplain access, culverts that reduce aquatic organism passage, and changes in groundwater levels that reduce oxygen exchange in streambeds for biota that burrow into the substrate.



Excessive Suspended and Bedded Sediments

Excessive Suspended and Bedded Sediments include suspended and bedded sediments, which are defined as particulate organic and inorganic matter that are suspended in or are carried by the water, and/or accumulate in a loose, unconsolidated form on the bottom of natural waterbodies. This includes the frequently used terms of clean sediment, suspended sediment, total suspended solids, bedload, turbidity (or in common terms, dirt, soils or eroded materials), as well as organic solids such as algal material, particulate leaf, and other organic material (USEPA 2003).



Altered Floodplains and Wetlands

Suspended and bedded sediments occur naturally in waterbodies in background amounts and are essential to the ecological function of a waterbody. However, excessive suspended and bedded sediments are considered the leading cause of impairment to rivers and streams nationwide (USEPA 2002; USEPA 2013). Excessive suspended and bedded sediments can result in a wide range of impacts to stream function, including aggradation and destabilization of stream channels, destruction of spawning areas for aquatic biota, and extirpation of species from degraded areas (USEPA 2003). Excessive suspended and bedded sediments can originate from numerous sources, including streambank erosion, unpaved roads, livestock pastures, and urban areas.



Altered Riparian Corridor

Altered Floodplains and Wetlands includes the alteration of terrestrial areas naturally prone to flooding and located inland from the riparian buffer (see Altered Riparian Corridor), as well as wetlands with physical and/or biological connections to the target. This differs from Altered Riparian Corridor in that it typically starts 100 feet or more from the stream channel. Examples include conversion of floodplain forests to livestock pasture and draining of floodplain wetlands for commercial development.

Altered Riparian Corridor is defined as the alteration of the riparian buffer within 100 feet of the stream or river. This differs from Altered Floodplains and Wetlands (see definition). Examples include removing trees directly from the streambank, narrowing the riparian zone, and converting deep-rooted vegetation (e.g., trees) to shallow-rooted vegetation (e.g., fescue).

In-stream Habitat Modification includes actions that directly and physically alter and/or disturb the stream channel or in-stream habitats at a site-specific location. In-stream Habitat Modifications can change or be persistent over time, typically resulting in small or mid-size-habitat changes that, in combination or over long time periods, can contribute to local changes in stream geomorphology (see Altered Stream Geomorphology). Examples include concrete revetments, dikes, and wing dams, riprap for streambank stabilization, in-stream gravel mining, cattle trampling, removal of large woody material, and all-terrain vehicle (ATV) usage across stream-channel habitats.



In-stream Habitat Modification

Altered Stream Geomorphology is the alteration of the pattern, dimension, and profile of a stream or river over an extended portion (i.e., reach scale) of a stream channel. This stress differs from In-stream Habitat Modification in that it is broader in scale; reflecting long-term, chronic changes in stream channel geomorphology versus more site-specific, fine-scale effects resulting from In-stream Habitat Modification (see definition). Examples include stream channelization, channel incision, and channel widening.



Altered Stream Geomorphology

Altered Hydrology is the alteration of the transport of water from the watershed to the stream channel, typically resulting in deviations from the natural flow regime, including the magnitude, frequency, duration, timing, and rate of change of flows. Altering river or stream hydrology can result in wide-ranging changes in stream hydraulic, geomorphological, physiochemical, and biological functions. As such, hydrologic alteration influences most other stresses identified herein. Examples of altered hydrology include impervious surfaces that make flooding more extreme and "flashy" (i.e., changing the magnitude and duration of floods) and municipal withdrawals that alter ground- and surface water availability in stream channels.



Altered Hydrology



Invasive Species (Nile tilapia)

Invasive Species are all of the physical and biological effects of non-native plants, animals, pathogens, microbes, or genetic materials that are harming or have the potential to measurably degrade the aquatic integrity of the target. Although there are numerous terrestrial invasive species within the project area, only those that pose a reasonable risk to aquatic and riparian ecosystems as described in the project scope are considered here.

Effects from invasive species are wide ranging, including habitat alteration and destruction, anoxia from decomposing individuals, competition, predation, and hybridization (Fuller et al. 1999). Of note, Invasive Species are classified differently for stresses and threats. As defined here, the stress is the combined result of the potential effects of invasive species on the targets.

Organic Pollution includes volatile, semi-volatile, and other organic compounds and pathogens in streams and rivers above ambient levels that degrade the target. Organic pollution often originates from wastewater, industrial effluents, and agricultural wastes (USEPA 2013). Like chemical pollution, the effects of organic pollution on aquatic ecosystems can be short-term to chronic, with a wide range of outcomes including physical impairment to direct killing of biota (USEPA 2013). Examples include *E. coli* and other oxygen-depleting pathogenic organisms or substances from sources, detergents, hydrocarbons, polychlorinated biphenyls, and inorganic agricultural chemicals, such as atrazine.



Organic Pollution


Nutrient Pollution (Historical)

Nutrient Pollution (Historical) consists of nitrogen, phosphorus, and ammonia-based compounds in streams and rivers above ambient levels that degrade targets. Nutrient pollution is considered to be among the leading causes of impairment to rivers and streams nationwide (USEPA 2002; USEPA 2013). Environmental effects of nutrient pollution include harmful (i.e., toxic) algal blooms, reduction in light availability, and anoxia, resulting in degraded aquatic habitats and direct harm to biota (USEPA 2013). This is typically a non-point source pollutant, originating from sources such as fertilizer and soil erosion from agricultural fields, stormwater runoff, wastewater discharge from sewer and septic systems, and fossil fuels.

Chemical Pollution (Historical) is defined as inorganic chemicals and compounds including mercury, solvents, pesticides, pharmaceuticals, dioxins, petroleum products, and a wide variety of other related substances that can degrade targets. Chemical Pollution does not include heavy metals or nitrogen-based compounds (see Nutrient Pollution). Effects of chemical pollution on aquatic ecosystems can be short-term to chronic, with a wide range of outcomes including physical impairment to direct killing of biota (USEPA 2013). Sources of chemical pollutants can include both point source discharges (e.g., municipal and industrial operations) and non-point source discharges (e.g., stormwater runoff from housing and urban areas).

1.4.2 Primary Threats

Primary threats are the proximate human activities or processes that have caused, are causing, or may cause the destruction, degradation, and/or impairment of biodiversity targets (e.g., unsustainable fishing or logging). Direct threats are synonymous with sources of stress and proximate pressures. Threats can be past (historical), ongoing, and/or likely to occur in the future.

Housing and Urban Areas include cities, towns, and settlements (including non-housing development typically integrated with housing such as urban and suburban areas, villages, vacation homes, shopping areas, offices, schools, hospitals, and most other areas with impervious surfaces). This threat also includes water-borne sewage and non-point runoff from housing and urban areas (e.g., nutrients, toxic chemicals, sediments), as well as the effects of these pollutants on the site where they are applied (e.g., leaking septic systems, untreated sewage, oil or sediments conveyed to roads, fertilizers and pesticides from lawns and golf courses, pet waste, road salt).

Commercial and Industrial Areas include factories and other commercial centers, military bases, factories, stand-alone shopping centers, office parks, power plants, train yards, shipyards, airports, and landfills. This primary threat also includes water-borne pollutants (e.g., nutrients, toxic chemicals and/or sediments, toxic chemicals from factories, illegal dumping of chemicals, leakage from fuel tanks).

Transportation, Utility, and Service Lines include threats from long, narrow transport corridors and the vehicles that use them, which affect stream and watershed ecosystem health. It also includes paved and unpaved highways, secondary roads, logging roads, bridges and causeways, and culverts, as well as electrical and phone wires and oil and gas pipelines. Impacts from this threat include excessive sediment originating from unpaved roads and altered hydrology, connectivity, geomorphology, floodplains, and riparian zones, as well as spills that come from oil tankers or pipelines. Nutrient, organic, and chemical pollution, which is often conveyed across this threat,



Housing and Urban Areas



Commercial and Industrial Area



Transportation, Utility, and Service Lines



Climate Change and Severe Weather

are not included here; however, they are addressed per their respective source (e.g., Housing and Urban Areas).

Climate Change and Severe Weather are threats from long-term climatic changes that may be linked to climate change and other severe climatic or weather events outside of the natural range of variation. This threat can wipe out vulnerable species or habitat, changing habitat composition and location (e.g., sea level rise), and cause droughts, temperature extremes, and extremes in storms and flooding (e.g., tropical storms, hurricanes, erosion of beaches during storms).

Invasive Species include threats from non-native and native plants, animals, pathogens, microbes, or genetic materials that have or are predicted to have harmful effects on watershed habitats and biodiversity following their introduction, spread, or increase in abundance. These harmful plants, animals, pathogens, and other microbes were not originally found within the ecosystem(s) in question and were directly or indirectly introduced and spread into it by human activities.

Garbage and Solid Waste includes rubbish and other solid materials including those that entangle wildlife (e.g., municipal waste, litter from cars, discarded objects from recreational boats, waste that entangles wildlife, construction debris, illegal dumping or dumpsites).

Canals, Dredging, and Other Ecosystem Modifications include actions that convert or degrade habitat in the service of managing natural systems to improve human welfare (e.g., land reclamation projects, abandonment of managed lands, riprap along shorelines, mowing grass, tree thinning in parks, beach construction, snag removal). These threats may also include transport on waterways; activities such as dredging, canals, or shipping lanes; and wakes from boats.

Dams and Water Management is defined as changing waterflow patterns from their natural range of variation, either deliberately or as a result of other activities. These threats include activities such as dam and weir construction, sediment



Invasive Species (cogongrass)



Canals, Dredging, and Other Ecosystem Modifications



Dams and Water Management



Flight Paths

Photo credit: Steven Conry

control, change in salt regime, wetland filling for mosquito control, levees and dikes, surface water diversion, groundwater pumping, channelization, ditching, and creation of artificial lakes and ponds.

Flight Paths include air transport such as flight paths and jets affecting birds. Impacts associated with an airport's footprint would be classified as Commercial and Industrial Areas.

Tourism and Recreation Areas include tourism and recreation sites with a substantial footprint. This threat focuses on the habitat effects of recreation areas, including vacation housing, golf courses, resorts, county parks, associated parking lots, trails, convention centers, and campgrounds. This category is not to be confused with Recreational Activities, which focuses on the disturbance effects posed by recreation. Additionally, this does not include hotels, motels, restaurants, and similar establishments, as they would be captured under Commercial and Industrial Areas.

Recreational Activities include threats from people spending time in nature or traveling in vehicles outside of established transport corridors, usually for recreational reasons. These effects can be caused by off-road vehicles, motorboats, motorcycles, jet-skis, mountain bikes, hikers, birdwatchers, pets brought into recreation areas, temporary campsites, ATVs, and horse riding.

Fire and Fire Suppression includes the suppression or increase in fire frequency and/or intensity outside of its natural range of variation. Examples include fire suppression to protect homes, inappropriate fire management, escaped agricultural fires, arson, campfires, and fires for hunting.

Logging and Wood Harvesting is the harvesting and management of trees and other woody vegetation for timber, fiber, or fuel, including clear-cutting of hardwoods, selective commercial logging, pulp or woodchip operations, and fuel-wood collection on both public and private properties. This threat also includes effects of pollutants and land disturbance to receiving waters in timbered areas such as



Tourism and Recreation Areas



Recreational Activities
Photo credit: Land Trust for the Mississippi Coastal Plain



Fire and Fire Suppression
Photo credit: Carlton Ward, Jr., TNC



Logging and Wood Harvesting
Photo credit: Mark Godfrey, TNC

excessive suspended and bedded sediments from soil erosion due to clear cutting.

Oil and Gas Drilling, Mining and Quarrying, and Renewable Energy are forms of production of non-biological resources and various forms of water use, including the exploration of, development, and production of petroleum and other liquid hydrocarbons (e.g., oil wells, natural gas drilling), minerals and rocks (e.g., gravel and sand quarries, salt mining), and renewable energy (e.g., geothermal power, solar farms, wind farms [including birds flying into windmills], tidal farms). Activities can include sediment or toxic chemical runoff from mining, oil spills that occur at the drill site, and deforestation. Spills that come from oil tankers or pipelines are categorized as Transportation, Utility, and Service Lines.

Fishing and Harvesting Aquatic Resources refers to harvesting aquatic wild animals or plants for commercial, recreation, subsistence, research, or cultural purposes, or for control/persecution reasons. It includes accidental mortality/bycatch and shellfish harvesting.

Air-borne Pollutants are atmospheric pollutants from point and non-point sources such as acid rain, smog from vehicle emissions, excess nitrogen/mercury deposition, wind dispersion of pollutants or sediments, and smoke from forest fires.

Agriculture and Aquaculture refers to effects of farming and aquaculture. In addition, agricultural forestry practices may include fertilizer runoff, soil erosion, and nutrient loading.



Oil and Gas Drilling, Mining and Quarrying, and Renewable Energy



Fishing and Harvesting Aquatic Resources



Air-borne Pollutants
Photo credit: Charlie Ott, TNC



Agriculture and Aquaculture

1.4.3 Terminology

For the purposes of this document, terminology is used that is either common in peer-reviewed scientific literature or is defined by federal conservation agencies such as the U.S. Environmental Protection Agency (USEPA). For threats, standardized language is defined by the World Conservation Union and the Conservation Measures Partnership (Salafsky et al. 2008; Conservation Measures Partnership 2014; see Table 1-4). The names for most threats were modified to reflect local terminology common among stakeholders in south Mississippi. In addition, some threat names represent a merger of two or more Conservation Measures Partnership taxonomies because of the relationship between threats and to simplify communication among the stakeholders.

Table 1-4
Threat Terminology and Taxonomy

CONSERVATION ACTION PLAN TERMINOLOGY	CONSERVATION MEASURES PARTNERSHIP TAXONOMY
Housing & Urban Areas	Housing & Urban Areas Household Sewage & Urban Waste Water
Commercial & Industrial Areas	Commercial & Industrial Areas Industrial & Military Effluents
Transportation, Utility, & Service Lines	Roads & Railroads Utility & Service Lines
Climate Change & Severe Weather	Habitat Shifting & Alteration Droughts Temperature Extremes Storms & Flooding
Invasive Species	Invasive Non-Native/Alien Species Problematic Native Species Introduced Genetic Material
Garbage & Solid Waste	Garbage & Solid Waste
Canals, Dredging, & Other Ecosystem Modifications	Other Ecosystem Modifications
Dams & Water Management	Dams & Water Management/Use
Flight Paths	Flight Paths
Tourism & Recreation Areas	Tourism & Recreation Area
Recreational Activities	Recreational Activities
Fire & Fire Suppression	Fire & Fire Suppression
Logging & Wood Harvesting	Logging & Wood Harvesting
Oil & Gas Drilling, Mining & Quarrying, & Renewable Energy	Oil & Gas Drilling Mining & Quarrying Renewable Energy
Fishing & Harvesting Aquatic Resources	Hunting & Collecting Terrestrial Animals Gathering Terrestrial Plants Fishing & Harvesting Aquatic Resources
Air-borne Pollutants	Air-borne Pollutants
Agriculture & Aquaculture	Agriculture & Aquaculture

1.5 Strategy Development

Strategies: actions or approaches that will be used to improve the health and condition of the stream

Strategies are actions or approaches that will be used to improve the health and condition of the stream. Some strategies were designed to enhance habitat, water quality, or natural function. Other strategies aim to reduce specific threat(s) that affect a stream or its associated values. These actions are intended to reach measurable objectives identified for each stream. Development of the strategies was based on input from the public and recommendations of the Technical Advisory Team.

Through the Public Listening Sessions, participants were asked to evaluate the potential effectiveness of seven commonly used general strategies (see Table 1-5). Participants were also asked for ideas or actions that could be implemented as a stream-specific or broad strategy that would affect multiple streams throughout all nine watersheds.

Table 1-5
General Strategies Ranked from Public Listening Sessions

GENERAL STRATEGY	DESCRIPTION
1. Species Management	Techniques that target individual species and collections of species, and the factors that affect their habitat and abundance
2. External Capacity Building	Engage individuals, agencies, companies, and organizations that have the means and the interest to assist
3. Livelihoods and Economic Incentives	Recognizes that many strategies that make good environmental sense also make good economic sense (on the Mississippi Coast, these would especially apply to the value of tourism in protecting scenic vistas, sportfish, and birds, making the coast a more attractive tourist destination)
4. Land and Water Protection	Includes protecting the physical and chemical integrity of the land and water and its ability to support life (land preservation, wetlands restoration, and non-point source pollution abatement are techniques used for land and water protection)
5. Education and Awareness	Provide information to local residents, decision-makers, educators, and others to encourage their participation in conservation efforts
6. Law and Policy	Work with local governments or communities to implement zoning regulations, and monitor and enforce existing laws, regulations, standards, and codes
7. Land and Water Management	Restore the quality and function of land and water habitats (some actions include removing invasive species, restoring natural habitat, and restoring natural function and stormwater and drainage management)

Two planning workshops for natural resource and conservation professionals were conducted to develop and refine strategic actions for each of the nine coastal streams. Strategies were proposed, then evaluated and ranked as shown in Table 1-6.

Table 1-6
Refined Strategies Ranked from Technical Advisory Team

REFINED STRATEGY	DESCRIPTION
1. Contribution	The degree to which the proposed strategic action, if successfully implemented, will contribute to conserving the target
2. Number of Threats Addressed	The number of threats that can reasonably be expected to be reduced for a stream within the next 10 years if the particular strategic action is successfully implemented
3. Number of Stresses Addressed	The number of stresses that might reasonably be expected to be reduced over 10 years if the strategic action is successfully implemented
4. Duration of Outcome	The degree to which the proposed strategy, if successfully implemented, is likely to secure a long-lasting outcome
5. Leverage	The estimate of any leverage towards other high-impact strategies
6. Leadership	The availability of a lead individual, institution, or organization to implement the potential strategy
7. Ease of Implementation	The degree to which this strategy can be easily implemented
8. Ability to Motivate	The degree to which key constituencies (e.g., landowners, public officials, and interest groups) whose involvement is critical to implementing the strategic action can be motivated to conservation action
9. Cost	The order of magnitude of the estimated costs for implementing the strategic action for the time horizon of the strategy, but no longer than 10 years

1.5.1 Establishment of Objectives

Objectives are specific and measurable statements and, for the purposes of this CAP, follow the S.M.A.R.T. criteria. S.M.A.R.T. is a philosophy that defines objectives using the acronym for specific, measurable, attainable, relevant, and time limited. The use of S.M.A.R.T. objectives ensures that restoration goals are realistic and target specific deficiencies in a timely manner. S.M.A.R.T. objectives also demand accountability from practitioners. Other objectives from conservation plans associated with the watersheds are noted where considered important to the CAP.

Thirty federal, regional, state, local, academic, and stakeholder conservation plans, policies, and publications were compiled and analyzed to extract objectives and strategies relevant to CSHI watersheds. These objectives were sorted into categories of "Threat Abatement," "Maintaining/Enhancing Target Viability," and "Other." Once sorted, S.M.A.R.T objectives were developed that synthesized the various, often-overlapping intent of the original references. The result was the identification of 17 S.M.A.R.T objectives for conserving aquatic resources in the nine coastal streams and watersheds. A full list of objectives suggested for CSHI streams, with references, is included in Appendix D.

The S.M.A.R.T. objectives established for this CAP are set to be applied to all streams combined as a single project area. These objectives are reflective of the best information available. As more information becomes known, these objectives will be refined to the specific stream. Much of the work conducted as part of the project design phase of the CSHI (described in Section 1.6.3), will help to refine objectives for

several streams. This iterative process has been applied to Bear Point Bayou; objectives listed in that chapter are specific to that stream based on information collected as part of the project described in Section 4.6.2.

1.6 Next Steps for Implementation

1.6.1 Site-specific Follow-up

During the CAP process, participants identified site-specific problems in the watersheds. TNC visited all locations to determine how to incorporate this information into the CAP. A full list of these sites and findings is included in Appendix E.

1.6.2 Community Engagement and Education

As an overall strategy for community engagement and education, the project team incorporated stewardship activities for local citizens to perform monitoring activities in their watersheds. The Pascagoula River Audubon Center led the effort to involve a variety of activities for citizen scientists to encourage community stewardship. Activities included water monitoring across the nine streams, seasonal bird monitoring (winter, spring [breeding], and fall) across four of the watersheds, and invasive species removal along several of the streams. Education and outreach efforts reached more than 1,000 schoolchildren and included building rain gardens, learning about native versus invasive species, water quality testing, and stormwater management.

The Pascagoula River Audubon Center staff was primarily responsible for education and outreach . With expertise in recruiting, training, and supporting volunteers; environmental education at all age levels; and classroom teaching experience, a variety of educational opportunities were presented to the community. The ultimate goal was to engage community members at all of the nine stream sites with volunteer initiatives that would positively affect the streamshed, the community, and the CSHI.

Water Quality Monitoring

Volunteer training for water quality monitoring was conducted in Jackson County, Hancock County, and Harrison County in the late summer and fall of 2015. More than 50 community members participated in the trainings, each of which lasted roughly 3 hours and included hands-on practice with the selected water test kits. A total of nine trainings were held across the counties—some with specific groups of volunteers and others open to the public.

Water quality parameters assessed included air and water temperature, pH, dissolved oxygen, salinity, dissolved nitrates, and dissolved phosphates. Volunteers were asked to conduct each test twice for quality control. Each site was tested approximately once monthly, though some sites had more consistent monitors than others. Data collected by volunteers were submitted in raw form to the Pascagoula River Audubon Center and entered into the Adopt-a-Stream website, which is accessible by the public.

Eight of the nine streams were routinely monitored by volunteers. Oyster Bayou was the only stream of the nine that did not receive regular visits from trained volunteers. Bear Point Bayou was monitored

successfully during the academic year by USM Gulf Coast campus students, though it was not visited regularly during the summer months when students were not attending classes.

Bird Monitoring

A volunteer training was held in late fall of 2015 for interested bird monitors. The decision was made to monitor three times each year, and that the monitoring would occur in four of the nine streams. Watts Bayou and Magnolia Bayou in Hancock County do not have much public access, which thereby prevented the use of standard bird-monitoring protocol.

Surveys were designed to be completed in the mid-winter, spring (migration/breeding), and fall (migration). Given the varying public access around each site and the differing acreage around each urban stream corridor, it was determined by skilled birders (and confirmed by consultation with a professional ornithologist from the American Bird Conservancy) that a survey format would be the most suitable for data collection and analysis. Unlike the water monitoring volunteers, bird monitors were expected to be skilled in birding by sight and sound before the start of the project.

Invasive Species Removal/Monitoring

Most of the urban stream corridors host invasive plant species. Several workshops and plant removal workdays were held to educate the public on recognizing, removing, and controlling the spread of invasive species. These workshops were intended to help homeowners recognize and remove invasive species in their own backyards, as well as to facilitate the removal of plants at some of the urban stream sites.

In Jackson County, three different workshops were held at different locations within the coastal stream sites. In Harrison County, a 2-day-long invasive species removal project took place in April 2016 at Clower-Thornton Wildlife Area, a public access point for Coffee Creek. Training on invasive species was also held for the summer 2016 participants of The Corps Network to facilitate their work in the coastal streams and throughout the coastal counties.

Tidal Marsh Restoration and Mitigation Workshops

Three workshops were offered at the Pascagoula River Audubon Center to help engage and educate about tidal marsh restoration best practices. These workshops were aimed at politicians, environmental professionals, and city, state, and county personnel. Approximately 60 people from across the coast participated.

Education and Outreach Initiatives

A variety of classroom and site visits were completed, primarily with middle school (sixth to eigth grade) students. All of the seventh graders at Colmer Middle School in Pascagoula (Jackson County) received 2 days of instruction about water quality, water monitoring, rain gardens, and stormwater runoff. Their second day of instruction was a field trip to I.G. Levy Park in Pascagoula, where they participated in water testing, planting a rain garden, and other hands-on activities designed to encourage problem solving around stormwater. This project reached approximately 140 students.

All of the sixth grade students in Gulfport Public Schools (Harrison County) attending Gulfport Central and Bayou View Middle schools received a 4-day training on stormwater management. Their culminating project was a student version of the urban streams public meetings, where students were able to decide their top three values about their urban stream. Brickyard Bayou and a small tributary to the bayou are accessible at each school site. This project was a collaboration with the Gulf Coast Community Design Studio and reached almost 500 sixth graders.

Finally, all of the eighth grade students from Magnolia Middle School (Moss Point, Jackson County) participated in a 1-day field trip designed to teach them about stormwater, runoff, native plant rain gardens, and the benefits of clean stream sheds. The students were able to do some water testing of Rhodes Bayou, plant a native plant garden, and make calculations about collecting rainwater from impervious surfaces. This project reached 140 students.

1.6.3 Development and Recommendations for Project Design

An important component of the CSHI was to take the information developed from the CAP process and create conceptual designs of potential projects. These conceptual projects were designed to support future restoration efforts by identifying and describing areas of stream impairments, providing baseline data needed for more advanced planning and, where possible, drafting a suite of possible options to improve those impairments. The number of projects considered, and ultimately initiated, was dependent on the amount of funding available. Efforts were made to achieve equivalency among the nine coastal streams in this project and to advance projects that would have the greatest conservation impact in future restoration efforts.



2 MAGNOLIA BAYOU

2.1 General Description of Watershed

Magnolia Bayou is a coastal stream in eastern Hancock County, Mississippi. The 772-acre watershed lies entirely within the city limits of Bay St. Louis. The stream has two forks, both forming from natural springs. One fork of the stream flows northeast from downtown Bay St. Louis and the other southeast, joining shortly before they enter the Bay of St. Louis at the Bay-Waveland Yacht Club. The stream is approximately 1 mile in length and is tidally influenced up to 0.5 mile upstream.

Today, Magnolia Bayou is a quiet stream, flowing through a stand of common reed and utilized only by wildlife and the occasional kayakers; however, there was a time when it was much more active. In the late 1800s, it was a lumber port, shipping the products of Mississippi's burgeoning timber industry. In 1904, it became the home of Peerless Oysters, a massive oyster processing and canning plant. This huge installation had its own fire department, a fleet of oyster boats, and many housing units for seasonal workers who came from the East Coast. In the off-season, the plant processed vegetables. The Great Hurricane of 1947 destroyed the plant. Many signs still mark its location, including the concrete floors of several of the buildings and the huge deposits of oyster shells along the beaches by the Yacht Club. Much of the watershed is developed with many single- and multi-family homes, retail areas, and schools. However, a portion of land west of the Yacht Club, perhaps 15% of the watershed, remains essentially unaltered marsh.

Many of the problems common to urban basins affect the Magnolia Bayou watershed. Issues such as streamside development, roads, bridges, stormwater runoff, degraded stream channels and riparian areas, fish passage barriers, and invasive species are widespread. Fish passage is blocked at U.S. Highway 90 on the southern branch by impassable culverts. Invasive species include Chinese tallow trees, bamboo, common reed, water hyacinth, and cogongrass.

The RSAs found an interesting diversity of native freshwater, estuarine, and marine fish species at various locations in the watershed. Marine invertebrates including mollusks, shrimp, crabs, hermit crabs, and sea jellies were found near the mouth of the stream. A list of the species is included in Appendix F.

Magnolia Bayou has limited recreation potential because of its small size and private ownership along the bayou. The best recreational opportunities are birding, wildlife viewing, and other types of nature study. The stream is accessible by kayak for less than 300 feet until the low bridge on Beach Boulevard. A limited amount of recreational fishing and crabbing is possible from the bridge at Beach Boulevard.

2.2 Conservation Action Plan

In the past, TNC has successfully implemented a ten-step CAP process for defining the conservation projects, developing and implementing strategies and measures, and using the results to adapt and improve conservation outcomes (TNC 2007). A facilitator led the CAP process with each watershed stakeholder group. Through a series of workshops or meetings, they worked together to identify conservation targets, analyze target threats, identify objectives and outcomes, develop strategic actions, and define indicators and measures to monitor success. In the CAP process, Watts Bayou and Magnolia Bayou were evaluated as a single target unit for their threat assessment and viability assessment due to similarities and size.

2.2.1 Stakeholder Engagement

The Magnolia Bayou Public Listening Sessions were part of a series of public forums for the CSHI within nine target stream areas. TNC conducted three Public Listening Sessions in May 2015 for residents of Watts Bayou and Magnolia Bayou watersheds. Input from these meetings informed the CAP process. The

summarized results of Magnolia Bayou's scope, perceived problems or threats, and identified solutions to the problems from the meetings are included in Appendix A.

2.2.2 Nested Targets

Imbedded or nested targets within Magnolia Bayou include a variety of biological and functional components to be considered for conservation as a part of this drainage. These include the actual stream, watershed, riparian corridor, and tidal zone. Upland native vegetation, forest habitat, and wetlands, as well as species assemblages of native fishes, stream invertebrates, and migratory bird species are also considered. A listing of species of conservation concern is included in Appendix F, and a listing of habitats in this stream is included in Appendix G. In addition to species and habitats, participants in the Public Listening Sessions were given a list of 16 biological and functional components to rank in order of importance for conservation value for their watershed. The top values from the Public Listening Sessions are as follows, in order of importance:

1. Habitat for Plants and Animals
2. Clean Water for the Gulf
3. Clean Water for the Watershed

2.3 Habitat Assessment: Stream Health

2.3.1 Rapid Stream Assessments

RSAs were conducted at three sites on Magnolia Bayou (see Appendix H). Scoring results were averaged from individual assessments, with an average score of 4.70 out of 10. This score indicates that Magnolia Bayou is in fair condition as rated by the SVAPv2. This is consistent with the overall viability ranking for the stream.



Northern branch of Magnolia Bayou

The most impaired areas of Magnolia Bayou are in the residential neighborhoods west of Dunbar Avenue on the north tributary. The greatest impacts observed on the stream were a lack of invertebrate habitat and poor invertebrate populations. An additional serious problem is the presence of many invasive plants, including common reed, bamboo, water hyacinth, and Chinese tallow tree along many stretches of the stream. There are no fish passage barriers along most of the stream's channels until the stream reaches U.S. Highway 90. The least impaired sections of Magnolia Bayou are the forested areas of the Society of the Divine Word Seminary grounds on the south tributary and the area of marsh just upstream from Beach Boulevard.

2.3.2 Water Quality Data

The quality of the water is a critical component to the health of stream habitats. It effects estuarine and marine environments in Mississippi Sound and can be reflective of conditions upstream and over the entire watershed. Creating a baseline of water quality is important to understanding the current conditions of a stream, monitoring its health, and measuring change over time. The MDEQ Field Services Division collected water quality data on all nine streams from March 1, 2016, to August 31, 2016. Data were collected under the guidelines of the MDEQ Quality Assurance Project Plan Section 106 Monitoring Network in the State Surface Water Monitoring and Assessment Program. Two sample locations were established for each stream, except in Watts Bayou where the limited public access points allowed for only one sample site. Nineteen different sampling measures were taken twice a month, and one measure for biological oxygen demand was taken monthly. A complete list of the parameters for the water quality analyses is included in Appendix I. Data collected from this sampling were used to inform the stream's Viability Assessment.

For Magnolia Bayou, data results showed multiple excursions of the existing dissolved oxygen standard, but there is no other evidence to indicate that these values are outside of the expected natural background in systems of this type. It is important to recognize that this sampling took place over a limited period, and longer-term monitoring is recommended. Extended monitoring will establish a more robust baseline, establish trends, and alert stakeholders to chronic or acute problems as they develop.

2.3.3 Viability Assessment Summary Results

Watts and Magnolia Bayous were analyzed together due to size and proximity. The overall ranking was "**Fair**" due to significant lack of floodplain connectivity, conversion of wetlands, channel alterations, and percent of impervious services. For Magnolia Bayou, land cover changes from development have removed the riparian vegetative zone areas. The stream channel appears to have been altered and redirected in places to support drainage. Two wildlife passage blockages were identified at the road crossings of U.S. Highway 90 and Esplanade Avenue. The condition ranking of "Fair" reflects the presence of invasive species; but in general, the streambank is stable with few litter issues. The attributes for water quality were ranked "Very Good" due to no impairments detected for nitrogen, nitrite, phosphorous, and dissolved oxygen. The size rating of "Fair" reflects the small size of remaining riparian corridor for both of these streams.

2.4 Factors of Stream Degradation: Stresses and Threats

2.4.1 Primary Stresses

The following six stresses were identified for Magnolia Bayou during the CAP process:

1. Altered Floodplains and Wetlands
2. Altered Riparian Corridor
3. In-stream Habitat Modification
4. Altered Stream Geomorphology
5. Altered Connectivity
6. Invasive Species

Altered Floodplains and Wetlands

Downstream stretches of Magnolia Bayou retain small areas of intact coastal marsh. In upstream areas, the floodplain is more heavily developed with roads, parking areas, retail business, homes, and schools. Undeveloped areas of the floodplain are nonexistent in the upper extent of the drainage.

Altered Riparian Corridor

In residential areas, little or no riparian vegetation remains, with landscaping and lawns established up to the streambank. Sections near the mouth of the stream have intact wetlands and riparian corridor for less than 0.25 mile.

In-stream Habitat Modification

Channelization has been noted in many areas of the northern branch of Magnolia Bayou, where the southern branch does not have obvious modifications. In residential areas, the small stream channels appear to have been modified for stormwater control.

Altered Stream Geomorphology

Sections of Magnolia Bayou appear to have been redirected, and some areas deepened for stormwater management purposes. This stream is not dredged often, as it is not currently navigable to vessels larger than a kayak.

Altered Hydrology

Increases in water quantity and water velocity of stormwater flow are likely due to impervious surfaces in the drainage. Residential roadways and U.S. Highway 90 cross the stream frequently. Extensive impervious surfaces (mostly parking lots) exist in commercial areas. Stormwater from these areas increases the amount and velocity of water entering the stream during rain events.

Altered Connectivity

Connectivity appears to exist in a few places, even with the developed land cover; however, little natural floodplain remains in the upper drainage. Several culverts act as wildlife passage impediments; in particular, the culverts that run under U.S. Highway 90 are not at stream grade and present a large connection problem for fish passage.

Invasive Species

Invasive species of concern in Magnolia Bayou include plant species such as cogongrass, Chinese tallow trees, torpedo grass, kudzu, and elephant ear. These species outcompete native plant communities—often resulting in a near monoculture with low biodiversity in comparison to a native riparian community. Water hyacinth is one invasive aquatic species observed. Giant salvinia was not observed, but should be monitored because it is a concern for resource managers. The only invasive animal species observed were domestic/feral cats, which pose a concern to native wildlife—particularly bird species. Nutria were not observed, but are likely to be present in this watershed. Nutria should be monitored as they are herbivores that can pose a threat to vegetation and small trees; their foraging activities can also directly damage bank stability. Nile tilapia were not observed in Magnolia Bayou, but have been collected in other Mississippi streams. Tilapia pose a threat to native species diversity and should be monitored.

2.4.2 Primary Threats

Primary threats were identified and ranked by stakeholders as the sources of stress for each watershed. The ten threats for Magnolia Bayou are as follows:

1. Housing and Urban Areas
2. Commercial and Industrial Areas
3. Transportation, Utility, and Service Lines
4. Climate Change and Severe Weather
5. Invasive Species
6. Garbage and Solid Waste
7. Canals, Dredging, and Other Ecosystem Modifications
8. Dams and Water Management
9. Recreational Activities
10. Fishing and Harvesting Aquatic Resources

2.5 Taking Action

Developing effective strategic action and objectives to abate critical threats and restore function to Magnolia Bayou watershed is essential to conservation planning. If successfully implemented, strong conservation strategies collectively should conserve the stream and realize the project vision.

2.5.1 Conservation Strategies

Ultimately, seven strategies were developed that are specific to Magnolia Bayou or are part of a broader watershed approach. Figure 2-1 depicts the development of these strategies and the potential stream improvements that would occur as a result of their implementation.

1. Create Community Outreach and Engagement (Adopt-a-Stream)

This strategy combines two individual strategies that were previously presented as standalone efforts in public meetings in November 2015. The first strategy was Create Community Outreach and Engagement, with specific actions to engage with the Keep Mississippi Beautiful program at the city and state levels. The

second strategy was to implement a local Adopt-a-Stream Program to engage the Hancock Chamber of Commerce. The combined strategy takes a watershed approach to community outreach and enables efforts to develop partnerships with local government and business groups. The message to these groups is that a healthy watershed is an important asset for economic interests and also provides benefits for the community.

2. Protect Land

Although much of the Magnolia Bayou watershed is developed, small sections remain in good condition and would need little restoration to improve function. In particular, intertidal areas around the mouth of the bayou maintain good connectivity to the Mississippi Sound and the Bay of St. Louis. Where applicable, land protection techniques such as establishing easements, negotiating deed restrictions for future development, or fee acquisition could be utilized. Acquisition of lands would only be from willing sellers and would require an appropriate land management agency or organization to manage.

3. Replace Failing Bulkheads (Living Shorelines)

Many waterfront areas of Magnolia Bayou use bulkheads or other hardened structures to protect and maintain property. As these structures age and begin to deteriorate, opportunities exist to replace these structures with more natural designs that promote habitat and connectivity, such as living shorelines. The use of living shorelines is not widespread in Mississippi, and the longer-term benefits are just now being realized. As these techniques continue to be refined and developed, their application for small, site-specific implementation will be better understood.

4. Stabilize Streambanks

Erosion of streambanks can cause buildup of suspended sediments in the water column and create alterations to the stream channel and its flow as deposition areas build up over time. In many areas, erosional issues are obvious, but in other locations, the issue is not easily identified. Stream areas should be surveyed to identify areas of erosion for planning purposes. Efforts could then be made to identify possible solutions to slow, stabilize, or abate the threat posed to the bank. These solutions may take the form of site-based installation concepts that can be used by landowners and/or partners for implementation.

5. Establish a Cooperative Invasive Species Program

Invasive species are a problem in every target stream of this CAP. A cooperative invasive species management program will engage landowners and local government in a coast-wide effort to identify invasive species hotspots and take corrective actions.

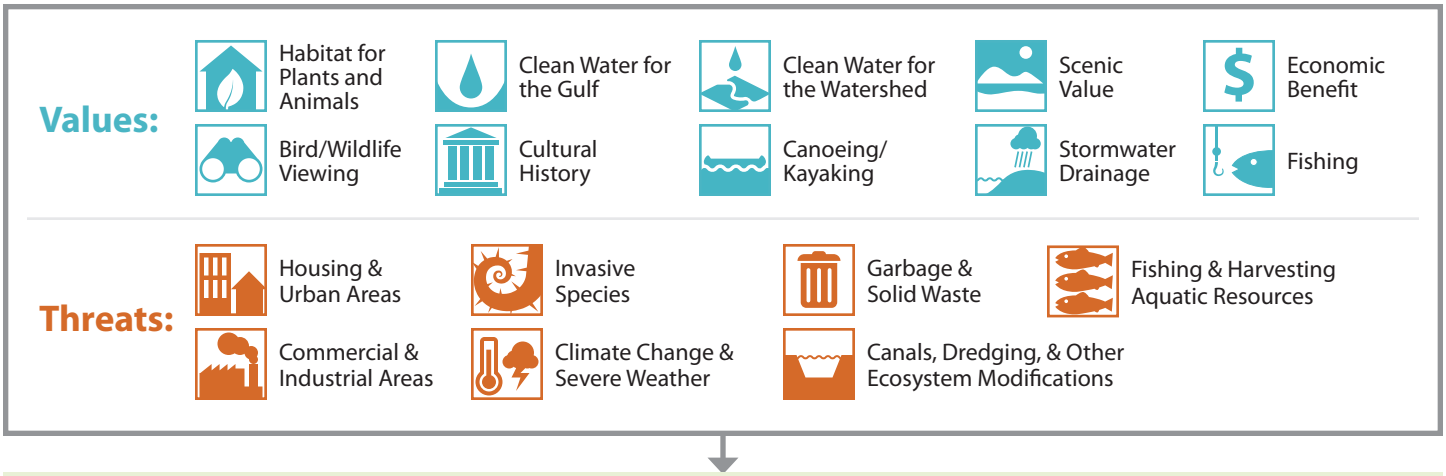
6. Create a Coast-wide Litter Literacy and Mitigation Strategy

Litter and solid waste were identified as major problems by the attendees at every CSHI public meeting. A litter literacy and mitigation program could devise ways to reduce litter. The most important part of this effort would be a public education program.

7. Engage Local Governments in the Implementation of Stormwater and Hazard Mitigation Plans

This strategy was proposed during Conservation Planning Workshops and presented at public meetings in November 2015, but was not developed for this CAP. Details are currently not available, and the ultimate inclusion of this approach should be considered for future iterations of this plan.

Figure 2-1
Magnolia Bayou Conservation Strategies



Conservation Strategies and Benefits to Streams

#1 Create Community Outreach and Engagement (Adopt-a-Stream)

(1) Percentage of Impervious Surfaces, (2) Percentage of Floodplain and Wetland Conversion, (3) Invasive Species, (4) Solid Waste and Litter, and (5) Vegetative Riparian Zone Width

#2 Protect Land

(1) Floodplain Accessibility, (2) Number of Aquatic Passage Barriers, (3) Percentage of Floodplain and Wetland Conversion, (4) Channel Alteration, (5) Bank Stability, and (6) Riparian Vegetative Zone Width

#3 Replace Failing Bulkheads (Living Shorelines)

(1) Floodplain Accessibility, (2) Channel Alteration, (3) Bank Stability, (4) Riparian Vegetation Zone Width, and (5) Number of Aquatic Barriers

#4 Stabilize Streambanks

(1) Floodplain Accessibility, (2) Channel Alteration, (3) Bank Stability, and (4) Riparian Vegetation Zone Width

#5 Establish a Cooperative Invasive Species Program

(1) Riparian Vegetation Zone Width, (2) Invasive Species, (3) Floodplain Accessibility, and (4) Bank Stability

#6 Create a Coast-wide Litter Literacy and Mitigation Strategy

(1) Solid Waste and Litter

#7 Engage Local Governments in the Implementation of Stormwater and Hazard Mitigation Plans

Details are currently not developed

2.5.2 S.M.A.R.T. Objectives

The S.M.A.R.T. objectives that apply to Magnolia Bayou are included in Table 2-1. The full list of objectives and their associated references are included in Appendix D.

Table 2-1
Magnolia Bayou S.M.A.R.T. Objectives

S.M.A.R.T. OBJECTIVE	NOTES
TRANSPORTATION, UTILITY &SERVICE LINES	
Protect stream connectivity: • By 2026, ensure that all new stream crossings use construction materials and techniques that do not alter connectivity in CSHI watersheds	*Magnolia Bayou is negatively affected by many road crossings. Work with local officials to see that any future crossings do not further affect the stream.*
INVASIVE SPECIES	
Restore or improve ecological balance in systems negatively affected by invasive species: • By 2026, reduce annual increase in Nonindigenous Aquatic Species to 3% annually	*Magnolia Bayou may have the most pervasive and diverse invasive plant community of any CSHI stream. Chinese tallow tree, bamboo, common reed, elephant ear, and water hyacinth are present in various stretches of Magnolia Bayou, making the stream an ideal candidate for a comprehensive invasive control and education project. Engage local officials, landowners, residents, and civic groups in locating, removing, and replacing nonnative plants.*
CANALS, DREDGING, & OTHER ECOSYSTEM MODIFICATIONS	
Encourage agencies that permit shoreline stabilization to consider alternative shoreline erosion control approaches before hardened stabilization is approved: • By 2026, remove or replace hardening structures that degrade habitat in CSHI watersheds at ten sites	*Some areas of Magnolia Bayou have hardened shorelines, including many homemade efforts involving bricks and concrete debris. See that all decision-makers, regulators, contractors, and local landowners have information on the techniques and advantages of more natural shoreline protection. Locate sites for one or more demonstration projects to showcase natural shoreline protection strategies.*
ALTERED FLOODPLAINS & WETLANDS	
Reduce impact of development on the physical habitat in freshwater systems: • By 2026, reduce the number of acres of altered freshwater wetlands drained or converted through development annually in CSHI watersheds to 50% • By 2026, increase the percentage of urban and suburban natural patches (10 to 100 acres) in CSHI watersheds by 35%	*Small areas of natural patches occur in Magnolia Bayou, especially on private lands along the south fork. Engage the Seminary (Eternal Word) and other landowners to secure protection for these natural sites.*
Conserve, restore, and create coastal estuarine and marine habitats: • By 2026, improve overall coastal condition indices in estuarine portions of CSHI streams to 3.9 • By 2026, reduce the percentage of CSHI estuarine areas rated "Poor" for water quality to 0% • By 2026, reduce the percentage of sediment-impaired CSHI estuarine areas to 11% (CSHI streams) • By 2026, reduce the percentage of benthic habitat rated "Poor" to 14% (CSHI streams),	*Magnolia Bayou has suffered from all of the listed impairments. Work with local elected officials, landowners, and interested citizens and groups to locate any areas that fit these indices and draft a comprehensive plan to correct as many problems as possible.*

S.M.A.R.T. OBJECTIVE	NOTES
• By 2026, reduce wetlands loss indices to 1.29 (Gulf of Mexico) • By 2026, prevent additional erosion on shorelines suffering "severe erosion" by 10% • By 2026, identify, create, restore, or enhance significant acreage of high-priority coastal wetlands	
OUTREACH, EDUCATION, & STAKEHOLDER ENGAGEMENT	
Expand conservation constituency: • By 2026, develop formal partnerships with five agencies, user groups, or neighborhood associations, and propose and implement local conservation efforts with these groups	*Magnolia Bayou has a small number of very interested constituents, including landowners, local residents, and various civic groups. Develop education and citizen participation efforts such as Adopt-a-Stream and community cleanups to further engage locals. Invite elected officials, other city leaders, business groups, and civic organizations to be part of the engagement effort.*

2.5.3 Other Objectives

Other objectives found to be relevant to the CAP are listed in Table 2-2.

Table 2-2
Magnolia Bayou Other Objectives

OTHER OBJECTIVE	NOTES
CANALS, DREDGING, & OTHER ECOSYSTEM MODIFICATIONS	
Encourage agencies that permit shoreline stabilization to consider alternative shoreline erosion control approaches before hardened stabilization is approved: • Involve all agencies and organizations in strategies related to shoreline stabilization • Provide appropriate information on alternative shoreline erosion control approaches • Protect and enhance aquatic biodiversity • Protect and enhance terrestrial biodiversity • Maintain healthy aquatic community integrity • Protect and restore existing native fish populations • Maintain populations of native non-game fishes and aquatic invertebrates at or above present levels throughout the basin • Improve water quality for drinking water, and to protect and restore existing native fish populations	*Some areas of Magnolia Bayou have hardened shorelines, including many homemade efforts involving bricks and concrete debris. See that all decision-makers, regulators, contractors, and local landowners have information on the techniques and advantages of more natural shoreline protection. Locate sites for one or more demonstration projects to showcase natural shoreline protection strategies.*
ALTERED FLOODPLAINS & WETLANDS	
Acquire and protect coastal habitat: • Identify, acquire, and protect significant acreage of high-priority coastal wetlands through fee simple, easements, or protective agreements	*A large and significant area of natural marsh still remains upstream from Beach Boulevard. Using acquisition, conservation easements, or other legal tools, secure protection for this area. Magnolia Bayou has suffered from all of the listed impairments. Work with local elected officials, landowners, and interested citizens and groups to locate any areas that fit these indices and draft a comprehensive plan to correct as many problems as possible.*

OTHER OBJECTIVE	NOTES
OUTREACH, EDUCATION, & STAKEHOLDER ENGAGEMENT	
Increase public awareness and interest in the values and functions of coastal wetlands, their habitats, and the ecosystem on which they are dependent: • Develop and deliver education materials and programs to inform the public about wetlands species, their habitat, and values to humans	*Magnolia Bayou has a small number of very interested constituents, including landowners, local residents, and various civic groups. Develop education and citizen participation efforts such as Adopt-a-Stream and community cleanups to further engage locals. Invite elected officials, other city leaders, business groups, and civic organizations to be part of the engagement effort.*
POLICY	
Work with cities to support, revise, and enforce city-wide tree protection ordinances	*Determine whether Bay St Louis has any ordinances that promote the protection and planting of trees. If no plan exists, work with the city to develop a plan that incentivizes or encourages the planting of native trees in the watershed.*
FUNDING	
Dedicate funding to support long-term restoration: • Find private funding sources • Investigate funding opportunities • Identify and create alternative funding strategies for capital projects and long-term sustainability of greenway infrastructure	*Following planned restoration effort, it is important to maintain the gains achieved. Look at all possible funding sources to continue for maintenance and monitoring efforts in perpetuity.*
Seek funding to expand CSHI coverage to other streams in Mississippi's coastal counties	*The Bay Waveland area has a number of other streams, both large and small, which could benefit from the same attention given Magnolia Bayou. Seek out funding and stakeholder groups to help push these efforts forward.*

2.6 Next Steps for Implementation

2.6.1 Site-specific Follow-up

Attendees at the two public meetings for Magnolia Bayou identified four sites of concern along the stream. Specific issues mentioned included invasive plants and a failing septic system. TNC staff visited all listed sites on October 27, 2015. At the same time, TNC staff visited four road and rail crossings to check for fish passage issues. During this visit, TNC detected a previously unknown tributary of Magnolia Bayou and added it to project maps. A full list of these sites and findings is included as Appendix E.

2.6.2 Development of Project Design

A component of the CSHI was to take the information developed from the conservation planning process and draft conceptual designs of potential projects. These conceptual projects were designed to support future restoration efforts by identifying and describing areas of stream impairments, providing baseline data needed for more advanced planning, and, where possible, drafting a suite of possible options to improve those impairments. The number of projects considered and ultimately initiated was dependent on the amount of funding available. Efforts were made to achieve equivalency among the nine coastal

streams in this project, and advance projects that would have the greatest conservation impact in future restoration efforts. For Magnolia Bayou, the following projects were recommended for conceptual design development to be completed by the end of September 2016.

Stream Assessments

As previously mentioned in the Viability Assessment section, very little baseline data on stream conditions were present prior to the start of this project. The initial snapshot created by the RSAs provided a needed general overview of each stream's condition. This assessment was not designed or intended to provide the site-specific level of detail needed for conceptual projects. The stream assessments conceptual project will identify, describe, map, and rank areas of impairments on the six mid-sized project streams. Data collected on existing in-stream conditions would identify future potential restoration opportunities. A limited number of "planning areas" will be identified, with recommendations and costs for potential improvements. The six streams included in this project are Watts Bayou, Magnolia Bayou, Coffee Creek, Oyster Bayou, Rhodes Bayou, and Bayou Chicot.

Evaluation of Land Protection Opportunities

While all streams in this project are located within urban areas, there is a limited amount of natural habitat that can be protected through standard land protection strategies. TNC would evaluate and rank areas of natural habitat as potential land protection areas. Part of this evaluation could include land appraisals of parcels when a willing landowner is identified. As mentioned in the Conservation Strategies section of this CAP, a second part of this evaluation would be to identify a potential land manager for any lands protected.

In addition to the conceptual projects listed above, additional projects were drafted, but funds were not available to implement. We recommend that these projects be considered for implementation as funding is secured. For Magnolia Bayou one such project was the Wildlife Corridor conceptual project. The main purpose of this project was to design culvert replacements and restore wildlife passage along the riparian corridor to address the wildlife passage issue and also maintain a stable stream channel. Over the course of the CSHI, approximately 15 wildlife passage impairments were identified across the nine streams.



3 WATTS BAYOU

3.1 General Description of Watershed

Watts Bayou is a coastal stream located in eastern Hancock County, Mississippi. The watershed covers 2,171 acres and begins in the town of Bay St. Louis. Watts Bayou flows northward into the Jourdan River, joining with Edwards Bayou at its mouth, south of Cameron Island. The total length of Watts Bayou is about 4 miles with two branches of approximate equal length (see Appendix B). Once known as Galare Bayou, the name was changed in the 1940s to align with a nearby development project. The stream is located in mostly urban areas with extensive housing development, particularly in the upper basin. U.S. Highway 90, the major east-west thoroughfare through Hancock County, crosses the bayou.

Watts Bayou has many challenges, including significant stream and riparian alteration, especially artificial access canals that have been constructed to allow homeowner access to the water near the mouth of the stream. Some of these canals may have been natural, but maintenance dredging has widened and deepened them over time. Other canals appear to have been constructed through the marsh to provide additional access. The watershed is populated with retail areas, hospitality businesses, and offices. The stream is tidally influenced for much of its length. There is also extensive shoreline hardening along the lower stream, ostensibly to protect waterfront homes. In many cases, these homes were destroyed by Hurricane Katarina and the hardening structures have fallen into disrepair. Invasive plants are widespread, particularly in the forested areas. In some areas, the primary tree species present is Chinese tallow.

The upper basin extends up to U.S. Highway 90, where habitat alteration has occurred by construction of roads, housing, and commercial development. Tracking the stream in this area is difficult due to development and stream alteration. Downstream of this commercial area, Watts Bayou transitions into its middle basin and maintains some natural areas including coastal pine savanna, freshwater marsh, and estuarine marsh. Invasive plant species dominate the remnant pine savanna habitat.

The stream has potential for outdoor recreation, including kayaking and canoeing, recreational fishing, and nature study. There is no public road access to the stream, but the stream is accessible by kayak for more than 1 mile upstream from the confluence with the Jourdan River.

3.2 Conservation Action Plan

In the past, TNC has successfully implemented a ten-step CAP process for defining the conservation projects, developing and implementing strategies and measures, and using the results to adapt and improve conservation outcomes (TNC 2007). A facilitator led the CAP process with each watershed stakeholder group. Through a series of workshops or meetings, they worked together to identify conservation targets, analyze target threats, identify objectives and outcomes, develop strategic actions, and define indicators and measures to monitor success. In the CAP process, Watts Bayou and Magnolia Bayou were evaluated as a single unit for their threat assessment and viability assessment due to similarities and size.

3.2.1 Stakeholder Engagement

The Watts Bayou Public Listening Sessions were part of a series of public forums for the CSHI within the nine target stream areas. TNC conducted three Public Listening Sessions in May 2015 for residents of the Watts Bayou and Magnolia Bayou watersheds. Input from these meetings informed the CAP process. The summarized results of Watts Bayou's scope, perceived problems or threats, and identified solutions to the problems from the meetings are included in Appendix A.

3.2.2 Nested Targets

Imbedded or nested targets within Watts Bayou include a variety of biological and functional components to be considered for conservation as a part of this drainage. These include the actual stream, watershed, riparian corridor, and tidal zone. Upland native vegetation, forest habitat, and wetlands, as well as species

assemblages of native fishes, stream invertebrates, and migratory bird species are also considered. A listing of species of conservation concern is included in Appendix F, and a listing of habitats in this stream is included in Appendix G. In addition to species and habitats, participants in the Public Listening Sessions were given a list of 16 biological and functional components to rank in order of importance for conservation value for their watershed. The top values from the Public Listening Sessions are as follows, in order of importance:

1. Habitat for Plants and Animals
2. Clean Water for the Gulf
3. Scenic Value
4. Bird and Wildlife Viewing

3.3 Habitat Assessment: Stream Health

3.3.1 Rapid Stream Assessments

RSAs were conducted at three sites on Watts Bayou (see Appendix H). Scoring results were averaged from individual assessments, with an average score of 5.62 out of 10. This score indicates that Watts Bayou is in fair to good condition as rated by the SVAPv2. This is consistent with the overall viability ranking for the stream.



Rapid Stream Assessment training

Impairments identified from the RSAs are largely due to alterations to the channel for residential access. The most impaired areas were found near the stream's confluence with the Jourdan River, where extensive waterfront home development has produced artificial boat channels and significant shoreline hardening. Another important impact observed was the stream's lack of canopy cover over much of its length. The strongest feature was the absence of fish passage barriers along almost the entire stream course. The least impaired sections of Watts Bayou include the middle stream areas where urban development is negligible and there is no road access. This area is characterized by expanses of intact marsh and pine savanna dominated by invasive plant species.

3.3.2 Water Quality Data

The quality of the water is a critical component to the health of stream habitats. It effects estuarine and marine environments in Mississippi Sound and can be reflective of conditions upstream and over the entire watershed. Creating a baseline of water quality is important to understanding the current conditions of a stream, monitoring its health, and measuring change over time. The MDEQ Field Services Division collected water quality data on all nine streams from March 1, 2016, to August 31, 2016. Data were collected under the guidelines of the MDEQ Quality Assurance Project Plan Section 106 Monitoring Network in the State Surface Water Monitoring and Assessment Program. Two sample locations were

established for each stream, except in Watts Bayou where the limited public access points allowed for only one sample site. Nineteen different sampling measures were taken twice a month, and one measure for biological oxygen demand was taken monthly. A complete list of the parameters for the water quality analyses is included in Appendix I. Data collected from this sampling were used to inform the stream's Viability Assessment.

For Watts Bayou, no water quality impairments or potential areas of concern were identified though this sampling. It is important to recognize that this sampling took place over a limited period, and longer-term monitoring is recommended. Extended monitoring will establish a more robust baseline, establish trends, and alert stakeholders to chronic or acute problems as they develop.

3.3.3 Viability Assessment Summary Results

Watts and Magnolia Bayou were analyzed together due to size and proximity. The overall ranking was "**Fair**" due to significant lack of floodplain connectivity, conversion of wetlands, channel alterations, and percent of impervious services. In Watts Bayou, much of the lower bayou has been developed as home sites with bulkhead and boat slips, and numerous artificial channels have been constructed to increase waterfront opportunities. In contrast, there are not many barriers to fish passage. The condition ranking of "Fair" reflects the presence of invasive species; but in general, the streambank is stable with few litter issues. The attributes for water quality were ranked "Very Good" due to no impairments detected for nitrogen, nitrite, phosphorous, and dissolved oxygen. The size rating of "Fair" reflects the small size of remaining riparian corridor for both of these streams.

3.4 Factors of Stream Degradation: Stresses and Threats

3.4.1 Primary Stresses

The following four stresses were identified for Watts Bayou during the CAP process:

1. Altered Floodplains and Wetlands
2. Altered Riparian Corridor
3. Altered Stream Geomorphology
4. Invasive Species

Altered Floodplains and Wetlands

Much of the lower reach of Watts Bayou has hardened shorelines (e.g., bulkheads), which were constructed to protect waterfront homes. Concrete boat slips are also common in this area. Artificial boat canals have been constructed to create waterfront home sites and boat access.

Altered Riparian Corridor

Hardened shorelines and waterfront development have eliminated the riparian corridor in the lower reaches of the stream. Residential streamside structures (e.g., boat slips, decks, piers, landscaped yards) extend to the water's edge.

Altered Stream Geomorphology

The lower reaches of Watts Bayou have many artificial channels and canals. These modifications typically consist of a straightened canal, connected with perpendicular access channels to home sites.

Invasive Species

In many areas of the Watts Bayou Watershed, Chinese tallow trees are the most common tree species present. Other invasive species of concern include cogongrass, torpedo grass, and elephant ear. These species outcompete native plant communities—often resulting in a near monoculture with low biodiversity in comparison to a native riparian community. Water hyacinth is one invasive aquatic species observed. Giant salvinia was not observed, but should be monitored because it is a concern for resource managers. The only invasive animal species observed were domestic/feral cats, which pose a concern to native wildlife—particularly bird species. Nutria were not observed, but are likely to be present in this watershed. Nutria should be monitored as they are herbivores that can pose a threat to vegetation and small trees; their foraging activities can also directly damage bank stability. .

3.4.2 Primary Threats

Primary threats were identified and ranked by stakeholders as the sources of stress for each watershed. The ten threats for Watts Bayou are as follows:

1. Housing and Urban Areas
2. Commercial and Industrial Areas
3. Transportation, Utility, and Service Lines
4. Climate Change and Severe Weather
5. Invasive Species
6. Garbage and Solid Waste
7. Canals, Dredging, and Other Ecosystem Modifications
8. Dams and Water Management
9. Recreational Activities
10. Fishing and Harvesting Aquatic Resources

3.5 Taking Action

Developing effective strategic action and objectives to abate critical threats and restore function to Watts Bayou watershed is essential to conservation planning. If successfully implemented, strong conservation strategies collectively should conserve the stream and realize the project vision.

3.5.1 Conservation Strategies

Ultimately, seven strategies were proposed and six strategies developed specific to Watts Bayou or part of a broader basin-wide approach. Figure 3-1 depicts the development of these strategies and the potential stream improvements that would occur as a result of their implementation.

1. Create Community Outreach and Engagement (Adopt-a-Stream)

This strategy combines two individual strategies that were previously presented as standalone efforts in public meetings in November 2015. The first strategy was Create Community Outreach and Engagement, with specific actions to engage with the Keep Mississippi Beautiful program at the city and state levels. The second strategy was to implement a local Adopt-a-Watershed Program to engage the Hancock Chamber of Commerce. The combined strategy takes a watershed approach to community outreach and enables efforts to develop partnerships with local government and business groups. The message to these groups is that a healthy watershed is an important asset for economic interests and also provides benefits for the community.

2. Protect Land

Although much of the Watts Bayou watershed is developed, some small sections still remain in good condition and would need little restoration for improved function. In particular, intertidal areas around the mouth of the bayou maintain good connectivity to the Mississippi Sound and Bay of St. Louis. Where applicable, land protection techniques such as establishing easements, negotiating deed restrictions for future development, or fee acquisition could be utilized. Acquisition of lands would only be from willing sellers and would require an appropriate land management agency or organization to manage.

3. Replace Failing Bulkheads (Living Shorelines)

Many waterfront areas of Watts Bayou use bulkheads or other hardened structures to protect and maintain property. As these structures age and begin to deteriorate, opportunities exist to replace these structures with more natural designs that promote habitat and connectivity, such as living shorelines. The use of living shorelines is not widespread in Mississippi, and the longer-term benefits are just now being realized. As these techniques continue to be refined and developed, their application for small, site-specific implementation will be better understood.

4. Stabilize Streambanks

Erosion of streambanks can cause buildup of suspended sediments in the water column and create alterations to the stream channel and its flow as deposition areas build up over time. In many areas, erosion issues are obvious, but in other locations, the issue is not easily identified. Stream areas should be surveyed to identify areas of erosion for planning purposes. Efforts could then be made to identify possible solutions to slow, stabilize, or abate the threat posed to the bank. These solutions may take the form of site-based installation concepts that can be used by landowners and/or partners for implementation.

5. Establish a Cooperative Invasive Species Program

Invasive species are a problem in every target stream of this CAP. A Cooperative Invasive Species Management program will engage landowners and local government in a coast-wide effort to identify invasive species hotspots and take corrective actions.

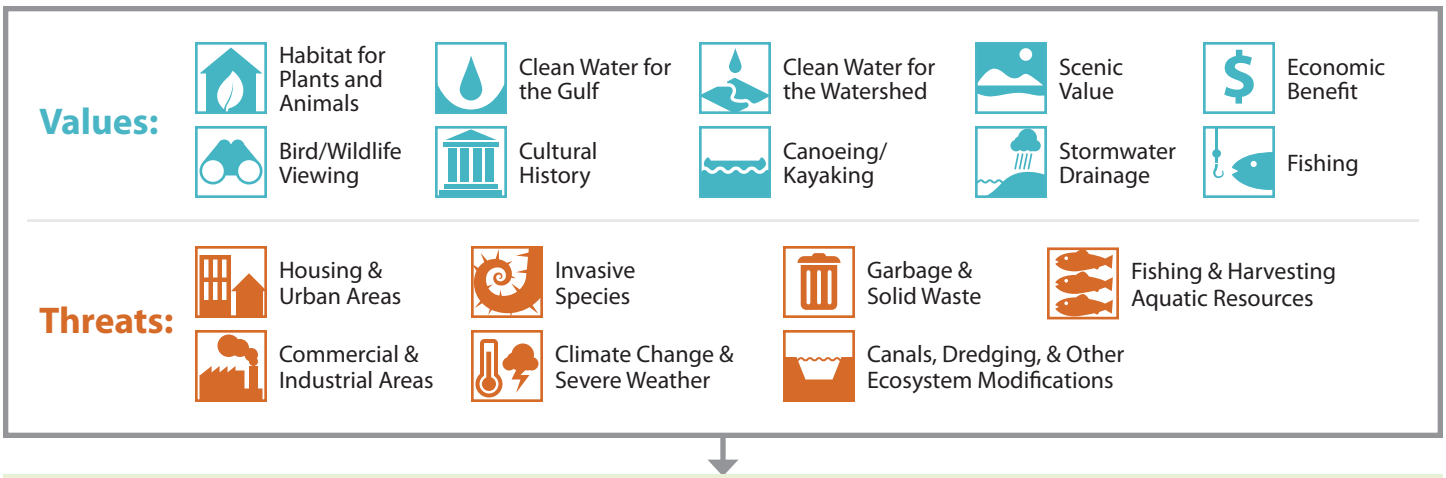
6. Create a Coast-wide Litter Literacy and Mitigation Strategy

Litter and solid waste were identified as major problems by the attendees at every CSHI public meeting. A litter literacy and mitigation program could devise ways to reduce litter. The most important part of this effort would be a public education program.

7. Engage Local Governments in the Implementation of Stormwater and Hazard Mitigation Plans

This strategy was proposed during Conservation Planning Workshops and presented at public meetings in November 2015, but was not developed for this CAP. Details are currently not available, and the ultimate inclusion of this approach should be considered for future iterations of this plan.

Figure 3-1
Watts Bayou Conservation Strategies



Conservation Strategies and Benefits to Streams

#1 Create Community Outreach and Engagement (Adopt-a-Stream)

(1) Percentage of Impervious Surfaces, (2) Percentage of Floodplain and Wetland Conversion, (3) Invasive Species, (4) Solid Waste and Litter, and (5) Vegetative Riparian Zone Width

#2 Protect Land

(1) Floodplain Accessibility, (2) Number of Aquatic Passage Barriers, (3) Percentage of Floodplain and Wetland Conversion, (4) Channel Alteration, (5) Bank Stability, and (6) Riparian Vegetative Zone Width

#3 Replace Failing Bulkheads (Living Shorelines)

(1) Floodplain Accessibility, (2) Channel Alteration, (3) Bank Stability, (4) Riparian Vegetation Zone Width, and (5) Number of Aquatic Barriers

#4 Stabilize Streambanks

(1) Floodplain Accessibility, (2) Channel Alteration, (3) Bank Stability, and (4) Riparian Vegetation Zone Width

#5 Establish a Cooperative Invasive Species Program

(1) Riparian Vegetation Zone Width, (2) Invasive Species, (3) Floodplain Accessibility, and (4) Bank Stability

#6 Create a Coast-wide Litter Literacy and Mitigation Strategy

(1) Solid Waste and Litter

#7 Engage Local Governments in the Implementation of Stormwater and Hazard Mitigation Plans

Details are currently not developed

3.5.2 S.M.A.R.T. Objectives

The S.M.A.R.T. objectives that apply to Watts Bayou are included in Table 3-1. The full list of objectives and their associated references are included in Appendix D.

Table 3-1
Watts Bayou S.M.A.R.T. Objectives

OBJECTIVE	NOTES
INVASIVE SPECIES	
Restore or improve ecological balance in systems negatively affected by invasive species: • By 2026, reduce annual increase in Nonindigenous Aquatic Species to 3% annually	*Watts Bayou has large areas of degraded pine savanna now populated primarily with Chinese tallow trees. Institute a comprehensive invasive species control project and engage local leaders and landowners through education and outreach.*
CANALS, DREDGING, & OTHER ECOSYSTEM MODIFICATIONS	
Encourage agencies that permit shoreline stabilization to consider alternative shoreline erosion control approaches before hardened stabilization is approved: • By 2026, remove or replace hardening structures that degrade habitat in CSHI watersheds at ten sites	*In Watts Bayou's lower reaches there are large stretches of bulkheads, designed to protect waterfront homes. Many of these structures are no longer maintained. In addition, many other shoreline modifications have taken place, including channelization of existing stream corridors, construction of new channels, and many other shoreline structures, such as boat slips. Work with local officials, the Department of Marine Resources, and the U.S. Army Corps of Engineers to take a closer look at this type of project during the permitting phase.*
ALTERED FLOODPLAINS & WETLANDS	
Maintain and restore physical habitat in freshwater systems: • By 2026, reduce acres of altered freshwater wetlands by permitted construction by 30% • By 2026, increase the miles of streams with improved physical habitat by 15% • By 2026, reduce number of stream miles destroyed or converted to unnatural or managed development in CSHI watersheds by 25%	*Objective 2 above details some of the physical harm that has been done to Watts Bayou. Take steps to protect these areas from poorly planned development. Ensure that any necessary structures follow best management practices to minimize environmental damage. Where applicable, look for restoration opportunities where structures have been lost due to storms.*
Reduce impact of development on the physical habitat in freshwater systems: • By 2026, reduce the number of acres of altered freshwater wetlands drained or converted through development annually in CSHI watersheds to 50% • By 2026, increase the percentage of urban and suburban natural patches (10 to 100 acres) in CSHI watersheds by 35%	*Watts Bayou watershed still has areas of natural lands not yet fragmented into small isolated habitats. Where applicable, work with local officials and private landowners to identify and protect developing natural patches, especially in areas along the southern boundary of the watershed.*

OBJECTIVE	NOTES
OUTREACH, EDUCATION, & STAKEHOLDER ENGAGEMENT	
Expand conservation constituency: • By 2026, develop formal partnerships with five agencies, user groups, or neighborhood associations, and propose and implement local conservation efforts with these groups	*Watts Bayou is not well known, even by those who live nearby. Engage with local officials, residents, and interested groups to examine the problems and prospects for Watts Bayou. Kayakers, recreational fishermen, and wildlife observers/photographers may be of particular value in carrying a restoration/conservation message about Watts Bayou. Build on current efforts of Pascagoula River Audubon Center to develop an Adopt-a-Stream program and other citizen groups.*

3.5.3 Other Objectives

Other objectives found to be relevant to the CAP are listed in Table 3-2.

Table 3-2

Watts Bayou Other Objectives

OTHER OBJECTIVE	NOTES
CANALS, DREDGING, & OTHER ECOSYSTEM MODIFICATIONS	
Encourage agencies that permit shoreline stabilization to consider alternative shoreline erosion control approaches before hardened stabilization is approved: • Involve all agencies and organizations in strategies related to shoreline stabilization • Provide appropriate information on alternative shoreline erosion control approaches • Protect and enhance aquatic biodiversity • Protect and enhance terrestrial biodiversity • Maintain healthy aquatic community integrity • Protect and restore existing native fish populations • Maintain populations of native non-game fishes and aquatic invertebrates at or above present levels throughout the basin • Improve water quality for drinking water, and to protect and restore existing native fish populations	*In Watts Bayou's lower reaches there are large stretches of bulkheads, designed to protect waterfront homes. Many of these structures are no longer maintained. In addition, many other shoreline modifications have taken place, including channelization of existing stream corridors, construction of new channels, and many other shoreline structures, such as boat slips. Work with local officials, the Department of Marine Resources, and the U.S. Army Corps of Engineers to take a closer look at this type of project during the permitting phase.*
POLICY	
Work with cities to support, revise, and enforce city-wide tree protection ordinances	

OTHER OBJECTIVE	NOTES
OUTREACH, EDUCATION, & STAKEHOLDER ENGAGEMENT	
Increase public awareness and interest in the values and functions of coastal wetlands, their habitats, and the ecosystem on which they are dependent: • Develop and deliver education materials and programs to inform the public about wetlands species, their habitat, and values to humans	*Watts Bayou is not well known, even by those who live nearby. Engage with local officials, residents, and interested groups to examine the problems and prospects for Watts Bayou. Kayakers, recreational fishermen, and wildlife observers/photographers may be of particular value in carrying a restoration/conservation message about Watts Bayou. Build on current efforts of Pascagoula River Audubon Center to develop an Adopt-a-Stream program and other citizen groups.*
FUNDING	
Dedicate funding to support long-term restoration: • Find private funding sources • Investigate funding opportunities • Identify and create alternative funding strategies for capital projects and long-term sustainability of greenway infrastructure	*As with all CSHI streams, any restoration completed will degrade over time without proper maintenance and monitoring. Locate the proper groups or individuals to head these efforts.*
Seek funding to expand CSHI coverage to other streams in Mississippi's coastal counties	*Look into all possible sources of short and long-term funding to keep efforts in place into the future.*

3.6 Next Steps for Implementation

3.6.1 Site-specific Follow-up

Attendees at the two Public Listening Sessions for Watts Bayou identified one site of concern along the stream. The specific issue mentioned was failing shoreline-hardening structures. TNC staff visited the listed site on October 28, 2015. At the same time, TNC staff visited two road crossings to check for fish passage issues. A full list of these sites and findings is included as Appendix E.

3.6.2 Development of Project Design

A component of the CSHI was to take the information developed from the conservation planning process and draft conceptual designs of potential projects. These conceptual projects were designed to support future restoration efforts by identifying and describing areas of stream impairments, providing baseline data needed for more advanced planning, and, where possible, drafting a suite of possible options to improve those impairments. The number of projects considered and ultimately initiated was dependent on the amount of funding available. Efforts were made to achieve equivalency among the nine coastal streams in this project, and advance projects that would have the greatest conservation impact in future restoration efforts. For Watts Bayou, the following project was recommended for conceptual design development to be completed by the end of September 2016.

Stream Assessments

As previously mentioned in the Viability Assessment section, very little baseline data on stream conditions were present prior to the start of this project. The initial snapshot created by the RSAs provided a needed general overview of each stream's condition. This assessment was not designed or intended to provide the site-specific level of detail needed for conceptual projects. The stream assessments conceptual project will identify, describe, map, and rank areas of impairments on the six mid-sized project streams. Data collected on existing in-stream conditions would identify future potential restoration opportunities. A limited number of "planning areas" will be identified, with recommendations and costs for potential improvements. The six streams included in this project include Watts Bayou, Magnolia Bayou, Coffee Creek, Oyster Bayou, Rhodes Bayou, and Bayou Chicot.

In addition to the conceptual projects listed above, additional projects were drafted, but funds were not available to implement. It was recommended that these projects be considered for implementation as funding is secured. For Watts Bayou one such project was the Wildlife Corridor conceptual project. The main purpose of this project was to design culvert replacements and restore wildlife passage along the riparian corridor to address the wildlife passage issue and also maintain a stable stream channel. Over the course of the CSHI, approximately 15 wildlife passage impairments were identified across the nine streams.



4 BEAR POINT BAYOU

4.1 General Description of Watershed

Bear Point Bayou is a coastal stream located in western Harrison County, Mississippi. The watershed covers 640 acres and is entirely within the city limits of Long Beach. Most of the watershed is developed with single- and multi-family residential areas, local businesses, and USM's Gulf Coast campus (see Appendix B). The stream's main branch is 1.3 miles and flows southwest into the Mississippi Sound. A small tributary, approximately 0.5 miles in length, flows from the northwest and joins the main stream on the USM campus. In most areas, the stream is very small (less than 6 feet wide). Tidal influence occurs for about 300 feet.

The stream features prominently in local history, as both native tribes and later European settlers located here for the high-quality fresh water. Bear Point Bayou appeared on maps in 1774, and the first known permanent home was built in 1788. Many local residents have a strong attachment to Bear Point Bayou with memories of playing in and around the stream as children.

Bear Point Bayou's headwaters form from artesian springs. The stream suffers from a variety of impairments common to urban streams, including channelization, erosion, streambank alteration, blockage of fish passage, and invasive species. Unfortunately, much of the stream's flow today is from urban runoff. Some infrastructure appears close to the stream and may be a source of significant runoff into the stream. The stream also travels under a campus parking lot for about 90 feet. Bear Point Bayou enters the Mississippi Sound across an artificially maintained sand beach, through a concrete canal.

Large native and non-native trees shade much of the stream. The most prevalent non-native plant species in the watershed include Chinese tallow trees, elephant ear, and torpedo grass. Some of the Chinese tallow trees are very large and part of local landscaping. The stream is a nice focal point on the USM campus, with footbridges and informational signs. A small dam forms a pond, where students and visitors enjoy feeding native turtles.

The dam may cause some issues related to fish passage. Other areas of concern include the CSX rail line and a campus road crossing. The stream contains a diversity of native freshwater, estuarine, and diadromous fishes. To date, non-native fish have not been found at this location. Most of the stream is too small and developed to support much outdoor recreation, other than nature study. Some recreational fishing and crabbing takes place in the lower portion of the stream that crosses the beach.

4.2 Conservation Action Plan

In the past, TNC has successfully implemented a ten-step CAP process for defining the conservation projects, developing and implementing strategies and measures, and using the results to adapt and improve conservation outcomes (TNC 2007). A facilitator led the CAP process with each watershed stakeholder group. Through a series of workshops or meetings, they worked together to identify conservation targets, analyze target threats, identify objectives and outcomes, develop strategic actions, and define indicators and measures to monitor success.

4.2.1 Stakeholder Engagement

The Bear Point Bayou Public Listening Sessions were part of a series of public forums for the CSHI within the nine target stream areas. TNC conducted two Public Listening Sessions in June 2015 for residents of the Bear Point Bayou watershed. Input from these meetings informed the CAP process. The summarized results of Bear Point Bayou's scope, perceived problems or threats, and identified solutions to the problems from the meetings are included in Appendix A.

4.2.2 Nested Targets

Imbedded or nested targets within Bear Point Bayou include a variety of biological and functional components to be considered for conservation as a part of this drainage. These include the actual stream, watershed, riparian corridor, and tidal zone. Upland native vegetation, forest habitat, and wetlands, as well as species assemblages of native fishes, stream invertebrates, and migratory bird species are also considered. A listing of species of conservation concern is included in Appendix F, and a listing of habitats in this stream is included in Appendix G. In addition to species and habitats, participants in the Public Listening Sessions were given a list of 16 biological and functional components to rank in order of importance for conservation value for their watershed. The top values from the Public Listening Sessions are as follows, in order of importance:

1. Habitat for Plants and Animals
2. Clean Water for the Gulf
3. Clean Water for the Watershed
4. Scenic Value
5. Stormwater drainage

4.3 Habitat Assessment: Stream Health

4.3.1 Rapid Stream Assessments

RSAs were conducted at four sites on Bear Point Bayou (see Appendix H). Scoring results were averaged from individual assessments, with an average score of 4.11 out of 10. This score indicates that Bear Point Bayou is in fair condition as rated by the SVAPv2. This is consistent with the overall viability ranking for the stream.



Rapid Stream Assessment

Impairments identified from the RSAs are due to habitat alterations to the stream riparian corridor and watershed/drainage. The most impaired section is where the stream enters the Mississippi Sound, across an artificially maintained sand beach, through a concrete canal. Invertebrate populations were poor primarily due to lack of good habitat, such as pools. Additional barriers to fish passage include culverts under-road crossings, an area of underground flow, and a concrete dam that forms the campus turtle pond. From this assessment, the largest impact to the stream appears to be the lack of a riparian zone along the majority of the stream, except for the upstream segment on the USM campus. The least impaired sections of the stream are those in the forested areas on the eastern side of the USM campus. This area has never been developed and has many natural features.

4.3.2 Biological Sampling of Fishes

For Bear Point Bayou, the only known fish information was generated by a high school Adopt-a-Stream team between 2000 and 2006; the collection of two American eels was noted.

4.3.3 Water Quality Data

The quality of the water is a critical component to the health of stream habitats. It effects estuarine and marine environments in Mississippi Sound and can be reflective of conditions upstream and over the entire watershed. Creating a baseline of water quality is important to understanding the current conditions of a stream, monitoring its health, and measuring change over time. The MDEQ Field Services Division collected water quality data on all nine streams from March 1, 2016, to August 31, 2016. Data were collected under the guidelines of the MDEQ Quality Assurance Project Plan Section 106 Monitoring Network in the State Surface Water Monitoring and Assessment Program. Two sample locations were established for each stream, except in Watts Bayou where the limited public access points allowed for only one sample site. Nineteen different sampling measures were taken twice a month, and one measure for biological oxygen demand was taken monthly. A complete list of the parameters for the water quality analyses is included in Appendix I. Data collected from this sampling were used to inform the stream's Viability Assessment.

For Bear Point Bayou, two excursions of the instantaneous minimum dissolved oxygen criteria of 4 mg/L were identified at the site near East 3rd Street, though occasional excursions of the existing criteria are expected in low-gradient, tidally influenced coastal streams. A small fish kill was documented and reported on August 10, 2016, and may indicate that low dissolved oxygen is a chronic problem at this location. It is important to recognize that this sampling took place over a limited period, and longer-term monitoring is recommended. Extended monitoring will establish a more robust baseline, establish trends, and alert stakeholders to chronic or acute problems as they develop.

4.3.4 Viability Assessment Summary Results

Bear Point Bayou and Coffee Creek were analyzed together due to similarities in size and location. However, different factors contribute to the condition of these streams. For example, Coffee Creek has good fish passage connectivity; while in contrast, Bear Point Bayou has numerous fish passage issues. The overall rating, landscape context, condition, and size of Bear Point Bayou and Coffee Creek was "**Fair**" primarily due to the urban nature of these streams. Some of the major stream landscape issues that exist in these watersheds include lack of a floodplain and conversion of wetlands and riparian habitat. The condition of these streams is also considered "Fair" primarily due to the abundance of solid waste and litter in the streams, presence of invasive species, and bank instability. Attributes for water quality were ranked "Very Good" due to no impairments detected for nitrogen, nitrite, phosphorous, and dissolved oxygen. The Size ranking was "Fair" because both streams are small with a small proportional riparian zone width.

4.4 Factors of Stream Degradation: Stresses and Threats

4.4.1 Primary Stresses

The following six stresses were identified for Bear Point Bayou during the CAP process:

1. Altered Floodplains and Wetlands
2. Altered Riparian Corridor
3. In-stream Habitat Modification
4. Altered Stream Geomorphology
5. Altered Hydrology
6. Invasive Species

Altered Floodplains and Wetlands

The Bear Point Bayou watershed is heavily developed with residential housing, commercial development, streets and roads, and many impervious surfaces (e.g., parking areas).

Altered Riparian Corridor

Intact sections of the riparian zone exist on USM property to the east of the main campus; however, the majority of the stream lacks a true riparian buffer. Mowing and the addition of aesthetic features, such as landscaping and pedestrian bridges added over time, have degraded the function of the riparian zone. The outfall of the creek flows onto an artificial sand beach with no riparian zone.

In-stream Habitat Modification

On the USM campus, Bear Point Bayou is dammed to create a pond in one location, restricting flow downstream, and reducing in-stream habitat. In addition, maintenance impacts (e.g., digging sediment from the channel) deepen the channel and further reduce natural habitat conditions.

Altered Stream Geomorphology

Sections of Bear Point Bayou appear to have been straightened to accommodate transportation infrastructure, specifically the CSX rail line. There are sections reinforced with concrete, rocky debris, or riprap in an attempt to stabilize the streambank. The outflow of the stream exits into a concrete, open-box culvert that may reduce tidal interchange and connectivity to Mississippi Sound. Finally, a weir is located on the USM campus to create a ponded landscape feature; this weir is not fully functional as water flow is undermining the structure.

Altered Hydrology

Quantity and velocity of water in the stream likely exceeds historical flows, as shown by a deepening channel, sediment buildups, and water frequently overtopping the streambanks. Anecdotal evidence suggests that artesian spring flow has lessened over the years and streamflow is now primarily due to urban runoff.

Invasive Species

Invasive species of concern in Bear Point Bayou include plant species such as cogongrass, Chinese tallow tree, torpedo grass, and elephant ear. These species outcompete native plant communities—often resulting in a near monoculture with low biodiversity in comparison to a native riparian community. Giant salvinia was not observed, but should be monitored because it is a concern for resource managers. The only invasive animal species observed were domestic/feral cats, which pose a concern to native wildlife—particularly bird species. Nutria were not observed, but are likely to be present in this watershed. Nutria should be monitored as they are herbivores that can pose a threat to vegetation and small trees; their foraging activities can also directly damage bank stability. Nile tilapia were not observed in Bear Point Bayou, but have been collected in nearby Oyster Bayou. Tilapia pose a threat to native species diversity and should also be monitored.

4.4.2 Primary Threats

Primary threats were identified and ranked by stakeholders as the sources of stress for each watershed. The nine threats for Bear Point Bayou are as follows:

1. Housing and Urban Areas
2. Commercial and Industrial Areas
3. Transportation, Utility, and Service Lines
4. Climate Change and Severe Weather
5. Invasive Species
6. Garbage and Solid Waste
7. Canals, Dredging, and Other Ecosystem Modifications
8. Dams and Water Management
9. Flight Paths

4.5 Taking Action

Developing effective strategic action and objectives to abate critical threats and restore function to Bear Point Bayou watershed is essential to conservation planning. If successfully implemented, strong conservation strategies collectively should conserve the stream and realize the project vision.

4.5.1 Conservation Strategies

Ultimately, six strategies were developed that are specific to Bear Point Bayou or are part of a broader basin-wide approach. Figure 4-1 depicts the development of these strategies and the potential stream improvements that would occur as a result of their implementation.

1. Re-establish the Bear Point Bayou Community Group

A Bear Point Bayou Community Group existed in the past and was known to be active in the 1990s. An effort to locate interested individuals in the area and re-engage them, as well as new members, in the plans and decisions involving the stream would be beneficial to the watershed protection efforts.

2. Restore and Stabilize Riparian Zones

Most of Bear Point Bayou's riparian zone has been lost, resulting in a relatively deep and narrow stream flowing through heavily landscaped areas. Rebuilding riparian zones, removing invasive plants, restoring proper slopes to streambanks, and reconnecting the stream with its floodplain are good strategies for this watershed. Many areas of development will preclude this strategy, but opportunities remain for best management practices and green installations on the campus of the USM and its neighbors.

3. Restore Fish Habitat and Connectivity

Several fish connectivity issues exist in Bear Point Bayou. These include infrastructure components such as streets and railroad, areas of long underground flow, round culverts, and a low-head dam. Efforts can be made to work collaboratively with landowners, local governments, the railroad, and other involved entities to replace crossings with fish-friendly structures.

4. Stabilize Streambanks

Erosion of streambanks can cause buildup of suspended sediments in the water column and create alterations to the stream channel and its flow as deposition areas build up over time. In many areas, erosion issues are obvious, but in other locations, the issue is not easily identified. Stream areas should be surveyed to identify areas of erosion for planning purposes. Efforts could then be made to identify possible solutions to slow, stabilize, or abate the threat posed to the bank. These solutions may take the form of site-based installation concepts that can be used by landowners and/or partners for implementation.

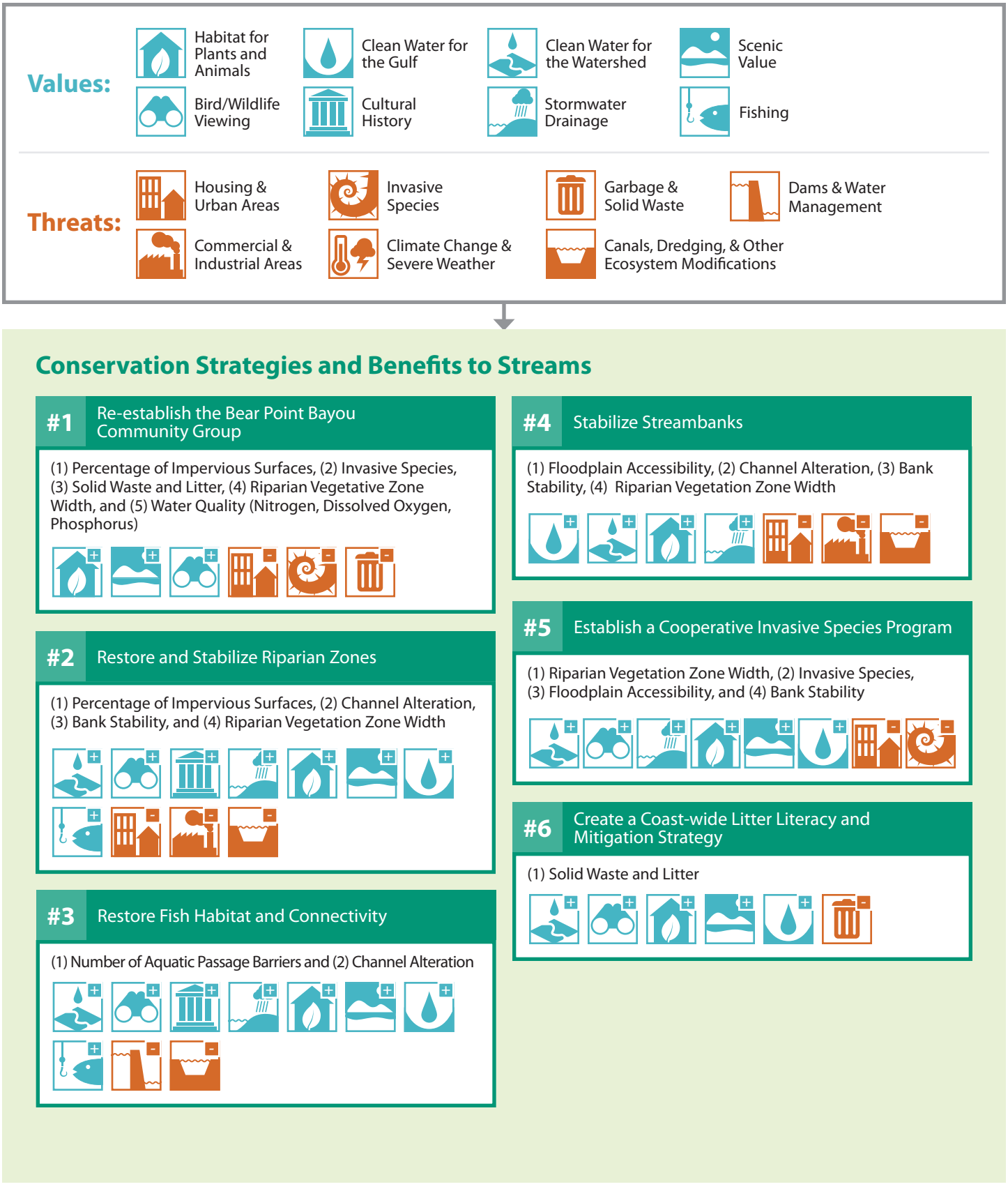
5. Establish a Cooperative Invasive Species Program

Invasive species are a problem in every target stream of this CAP. A Cooperative Invasive Species Management program will engage landowners and local government in a coast-wide effort to identify invasive species hotspots and take corrective actions.

6. Create a Coast-wide Litter Literacy and Mitigation Strategy

Litter and solid waste were identified as major problems by the attendees at every CSHI public meeting. A litter literacy and mitigation program could devise ways to reduce litter. The most important part of this effort would be a public education program.

Figure 4-1
Bear Point Bayou Conservation Strategies



4.5.2 S.M.A.R.T. Objectives

The S.M.A.R.T. objectives that apply to Bear Point Bayou are included in Table 4-1. Objectives for Bear Point Bayou are specific to this stream based on information collected as part of the project described in Section 4.6.2, whereas the objectives for the other project streams reflect the overall objectives for the whole initiative. The full list of objectives and their associated references are included in Appendix D.

Table 4-1
Bear Point Bayou S.M.A.R.T. Objectives

OBJECTIVE	NOTES
HOUSING & URBAN AREAS, STREAM GEOMORPHOLOGY	
By 2026, reduce the number of stream miles of Bear Point Bayou impaired by excessive sedimentation by 90%: • Reduce the number of stream miles impaired by excess sediment	*A major limiting factor in the aquatic habitat in the lower reaches of Bear Point Bayou is heavy sediment, primarily sand. In many areas, sand is the primary substrate. Elimination of the upstream sources of this sediment by stabilizing or restoring upstream shorelines would improve habitat.*
By 2026, stabilize or restore 250 feet of unstable shoreline along Bear Point Bayou	
HOUSING & URBAN AREAS, CONNECTIVITY	
By 2026, ensure that 100% of all new stream crossings projects use construction materials and techniques that do not alter connectivity in coastal watersheds: • Work with local governments, land developers, and contractors to ensure that all future road crossings utilize structures that do not block aquatic organism passage	*Bear Point Bayou has a number of existing structures (e.g., roads, parking lots, railroad, small dam, and culverts) which likely are barriers to fish passage. This objective requests that, with any future stream alterations, fish passage, and stream connectivity will be taken into consideration in project design and construction. Shifting sands on the beach sometimes cause temporary fish passage issues near the mouth of the stream. In addition, replacement of some of the existing structures would enhance Bear Point Bayou's value as fish habitat.*
By 2026, restore fish access to 100% of stream miles formerly blocked: • Improve or maintain watershed connectivity by removing and replacing culverts and crossing structures that block fish passage • Work with USM to develop a fish passage structure (fish ladder) to allow passage of aquatic organisms while maintaining the campus turtle pond	
INVASIVE SPECIES	
By 2026, reduce annual increase in Nonindigenous Aquatic Species to 90% annually: • Restore or improve ecological balance in systems negatively affected by invasive species	*Nonindigenous aquatic species are members (i.e., individual, group, or population) of a species that enters a body of water or aquatic ecosystem outside of its historical or native range. Bear Point Bayou's watershed has extensive stands of invasive trees, grasses, and aquatic plants, some of which were intentionally planted for landscaping. Wherever possible, invasive plants should be controlled or eliminated using acceptable methods, and replaced with native species.*
CANALS, DREDGING, & OTHER ECOSYSTEM MODIFICATIONS	
By 2026, ensure that beach management plans and techniques are revised to protect coastal streams and watersheds	

OBJECTIVE	NOTES
By 2026, concrete channels that contain Bear Point Bayou are removed and the stream is allowed to "re-naturalize" where it crosses the Harrison County beaches	*Bear Point Bayou enters the Gulf of Mexico by flowing across an artificially maintained sand beach, through a concrete canal. Shifting sands often create temporary blockages. One solution would be to remove the concrete ditches and allow the stream to set its own course across the beach. It is understood, however, that this may not be possible with Bear Point Bayou due to sand beach management requirements. Discuss with the Sand Beach Commission other possible ways of managing the stream on the beach to achieve better habitat.*
By 2026, 25% of all lands within 100 feet of Bear Point Bayou have adequate riparian protection: • Establish, improve, and maintain riparian zones by reconstructing areas immediately adjacent to the stream, restoring reasonable stream slopes, and eliminating invasive plants	*In many lower reaches of Bear Point Bayou, a riparian zone is very limited because streamside landscaping extends to the bank of the stream. Space is available in many areas to recreate and reconnect the riparian zone. In some upper reaches, the riparian zone can be preserved and enhanced.*
By 2026, develop and implement an educational program to inform the public about wetlands species, their habitat, and value: • Develop partnerships with agencies, user groups, or neighborhood associations, and propose and implement local conservation efforts with these groups • Increase public awareness and interest in the values and functions of coastal wetlands, habitats, and ecosystems • Re-engage the Bear Point Bayou Interest Group	

4.6 Next Steps for Implementation

4.6.1 Site-specific Follow-up

Attendees at the two public meetings for Bear Point Bayou identified two sites of concern along the stream. The specific issue mentioned was fish passage. TNC staff visited both sites on October 6, 2015. TNC staff also evaluated eight road and railroad crossings for fish passage issues. While working in Bear Point Bayou, TNC staff detected a tributary of Bear Point Bayou in the residential areas north of Railroad Street, which was previously unknown to us, and added it to project maps.

4.6.2 Development of Project Design

A component of the CSHI was to take the information developed from the conservation planning process and draft conceptual designs of potential projects. These conceptual projects were designed to support future restoration efforts by identifying and describing areas of stream impairments, providing baseline data needed for more advanced planning, and, where possible, drafting a suite of possible options to improve those impairments. The number of projects considered and ultimately initiated was dependent on the amount of funding available. Efforts were made to achieve equivalency among the nine coastal streams in this project, and advance projects that would have the greatest conservation impact in future

restoration efforts. For Bear Point Bayou, the following project was recommended for conceptual design development to be completed by the end of September 2016.

Bear Point Bayou Stream Restoration Project

The outcome of the "Bear Point Bayou Stream Restoration Project" is the creation of a conceptual design that will target a variety of threats and impediments to the stream and its riparian zone. This design will consist of site-specific "elements" that will target impediments such as areas of stream bank erosion, channelization, sedimentation, and connectivity. Enhancements of habitat and water quality will also be considered with best management practices such as recommendations to manage native vegetation or install rain gardens.

A majority of Bear Point Bayou's stream length is located on the property of USM's Gulf Coast Campus and the St. Thomas Catholic Church. TNC has coordinated with these organizations to conduct field surveys and take stream-side measurements. Additionally, TNC is in communication with USM to make sure the design recommendations are consistent with their Campus Master Plan; input has been received from their facilities management staff. The location of the stream on a university campus makes it an ideal location for the demonstration of management practices and restoration. If implemented, many elements and techniques used in the conceptual design would be potentially transferrable to streams with similar impediments in Mississippi and the Gulf Coast.



5 TURKEY CREEK

5.1 General Description of Watershed

Turkey Creek is a coastal stream located in central Harrison County, Mississippi. The stream flows southeast through Harrison County before turning northeast and flowing into Bayou Bernard, then into Biloxi Bay. This is the largest watershed in the CSHI, with an area of approximately 17,000 acres. The length of the main channel is 13 miles. South of Interstate 10, portions of the watershed are mostly developed with single- and multi-family residences, extensive commercial and retail areas, the Gulfport-Biloxi International Airport, and areas of two military bases. In addition, numerous roads, utility corridors, and railroads cross the watershed.

Turkey Creek retains significant ecological, scenic, historic, and recreational value. Local residents and groups have designed a kayak trail and are developing a greenway trail. Turkey Creek supports an important recreational and subsistence fishery. Most residents fish for species such as bluegill, largemouth bass, gar, pickerel, and crappie.

Turkey Creek is moderately impaired, particularly through the lower reaches of the stream. The upstream portions are less impacted. Primary impacts include shoreline development, road and rail corridors, stream channel alteration, invasive plants, stormwater runoff issues, failing septic systems, urban litter and dumping, and historical and existing pollution sources, including a past USEPA Superfund site (Cavenham Industries) which has been fully mitigated. Turkey Creek includes some of the Mississippi Coast's most important commercial, retail, and transportation centers, and is under constant development pressure. The most serious current threat is a proposed road and retail development along the Interstate 10 corridor that would cut across the entire watershed.

Conservation and watershed planning have been ongoing in the Turkey Creek watershed with a variety of partnerships and efforts for more than 10 years. The strategies listed in this chapter are not intended to replace previous planning efforts, but to complement and support those in progress. An intentional effort was made not to duplicate strategies and actions previously published, specifically in the *Turkey Creek Watershed Implementation Plan* (LTMCP 2006). Overlap exists because concerns, threats, or strategies were strongly emphasized in public meetings, workshops, or other methods of stakeholder input. The recent award of the National Fish and Wildlife Foundation's Gulf Environmental Benefit Fund Project, Habitat Restoration and Conservation in Turkey Creek, offers the opportunity to put strategies and actions of these planning efforts towards implementation. The information in this CAP should be used to support that award and ongoing conservation efforts.

5.2 Conservation Action Plan

In the past, TNC has successfully implemented a ten-step CAP process for defining the conservation projects, developing and implementing strategies and measures, and using the results to adapt and improve conservation outcomes (TNC 2007). A facilitator led the CAP process with each watershed stakeholder group. Through a series of workshops or meetings, they worked together to identify conservation targets, analyze target threats, identify objectives and outcomes, develop strategic actions, and define indicators and measures to monitor success.

5.2.1 Stakeholder Engagement

The Turkey Creek Public Listening Sessions were part of a series of public forums for the CSHI within nine target stream areas. TNC conducted two Public Listening Sessions in May 2015 for residents of the Turkey Creek watershed. Input from these meetings informed the CAP process. The summarized results of Turkey Creek's scope, perceived problems or threats, and identified solutions to the problems from the meetings are included in Appendix A.

5.2.2 Nested Targets

Imbedded or nested targets within Turkey Creek include a variety of biological and functional components to be considered for conservation as a part of this drainage. These include the actual stream, watershed, riparian corridor, and tidal zone. Upland native vegetation, forest habitat, and wetlands, as well as species assemblages of native fishes, stream invertebrates, and migratory bird species are also considered. A listing of species of conservation concern is included in Appendix F, and a listing of habitats in this stream is included in Appendix G. In addition to species and habitats, participants in the Public Listening Sessions were given a list of 16 biological and functional components to rank in order of importance for conservation value for their watershed. The top values from the Public Listening Sessions are as follows, in order of importance:

1. Habitat for Plants and Animals
2. Clean Water for the Watershed
3. Fishing
4. Cultural History

5.3 Habitat Assessment: Stream Health

5.3.1 Rapid Stream Assessments

RSAs were conducted at four sites on Turkey Creek (see Appendix H). Scoring results were averaged from individual assessments, with an average score of 5.45 out of 10. This score indicates that Turkey Creek is in fair to good condition as rated by the SVAPv2. This is consistent with the overall viability ranking for the stream.



Rapid Stream Assessment
Photo credit: The Corps Network

Impairments identified from the RSAs are largely due to changes in land cover to the lower end of the stream. Increases in water volume and the velocity in which it flows during storm events are the likely cause of many detected in-stream impairments. Increased volume and velocity affect the stability of the streambank, causing erosion and increased sedimentation. Additionally, RSAs detected invasive species and litter impacts to stream habitats. Other impacts observed included poor habitat for invertebrate populations. The strongest feature was the absence of fish passage barriers along the stream's main channel.

5.3.2 Water Quality Data

The quality of the water is a critical component to the health of stream habitats. It effects estuarine and marine environments in Mississippi Sound and can be reflective of conditions upstream and over the entire watershed. Creating a baseline of water quality is important to understanding the current conditions of a stream, monitoring its health, and measuring change over time. The MDEQ Field Services Division

collected water quality data on all nine streams from March 1, 2016, to August 31, 2016. Data were collected under the guidelines of the MDEQ Quality Assurance Project Plan Section 106 Monitoring Network in the State Surface Water Monitoring and Assessment Program. Two sample locations were established for each stream, except in Watts Bayou where the limited public access points allowed for only one sample site. Nineteen different sampling measures were taken twice a month, and one measure for biological oxygen demand was taken monthly. A complete list of the parameters for the water quality analyses is included in Appendix I. Data collected from this sampling were used to inform the stream's Viability Assessment.

For Turkey Creek, slight excursions of the instantaneous minimum dissolved oxygen criteria of 4 mg/L were noted, though occasional excursions of the existing criteria are expected in low-gradient, tidally influenced coastal streams. Testing for biological pathogens was not conducted; however, an effort led by USEPA has engaged in community monitoring for this impairment. Additionally, efforts are underway to connect point sources that contribute biological pathogens into Turkey Creek. It is recommended that community-led testing continue for biological pathogens, and that MDEQ continue to monitor Turkey Creek as part of their ambient monitoring program. It is important to recognize that this sampling took place over a limited time, and longer-term continuous monitoring is recommended. Extended monitoring would establish a more robust baseline, establish trends, and alert stakeholders to chronic or acute problems as they may develop.

5.3.3 Viability Assessment Summary Results

Turkey Creek had an overall ranking of "**Fair**," primarily due to high wetlands conversion, lack of floodplain connectivity, and channel alterations. A high percentage of impervious surfaces covers much of the developed residential and commercial areas, including significant transportation infrastructure. The condition of Turkey Creek was also ranked "Fair" due to the occurrence of invasive species, an abundance of trash and debris in the stream, and a Total Maximum Daily Load (TMDL) for biological pathogens. Attributes for nutrient water quality were ranked "Very Good" due to no impairments detected for nitrogen, nitrite, phosphorous, or dissolved oxygen. Additionally, there are not many fish passage barriers in the watershed. Sportfish assemblages and bank stabilization were considered "Good" due to the large scale of the watershed. However, it is important to note that bank stabilization issues are acute in some localized areas. Conversely, the size ranking for Turkey Creek is "Good" due to the intact upper floodplain and the healthy width of the riparian zone along most of the stream. Maintaining or improving the overall viability ranking for Turkey Creek will be partially dependent upon preserving the current size of the riparian zone and floodplain.

Total Maximum Daily Load: pollution budget that calculates the maximum total amount of a pollutant that can enter a waterbody

5.4 Factors of Stream Degradation: Stresses and Threats

5.4.1 Primary Stresses

The following 11 stresses were identified for Turkey Creek during the CAP process:

1. Excessive Suspended and Bedded Sediments
2. Altered Floodplains and Wetlands
3. Altered Riparian Corridor
4. In-stream Habitat Modification
5. Altered Stream Geomorphology
6. Altered Hydrology
7. Altered Connectivity
8. Invasive Species
9. Organic Pollution
10. Nutrient (Historical)
11. Chemical (Historical)

Excessive Suspended and Bedded Sediments

Excessive sediment loads are caused by erosion within the stream and within the drainage area. Moderate to severe erosion occurs within the watershed of Turkey Creek. One area of note is the heavily developed stream reaches from Ohio Street to the confluence with Bayou Bernard. Other areas especially susceptible to excessive sediment loading are those where bridges or other structures restrict the natural width of the waterway. Excavation, replacement of fill dirt, and other soil disturbance of the streambank during construction often destabilize the stream channel, making it more exposed to erosion and incision over time. The existence of unconsolidated sand bars at several sites in the lower bayou are a clear sign of erosion problems upstream.

Altered Floodplains and Wetlands

Stretches of Turkey Creek contain important areas of upland, riparian, and wetland habitats that likely support many habitat and water quality services. Other sections of the watershed include areas of urban, commercial, and residential land cover with large areas of impervious surfaces. Major roadways (e.g., Interstate 10, Canal Road, and U.S. Highway 49) traverse the Turkey Creek watershed. The Gulfport-Biloxi International Airport and the Mississippi Air National Guard Combat Readiness Training Center are located in the watershed north of the creek. Several residential neighborhoods support tree cover and landscaped yards.

Like most urban streams, parts of Turkey Creek have undergone development and alteration extending to the streambanks. This is most noticeable where Turkey Creek crosses the flyway right-of-way at Gulfport-Biloxi International Airport, and in the lowest reaches of the stream below Rippy Road where a floodplain is essentially nonexistent.

Altered Riparian Corridor

In the urban and commercial areas of the watershed, the riparian zone is developed up to the streambank. In undeveloped areas, much of the riparian zone remains intact and scenic. Other factors also damage the riparian corridor; most critical is the presence of invasive plants, a locally severe problem in several reaches of Turkey Creek.

In-stream Habitat Modification

An area of Turkey Creek has been negatively affected by ATV usage. ATV damage has been found within the bayou, as well as adjacent watershed and riparian areas.

Altered Stream Geomorphology

The geomorphology of Turkey Creek has been altered most notably where the stream flows across the north end of Gulfport-Biloxi International Airport. At this location, the bayou is confined between straightened and high banks to protect flight paths and the airport from flooding. Additionally, several small tributaries flow under Interstate 10, through a variety of structures that alter the geomorphology of the streams for at least a short distance.



Bank erosion undermining trees



Stormwater outfall into Turkey Creek



Chinese tall tree at Ohio Street Bridge

Altered Hydrology

Turkey Creek suffers from altered hydrology in two distinct ways. First, there are extensive areas of impervious surfaces at Gulfport-Biloxi International Airport and large retail and business areas along U.S. Highway 49 increasing surface runoff into Turkey Creek. Second, diversionary canals route water out of the watershed, through Canals 1, 2, and 3 into the Mississippi Sound. These canals flow westward north of Long Beach and route floodwaters from Turkey Creek into Bayou Portage, Bay St. Louis. The canals were constructed to reduce surface flooding in the Turkey Creek watershed.

Altered Connectivity

The most serious loss of connectivity within the bayou occurs between Ohio Street and the confluence with Bayou Bernard. Lack of a floodplain connection reduces water absorption, thereby increasing water velocity and streambank erosion, which produces more destructive flooding.

Invasive Species

Invasive species of concern in the Turkey Creek Watershed include cogongrass, Chinese tallow tree, torpedo grass, and

elephant ear. These species outcompete native plant communities—often resulting in a near monoculture with low biodiversity in comparison to a native riparian community. Giant salvinia was not observed, but should be monitored because it is a concern for resource managers. The only invasive animal species observed were domestic/feral cats, which pose a concern to native wildlife—particularly bird species. Nutria were not observed, but are likely to be present in this watershed. Nutria should be monitored as they are herbivores that can pose a threat to vegetation and small trees; their foraging activities can also directly damage bank stability. Nile tilapia were not observed in Turkey Creek, but have been collected in nearby Oyster Bayou.

Organic Pollution

Turkey Creek is on the state MDEQ 303(d) list of impaired water bodies for biological pathogens, from Long Beach to U.S. Highway 49, and has an associated TMDL for biological pathogens. The sources of organic pollution in Turkey Creek have not been fully identified. Some efforts to reduce biological impairment are currently underway. One such effort will connect a mobile home park with septic systems in the Canal Road area to city sewers.

Nutrient Pollution (Historical)

To date, several monitoring programs in Turkey Creek have not detected total nitrogen, nitrite, or phosphorus at levels that cause impairment. If the monitoring efforts currently underway do not show impairment, this stress will be removed from the final document. Previously, a TMDL for alkalinity existed for Turkey Creek but has been removed as an impairment.

Chemical Pollution (Historical)

Two major chemical pollution issues have affected Turkey Creek. One is a large abandoned timber treatment plant along the north shore at the confluence with Bayou Bernard that polluted the stream and the soil with creosote. This area, known as the Cavenham Site, is now an U.S. Environmental Protection Agency Superfund site and has been fully mitigated (E. Allan, USEPA, personal communication). The second issue was the storage of Agent Orange (an aerial defoliant used during the Vietnam War) at the Naval Construction Battalion site at the south end of the Turkey Creek watershed. Agent Orange may have leaked into Turkey Creek during the 1970s; the chemical was removed and destroyed during that decade (for more information, see ATSDR 2005 and USEPA 2013).

5.4.2 Primary Threats

Primary threats were identified and ranked by stakeholders as the sources of stress for each watershed. The 14 threats for Turkey Creek are as follows:

1. Housing and Urban Areas
2. Commercial and Industrial Areas
3. Transportation, Utility, and Service Lines
4. Climate Change and Severe Weather
5. Invasive Species
6. Garbage and Solid Waste
7. Canals, Dredging and Other Ecosystem Modifications
8. Dams and Water Management
9. Tourism and Recreation Areas
10. Flight Paths
11. Recreational Activities
12. Logging and Wood Harvesting
13. Oil and Gas Drilling, Mining and Quarrying, and Renewable Energy
14. Fishing and Harvesting Aquatic Resources

5.5 Taking Action

Developing effective strategic action and objectives to abate critical threats and restore function to Turkey Creek watershed is essential to conservation planning. If successfully implemented, strong conservation strategies collectively should conserve the stream and realize the project vision.

5.5.1 Conservation Strategies

Ultimately, seven strategies were developed that are specific to the Turkey Creek Watershed or are part of a broader basin wide approach. Figure 5-1 depicts the development of these strategies and the potential stream improvements that would occur as a result of their implementation.

1. Promote Retention Stream Buffer Areas on Private and Public Lands

The Turkey Creek Watershed is an U.S. Environmental Protection Agency Priority Watershed where land ownership is held by a combination of private individuals, businesses, civic organizations, governmental, and non-governmental organization groups. Working with interested landowners, this strategy would encourage management of the stream buffer and riparian vegetative zone. Landowners would be encouraged to maintain as much of the stream buffer as possible with existing private, public, and non-governmental agencies and organizations and partnerships to promote and support protection.

In addition, parts of the Turkey Creek watershed are owned and managed by the Land Trust for the Mississippi Coastal Plain, Gulfport-Biloxi International Airport, Mississippi Department of Transportation, and the City of Gulfport. Within these areas, the implementation of invasive species control, forest habitat management, and educational and recreational access is recommended. These landowners may also be

willing to implement best management practices and habitat-friendly infrastructure to reduce sedimentation, nutrients, or capture biological pathogens.

2. Promote Commercial and Business Stakeholder Outreach

Developed areas of the Turkey Creek watershed include numerous business, retail, commercial, and hospitality areas that play an important economic role in Gulfport. These business entities have a major stake in the long-term well being of the local area, and are vital participants in the CAP process. Outreach efforts would encourage best management practices to reduce the impact of land cover changes, encourage employees to participate in conservation events or activities, and focus on the economic benefits of natural infrastructure versus new construction.

3. Explore Land Protection Opportunities

The Turkey Creek watershed has large expanses of undeveloped lands, which present numerous opportunities to protect upland and riparian habitats. There is a high capacity for this type of work in Southern Mississippi as there are non-governmental organizations, state agencies, and federal agencies that specialize in land protection. Land protection activities could include conservation easements, land deed, and fee acquisition. Fee acquisition of lands would be from willing sellers and purchased lands would be transferred to an appropriate land management agency or organization.

4. Address Biological Pathogens

Turkey Creek is listed on the MDEQ 303(d) list of impaired streams for contamination from biological pathogens. Currently, efforts are underway to establish sewer connections to areas previously not tied into a sewer system. The effects of this action should be monitored to see if this reduces impairments below the TMDL. If monitoring shows a continued problem, additional measures should be taken to locate the sources of the problem and then take corrective measures. First, utilizing source tracking to map and identify sources of biological pathogen inputs would identify whether the impairment is caused by human activity, wildlife activity, or a combination of both. Once sources of contamination are located, best management practices (e.g., nutrient filters and other biological installations to reduce or eliminate inputs) could be implemented. Additionally, efforts to monitor biological pathogens should continue, with stakeholders informed of the results.

5. Stabilize Streambanks

Erosion of streambanks can cause buildup of suspended sediments in the water column and create alterations to the stream channel and its flow as deposition areas build up over time. In many areas, erosional issues are obvious, but in other locations, the issue is not easily identified. Stream areas should be surveyed to identify areas of erosion for planning purposes. Efforts could then be made to identify possible solutions to slow, stabilize, or abate the threat posed to the bank. These solutions may take the form of site-based installation concepts that can be used by landowners and/or partners for implementation. Based on stakeholder input, it was recommended that immediate focus be put on Turkey Creek and Brickyard Bayou.

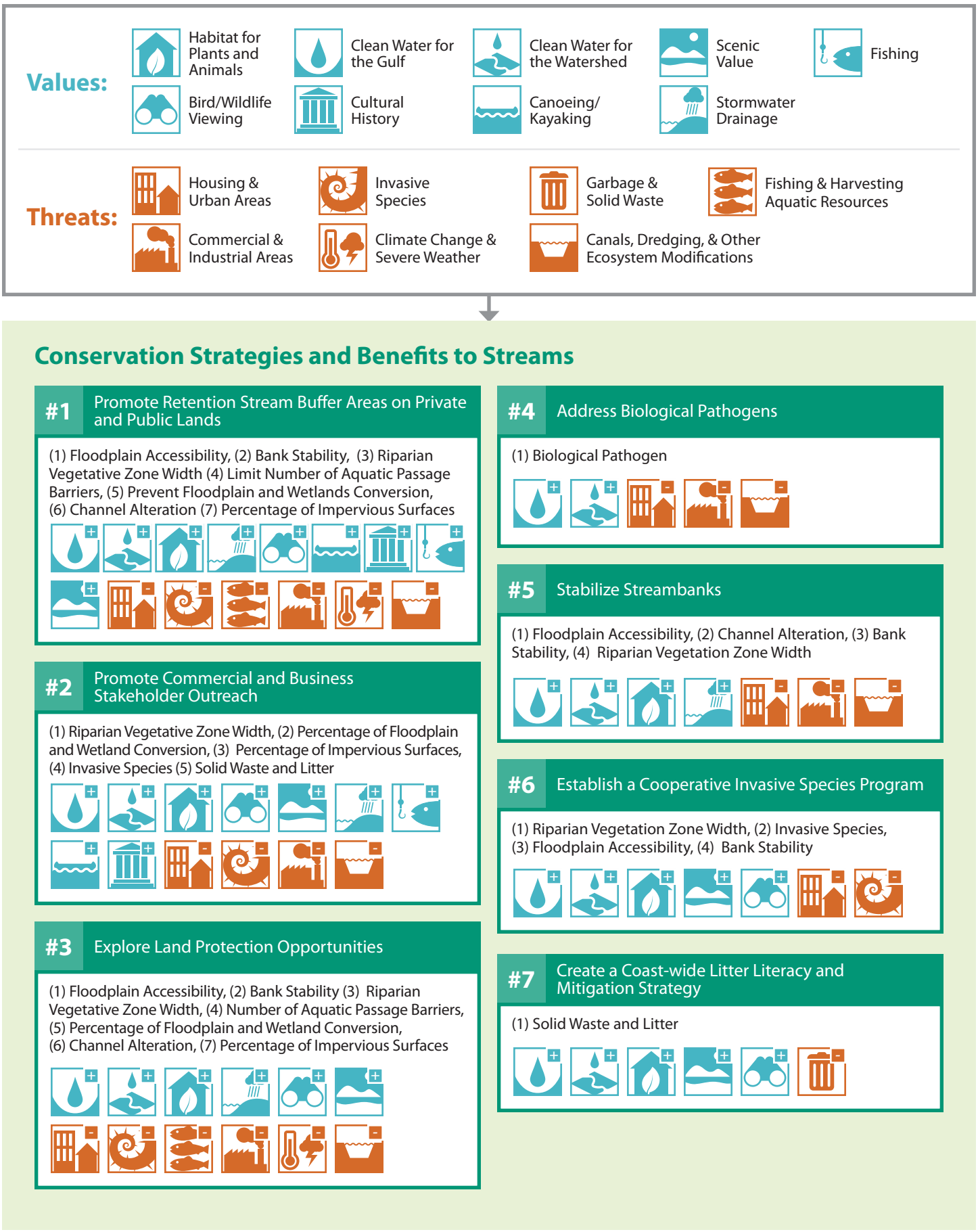
6. Establish a Cooperative Invasive Species Program

Invasive species are a problem in every target stream of this CAP. A cooperative invasive species management program will engage landowners and local government in a coast-wide effort to identify invasive species hotspots and take corrective actions.

7. Create a Coast-wide Litter Literacy and Mitigation Strategy

Litter and solid waste were identified as major problems by the attendees at every CSHI public meeting. A litter literacy and mitigation program could devise ways to reduce litter. The most important part of this effort would be a public education program.

Figure 5-1
Turkey Creek Conservation Strategies



5.5.2 S.M.A.R.T. Objectives

The S.M.A.R.T. objectives that apply to Turkey Creek are included in Table 5-1. The full list of objectives and their associated references are included in Appendix D.

Table 5-1
Turkey Creek S.M.A.R.T. Objectives

S.M.A.R.T. OBJECTIVE	NOTES
WATER QUALITY	
Improve or maintain water quality: • By 2026, reduce the number of sites in Turkey Creek exceeding TMDL guidelines by 100% • By 2026, reduce to 10% urban sites exceeding 2 parts per million (ppm) nitrates • By 2026, reduce to 60% urban stream sites exceeding .1 ppm phosphorus • By 2026, take action to meet or exceed TMDL for coliforms on Turkey Creek	
Eliminate potential sources for biological pathogen contamination: • By 2026, implement repairs of failing on-site wastewater systems or connect them to wastewater collection systems to 90% compliance	
Eliminate failing infrastructure sources of biological pathogen contamination: • By 2026, identify and plan for elimination and repair of 100% of failing public sewer lines in CSHI watersheds	
INVASIVE SPECIES	
Restore or improve ecological balance in systems negatively affected by invasive species: • By 2026, reduce annual increase in Nonindigenous Aquatic Species to 3% annually	*Throughout the Turkey Creek watershed, there are locally severe invasive species issues, especially with Chinese tallow trees and cogongrass. Some strong local efforts to control these have been completed, but much remains to be done. The City of Gulfport, neighborhood groups, and major landowners could work together under a comprehensive control plan to eliminate invasive species in Turkey Creek.*
CANALS, DREDGING, & OTHER ECOSYSTEM MODIFICATIONS	
Encourage agencies that permit shoreline stabilization to consider alternative shoreline erosion control approaches before hardened stabilization is approved: • By 2026, remove or replace hardening structures that degrade habitat in CSHI watersheds at ten sites	*Turkey Creek does not have the high percentage of impervious surfaces found in other CSHI watersheds, but its actual area of paved areas exceeds many of the small streams in this project. Turkey Creek faces constant development pressure, especially in the retail corridor along U.S. Highway 49. Businesses building here will logically look to traditional methods to protect shoreline structures. Ensure that all local decision makers, regulators, contractors, and landowners have access to all land protection options.*
Support compatible management of natural habitats: By 2026, ensure that beach management plans and techniques are revised to protect CSHI streams and watersheds	

S.M.A.R.T. OBJECTIVE	NOTES
ALTERED FLOODPLAINS & WETLANDS	
Maintain and restore physical habitat in freshwater systems: • By 2026, reduce acres of altered freshwater wetlands by permitted construction by 30% • By 2026, increase the miles of streams with improved physical habitat by 15% • By 2026, reduce number of stream miles destroyed or converted to unnatural or managed development in CSHI watersheds by 25%	*Much of Turkey Creek's upper basin remains in wetlands and forests, but is under constant development pressure. Currently, one threat is a road/retail development proposed for the Interstate 10 corridor. Use a diverse suite of methods to protect high-quality habitat and minimize impacts of development, such as fish-friendly culverts and pervious surface parking areas. Ensure that mitigation for Turkey Creek projects is completed within the Turkey Creek watershed.*
Reduce impact of development on the physical habitat in freshwater systems: • By 2026, reduce the number of acres of altered freshwater wetlands drained or converted through development annually in CSHI watersheds to 50% • By 2026, increase the percentage of urban and suburban natural patches (10 to 100 acres) in CSHI watersheds by 35%	*Large areas of Turkey Creek's upper basin remain in forests and wetlands, which are available for conservation. Use acquisition, conservation easements, and other legal tools to minimize development in upper Turkey Creek. Land preservation may be enhanced in this area by large tracts of land held by a small number of landowners.*
Conserve, restore, and create coastal estuarine and marine habitats: • By 2026, improve overall coastal condition indices in estuarine portions of CSHI streams to 3.9 • By 2026, reduce the percentage of CSHI estuarine areas rated "Poor" for water quality to 0% • By 2026, reduce the percentage of sediment-impaired CSHI estuarine areas to 11% (CSHI streams) • By 2026, reduce the percentage of benthic habitat rated "Poor" to 14% (CSHI streams), • By 2026, reduce wetlands loss indices to 1.29 (Gulf of Mexico) • By 2026, prevent additional erosion on shorelines suffering "severe erosion" by 10% • By 2026, identify, create, restore, or enhance significant acreage of high-priority coastal wetlands	*Turkey Creek has streamside erosion, and many areas of past and present land loss. In addition to protecting undamaged lands, seek out ways to restore and enhance areas already impacted. Work with the City of Gulfport, Gulfport-Biloxi International Airport, and other major landowners to find ways to implement local restoration projects.*
OUTREACH, EDUCATION, & STAKEHOLDER ENGAGEMENT	
Expand conservation constituency: • By 2026, develop formal partnerships with five agencies, user groups, or neighborhood associations, and propose and implement local conservation efforts with these groups	*Turkey Creek residents are the most involved stakeholders in any CSHI watershed. Build on this strong base of interest and knowledge to propose and complete restoration projects. Utilize local organizations to disseminate public information.*
RECREATIONAL ACTIVITIES	
Reduce impact of water-borne or shoreline recreational activities; discourage incompatible recreational uses: • By 2026, implement best management practices for on-site erosion, sediment, stormwater, and debris management for 100% of new water-borne or shoreline recreational areas • By 2026, implement best management practices for on-site erosion, sediment, stormwater, and debris management for all pre-existing water-borne or shoreline recreational areas	

5.5.3 Other Objectives

Other objectives found to be relevant to the CAP are listed in Table 5-2.

Table 5-2
Turkey Creek Other Objectives

OTHER OBJECTIVE	NOTES
WATER QUALITY	
Protect, restore, maintain, and improve water quality by financing wastewater treatment infrastructure	
Identify and mitigate all pollution sources for Turkey Creek and establish regular monitoring to ensure water quality	
STORMWATER	
Implement state-of-the-art stormwater management plans to maintain or restore hydrology on two new or in-progress projects on private land: • Ensure that basin streams meet state water quality standards • Improve water quality	*Turkey Creek is the only CSHI stream with demonstrated water quality issues. Part of a comprehensive Turkey Creek restoration program should deal decisively with these issues. Greatest importance should be given to identifying and correcting upstream sources of biological pathogens. There are also anecdotal reports of failing sewer lines in North Gulfport and other watershed neighborhoods. In addition to pollution, Turkey Creek suffers from periodic flooding, due to stormwater runoff. The city, neighborhoods, and major landowners such as Gulfport-Biloxi International Airport should be engaged to find solutions.*
CANALS, DREDGING, & OTHER ECOSYSTEM MODIFICATIONS	
Encourage agencies that permit shoreline stabilization to consider alternative shoreline erosion control approaches before hardened stabilization is approved: • Involve all agencies and organizations in strategies related to shoreline stabilization • Provide appropriate information on alternative shoreline erosion control approaches • Protect and enhance aquatic biodiversity • Protect and enhance terrestrial biodiversity • Maintain healthy aquatic community integrity • Protect and restore existing native fish populations • Maintain populations of native non-game fishes and aquatic invertebrates at or above present levels throughout the basin • Improve water quality for drinking water, and to protect and restore existing native fish populations	*Turkey Creek does not have the high percentage of impervious surfaces found in other CSHI watersheds, but its actual area of paved areas exceeds many of the small streams in this project. Turkey Creek faces constant development pressure, especially in the retail corridor along U.S. Highway 49. Businesses building here will logically look to traditional methods to protect shoreline structures. Ensure that all local decision makers, regulators, contractors, and landowners have access to all land protection options.*

OTHER OBJECTIVE	NOTES
ALTERED FLOODPLAINS & WETLANDS	
Acquire and protect coastal habitat: • Identify, acquire, and protect significant acreage of high-priority coastal wetlands through fee simple, easements, or protective agreements	*Turkey Creek has streamside erosion, and many areas of past and present land loss. In addition to protecting undamaged lands, seek out ways to restore and enhance areas already impacted. Work with the City of Gulfport, Gulfport-Biloxi International Airport, and other major landowners to find ways to implement local restoration projects.* *Large areas of Turkey Creek's upper basin remain in forests and wetlands, which are available for conservation. Use acquisition, conservation easements, and other legal tools to minimize development in upper Turkey Creek. Land preservation may be enhanced in this area by large tracts of land held by a small number of landowners.*
OUTREACH, EDUCATION, & STAKEHOLDER ENGAGEMENT	
Increase public awareness and interest in the values and functions of coastal wetlands, their habitats, and the ecosystem on which they are dependent: • Develop and deliver education materials and programs to inform the public about wetlands species, their habitat, and values to humans	*Turkey Creek residents are the most involved stakeholders in any CSHI watershed. Build on this strong base of interest and knowledge to propose and complete restoration projects. Utilize local organizations to disseminate public information.*
POLICY	
Work with cities to support, revise, and enforce city-wide tree protection ordinances	*The City of Gulfport has a strong tree ordinance. Support local government in fair and effective enforcement of tree protection laws.*

5.6 Next Steps for Implementation

5.6.1 Site Specific Follow-up

Attendees at the two public meetings for Turkey Creek identified 12 sites of concern along the stream. Specific issues mentioned included pollution, erosion, flooding, litter, invasive species, and sewer problems. TNC staff visited all listed sites on November 4, 2015, November 9, 2015, and December 1, 2015. At the same time, TNC staff visited ten road and rail crossings to check for fish passage issues. A full list of these sites and findings is included as Appendix E.

5.6.2 Development of Project Design

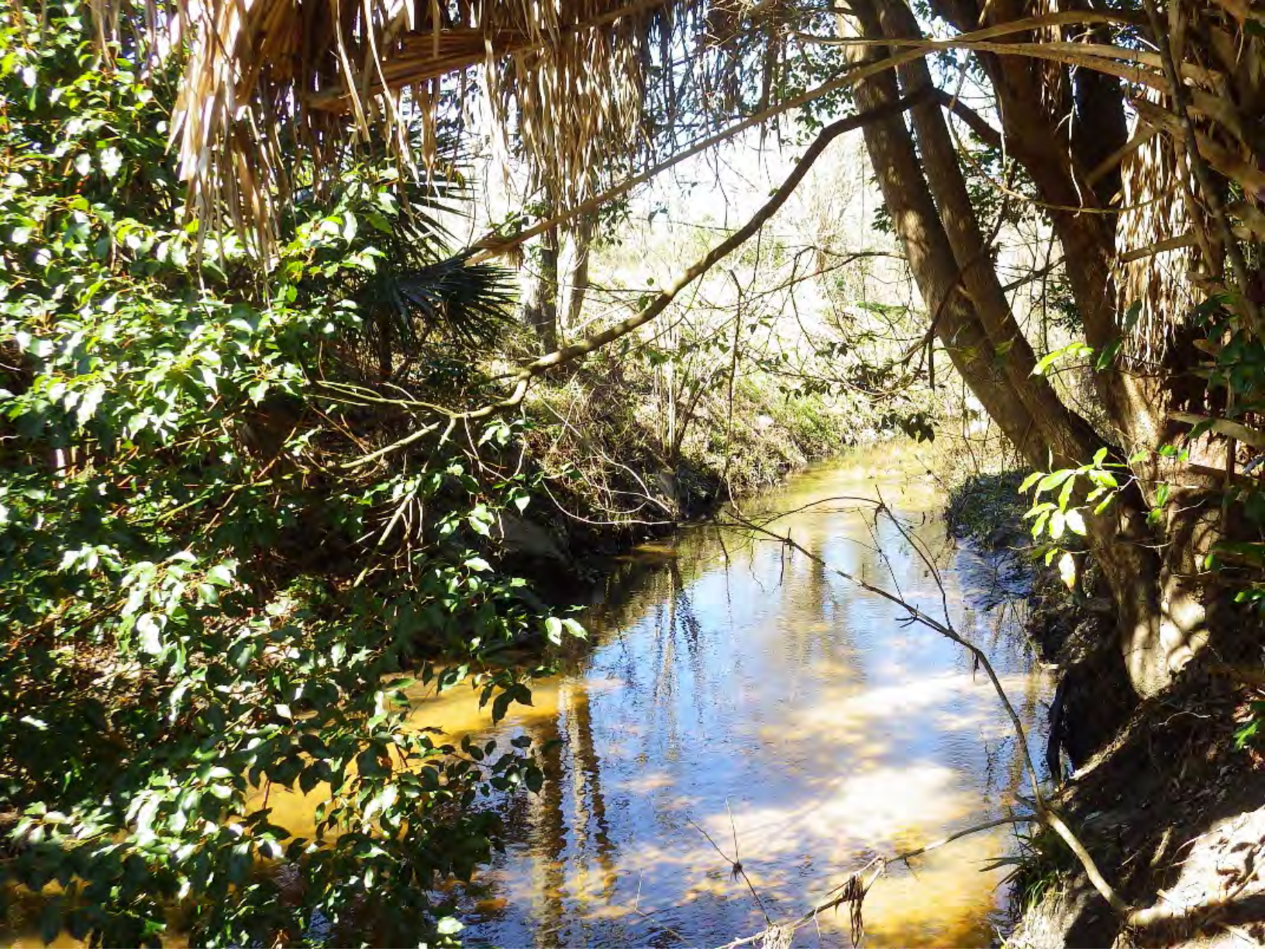
A component of the CSHI was to take the information developed from the conservation planning process and draft conceptual designs of potential projects. These conceptual projects were designed to support future restoration efforts by identifying and describing areas of stream impairments, providing baseline data needed for more advanced planning, and, where possible, drafting a suite of possible options to improve those impairments. The number of projects considered and ultimately initiated was dependent on the amount of funding available. Efforts were made to achieve equivalency among the nine coastal

streams in this project, and advance projects that would have the greatest conservation impact in future restoration efforts. For the Turkey Creek watershed, the following project was recommended for conceptual design development was completed in July 2016.

Turkey Creek and Brickyard Bayou Streambank Assessment

Although there is more information on the Turkey Creek and Brickyard Bayou watersheds compared to the other streams in the CSHI, the site-specific data needed to identify in-stream channel impairments for restoration were unavailable. Therefore, TNC initiated the following conceptual project in order to identify specific impairments, the nature of those impairments, and potential solutions for landowners.

The first part of this project was to conduct stream surveys to measure the condition of the creek and to identify impairments to bank stability, the stream channel, or the stream's hydrology. This was designed to map and prioritize areas of impairment and to highlight locations most in need of restoration. The second part of this project built on the completed survey to create recommendations for restoration in the areas of impairment. These recommendations will be the basis to fund restoration or develop project proposals and contain multiple restoration options and techniques to repair identified impairments. A cost comparison of the different techniques is provided, along with general descriptions of project elements included in the conceptual design. Finally, four project sites were identified prior to the survey for conceptual design at the Ohio Avenue Bridge, Arkansas Street Bridge, Canal Street Bridge, and Hutter Street culvert. These areas were selected as areas of concern due to the observable streambank erosion that may be a concern to transportation and municipal infrastructure.



6 COFFEE CREEK

6.1 General Description of Watershed

Coffee Creek is located in central Harrison County in South Mississippi and is located entirely within the city of Gulfport. This coastal stream flows eastward out of downtown Gulfport before turning south and entering the Mississippi Sound. The stream is tidally influenced for a distance of about 0.25 mile. A smaller tributary enters Coffee Creek from the east, but becomes difficult to trace further upstream. An additional small spring-fed tributary enters the main stream at the Clower-Thornton Nature Trail.

The lower portion of Coffee Creek borders on Centennial Plaza, a city-owned development area that was once a Veteran's Administration Hospital. The Gulfport Veteran's Administration Hospital was built in 1916 and was leased to the U.S. Navy as a training facility until 1921. It was then transferred to the Public Health Service, passed to the Veteran's Administration in 1922, and operated until 2005 when it was heavily damaged by Hurricane Katrina. Following its permanent closure, the property was transferred to the City of Gulfport, who is seeking tenants for redevelopment.

The Coffee Creek watershed has extensive urban development with single- and multi-family residential areas, and concentrated commercial areas along the northern edge of the basin. Much of the stream's riparian areas are actually the backyards of residential homes. Several road and railroad crossings create potential fish passage barriers. The watershed has extensive hardened surfaces, including large expanses of parking lots for retail areas. Several large recreational areas, including sports venues, are located within the watershed. Invasive plants are also common, including Chinese tallow tree, elephant ear, kudzu, and camphor tree. In the upper basin, streamflow is channeled underground at times. The last 0.25 mile of the stream above the beach is contained by a concrete ditch, which also covers the stream bottom. Below this stretch, Coffee Creek flows across an artificial sand beach within a concrete canal. Extensive urban litter is also a major issue.

Coffee Creek has limited nature recreational opportunities because the stream is too small for boating. Limited recreational crabbing is available in the portions of the stream south of U.S. Highway 90. Other recreational opportunities exist within the watershed, including birding at the Clower-Thornton Nature Trail, an 18-acre preserve near the mouth of the stream. This site is jointly owned by the City of Gulfport and the Land Trust for the Mississippi Coastal Plain, and is managed by the Gulfport Parks and Recreation Department. This renowned birding site is listed on the Audubon Mississippi Coastal Birding Trail and has well-maintained hiking trails along each side of the stream. There is potential for land acquisition next to the Clower-Thornton Wildlife Area to expand this area. The City of Gulfport has also been awarded a grant to design a nature trail along Coffee Creek close to the Clower-Thornton Wildlife Area.

6.2 Conservation Action Plan

In the past, TNC has successfully implemented a ten-step CAP process for defining the conservation projects, developing and implementing strategies and measures, and using the results to adapt and improve conservation outcomes (TNC 2007). A facilitator led the CAP process with each watershed stakeholder group. Through a series of workshops or meetings, they worked together to identify conservation targets, analyze target threats, identify objectives and outcomes, develop strategic actions, and define indicators and measures to monitor success.

6.2.1 Stakeholder Engagement

The Coffee Creek Public Listening Sessions were the part of a series of public forums for the CSHI within the nine target stream areas. TNC conducted two Public Listening Sessions in June 2015 for residents of the Coffee Creek watershed. Input from these meetings informed the CAP process. The summarized results of

Coffee Creek's scope, perceived problems or threats, and identified solutions to the problems from the meetings are included in Appendix A.

6.2.2 Nested Targets

Imbedded or nested targets within Coffee Creek include a variety of biological and functional components to be considered for conservation as a part of this drainage. These include the actual stream, watershed, riparian corridor, and tidal zone. Upland native vegetation, forest habitat, and wetlands, as well as species assemblages of native fishes, stream invertebrates, and migratory bird species are also considered. A listing of species of conservation concern is included in Appendix F, and a listing of habitats in this stream is included in Appendix G. In addition to species and habitats, participants in the Public Listening Sessions were given a list of 16 biological and functional components to rank in order of importance for conservation value for their watershed. The top values from the Public Listening Sessions are as follows, in order of importance:

1. Clean Water for the Gulf
2. Stormwater Drainage
3. Clean Water for the Watershed
4. Bird/Wildlife Viewing

6.3 Habitat Assessment: Stream Health

6.3.1 Rapid Stream Assessments

RSAs were conducted at five sites on Coffee Creek (see Appendix H). Scoring results were averaged from individual assessments, with an average score of 4.11 out of 10. This score indicates that Coffee Creek is in fair condition as rated by the SVAPv2. This is consistent with the overall viability ranking for the stream.



Rapid Stream Assessment

The most impaired area in the Coffee Creek watershed is where the stream is contained in a concrete channel across the sand beach before entering the Mississippi Sound. This containment has limited invertebrate habitat, such as pools. The strongest feature of this stream was the absence of barriers to fish passage along most of the stream course. The least impaired section is along a small, spring-fed tributary within the Clower-Thornton Nature Trail area. The Clower-Thornton Nature Trail area is characterized by intact freshwater marshes, high-quality spring water, and a canopy of mostly native trees.

6.3.2 Water Quality Data

The quality of the water is a critical component to the health of stream habitats. It effects estuarine and marine environments in Mississippi Sound and can be reflective of conditions upstream and over the entire

watershed. Creating a baseline of water quality is important to understanding the current conditions of a stream, monitoring its health, and measuring change over time. The MDEQ Field Services Division collected water quality data on all nine streams from March 1, 2016, to August 31, 2016. Data were collected under the guidelines of the MDEQ Quality Assurance Project Plan Section 106 Monitoring Network in the State Surface Water Monitoring and Assessment Program. Two sample locations were established for each stream, except in Watts Bayou where the limited public access points allowed for only one sample site. Nineteen different sampling measures were taken twice a month, and one measure for biological oxygen demand was taken monthly. A complete list of the parameters for the water quality analyses is included in Appendix I. Data collected from this sampling were used to inform the stream's Viability Assessment.

For Coffee Creek, no water quality impairments or potential areas of concern were identified though this sampling. It is important to recognize that this sampling took place over a limited period, and longer-term continuous monitoring is recommended. Extended monitoring would establish a more robust baseline, establish trends, and alert stakeholders to chronic or acute problems as they may develop.

6.3.3 Viability Assessment Summary Results

Bear Point Bayou and Coffee Creek were analyzed together due to similarities in size and location. However, different factors contribute to the condition of these streams. For example, Coffee Creek has good fish passage connectivity, while in contrast, Bear Point Bayou has numerous fish passage issues. The overall rating, landscape context, condition, and size of Bear Point Bayou and Coffee Creek was "Fair" primarily due to the urban nature of these streams. Some of the major stream landscape issues that exist in these watersheds include lack of a floodplain and conversion of wetlands and riparian habitat. The condition of these streams is also considered "Fair" primarily due to the abundance of solid waste and litter in the streams, presence of invasive species, and bank instability. Attributes for water quality were ranked "Very Good" due to no impairments detected for nitrogen, nitrite, phosphorous, and dissolved oxygen. The Size ranking was "Fair" because both streams are small with a small proportional riparian zone width.

6.4 Factors of Stream Degradation: Stresses and Threats

6.4.1 Primary Stresses

The following seven stresses were identified for Coffee Creek during the CAP process:

1. Excessive Suspended and Bedded Sediments
2. Altered Floodplains and Wetlands
3. Altered Riparian Corridor
4. In-stream Habitat Modification
5. Altered Stream Geomorphology
6. Altered Hydrology
7. Invasive Species

Excessive Suspended and Bedded Sediments
Much of the substrate in the lower portion of Coffee Creek is sand and is poor habitat for invertebrates and/or fish. The sand bottoms, along with some visible bank erosion, suggests that excessive sediment is a problem in Coffee Creek.

Altered Floodplains and Wetlands
Most of the Coffee Creek drainage is within residential areas, but there is a small commercial zone in the upstream reach. Several main roads, the CSX rail line, and U.S. Highway 90 also traverse the watershed. The largest natural area is the Clower-Thornton Nature Trail. Centennial Plaza (site of a now closed Veteran's Administration Hospital) occupies a large section of the watershed.

Altered Riparian Corridor
Riparian habitat is limited along the main channel; however; much of it is poor quality due to residential landscaping and transportation infrastructure. The healthiest example of riparian habitat is within the Clower-Thornton Nature Trail.

In-stream Habitat Modification
Areas of sediment buildup within the stream channel were noted during the RSAs. Excess sediment is likely from excavation of attached drainage channels (for stormwater maintenance), bank instability, and erosion.

Altered Stream Geomorphology
Sections of the upper stream have been altered and redirected for stormwater management. Deepening may occur when these drainage channels are maintained, or when the stream channel becomes clogged. Multiple sections of the stream have been straightened and channelized. The outflow of Coffee Creek exits into a concrete, open-box culvert, and tidal exchange appears unaffected between the stream and Mississippi Sound.

Altered Hydrology
Impervious surfaces within the watershed likely cause an increase in water volume within Coffee Creek. Stormwater is not absorbed readily and runs into the creek at a greater velocity and volume, resulting in incised channels and more severe flooding impacts.



Bank erosion and streambed sedimentation



Leveed bank



Railroad bridges and pipes



Debris creating Altered Hydrology

Invasive Species

Invasive species of concern in Coffee Creek include plant species such as cogongrass, Chinese tallow tree, torpedo grass, Japanese climbing fern, elephant ear, kudzu, and camphor tree. These species outcompete native plant communities—often resulting in a near monoculture with low biodiversity in comparison to a native riparian community. Giant salvinia was not observed, but should be monitored because it is a concern for resource managers. The only invasive animal species observed were domestic/feral cats, which pose a concern to native wildlife—particularly bird species. Nutria were not observed, but are likely to be present in this watershed. Nutria should be monitored as they are herbivores that can pose a threat to vegetation and small trees; their foraging activities can also directly damage bank stability. Nile tilapia were not observed in Coffee Creek, but have been collected in nearby Oyster Bayou. Tilapia pose a threat to native species diversity and should also be monitored.

6.4.2 Primary Threats

Primary threats were identified and ranked by stakeholders as the sources of stress for each watershed. The nine threats for Coffee Creek are as follows:

1. Housing and Urban Areas
2. Commercial and Industrial Areas
3. Transportation, Utility, and Service Lines
4. Climate Change and Severe Weather
5. Invasive Species
6. Garbage and Solid Waste
7. Canals, Dredging, and Other Ecosystem Modifications
8. Dams and Water Management
9. Flight Paths

6.5 Taking Action

Developing effective strategic action and objectives to abate critical threats and restore function to Coffee Creek watershed is essential to conservation planning. If successfully implemented, strong conservation strategies collectively should conserve the stream and realize the project vision.

6.5.1 Conservation Strategies

Ultimately, five strategies were developed that are specific to Bear Point Bayou or are part of a broader basin wide approach. Figure 6-1 depicts the development of these strategies and the potential stream improvements that would occur as a result of their implementation.

1. Support and Expand Public Natural Areas

The lower portion of Coffee Creek currently has a few areas set aside for preservation and public use. These areas are important to the Coffee Creek watershed and stream. Expansion of these areas is recommended, with increased management of invasive species and native plantings to increase values of maintaining

water quality and improving wildlife habitat. Well-developed hiking trails parallel Coffee Creek in its lower reaches, which promote public recreation and interaction with nature.

2. Stabilize Streambanks

Erosion of streambanks can cause buildup of suspended sediments in the water column and create alterations to the stream channel and its flow as deposition areas build up over time. In many areas, erosional issues are obvious, but in other locations, the issue is not easily identified. Stream areas should be surveyed to identify areas of erosion for planning purposes. Efforts could then be made to identify possible solutions to slow, stabilize, or abate the threat posed to the bank. These solutions may take the form of site-based installation concepts that can be used by landowners and/or partners for implementation.

3. Re-establish Intertidal Habitat

The contained outfall of Coffee Creek empties into the Mississippi Sound through an open-box culvert past a maintained public recreational beach. Historically, this habitat would have consisted of upland pocket beaches mixed with wetland plants and maritime forest. Re-designing the outfall and restoring native habitat could return the area to its historical state. These improvements would add to the natural aesthetic of the public beach area, and reduce the need for sand management.

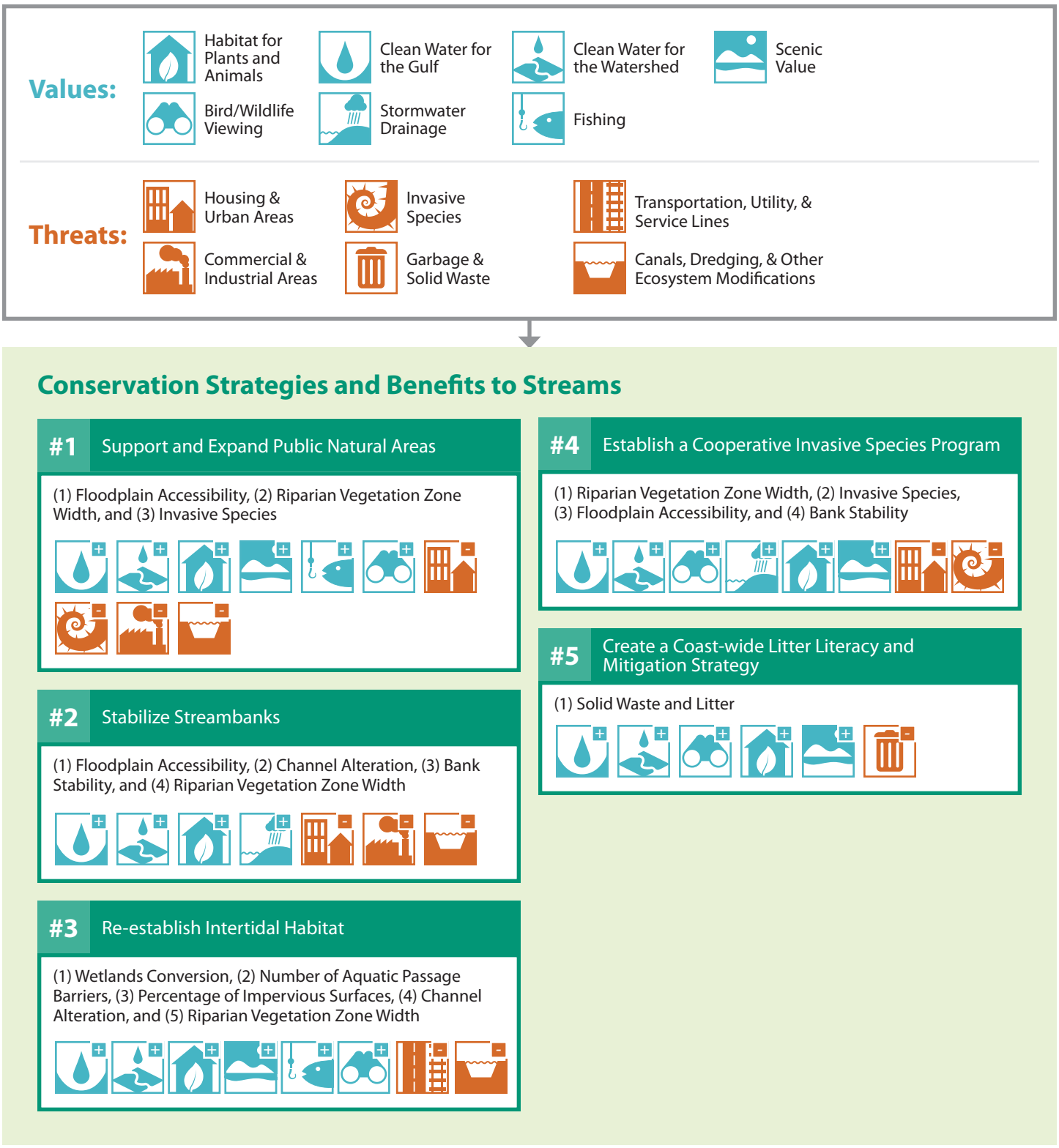
4. Establish a Cooperative Invasive Species Program

Invasive species are a problem in every target stream of this CAP. A cooperative invasive species management program will engage landowners and local government in a coast-wide effort to identify invasive species hotspots and take corrective actions.

5. Create a Coast-wide Litter Literacy and Mitigation Strategy

Litter and solid waste were identified as major problems by the attendees at every CSHI public meeting. A litter literacy and mitigation program could devise ways to reduce litter. The most important part of this effort would be a public education program.

Figure 6-1
Coffee Creek Conservation Strategies



6.5.2 S.M.A.R.T. Objectives

The S.M.A.R.T. objectives that apply to Coffee Creek are provided in Table 6-1. The full list of objectives and their associated references are included in Appendix D.

Table 6-1
Coffee Creek S.M.A.R.T. Objectives

OBJECTIVE	NOTES
INVASIVE SPECIES	
Restore or improve ecological balance in systems negatively affected by invasive species: • By 2026, reduce annual increase in Nonindigenous Aquatic Species to 3% annually	*Nonindigenous Aquatic Species are species (i.e., individual, group, or population) that enter a body of water or aquatic ecosystem outside of its historical or native range. While some invasive control has been done, especially on the Clower-Thornton Nature Trail, Coffee Creek's watershed has extensive stands of invasive trees, grasses, and aquatic plants. Wherever possible, invasive plants should be controlled or eliminated using acceptable methods and replaced with native species.*
CANALS, DREDGING, & OTHER ECOSYSTEM MODIFICATIONS	
Encourage agencies that permit shoreline stabilization to consider alternative shoreline erosion control approaches before hardened stabilization is approved: • By 2026, remove or replace hardening structures that degrade habitat in CSHI watersheds at ten sites	
Support implementation of best management practices at stream outfalls: • By 2026, remove one concrete stream outfall channel and allow the streams to "renaturailze" where they cross the Harrison County beaches in either Bear Point Bayou, Coffee Creek, or Oyster Bayou	*Coffee Creek enters the Gulf of Mexico across an artificially maintained sand beach through a concrete canal. Shifting sands often create temporary blockages. One solution would be to remove the concrete ditches and allow the stream to set its own course across the beach.*
HYDROLOGY	
Establish, improve, or maintain appropriate sediment flow: • By 2026 stabilize or restore 5 miles of unstable shoreline along CSHI streams • By 2026, reduce the miles of CSHI streams impaired by excessive sedimentation by 25%	*In the lower reaches of Coffee Creek, the most prominent bottom substrate is sand, which usually indicates erosion in the upstream reaches. For most of its length, Coffee Creek has steep, artificially maintained banks that are highly erosional. By using best management practices and modifying stream maintenance, it will be possible to reduce erosion and promote more biologically useful substrates.*
RIPARIAN CORRIDOR	
Establish, improve, and maintain riparian zones • By 2026, ensure that 15% of all lands within 100 feet of a stream have adequate riparian protection	*Through much of its length, Coffee Creek flows through highly developed landscapes, including homeowners' yards. In many cases, hardened infrastructure or urban landscaping extends to the top of the stream channel, and riparian floodplain is marginal or nonexistent. Wherever possible, rebuild and reconnect floodplains to the stream.*

OBJECTIVE	NOTES
Restore, enhance, manage, and protect Mississippi's remaining coastal habitat functional riparian/floodplain habitat: • By 2026, increase the area of functional floodplain in CSHI watersheds by 5% • By 2026, stabilize or restore 10% of degraded riparian lands in CSHI watersheds • By 2026, ensure that best management practices that protect riparian corridors are implemented on 50% of all construction projects on private land	*In many lower reaches of Coffee Creek, a riparian zone is very limited. Streamside landscaping extends to the bank of the stream. There is ample space in many areas to recreate and reconnect a riparian zone. In some upper reaches, the riparian zone still exists and can be preserved and enhanced.*
ALTERED FLOODPLAINS & WETLANDS	
Maintain and restore physical habitat in freshwater systems: • By 2026, reduce the acres of altered freshwater wetlands by permitted construction by 30% • By 2026, increase the miles of streams with improved physical habitat by 15% • By 2026, reduce the number of stream miles destroyed or converted to unnatural or managed development in CSHI watersheds by 25%	*As noted previously, Coffee Creek has been highly altered, channelized, and deepened for use as drainage. Despite this alteration, there are opportunities on both public and private lands to improve the physical habitat of the stream, using a wide variety of techniques. Lands owned by the City of Gulfport in Centennial Plaza and Clower-Thornton Nature Trail have excellent restoration potential.*
Reduce impact of development on the physical habitat in freshwater systems: • By 2026, reduce the number of acres of altered freshwater wetlands drained or converted through development annually in CSHI watersheds to 50% • By 2026, increase the percentage of urban and suburban natural patches (10 to 100 acres) in CSHI watersheds by 35%	*Acquisition and restoration of lands in the Centennial Plaza and Clower-Thornton Nature Trail are a high priority.*
OUTREACH, EDUCATION, & STAKEHOLDER ENGAGEMENT	
Expand conservation constituency: • By 2026, develop formal partnerships with five agencies, user groups, or neighborhood associations, and propose and implement local conservation efforts with these groups	*Many people who live and work in the Coffee Creek watershed may not know that this is a natural stream. Community awareness of the values associated with healthy stream habitat will produce a constituency that will support sound conservation actions.*

6.5.3 Other Objectives

Other objectives found to be relevant to the CAP are listed in Table 6-2.

Table 6-2

Coffee Creek Other Objectives

OTHER OBJECTIVE	NOTES
ALTERED FLOODPLAINS & WETLANDS	
Acquire and protect coastal habitat: • Identify, acquire, and protect significant acreage of high-priority coastal wetlands through fee simple, easements, or protective agreements	*The city of Gulfport and the Land Trust for the Mississippi Coastal Plain own and manage lands in the Clower-Thornton Nature Trail. Several tracts remain to complete protection of this important site.*

OTHER OBJECTIVE	NOTES
POLICY	
Work with cities to support, revise, and enforce city-wide tree protection ordinances	*Through much of its length, Coffee Creek flows through individual yards. While this is typically detrimental to stream health, many of these yards also contain mature native trees, especially live oaks, which act as important canopy for the stream. Ensure that the City of Gulfport enforces its current tree protection ordinance to protect native trees on public and private land.*

6.6 Next Steps for Implementation

6.6.1 Site-specific Follow-up

Attendees at the two public meetings for Coffee Creek identified seven sites of concern along the stream. Specific issues mentioned included pollution, erosion, flooding, litter, and invasive species. TNC staff visited all listed sites on October 6, 2015, and December 1, 2015. In addition, TNC staff visited 15 road and rail crossings to check for fish passage issues. A full list of these sites and findings is included as Appendix E.

6.6.2 Development of Project Design

A component of the CSHI was to take the information developed from the conservation planning process and draft conceptual designs of potential projects. These conceptual projects were designed to support future restoration efforts by identifying and describing areas of stream impairments, providing baseline data needed for more advanced planning, and, where possible, drafting a suite of possible options to improve those impairments. The number of projects considered and ultimately initiated was dependent on the amount of funding available. Efforts were made to achieve equivalency among the nine coastal streams in this project, and advance projects that would have the greatest conservation impact in future restoration efforts. For Coffee Creek, the following projects were recommended for conceptual design development to be completed by the end of September 2016.

Stream Assessments

As previously mentioned in the Viability Assessment section, very little baseline data on stream conditions were present prior to the start of this project. The initial snapshot created by the RSAs provided a needed general overview of each stream's condition. This assessment was not designed or intended to provide the site-specific level of detail needed for conceptual projects. The stream assessments conceptual project will identify, describe, map, and rank areas of impairments on the six mid-sized project streams. Data collected on existing in-stream conditions would identify future potential restoration opportunities. A limited number of "planning areas" will be identified, with recommendations and costs for potential improvements. The six streams included in this project include Watts Bayou, Magnolia Bayou, Coffee Creek, Oyster Bayou, Rhodes Bayou, and Bayou Chicot.

Evaluation of Land Protection Opportunities

While all streams in this project are located within urban areas, there is a limited amount of natural habitat that can be protected through standard land protection strategies. TNC would evaluate and rank areas of natural habitat as potential land protection areas. Part of this evaluation would include land appraisals of parcels if a willing landowner is identified. As mentioned in the Conservation Strategies section of this CAP, a second part of this evaluation would be to identify a potential land manager for any lands protected.

In addition to the conceptual projects listed above, additional projects were drafted, but funds were not available to implement. It is recommended that these projects be considered for implementation as funding is secured. For Coffee Creek, two such projects were the Wildlife Corridor and Stream Outfall conceptual projects. The main purpose of the Wildlife Corridor project was to design culvert replacements and restore wildlife passage along the riparian corridor and also maintain a stable stream channel. Over the course of the CSHI, approximately 15 wildlife passage impairments were identified across the nine streams. The purpose of the Stream Outfall project is to naturalize the tidal zone of Coffee Creek that would likely reestablish marsh vegetation and substrate. It is believed that this project would serve several other non-habitat functions, such as reduction of sand blown on the highway and aesthetic improvements that would improve the appearance of the outfall culvert.



7 BRICKYARD BAYOU

7.1 General Description of Watershed

Brickyard Bayou is a coastal stream located in Harrison County, Mississippi. The watershed covers 3485 acres and is the single largest drainage basin in south Gulfport. The stream is approximately 9 miles in length and flows northeast through downtown Gulfport into Bayou Bernard, then into Biloxi Bay. Two small tributaries enter the stream: one in the Bayou View neighborhood and one in downtown Gulfport. Tidal influence extends for at least 0.5 mile upstream.

This watershed is mostly developed with numerous single- and multi-family housing areas, major retail and manufacturing areas, and—like nearby Turkey Creek watershed—contains portions of the Gulfport-Biloxi International Airport and two military bases. The stream's course is highly altered, often flowing in straight lines and around street corners to accommodate roadways and urban development.

Brickyard Bayou has extensive shoreline development, stream channel and riparian alteration, invasive plants, heavy littering, urban runoff, and numerous road and rail crossings. In addition, there are areas in the upper portion of the stream channeled into underground culverts for distances of up to one city block.

Despite these impacts, Brickyard Bayou has significant recreational potential and is accessible by kayak through a boat launch on Bayou Bernard, which is approximately 2.5 miles downstream from the mouth of the stream. A small natural forest (approximately 270 acres) remains intact and is located southwest of the airport. The stream supports a popular sport fishery through its lower reaches. Initial fish sampling showed a diversity of native freshwater and estuarine species, including gar, bass, striped mullet, and bluegill.

Much of Brickyard Bayou has been altered and modified to aid in stormwater management. These changes have added additional water volume that moves at a much faster rate through the stream. This has the effect of deepening the stream channel and causes erosional impairments to occur at sections along the streambank. Additionally, in some areas commercial and residential development extends up to the stream channel. Streamside management in these areas can include landscaping and mowing in the riparian vegetation zone. Lack of vegetation to support the stability of the stream bank can add to erosion issues as well as damage to the streambank.

7.2 Conservation Action Plan

In the past, TNC has successfully implemented a ten-step CAP process for defining the conservation projects, developing and implementing strategies and measures, and using the results to adapt and improve conservation outcomes (TNC 2007). A facilitator led the CAP process with each watershed stakeholder group. Through a series of workshops or meetings, they worked together to identify conservation targets, analyze target threats, identify objectives and outcomes, develop strategic actions, and define indicators and measures to monitor success.

7.2.1 Stakeholder Engagement

The Brickyard Bayou Public Listening Sessions were part of a series of public forums for the CSHI within nine target stream areas. TNC conducted two Public Listening Sessions in July 2015 for residents of the Brickyard Bayou watershed. Input from these meetings informed the CAP process. The summarized results of Brickyard Bayou's scope, perceived problems or threats, and identified solutions to the problems from the meetings are included in Appendix A.

7.2.2 Nested Targets

Imbedded or nested targets within Brickyard Bayou include a variety of biological and functional components to be considered for conservation as a part of this drainage. These include the actual stream,

watershed, riparian corridor, and tidal zone. Upland native vegetation, forest habitat, and wetlands, as well as species assemblages of native fishes, stream invertebrates, and migratory bird species are also considered. A listing of species of conservation concern is included in Appendix F, and a listing of habitats in this stream is included in Appendix G. In addition to species and habitats, participants in the Public Listening Sessions were given a list of 16 biological and functional components to rank in order of importance for conservation value for their watershed. The top values from the Public Listening Sessions are as follows, in order of importance:

1. Stormwater Drainage
2. Fishing
3. Habitat for Plants and Animals

7.3 Habitat Assessment: Stream Health

7.3.1 Rapid Stream Assessments



Rapid Stream Assessment

RSAs were conducted at eight sites on Brickyard Bayou (see Appendix H). Scoring results were averaged from individual assessments, with an average score of 5.09 out of 10. This score indicates that Brickyard Bayou is in fair condition as rated by the SVAPv2. This is consistent with the overall viability ranking for the stream. The impairments identified within the RSAs are generally caused by long-term maintenance and stormwater management. The most impaired areas of the stream are in the residential and business areas in downtown Gulfport. The greatest impacts observed during the RSAs were stream channelization, streambank straightening, and reinforcement of banks through hardened shorelines. Additionally, heavy infestation of invasive species, particularly Chinese tallow trees, were documented. No fish passage barriers were observed along the stream's main channel. The least impaired sections are located at the lower stretches of the stream, where both sides of the stream have levees for flood protection. Some riparian habitat remains inside the levees, which protect and create a natural area for approximately 2 miles.

7.3.2 Biological Sampling of Fishes

A small number of specimens were collected in Brickyard Bayou in 1985 are preserved in the collections of Tulane University. The species included in this collection are the bay anchovy, spotfin mojarra, western mosquitofish, darter goby, freshwater goby, spot, inland silversides, striped mullet, and hogchoker.

7.3.3 Water Quality Data

The quality of the water is a critical component to the health of stream habitats. It effects estuarine and marine environments in Mississippi Sound and can be reflective of conditions upstream and over the entire

watershed. Creating a baseline of water quality is important to understanding the current conditions of a stream, monitoring its health, and measuring change over time. The MDEQ Field Services Division collected water quality data on all nine streams from March 1, 2016, to August 31, 2016. Data were collected under the guidelines of the MDEQ Quality Assurance Project Plan Section 106 Monitoring Network in the State Surface Water Monitoring and Assessment Program. Two sample locations were established for each stream, except in Watts Bayou where the limited public access points allowed for only one sample site. Nineteen different sampling measures were taken bimonthly, and one measure for biological oxygen demand was taken monthly. A complete list of the parameters for the water quality analyses is included in Appendix I. Data collected from this sampling was used to inform the stream's Viability Assessment.

For Brickyard Bayou, no water quality impairments or potential areas of concern were identified though this sampling. It is important to recognize that this sampling took place over a limited period, and longer-term continuous monitoring is recommended. Extended monitoring would establish a more robust baseline, establish trends, and alert stakeholders to chronic or acute problems as they may develop.

7.3.4 Viability Assessment Summary Results

The overall ranking, landscape context, condition, and size of Brickyard Bayou was "**Fair**" due to poor floodplain connectivity with many hardened shorelines (bulkhead), channelization and development right up to the stream. In addition, a "Fair" rating was given for landscape context because of wetlands conversion, impervious surface, and channel alteration. The condition of the stream is also "Fair" due to high amounts of debris creating stream blockage, presence of invasive species and moderate amounts of unstable streambanks. The size ranking was "Poor" because very little riparian zone remains as commercial and residential development are up to the streambank.

7.4 Factors of Stream Degradation: Stresses and Threats

7.4.1 Primary Stresses

The following seven stresses were identified for Brickyard Bayou during the CAP process:

1. Excessive Suspended and Bedded Sediments
2. Altered Floodplains and Wetlands
3. Altered Riparian Corridor
4. In-stream Habitat Modification
5. Altered Stream Geomorphology
6. Altered Hydrology
7. Invasive Species

Excessive Suspended and Bedded Sediments

Much of Brickyard Bayou has been altered and modified to aid in stormwater management. These changes have added additional water volume that moves at a much faster rate through the stream. This has the effect of causing erosion that deepens the stream channel and causes erosional impairments to occur at

sections along the streambank. Additionally, in some areas commercial and residential development extends up to the stream channel. Stream-side management in these areas can include landscaping and mowing in the riparian vegetation zone. Lack of vegetation to support the stability of the streambank can add to erosion issues as well as damage to the stream bank.

Altered Floodplains and Wetlands

The majority of Brickyard Bayou's drainage includes commercial and residential development, consisting of retail areas, large parking lots, businesses, and apartments. These developments include large areas of impervious surface with little natural habitat. Some home sites contain trees and landscaping, but invasive species are common, especially Chinese tallow trees, Chinese privet, and cogongrass. Small stretches of the stream retain some trees and buffer the area, but these are not common. Some home sites are targeted for flood mitigation buy-out programs, these areas are currently cleared of any buildings and being left in their current condition.

Altered Riparian Corridor

The Brickyard Bayou riparian zone is heavily developed close to the stream, although short stretches of the stream have areas of canopy cover near its confluences with Bayou Bernard. Roads, bridges, businesses, homes, and residential yards line most of the stream. Where waterfront homes exist, bulkheads and boat slips line the stream. Much of the center stretch of the stream is contained within flood-control levees.

In-stream Habitat Modification

Extensive modifications of the stream channel are apparent through much of the stream's length, suggesting that very little original stream habitat remains.

Altered Stream Geomorphology

Unaltered stretches of Brickyard Bayou are very rare. Stream modifications include channelization and channel incision, widening, and straightening.

Altered Hydrology

Increases in water quantity and water velocity of storm flow are likely due to impervious surfaces in the drainage. Additionally, Brickyard Bayou is an important component to stormwater management for the City of Gulfport. As such, it is maintained to protect property against the effects of flooding.

Altered Connectivity

Through most of its length, Brickyard Bayou is not connected with its floodplain. Streambanks are stabilized with hard structures creating vertical streambanks, and the stream course is channelized with little access to upland areas.



Altered Hydrology destabilizing streambanks

Invasive Species

Invasive species of concern in Brickyard Bayou include plant species such as cogongrass, Chinese tallow trees, Chinese privet, Japanese climbing fern, torpedo grass, and elephant ear. These species outcompete native plant communities—often resulting in a near monoculture with low biodiversity in comparison to a native riparian community. Giant salvinia was not observed, but should be monitored because it is a concern for resource managers. The only invasive animal species observed were domestic/feral cats, which pose a concern to native wildlife—particularly bird species. Nutria were not observed, but are likely to be present in this watershed. Nutria should be monitored as they are herbivores that can pose a threat to vegetation and small trees; their foraging activities can also directly damage bank stability. Nile tilapia were not observed in Brickyard Bayou, but have been collected in nearby Oyster Bayou. Tilapia pose a threat to native species diversity and should also be monitored.

7.4.2 Primary Threats

Primary threats were identified and ranked by stakeholders as the sources of stress for each watershed. The 11 threats for Brickyard Bayou are as follows:

1. Housing and Urban Areas
2. Commercial and Industrial Areas
3. Transportation, Utility, and Service Lines
4. Climate Change and Severe Weather
5. Invasive Species
6. Garbage and Solid Waste
7. Canals, Dredging, and Other Ecosystem Modifications
8. Dams and Water Management
9. Tourism and Recreation Areas
10. Fishing and Harvesting Aquatic Resources
11. Flight Paths

7.5 Taking Action

Developing effective strategic action and objectives to abate critical threats and restore function to Brickyard Bayou watershed is essential to conservation planning. If successfully implemented, strong conservation strategies collectively should conserve the stream and realize the project vision.

7.5.1 Conservation Strategies

Ultimately, three strategies were developed that are specific to Brickyard Bayou or are part of a broader basin-wide approach. Figure 7-1 depicts the development of these strategies and the potential stream improvements that would occur as a result of their implementation.

1. Stabilize Streambanks

Erosion of streambanks can cause buildup of suspended sediments in the water column and create alterations to the stream channel and its flow as deposition areas build up over time. In many areas,

erosional issues are obvious, but in other locations, the issue is not easily identified. Stream areas should be surveyed to identify areas of erosion for planning purposes. Efforts could then be made to identify possible solutions to slow, stabilize, or abate the threat posed to the bank. These solutions may take the form of site-based installation concepts that can be used by landowners and/or partners for implementation. Based on stakeholder input, it was recommended that immediate focus be put on Turkey Creek and Brickyard Bayou.

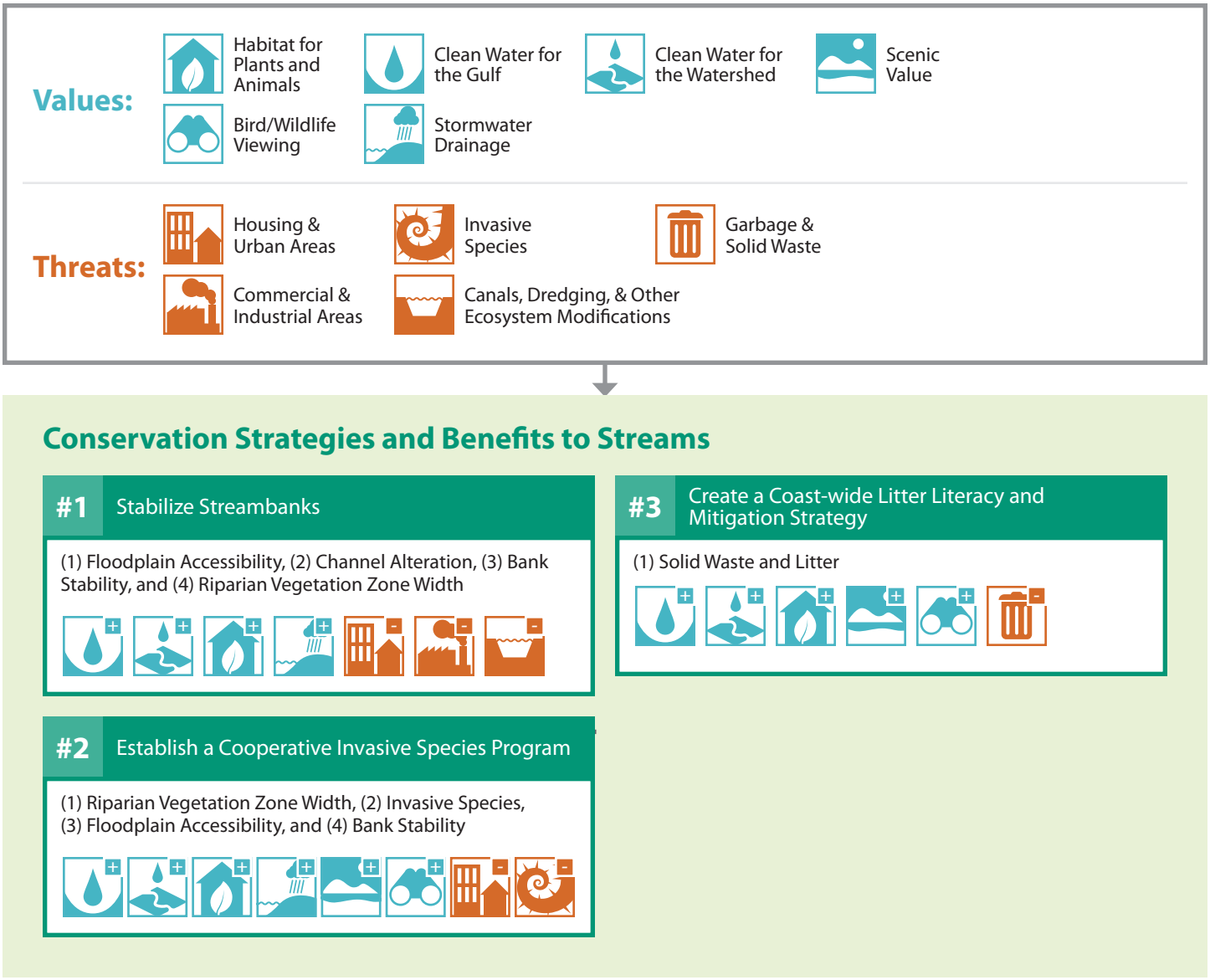
2. Establish a Cooperative Invasive Species Program

Invasive species are a problem in every target stream of this CAP. A cooperative invasive species management program will engage landowners and local government in a coast-wide effort to identify invasive species hotspots and take corrective actions.

3. Create a Coast-wide Litter Literacy and Mitigation Strategy

Litter and solid waste were identified as major problems by the attendees at every CSHI public meeting. A litter literacy and mitigation program could devise ways to reduce litter. The most important part of this effort would be a public education program.

Figure 7-1
Brickyard Bayou Conservation Strategies



7.5.2 S.M.A.R.T. Objectives

The S.M.A.R.T. Objectives that apply to Brickyard Bayou are provided in Table 7-1. The full list of objectives and their associated references are included in Appendix D.

Table 7-1
Brickyard Bayou S.M.A.R.T. Objectives

S.M.A.R.T. OBJECTIVE	NOTES
INVASIVE SPECIES	
Restore or improve ecological balance in systems negatively affected by invasive species: • By 2026, reduce annual increase in Nonindigenous Aquatic Species to 3% annually	*Brickyard Bayou has severe problems with invasive plants throughout the watershed, particularly Chinese tallow tree. Use environmentally effective and safe methods to reduce invasive species present. Wherever possible, replace with native plants. Educate the public on the advantages of native species.*
CANALS, DREDGING, & OTHER ECOSYSTEM MODIFICATIONS	
Encourage agencies that permit shoreline stabilization to consider alternative shoreline erosion control approaches before hardened stabilization is approved: • By 2026, remove or replace hardening structures that degrade habitat in CSHI watersheds at ten sites	*Brickyard Bayou has larges stretches of hardened shorelines (e.g., bulkheads). Ensure that all public decision-makers, regulators, architects, and contractors have knowledge of alternative methods to shoreline hardening. Find one or more acceptable sites for demonstration projects to convert traditional methods of shoreline protection to more environmentally friendly methods.*
ALTERED FLOODPLAINS & WETLANDS	
Maintain and restore physical habitat in freshwater systems: • By 2026, reduce acres of altered freshwater wetlands by permitted construction by 30% • By 2026, increase the miles of streams with improved physical habitat by 15% • By 2026, reduce number of stream miles destroyed or converted to unnatural or managed development in CSHI watersheds by 25%	*Much of the Brickyard Bayou watershed has already been developed. Locate any remaining natural or restorable areas for protection and restoration.*
Reduce impact of development on the physical habitat in freshwater systems: • By 2026, reduce the number of acres of altered freshwater wetlands drained or converted through development annually in CSHI watersheds to 50% • By 2026, increase the percentage of urban and suburban natural patches (10 to 100 acres) in CSHI watersheds by 35%	*Since remaining undeveloped land in Brickyard Bayou is rare, natural patches are of great importance. Locate available sites and engage landowners in protection methods.*
Conserve, restore, and create coastal estuarine and marine habitats: • By 2026, improve overall coastal condition indices in estuarine portions of CSHI streams to 3.9 • By 2026, reduce the percentage of CSHI estuarine areas rated "Poor" for water quality to 0% • By 2026, reduce the percentage of sediment-impaired CSHI estuarine areas to 11% (CSHI streams) • By 2026, reduce the percentage of benthic habitat rated "Poor" to 14% (CSHI streams),	*Among all of the CSHI streams, Brickyard Bayou is likely the most heavily altered. Look for methods, locations, and opportunities to restore habitat.*

S.M.A.R.T. OBJECTIVE	NOTES
• By 2026, reduce wetlands loss indices to 1.29 (Gulf of Mexico) • By 2026, prevent additional erosion on shorelines suffering "severe erosion" by 10% • By 2026, identify, create, restore, or enhance significant acreage of high-priority coastal wetlands	
OUTREACH, EDUCATION, & STAKEHOLDER ENGAGEMENT	
Expand conservation constituency: • By 2026, develop formal partnerships with five agencies, user groups, or neighborhood associations, and propose and implement local conservation efforts with these groups	*Many residents and landowners may not even be aware of Brickyard Bayou's identity as a natural stream and may think of it as a drainage structure. Throughout much of its length, Brickyard's appearance reinforces this perception. Using various education techniques and programs such as Adopt-a-Stream, engage local residents in the protection of the stream. Involve neighborhood groups, churches, civic organizations, and local governments in all efforts.*

7.5.3 Other Objectives

Other objectives found to be relevant to the CAP are listed in Table 7-2.

Table 7-2

Brickyard Bayou Other Objectives

OTHER OBJECTIVE	NOTES
CANALS, DREDGING AND OTHER ECOSYSTEM MODIFICATIONS	
Encourage agencies that permit shoreline stabilization to consider alternative shoreline erosion control approaches before hardened stabilization is approved: • Involve all agencies and organizations in strategies related to shoreline stabilization • Provide appropriate information on alternative shoreline erosion control approaches • Protect and enhance aquatic biodiversity • Protect and enhance terrestrial biodiversity • Maintain healthy aquatic community integrity • Protect and restore existing native fish populations • Maintain populations of native non-game fishes and aquatic invertebrates at or above present levels throughout the basin • Improve water quality for drinking water, and to protect and restore existing native fish populations	*Brickyard Bayou has larges stretches of hardened shorelines (e.g., bulkheads). Ensure that all public decision-makers, regulators, architects, and contractors have knowledge of alternative methods to shoreline hardening. Find one or more acceptable sites for demonstration projects to convert traditional methods of shoreline protection to more environmentally friendly methods.*

OTHER OBJECTIVE	NOTES
ALTERED FLOODPLAINS & WETLANDS	
Acquire and protect coastal habitat: • Identify, acquire, and protect significant acreage of high-priority coastal wetlands through fee simple, easements, or protective agreements	*Land acquisition possibilities in Brickyard Bayou are rare. Work with local government and other important entities (e.g., Gulfport-Biloxi International Airport) to locate any potential preservation sites and protect them, using acquisition, conservation easements, or other legal tools. City buyout areas for flooding and airport noise mitigation can be an important component of natural areas.* *Among all of the CSHI streams, Brickyard Bayou is likely the most heavily altered. Look for methods, locations, and opportunities to restore habitat.*
OUTREACH, EDUCATION, & STAKEHOLDER ENGAGEMENT	
Increase public awareness and interest in the values and functions of coastal wetlands, their habitats, and the ecosystem on which they are dependent: • Develop and deliver education materials and programs to inform the public about wetlands species, their habitat, and values to humans	*Many residents and landowners may not even be aware of Brickyard Bayou's identity as a natural stream and may think of it as a drainage structure. Throughout much of its length, Brickyard's appearance reinforces this perception. Using various education techniques and programs such as Adopt-a-Stream, engage local residents in the protection of the stream. Involve neighborhood groups, churches, civic organizations, and local governments in all efforts.*
POLICY	
Work with cities to support, revise, and enforce city-wide tree protection ordinances	*The City of Gulfport has a strong tree protection ordinance. Support local leaders in utilizing the laws to protect important native trees in Brickyard Bayou.*
FUNDING	
Dedicate funding to support long-term restoration: • Find private funding sources • Investigate funding opportunities • Identify and create alternative funding strategies for capital projects and long-term sustainability of greenway infrastructure	*Monitor restoration and protection efforts of Brickyard Bayou in perpetuity. Locate the players and funding sources that will make this happen.*
Seek funding to expand CSHI coverage to other streams in Mississippi's coastal counties	*The City of Gulfport has a number of other streams that could benefit from restoration and protection. Locate and evaluate these streams.*

7.6 Next Steps for Implementation

7.6.1 Site Specific Follow-up

Attendees at the two public meetings for Brickyard Bayou identified ten sites of concern along the stream. Specific issues mentioned included erosion, flooding, and debris. TNC staff visited all listed sites on October 23, 2015. At the same time, TNC staff visited 28 road and rail crossings to check for fish passage issues. A full list of these sites and findings is included as Appendix E.

7.6.2 Development of Project Design

A component of the CSHI was to take the information developed from the conservation planning process and draft conceptual designs of potential projects. These conceptual projects were designed to support future restoration efforts by identifying and describing areas of stream impairments, providing baseline data needed for more advanced planning, and, where possible, drafting a suite of possible options to improve those impairments. The number of projects considered and ultimately initiated was dependent on the amount of funding available. Efforts were made to achieve equivalency among the nine coastal streams in this project, and advance projects that would have the greatest conservation impact in future restoration efforts. For Brickyard Bayou, the following project was recommended for conceptual design development and was completed in July 2016.

Turkey Creek and Brickyard Bayou Streambank Assessment

Although there is more information on the Brickyard Bayou Turkey Creek watersheds compared to the other streams in the CSHI, the site-specific data needed to identify in-stream channel impairments for restoration were unavailable. Therefore, TNC initiated the following conceptual project in order to identify specific impairments, the nature of those impairments, and potential solutions for landowners.

The first part of this project was to conduct stream surveys to measure the condition of the creek and to identify impairments to bank stability, the stream channel, or the stream's hydrology. This was designed to map and prioritize areas of impairment and to highlight locations most in need of restoration. The second part of this project built on the completed survey to create recommendations for restoration in the areas of impairment. These recommendations will be the basis to fund restoration or develop project proposals and contain multiple restoration options and techniques to repair identified impairments. A cost comparison of the different techniques is provided, along with general descriptions of project elements in this conceptual design.

In addition to the conceptual project listed above, additional projects were drafted, but funds were not available to implement them. It was recommended that these projects be considered for implementation as funding is secured. For Brickyard Bayou one such project was the Wildlife Corridor conceptual project. The main purpose of this project was to design culvert replacements and restore wildlife passage along the riparian corridor to address the wildlife passage issue and also maintain a stable stream channel. Over the course of the CSHI, approximately 15 wildlife passage impairments were identified across the nine streams.



8 OYSTER BAYOU

8.1 General Description of Watershed

Oyster Bayou is a coastal stream located in Harrison County, Mississippi. The entire watershed is within the city limits of Biloxi and encompasses 669 acres. The exact beginning of the stream and its tributaries are difficult to trace today. Water hazard ponds on the abandoned golf course to the northeast of Oyster Bayou may represent cut-off tributaries. Access to stream areas above the CSX rail line is extremely difficult; as a result, the exact condition of the stream in these areas is not entirely known.

The bayou travels through pipes across the Mississippi Coast Coliseum and Convention Center property, and under Beauvoir Road to the historic site at Beauvoir, which has preserved much of the forest in the watershed. From Beauvoir, the bayou flows under U.S. Highway 90, where it enters the Mississippi Sound across an artificially maintained sand beach. The stream is tidally influenced to a pond on the Beauvoir property, about 700 feet.

The largest land holding in the watershed, Beauvoir is a historic site owned by the Sons of the Confederacy. Jefferson Davis, former president of the Confederacy, lived here as a boarder in the late 1870s, and purchased the property in 1879. The property passed to his daughter on his death in 1888. It was used as a Confederate retirement home until 1957.

While significant areas of the watershed contain single- and multi-family housing, commercial and retail areas, and tourism sites, extensive areas of undeveloped land remain. Much of the eastern portion of the watershed is an abandoned golf course that is slowly reverting to natural conditions. Some areas of intact forest remain in the western portion of the stream. Challenges for Oyster Bayou include several road and railroad crossings that are fish passage issues, as well as culverted flow under the Mississippi Coast Coliseum and Convention Center. In addition, there are extensive hardened surfaces, particularly around the Mississippi Coast Coliseum and Convention Center and in the retail areas along Beauvoir and Pass Roads. Non-native trees including Chinese tallow exist at low levels across Beauvoir, and invasive Nile tilapia have been confirmed in Oyster Bayou. A small dam creates a fish and turtle pond on Beauvoir.

8.2 Conservation Action Plan

In the past, TNC has successfully implemented a ten-step CAP process for defining the conservation projects, developing and implementing strategies and measures, and using the results to adapt and improve conservation outcomes (TNC 2007). A facilitator led the CAP process with each watershed stakeholder group. Through a series of workshops or meetings, they worked together to identify conservation targets, analyze target threats, identify objectives and outcomes, develop strategic actions, and define indicators and measures to monitor success.

8.2.1 Stakeholder Engagement

The Oyster Bayou Public Listening Sessions were part of a series of public forums for the CSHI within the nine target stream areas. TNC conducted two Public Listening Sessions in June 2015 for residents of the Oyster Bayou watershed. Input from these meetings informed the CAP process. The summarized results of Oyster Bayou's scope, perceived problems or threats, and identified solutions to the problems from the meetings are included in Appendix A.

8.2.2 Nested Targets

Imbedded or nested targets within Oyster Bayou include a variety of biological and functional components to be considered for conservation as a part of this drainage. These include the actual stream, watershed, riparian corridor, and tidal zone. Upland native vegetation, forest habitat, and wetlands, as well as species assemblages of native fishes, stream invertebrates, and migratory bird species are also considered. A

listing of species of conservation concern is included in Appendix F, and a listing of habitats in this stream is included in Appendix G. In addition to species and habitats, participants in the Public Listening Sessions were given a list of 16 biological and functional components to rank in order of importance for conservation value for their watershed. The top values from the Public Listening Sessions are as follows, in order of importance:

1. Habitat for Plants and Animals
2. Clean Water for the Gulf
3. Wildlife Viewing

8.3 Habitat Assessment: Stream Health

8.3.1 Rapid Stream Assessments

RSAs were conducted at four sites on Oyster Bayou (see Appendix H). Scoring results were averaged from individual assessments, with an average score of 4.87 out 10. This score indicates that Oyster Bayou is in fair condition as rated by the SVAPv2. This is consistent with the overall viability assessment ranking for the stream.



Invertebrate sampling
Photo credit: The Corps Network

A major area of impairment includes the stream outfall, which lacks any natural wetland habitat and is contained in an open, concrete, box culvert, which restricts lateral connectivity. A large stretch of the stream is inaccessible and presumed to be shunted through underground pipes east of Beauvoir Road. The presence of several barriers to fish passage were observed and there was a lack of invertebrate habitat. The least impaired sample point surveyed on the stream was the section between the pond and Beauvoir Road where forest and native vegetation restoration has occurred. Additional restoration to this riparian zone would be beneficial to the stream's vegetative corridor and support maintenance of prior restoration efforts.

8.3.2 Biological Sampling of Fishes

One fish species of note collected during the RSAs was the American eel. Nile tilapia were suspected and believed to have been seen at the surface of Oyster Bayou in the pond located North of the Jefferson Davis Presidential Library at Beauvoir. A sampling trip was organized in which 21 specimens of tilapia were collected by a 50-foot bag seine. These samples were preserved and deposited in the Mississippi Museum of Natural Science.



Sampling for Nile tilapia
Photo credit: Robert Smith at photobiologist.com

8.3.3 Water Quality Data

The quality of the water is a critical component to the health of stream habitats. It effects estuarine and marine environments in Mississippi Sound and can be reflective of conditions upstream and over the entire watershed. Creating a baseline of water quality is important to understanding the current conditions of a stream, monitoring its health, and measuring change over time. The MDEQ Field Services Division collected water quality data on all nine streams from March 1, 2016, to August 31, 2016. Data were collected under the guidelines of the MDEQ Quality Assurance Project Plan Section 106 Monitoring Network in the State Surface Water Monitoring and Assessment Program. Two sample locations were established for each stream, except in Watts Bayou where the limited public access points allowed for only one sample site. Nineteen different sampling measures were taken bimonthly, and one measure for biological oxygen demand was taken monthly. A complete list of the parameters for the water quality analyses is included in Appendix I. Data collected from this sampling were used to inform the stream's Viability Assessment.

For Oyster Bayou at Beauvoir, there is evidence of nutrient enrichment (three total Kjeldahl nitrogen values greater than1.5 mg/l [maximum of 2.49 mg/L] and four chlorophyll-*a* values greater than 30 ug/L [maximum of 144 ug/L]), dissolved oxygen criteria violation (2.4 mg/L), and biological oxygen demand elevation. At the Oyster Bayou beach sample site, potential nutrient enrichment may be occurring as elevated chlorophyll-*a* (two samples greater than 30 ug/L [maximum of 74.4 ug/L]) was reported. It is important to recognize that this sampling took place over a limited period, and longer-term continuous monitoring is recommended. Extended monitoring would establish a more robust baseline, establish trends, and alert stakeholders to chronic or acute problems as they may develop.

8.3.4 Viability Assessment Summary Results

Oyster Bayou received an overall rating of "**Fair**," primarily due to factors associated with landscape condition and size. Some of these indicators include impediments to fish passage issues and a large amount of impervious surface. Additionally, some major issues are low accessibility to and lack of a floodplain, conversion of wetlands, and channel alterations. For example, the stream runs underground at the Convention Center for about .25 miles. The stream's condition was ranked "Fair" due to a high percentage of invasive species and an abundance of solid waste and litter. Oyster Bayou's bank is considered moderately stable, and KEAs for water quality were ranked "Very Good" due to no impairments detected for nitrogen, nitrite, phosphorous, or dissolved oxygen. Where a riparian corridor does exist along a small stretch of the stream, it is generally in "Good" condition; however, the majority of the stream does not have a corridor.

8.4 Factors of Stream Degradation: Stresses and Threats

8.4.1 Primary Stresses

The following eight stresses were identified for Oyster Bayou during the CAP process:

1. Excessive Suspended and Bedded Sediments
2. Altered Floodplains and Wetlands
3. Altered Riparian Corridor
4. In-stream Habitat Modification
5. Altered Stream Geomorphology
6. Altered Hydrology
7. Altered Connectivity
8. Invasive Species

Excessive Suspended and Bedded Sediments

Much of the substrate in the lower reaches of Oyster Bayou is sand, which is poor habitat for fish and invertebrates. The presence of sand is usually indicative of erosion and other sedimentation issues upstream.



Excessive Sediments and Bedded Sediments

Altered Floodplains and Wetlands

The upstream limit of Oyster Bayou drains commercial areas of Pass Road in Biloxi. Although this is a narrow strip, it is dense with commercial and residential areas, most of which are covered by impervious surfaces. An abandoned golf course is also included in the upper stretch of the drainage, and the Coast Coliseum and Convention Center drains runoff from the west. A proposed connector road from Pass Road to the Coast Coliseum and Convention Center will create addition impervious surfaces and divert more stormwater into Oyster Bayou. Portions of the drainage that fall within the Beauvoir property include several wooded areas, including a 40-acre maritime forest. The watershed has many streets and parking areas, and the stream course crosses under U.S. Highway 90 near its outfall to the Mississippi Sound.

Altered Riparian Corridor

The riparian zone of Oyster Bayou is lacking vegetation or tree cover in the developed areas and, in most cases, is covered by impermeable surfaces. Stretches of the creek are natural along the CSX rail line south of the Coast Coliseum and Convention Center, and through the Beauvoir property. Invasive species are present in moderate numbers and include Chinese tallow trees, Chinese privet, and cogongrass.

In-stream Habitat Modification

Removal of large woody material is needed in some parts of the stream to allow proper flow. In addition, two weirs were created on the Beauvoir property that were most likely installed to assist with tidal flooding. These weirs have also created a pond on the property.



In-stream Habitat Modification

Altered Stream Geomorphology

Examples of altered stream geomorphology in Oyster Bayou include a large portion of the stream that has been routed through underground pipes under the Coast Coliseum and Convention Center, daylighting on the east side of Beauvoir, and the concrete ditch which conveys the stream across the sand beach.



Altered Stream Geomorphology

Altered Hydrology

Increased water volume and velocity in Oyster Bayou are likely responses to impervious surfaces as well as stormwater. As the proposed Popps Ferry Connector Road is completed, it will likely add to the volume and velocity of flow. Oyster Bayou was historically a tidal system. There is anecdotal evidence that the extensive impervious surfaces at the Coast Coliseum and Convention Center may route rainfall out of Oyster Bayou and onto the sand beach as surface flow.



Altered Hydrology

Altered Connectivity

Several impediments to wildlife passage and connectivity are present in Oyster Bayou. The mouth of the stream is a concrete, flat-bottom, box culvert that lacks lateral connectivity. Farther upstream, a pair of weirs and a dam block passage within the stream at Beauvoir. The effluents crossing Beauvoir Road from under the Coast Coliseum and Convention Center are above grade and screened, preventing connectivity to the lower drainage.

Invasive Species

Invasive species of concern in Oyster Bayou include cogongrass, Chinese tallow tree, torpedo grass, Chinese privet, and elephant ear. These species outcompete native plant communities—often resulting in a near monoculture with low biodiversity in comparison to a native riparian community. Giant salvinia was not observed, but should be monitored because it is a concern for resource managers. Domestic/feral cats were observed. Cats pose a concern to native wildlife—particularly bird species. Nutria were not observed, but are likely to be present in this watershed. Nutria should be monitored as they are herbivores that can pose a threat to vegetation and small trees; their foraging activities can also directly damage bank stability. Nile tilapia were collected in Oyster Bayou, which pose a threat to native species diversity and should be monitored.

8.4.2 Primary Threats

Primary threats were identified and ranked by stakeholders as the sources of stress for each watershed. The nine threats for Oyster Bayou are as follows:

1. Housing and Urban Areas
2. Commercial and Industrial Areas
3. Transportation, Utility, and Service Lines
4. Climate Change and Severe Weather
5. Invasive Species
6. Garbage and Solid Waste
7. Canals, Dredging, and Other Ecosystem Modifications
8. Dams and Water Management
9. Tourism and Recreation Areas

8.5 Taking Action

Developing effective strategic action and objectives to abate critical threats and restore function to Oyster Bayou watershed is essential to conservation planning. If successfully implemented, strong conservation strategies collectively should conserve the stream and realize the project vision.

8.5.1 Conservation Strategies

Ultimately, seven strategies were developed that are specific to Oyster Bayou or are part of a broader basin-wide approach. Figure 8-1 depicts the development of these strategies and the potential stream improvements that would occur as a result of their implementation.

1. Daylight Underground Sections of Stream

A large section of Oyster Bayou runs directly under the Coast Coliseum and Convention Center, presumably through a series of pipes. Oyster Bayou re-emerges on the east side of Beauvoir Road, where it discharges onto the Beauvoir property. This strategy would include opening up sections of Oyster Bayou that are currently underground, in cooperation with state, county, and local partners. The re-establishment of these stream sections would be promoted as an amenity surrounding the Coast Coliseum and Convention Center. Free-flowing streams and riparian habitat would offer increased aesthetic and landscaping opportunities that would benefit the experience of visitors, as well as nature.

2. Protect Golf Course Land

The former site of the Broadwater Golf Course offers a unique and valuable opportunity to protect a large portion of an otherwise developed watershed. Located in the northeast part of the Oyster Bayou drainage, protection of this site would help to maintain current stream functions (e.g., water filtration, stormwater management, drainage), and help to reduce stormwater volume and velocity. Restoration of this site would increase the benefits of these services, as well as add important habitat for plants and animals. Furthermore, this can be achieved while integrating compatible human use activities that would enhance

the area for its residents. The loss of services currently provided by this site would likely add to the expense of maintaining and building city infrastructure that would be necessary if the area is developed.

3. Restore and Maintain Hydrologic Function

As its name suggests, Oyster Bayou once had an unimpeded intertidal connection to the Mississippi Sound, and the brackish area was capable of sustaining oysters. Currently, the principal impediment to restoring tidal flow to the bayou is an open-box culvert, located south of U.S. Highway 90, where the stream's outfall is contained. Adjacent to the box culvert is a public beach. Re-designing the outfall and restoring native habitat could return an area of natural marsh and pocket beaches, and help to restore connectivity of Oyster Bayou to the Mississippi Sound. Additionally, these improvements would add to the natural aesthetic of the public beach, and possibly reduce the need for sand management on U.S. Highway 90.

4. Support Management of Beauvoir Urban Forest

The Beauvoir property is host to an urban forest of approximately 40 acres. This forest is an important component to the Oyster Bayou watershed as the only continuous area of forested land in the Oyster Bayou drainage. It is also an important stopover area for migratory birds and nesting sites for osprey and herons. Maintaining this forest by removing invasive species to support a healthy native forest would conserve this area as an example of a native coastal forest.

5. Stabilize Streambanks

Erosion of streambanks can cause buildup of suspended sediments in the water column and create alterations to the stream channel and its flow as deposition areas build up over time. In many areas, erosion issues are obvious, but in other locations, the issue is not easily identified. Stream areas should be surveyed to identify areas of erosion for planning purposes. Efforts could then be made to identify possible solutions to slow, stabilize, or abate the threat posed to the bank. These solutions may take the form of site-based installation concepts that can be used by landowners and/or partners for implementation.

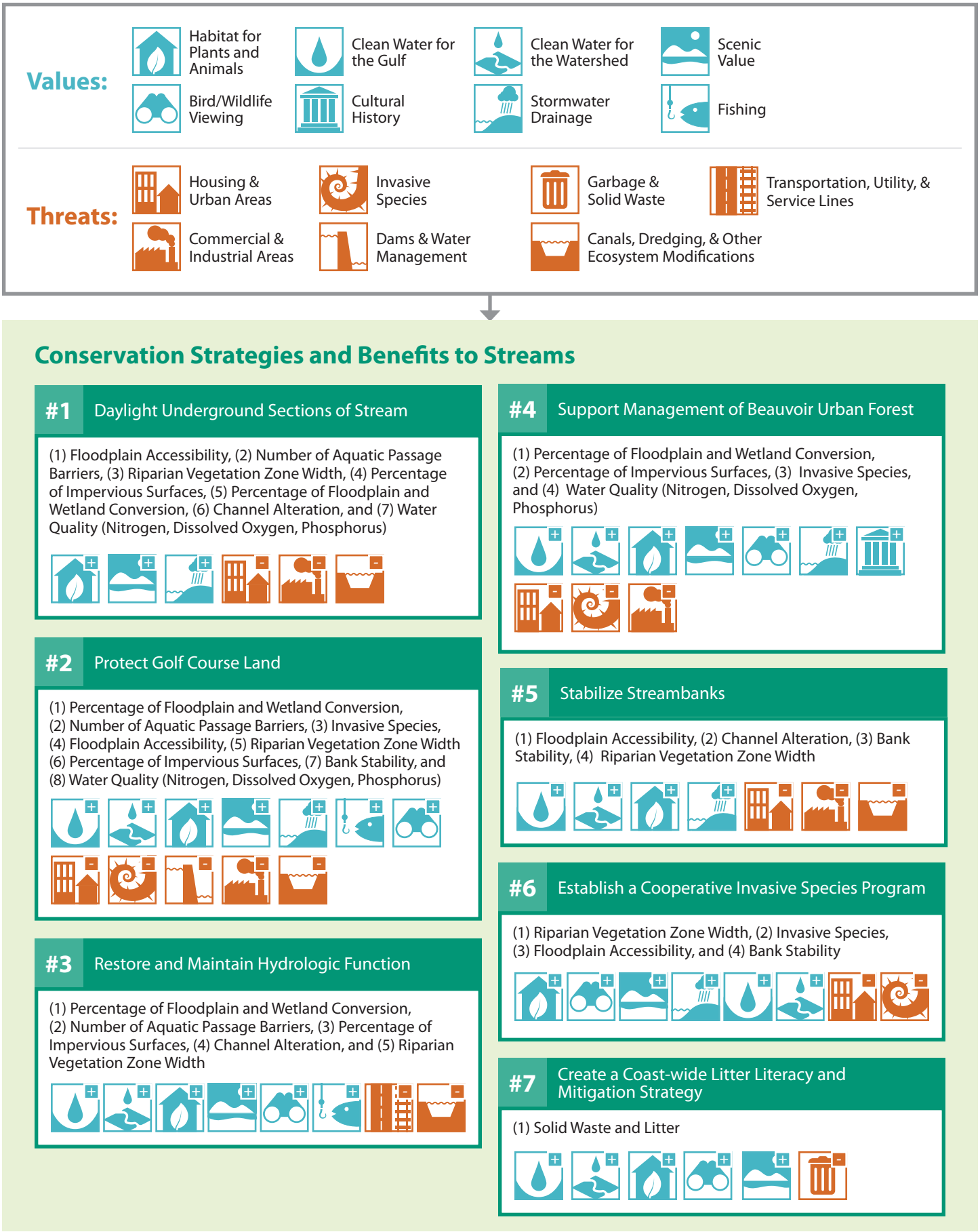
6. Establish a Cooperative Invasive Species Program

Invasive species are a problem in every target stream of this CAP. A cooperative invasive species management program will engage landowners and local government in a coast-wide effort to identify invasive species hotspots and take corrective actions.

7. Create a Coast-wide Litter Literacy and Mitigation Strategy

Litter and solid waste were identified as major problems by the attendees at every CSHI public meeting. A litter literacy and mitigation program could devise ways to reduce litter. The most important part of this effort would be a public education program.

Figure 8-1
Oyster Bayou Conservation Strategies



8.5.2 S.M.A.R.T. Objectives

The S.M.A.R.T. Objectives that apply to Oyster Bayou are provided in Table 8-1. The full list of objectives and their associated references are included in Appendix D.

Table 8-1
Oyster Bayou S.M.A.R.T. Objectives

S.M.A.R.T. OBJECTIVE	NOTES
CONNECTIVITY	
Improve or maintain watershed connectivity: • By 2026, restore fish access to 100% of stream miles formerly blocked (SARP 2008)	*Oyster Bayou has a number of existing structures (e.g., roads, parking lots, railroad, small dam, culverts) which likely are barriers to fish passage. This objective requests that with any future stream alterations, fish passage, and stream connectivity will be taken into consideration in project design and construction. Shifting sands on the beach sometimes cause temporary fish passage issues near the mouth of the stream. In addition, replacement of some of the existing structures would enhance Oyster Bayou's value as fish habitat.*
INVASIVE SPECIES	
Restore or improve ecological balance in systems negatively affected by invasive species: • By 2026, reduce annual increase in Nonindigenous Aquatic Species to 3% annually	*Nonindigenous aquatic species are members (i.e., individual, group, or population) of a species that enter a body of water or aquatic ecosystem outside of its historical or native range. Oyster Bayou has undergone some very effective invasive plants control, but stands of invasive trees, grasses, and aquatic plants remain. In addition, Oyster Bayou also contains the only invasive fish population known to exist in the CSHI watershed. The Nile tilapia were likely intentionally released. Wherever possible, invasive plants and animals should be controlled or eliminated using acceptable method, and replaced with native species.*
CANALS, DREDGING, & OTHER ECOSYSTEM MODIFICATIONS	
Support implementation of best management practices at stream outfalls: • By 2026, remove one concrete stream outfall channel and allow the streams to "renaturailze" where they cross the Harrison County beaches in either Bear Point Bayou, Coffee Creek, or Oyster Bayou	*Oyster Bayou enters the Gulf of Mexico by flowing across an artificially maintained sand beach, through a concrete canal. Shifting sands often create temporary blockages. One solution would be to remove the concrete ditches and allow the stream to set its own course across the beach.*
RIPARIAN CORRIDOR	
Establish, improve, and maintain riparian zones: • By 2026, ensure that 15% of all lands within 100 feet of a stream have adequate riparian protection	*In many lower reaches of Oyster Bayou, the riparian zone is very limited. Streamside landscaping extends right to the bank of the stream. There is ample space in many areas to recreate and reconnect a riparian zone to the waterway.*

S.M.A.R.T. OBJECTIVE	NOTES
Restore, enhance, manage, and protect Mississippi's remaining coastal habitat functional riparian/floodplain habitat: • By 2026, increase the area of functional floodplain in CSHI watersheds by 5% • By 2026, stabilize or restore 10% of degraded riparian lands in CSHI watersheds • By 2026, ensure that best management practices that protect riparian corridors are implemented on 50% of all construction projects on private land	*One idea to emerge from the workshops on Oyster Bayou was perhaps the most ambitions restoration idea of any CSHI stream, to "daylight" the stream where it flows across the grounds of the Coast Coliseum and Convention Center. This would be an extremely large undertaking, and would require a redesign of the Coliseum parking surfaces, roads, and walkways. Properly done, a "sun lighted" Oyster Bayou could be a scenic asset to the Coliseum, a small urban natural pathway.* *Some riparian habitat restoration has been completed in Oyster Bayou, but there are significant areas at Beauvoir where riparian habitat has been lost to artificial landscaping. Wherever possible, restore and reconnect lost riparian and floodplain habitats.*
ALTERED FLOODPLAINS & WETLANDS	
Reduce impact of development on the physical habitat in freshwater systems: • By 2026, reduce the number of acres of altered freshwater wetlands drained or converted through development annually in CSHI watersheds to 50% • By 2026, increase the percentage of urban and suburban natural patches (10 to 100 acres) in CSHI watersheds by 35%	*This objective would be accomplished by the purchase and restoration of the lands listed in objective 7 above.*
OUTREACH, EDUCATION, & STAKEHOLDER ENGAGEMENT	
Expand conservation constituency: • By 2026, develop formal partnerships with five agencies, user groups, or neighborhood associations, and propose and implement local conservation efforts with these groups	

8.5.3 Other Objectives

Other objectives found to be relevant to the CAP are listed in Table 8-2.

Table 8-2

Oyster Bayou Other Objectives

OTHER OBJECTIVE	NOTES
ALTERED FLOODPLAINS & WETLANDS	
Acquire and protect coastal habitat: • Identify, acquire, and protect significant acreage of high-priority coastal wetlands through fee simple, easements, or protective agreements	*Much of the upper portion of the Oyster Bayou watershed encompasses an abandoned golf course, currently owned by a land developer. This tract has huge potential for restoration as urban wildlife habitat and low impact outdoor recreation lands. The purchase price is significant.*

8.6 Next Steps for Implementation

8.6.1 Site-specific Follow-up

Attendees at the two public meetings for Oyster Bayou identified seven sites of concern along the stream. Specific issues mentioned included pollution, erosion, flooding, litter, and invasive species. TNC staff visited all listed sites on October 6, 2015, and December 1, 2015. At the same time, TNC staff visited three road and railroad crossings to check for fish passage issues. A full list of these sites and findings is included as Appendix E.

8.6.2 Development of Project Design

A component of the CSHI was to take the information developed from the conservation planning process and draft conceptual designs of potential projects. These conceptual projects were designed to support future restoration efforts by identifying and describing areas of stream impairments, providing baseline data needed for more advanced planning, and, where possible, drafting a suite of possible options to improve those impairments. The number of projects considered and ultimately initiated was dependent on the amount of funding available. Efforts were made to achieve equivalency among the nine coastal streams in this project, and advance projects that would have the greatest conservation impact in future restoration efforts. For Oyster Bayou, the following projects were recommended for conceptual design development to be completed by the end of September 2016.

Stream Assessments

As previously mentioned in the Viability Assessment section, very little baseline data on stream conditions were present prior to the start of this project. The initial snapshot created by the RSAs provided a needed general overview of each stream's condition. This assessment was not designed or intended to provide the site-specific level of detail needed for conceptual projects. The stream assessments conceptual project will identify, describe, map, and rank areas of impairments on the six mid-sized project streams. Data collected on existing in-stream conditions would identify future potential restoration opportunities. A limited number of "planning areas" will be identified, with recommendations and costs for potential improvements. The six streams included in this project include Watts Bayou, Magnolia Bayou, Coffee Creek, Oyster Bayou, Rhodes Bayou, and Bayou Chicot.

Evaluation of Land Protection Opportunities

While all streams in this project are located within urban areas, there is a limited amount of natural habitat that can be protected through standard land protection strategies. TNC would evaluate and rank areas of natural habitat as potential land protection areas. Part of this evaluation could include land appraisals of parcels when a willing landowner is identified. As mentioned in the Conservation Strategies section of this CAP, a second part of this evaluation would be to identify a potential land manager for any lands protected.



Photo credit: Audra Melton, TNC

9 RHODES BAYOU

9.1 General Description of Watershed

Rhodes Bayou is a large urban tidal stream located in Jackson County, Mississippi. The watershed area is 800 acres, and the stream flows south to north through mostly residential areas in Moss Point, into the Escatawpa River, and finally to the Mississippi Sound. Despite its urban nature, extensive areas of estuarine and freshwater marsh remain intact, in all sections of the watershed. Approximately 50 acres of forest still exists, primarily in upstream areas. The watershed contains mostly single-family housing, along with schools and public recreation sites (ballparks). The eastern edge of the watershed contains retail and commercial areas along Highway 613 through downtown Moss Point.

Much of the history of this area is linked to the timber industry, especially the extensive logging and processing of virgin longleaf stands to the north. The stream is named for John Rhodes, who built one of the first sawmills in Moss Point.

Rhodes Bayou has strong tidal influence, extending at least 75% of the stream's main channel length. There is a small lake at the head of the stream, which appears to be artificial based on historic aerial photographs. At least eight small tributaries flow into the stream from both the east and west. This stream is unique because it contains two small areas of state coastal preserve; the Land Trust for the Mississippi Coastal Plain also owns conservation properties along the waterway. In addition, a portion of the lower stream is the site of the Pascagoula River Audubon Center and some of these areas are undergoing restoration.

Rhodes Bayou has many of the challenges common to urbans streams, but remains significantly natural. Major impairments include extensive stands of non-native plants (especially Chinese tallow tree), altered hydrology, some shoreline hardening, and stormwater and flooding issues. Wetlands have been reduced over the last 50 years, as seen by historic aerial photography. This is possibly due to an alteration in the salinity regime whereby the lower reaches of the watershed have become more saline. Freshwater species have died off, allowing for erosion of the substrate. Saltwater-tolerant species have not been able to colonize fast enough to prevent a net loss of wetlands.

In general, this stream is in better condition, with better conservation and restoration potential, than most of the CSHI streams. This watershed also has strong citizen interest and support. The City of Moss Point actively promotes ecotourism on Rhodes Bayou.

Rhodes Bayou is regularly used for recreational activities. The stream is accessible by kayak upstream to Belleview Bridge, a distance of about 0.33 mile. The stream above Belleview is excellent for kayaking, but a water level pipe beneath the bridge blocks further access. Currently, the only usable kayak and canoe launch is on the waterfront in downtown Moss Point, requiring several miles of paddling to reach the mouth of Rhodes Bayou. The bayou also supports extensive recreational fishing and crabbing through much of its length. The area is an exceptional birding and nature study site, and these opportunities can be explored at the Pascagoula River Audubon Center.

9.2 Conservation Action Plan

In the past, TNC has successfully implemented a ten-step CAP process for defining the conservation projects, developing and implementing strategies and measures, and using the results to adapt and improve conservation outcomes (TNC 2007). A facilitator led the CAP process with each watershed stakeholder group. Through a series of workshops or meetings, they worked together to identify conservation targets, analyze target threats, identify objectives and outcomes, develop strategic actions, and define indicators and measures to monitor success.

9.2.1 Stakeholder Engagement

The Rhodes Bayou Public Listening Sessions were part of a series of public forums for the CSHI within the nine target stream areas. TNC conducted two Public Listening Sessions in July 2015 for residents of the Rhodes Bayou and Bayou Chicot watersheds. Input from these meetings informed the CAP process. The summarized results of Rhodes Bayou's scope, perceived problems or threats, and identified solutions to the problems from the meetings are included in Appendix A.

9.2.2 Nested Targets

Imbedded or nested targets within Rhodes Bayou include a variety of biological and functional components to be considered for conservation as a part of this drainage. These include the actual stream, watershed, riparian corridor, and tidal zone. Upland native vegetation, forest habitat, and wetlands, as well as species assemblages of native fishes, stream invertebrates, and migratory bird species are also considered. A listing of species of conservation concern is included in Appendix F, and a listing of habitats in this stream is included in Appendix G. In addition to species and habitats, participants in the Public Listening Sessions were given a list of 16 biological and functional components to rank in order of importance for conservation value for their watershed. The top values from the Public Listening Sessions are as follows, in order of importance:

1. Bird/Wildlife Viewing
2. Scenic Vale
3. Habitat for Plants and Animals
4. Fishing

9.3 Habitat Assessment: Stream Health

9.3.1 Rapid Stream Assessments

RSAs were conducted at three sites on Rhodes Bayou (see Appendix H). Scoring results were averaged from individual assessments, with an average score of 5.36 out of 10. This score indicates that Rhodes Bayou is in good condition as rated by the SVAPv2. This is consistent with the overall viability ranking for the stream.

The impairments identified from the RSAs are likely due to changes in salinity regime and loss of wetlands. The least impaired sections are those near the mouth of the stream, where areas of intact coastal salt marsh are still present. The most impaired areas are in the residential neighborhoods along the upper stream. The greatest impacts observed on the stream were decreased invertebrate populations. The



Rapid Stream Assessment
Photo credit: Audra Melton, TNC

strongest feature was the absence of fish passage barriers along much of the stream's main channel.

9.3.2 Biological Sampling of Fishes

For Rhodes Bayou, the only known fish information was generated by an Audubon sampling held at Pascagoula River Audubon Center over the last few years. Species captured included spot, red drum, bluegill, redear sunfish, and western mosquitofish.

9.3.3 Water Quality Data

The quality of the water is a critical component to the health of stream habitats. It effects estuarine and marine environments in Mississippi Sound and can be reflective of conditions upstream and over the entire watershed. Creating a baseline of water quality is important to understanding the current conditions of a stream, monitoring its health, and measuring change over time. The MDEQ Field Services Division collected water quality data on all nine streams from March 1, 2016, to August 31, 2016. Data were collected under the guidelines of the MDEQ Quality Assurance Project Plan Section 106 Monitoring Network in the State Surface Water Monitoring and Assessment Program. Two sample locations were established for each stream, except in Watts Bayou where the limited public access points allowed for only one sample site. Nineteen different sampling measures were taken bimonthly, and one measure for biological oxygen demand was taken monthly. A complete list of water quality analyses performed is included in Appendix I. Data collected from this sampling were used to inform the stream's Viability Assessment.

For Rhodes Bayou, multiple excursions of the existing instantaneous minimum dissolved oxygen criteria of 4 mg/L were detected. No other evidence indicates that these values are outside of the expected natural background in systems of this type. It is important to recognize that this sampling took place over a limited period, and longer-term continuous monitoring is recommended. Extended monitoring would establish a more robust baseline, establish trends, and alert stakeholders to chronic or acute problems as they may develop.

9.3.4 Viability Assessment Summary Results

Rhodes Bayou was the only coastal stream in the CSHI with an overall biodiversity health ranking of "**Good**." In spite of historical wetland loss in the downstream section of the watershed, the basin landscape has good floodplain connectivity, little channel alterations, a low number of impervious surfaces, and only a few minor fish passage issues. The stream condition was ranked "Fair" due to presence of invasive species and trash and debris piles, mostly next to bridges. Attributes for water quality were ranked "Very Good" due to no impairments detected for nitrogen, nitrite, phosphorous, or dissolved oxygen. The stream's riparian corridor is ranked "Very Good" because it is healthy and intact throughout the entire length of the stream.

9.4 Factors of Stream Degradation: Stresses and Threats

9.4.1 Primary Stresses

The following five stresses were identified for Rhodes Bayou during the CAP process:

1. Altered Floodplains and Wetlands
2. Altered Riparian Corridor
3. Altered Stream Geomorphology
4. Altered Hydrology
5. Invasive Species

Organic pollution was also a raised by participants in the Public Listening Sessions, but no evidence was found to indicate that this is a current stress to the drainage.

Altered Floodplains and Wetlands

Rhodes Bayou has several areas of intact upland forest, neighborhoods with good canopy and vegetative cover, and intact tidally influenced wetlands. There are developed areas with impervious surfaces (e.g., schools, businesses, roads), but the density of development is lower than other coastal watershed communities in Mississippi. Wetlands in Rhodes Bayou, although intact, are in decline based on historical aerial photography. Over the last 50 years, wetlands have been converted to open water along the lower channel of Rhodes Bayou and in the mouth of Beardsley Lake. Alteration to stream geomorphology and hydrology are likely contributors to wetland degradation. It is believed that a change in salinity regime is largely responsible for this wetland loss; as freshwater wetland species decline, saltwater-tolerant species are too slow to colonize before sediments are lost to erosion. The result is a net loss in wetland land cover.

Altered Stream Geomorphology

Parts of Rhodes Bayou have been altered due to roadway transportation projects that have dredged and filled in waterways downstream of Rhodes Bayou. Some sediment was mined for construction of causeways, overpasses, and a historic trolley line. This may have altered the historic flow pattern of freshwater moving from the Escatawpa River, downstream past Rhodes Bayou enroute to the lower Pascagoula River. Sections of the main channel of the Escatawpa River have been dredged and maintained to support large fishing vessels, "pogie boats," and access to processing plants. Alterations and maintenance to the Escatawpa River potentially have allowed for increases in saltwater entering Rhodes Bayou tidally. Upstream channelization affects the residence time of fresh water, allowing it to move faster through the watershed.



Stormwater runoff to the bayou

Altered Hydrology

Stormwater runoff from roads, parking lots and other impervious surfaces has increased the volume and velocity of freshwater entering the watershed during rain events. Water may be draining faster and in a greater amount, causing a

reduction in freshwater residence time within the water table and stream channel. Therefore, there is likely reduced freshwater "feeding" into the stream during periods with little rainfall. Another effect of added volume and velocity would be increased streambank and streambed erosion, resulting in sedimentation, channel incision, and habitat degradation.

Altered Riparian Corridor

In many parts of Rhodes Bayou, the riparian area is fairly intact, but parts of the drainage have residential areas up to the water's edge. Invasive species are found throughout the drainage especially within the riparian zone.

Invasive Species

Invasive species of concern in Rhodes Bayou include plant species such as cogongrass, Chinese tallow tree, Japanese climbing fern, torpedo grass, and elephant ear. These species outcompete native plant communities—often resulting in a near monoculture with low biodiversity in comparison to a native riparian community. Giant salvinia was not observed, but should be monitored because it is a concern for resource managers. The only invasive animal species observed were domestic/feral cats, which pose a concern to native wildlife—particularly bird species. Nutria were not observed, but are likely to be present in this watershed. Nutria should be monitored as they are herbivores that can pose a threat to vegetation and small trees; their foraging activities can also directly damage bank stability. Tilapia pose a threat to native species diversity and should also be monitored.

9.4.2 Primary Threats

Primary threats were identified and ranked by stakeholders as the sources of stress for each watershed. The 11 threats for Rhodes Bayou are as follows:

1. Housing and Urban Areas
2. Commercial and Industrial Areas
3. Transportation, Utility, and Service Lines
4. Climate Change and Severe Weather
5. Invasive Species
6. Garbage and Solid Waste
7. Canals, Dredging, and Other Ecosystem Modifications
8. Dams and Water Management
9. Tourism and Recreation Areas
10. Recreational Activities
11. Fishing and Harvesting Aquatic Resources

9.5 Taking Action

Developing effective strategic action and objectives to abate critical threats and restore function to Rhodes Bayou watershed is essential to conservation planning. If successfully implemented, strong conservation strategies collectively should conserve the stream and realize the project vision.

9.5.1 Conservation Strategies

Ultimately, five strategies were developed that are specific to Rhodes Bayou or are part of a broader basin-wide approach. Figure 9-1 depicts the development of these strategies and the potential stream improvements that would occur as a result of their implementation.

1. Restore Historic Wetlands

Rhodes Bayou has a large amount of tidal wetlands within its riparian corridor; however, this area has been reduced significantly over time. Comparisons of aerial photography over the past few decades indicate that losses have occurred primarily at the mouth of the bayou in Beardsley Lake and within the lower bayou's stream channel. It is believed that changes in the salinity regime caused corresponding loss of vegetative cover, resulting in more open water. Since the physical changes to the estuary are not likely to change, the restoration of the Rhodes Bayou wetlands should account for the current salinity regime and appropriate plant species. Additionally, design features should include measures that will prevent wetland loss in the future.

2. Implement Education and Outreach Programs

The need for education and outreach were listed in both Rhodes Bayou and Bayou Chicot in Jackson County. Rhodes Bayou is ideal for education due to opportunities associated with its largely intact condition. Additionally, the Pascagoula River Audubon Center is situated for education programs and access to the Bayou. This strategy would target different groups of stakeholders based on perceived needs and feedback on potential programs. Technical education of restoration techniques, invasive species management, and science-based programs could be targeted at resource managers, elected officials, and other decision-makers. Land management, community outreach, citizen science, and conservation programs would target local landowners, citizens, and other interested stakeholders.

3. Stabilize Streambanks

Erosion of streambanks can cause buildup of suspended sediments in the water column and create alterations to the stream channel and its flow as deposition areas build up over time. In many areas, erosional issues are obvious, but in other locations, the issue is not easily identified. Stream areas should be surveyed to identify areas of erosion for planning purposes. Efforts could then be made to identify possible solutions to slow, stabilize, or abate the threat posed to the bank. These solutions may take the form of site-based installation concepts that can be used by landowners and/or partners for implementation.

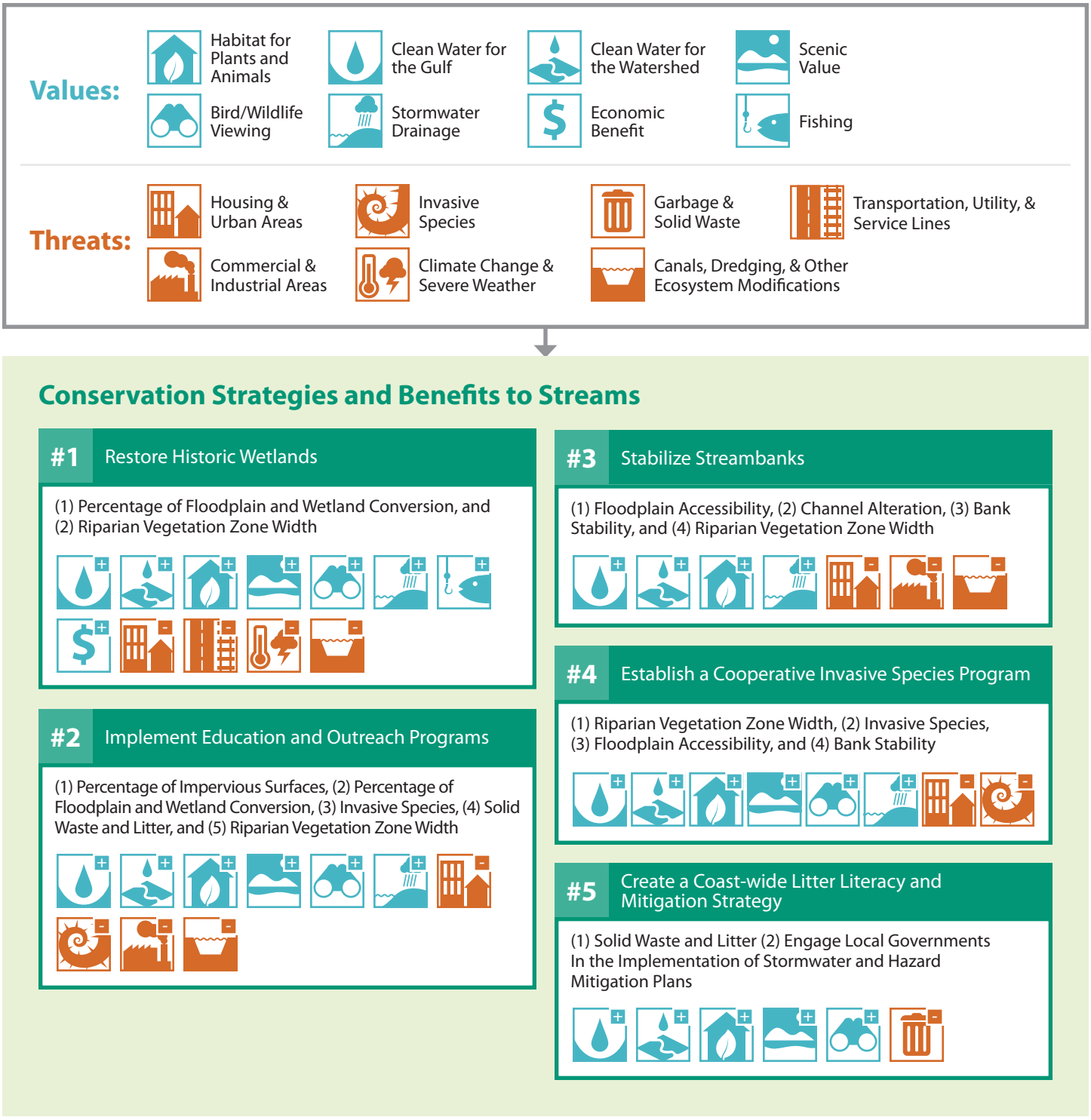
4. Establish a Cooperative Invasive Species Program

Invasive species are a problem in every target stream of this CAP. A Cooperative Invasive Species Management program will engage landowners and local government in a coast-wide effort to identify invasive species hotspots and take corrective actions.

5. Create a Coast-wide Litter Literacy and Mitigation Strategy

Litter and solid waste were identified as major problems by the attendees at every CSHI public meeting. A litter literacy and mitigation program could devise ways to reduce litter. The most important part of this effort would be a public education program.

Figure 9-1
Rhodes Bayou Conservation Strategies



9.5.2 S.M.A.R.T. Objectives

The S.M.A.R.T. objectives that apply to Rhodes Bayou are provided in Table 9-1. The full list of objectives and their associated references are included in Appendix D.

Table 9-1
Rhodes Bayou S.M.A.R.T. Objectives

S.M.A.R.T. OBJECTIVE	NOTES
INVASIVE SPECIES	
Restore or improve ecological balance in systems negatively affected by invasive species: • By 2026, reduce annual increase in Nonindigenous Aquatic Species to 3% annually	*Rhodes Bayou does not have the invasive species problem common among CSHI streams. Local areas of high Chinese tallow tree infestation exist, particularly in the upper basin. This should allow an effective eradication strategy, by engaging shoreline landowners and local officials.*
CANALS, DREDGING, & OTHER ECOSYSTEM MODIFICATIONS	
Encourage agencies that permit shoreline stabilization to consider alternative shoreline erosion control approaches before hardened stabilization is approved: • By 2026, remove or replace hardening structures that degrade habitat in CSHI watersheds at ten sites	*Rhodes Bayou does not have as severe a problem with hardening structures as other CSHI streams. This presents the opportunity to utilize environmentally sound alternatives in virtually any future project. Ensure that decision-makers, regulators, contractors, and landowners have all available information on alternative methods for protecting shoreline property.*
ALTERED FLOODPLAINS & WETLANDS	
Maintain and restore physical habitat in freshwater systems: • By 2026, reduce acres of altered freshwater wetlands by permitted construction by 30% • By 2026, increase the miles of streams with improved physical habitat by 15% • By 2026, reduce number of stream miles destroyed or converted to unnatural or managed development in CSHI watersheds by 25%	*Rhodes Bayou has more remaining natural marsh than most other CSHI streams, presenting the opportunity to have marsh preservation as part of any future development plans.*
Reduce impact of development on the physical habitat in freshwater systems: • By 2026, reduce the number of acres of altered freshwater wetlands drained or converted through development annually in CSHI watersheds to 50% • By 2026, increase the percentage of urban and suburban natural patches (10 to 100 acres) in CSHI watersheds by 35%	*In addition to the larger marsh parcels, many natural patches occur throughout the watershed. Educate local landowners in the advantages of and methods for preserving and restoring small natural habitats.*
Conserve, restore, and create coastal estuarine and marine habitats: • By 2026, improve overall coastal condition indices in estuarine portions of CSHI streams to 3.9 • By 2026, reduce the percentage of CSHI estuarine areas rated "Poor" for water quality to 0% • By 2026, reduce the percentage of sediment-impaired CSHI estuarine areas to 11% (CSHI streams) • By 2026, reduce the percentage of benthic habitat rated "Poor" to 14% (CSHI streams), • By 2026, reduce wetlands loss indices to 1.29 (Gulf of Mexico)	*As mentioned above, Rhodes Bayou is in better condition than other CSHI streams, but habitat degradation has occurred in the past and continues today. Look at all possible methods and engage all applicable players in protecting and enhancing the high-quality habitat along Rhodes Bayou.*

S.M.A.R.T. OBJECTIVE	NOTES
• By 2026, prevent additional erosion on shorelines suffering "severe erosion" by 10% • By 2026, identify, create, restore, or enhance significant acreage of high-priority coastal wetlands	
OUTREACH, EDUCATION, & STAKEHOLDER ENGAGEMENT	
Expand conservation constituency: • By 2026, develop formal partnerships with five agencies, user groups, or neighborhood associations, and propose and implement local conservation efforts with these groups	*Among all CSHI streams, Rhodes Bayou has one of the highest public interest levels. Attendance at and participation in TNC's Public Listening Sessions on Rhodes Bayou was very high. Engaging local civic groups, elected officials, churches, and others in Adopt-a-Stream effort, community cleanups, and other events that highlight the stream, its history, and potential are ways to build on interest and public support. Involve the Pascagoula River Audubon Center and local churches in all restoration efforts.*

9.5.3 Other Objectives

Other objectives found to be relevant to the CAP are listed in Table 9-2.

Table 9-2
Rhodes Bayou Other Objectives

OTHER OBJECTIVE	NOTES
CANALS, DREDGING, & OTHER ECOSYSTEM MODIFICATIONS	
Encourage agencies that permit shoreline stabilization to consider alternative shoreline erosion control approaches before hardened stabilization is approved: • Involve all agencies and organizations in strategies related to shoreline stabilization • Provide appropriate information on alternative shoreline erosion control approaches • Protect and enhance aquatic biodiversity • Protect and enhance terrestrial biodiversity • Maintain healthy aquatic community integrity • Protect and restore existing native fish populations • Maintain populations of native non-game fishes and aquatic invertebrates at or above present levels throughout the basin • Improve water quality for drinking water, and to protect and restore existing native fish populations	*Rhodes Bayou does not have as severe a problem with hardening structures as other CSHI streams. This presents the opportunity to utilize environmentally sound alternatives in virtually any future project. Ensure that decision-makers, regulators, contractors, and landowners have all available information on alternative methods for protecting shoreline property.*
ALTERED FLOODPLAINS & WETLANDS	
Acquire and protect coastal habitat: • Identify, acquire, and protect significant acreage of high-priority coastal wetlands through fee simple, easements, or protective agreements	*As noted above, Rhodes Bayou has large stretches of high-quality natural marsh. Working with local officials and landowners, preserve natural marsh using acquisition, conservation easements, and other legal tools. Many waterfront landowners on Rhodes Bayou have not developed their wetlands, indicating a possible conservation mindset; in addition, much marsh is owned and managed by local*

OTHER OBJECTIVE	NOTES
	government agencies, which should be amenable to preservation efforts. *Rhodes Bayou is in better condition than other CSHI streams, but habitat degradation has occurred in the past and continues today. Look at all possible methods and engage all applicable players in protecting and enhancing the high-quality habitat along Rhodes Bayou.*
POLICY	
Work with cities to support, revise, and enforce city-wide tree protection ordinances	*Determine whether Moss Point has a tree protection ordinance. If so, support local officials in the fair and effective enforcement of the laws.*
OUTREACH, EDUCATION, & STAKEHOLDER ENGAGEMENT	
Increase public awareness and interest in the values and functions of coastal wetlands, their habitats, and the ecosystem on which they are dependent: • Develop and deliver education materials and programs to inform the public about wetlands species, their habitat, and values to humans	*Among all CSHI streams, Rhodes Bayou has one of the highest public interest levels. Attendance at and participation in TNC's Public Listening Sessions on Rhodes Bayou was very high. Engaging local civic groups, elected officials, churches, and others in Adopt-a-Stream effort, community cleanups, and other events that highlight the stream, its history, and potential are ways to build on interest and public support. Involve the Pascagoula River Audubon Center and local churches in all restoration efforts.*
FUNDING	
Dedicate funding to support long-term restoration: • Find private funding sources • Investigate funding opportunities • Identify and create alternative funding strategies for capital projects and long-term sustainability of greenway infrastructure	*Capitalize on the high level of local interest in Rhodes Bayou to find funding for maintenance and monitoring efforts. Engage citizen science groups as part of the monitoring effort.*
Seek funding to expand CSHI coverage to other streams in Mississippi's coastal counties	*Moss Point has other streams that would benefit from restoration. Locate and identify these streams and bring them to the attention of local officials, local citizens, and funding agencies.*

9.6 Next Steps for Implementation

9.6.1 Site-specific Follow-up

Attendees at the two public meetings for Rhodes Bayou identified two sites of concern along the stream. Specific issues mentioned were flooding and invasive species. TNC staff visited all listed sites on September 30, 2015, and October 1, 2015. At the same time, TNC staff visited four road crossings to check for fish passage issues. A full list of these sites and findings is included as Appendix E.

9.6.2 Development of Project Design

A component of the CSHI was to take the information developed from the conservation planning process and draft conceptual designs of potential projects. These conceptual projects were designed to support future restoration efforts by identifying and describing areas of stream impairments, providing baseline data needed for more advanced planning, and, where possible, drafting a suite of possible options to improve those impairments. The number of projects considered and ultimately initiated was dependent on the amount of funding available. Efforts were made to achieve equivalency among the nine coastal streams in this project, and advance projects that would have the greatest conservation impact in future restoration efforts. For Rhodes Bayou, the following project is recommended for conceptual design development to be completed by the end of September 2016.

Stream Assessments

As previously mentioned in the Viability Assessment section, very little baseline data on stream conditions were present prior to the start of this project. The initial snapshot created by the RSAs provided a needed general overview of each stream's condition. This assessment was not designed or intended to provide the site-specific level of detail needed for conceptual projects. The stream assessments conceptual project will identify, describe, map, and rank areas of impairments on the six mid-sized project streams. Data collected on existing in-stream conditions would identify future potential restoration opportunities. A limited number of "planning areas" will be identified, with recommendations and costs for potential improvements. The six streams included in this project include Watts Bayou, Magnolia Bayou, Coffee Creek, Oyster Bayou, Rhodes Bayou, and Bayou Chicot.



10 BAYOU CHICOT

10.1 General Description of Watershed

Bayou Chicot is a coastal stream in Jackson County, Mississippi, which flows southeast through the city of Pascagoula into the Mississippi Sound. The stream consists of two major forks: a west fork that is approximately 2.6 miles in length and starts north of U.S. Highway 90, and a shorter eastern fork that is 1.6 miles long that joins the main stream 0.5 mile above the mouth. There is a short canal off the mainstem about 0.33 mile in length to provide boat access to waterfront homes. The stream is tidal for approximately 1 mile.

The first Europeans to arrive at Pascagoula were the French explorers D'Iberville and Bienville who stood on the banks of the river in 1699. The first large permanent structure here was the Old Spanish Fort built in 1718. The U.S. Army built Camp Jeff Davis on Greenwood Island, at the mouth of Bayou Chicot, in 1848. The Town of Scranton was incorporated in 1886, followed by the Town of East Pascagoula in 1892. These two towns would merge in 1904 to form the City of Pascagoula. The area has suffered many tragedies through the years, including hurricanes and a devastating yellow fever outbreak in 1897 that killed 50 residents. Today, shipbuilding, oil industry support, and commercial fishing, located on the Pascagoula River, the Escatawpa River and neighboring Bayou Casotte, are the backbone of the local economy.

Bayou Chicot's name derives from the French term for "snaggy or stumpy." It is a popular coastal stream for outdoor recreation. Singing River Yacht Club is located near the mouth and numerous private boat slips line the stream. A public access area north of the yacht club is popular for recreational fishing, and it is accessible to kayaks along both forks of the stream. Bayou Chicot appears to have many of the problems associated with highly developed urban watersheds including urban development, extensive shoreline development, alteration of the stream channel and riparian areas, invasive plants, excessive litter, urban runoff, shoreline hardening, and road and railroad crossings that may prevent fish passage. Only very small fragmented areas of natural forest remain throughout the watershed. Some small areas of natural estuarine wetlands still exist, especially in the lower reaches and along the eastern fork. A natural fringing intertidal oyster reef exists along the lower reaches, extending upstream approximately 0.5 miles.

The eastern part of Pascagoula supports chemical/petroleum refineries and ship building capacity. This supports significant workforce and is an important driver for the Mississippi coast economy. Through our Conservation Planning Workshops, Air-borne Pollutants were identified as a threat affecting Bayou Chicot and ranked "low." This ranking is in large part due to citizen concerns related to nearby industrial areas. In particular, industrial sand blasting of ships is believed to be a source of airborne particulates. In response to citizen concerns, a community group was formed in the Cherokee subdivision in 2014 to facilitate communication between local residents and neighboring industry. This group maintains regular meetings that are open to the public, and has hosted speakers and events such as guided tours of the industrial facilities.

10.2 Conservation Action Plan

In the past, TNC has successfully implemented a ten-step CAP process for defining the conservation projects, developing and implementing strategies and measures, and using the results to adapt and improve conservation outcomes (TNC 2007). A facilitator led the CAP process with each watershed stakeholder group. Through a series of workshops or meetings, they worked together to identify conservation targets, analyze target threats, identify objectives and outcomes, develop strategic actions, and define indicators and measures to monitor success.

10.2.1 Stakeholder Engagement

The Bayou Chicot Public Listening Sessions were part of a series of public forums for the CSHI within the nine target stream areas. TNC conducted two Public Listening Sessions in July 2015 for residents of the

Rhodes Bayou and Bayou Chicot watersheds. Input from these meetings informed the CAP process. The summarized results of Rhodes Bayou's scope, perceived problems or threats, and identified solutions to the problems from the meetings are listed in Appendix A.

10.2.1 Nested Targets

Imbedded or nested targets within Bayou Chicot include a variety of biological and functional components to be considered for conservation as a part of this drainage. These include the actual stream, watershed, riparian corridor, and tidal zone. Upland native vegetation, forest habitat, and wetlands, as well as species assemblages of native fishes, stream invertebrates, and migratory bird species are also considered. A listing of species of conservation concern is included in Appendix F, and a listing of habitats in this stream is included in Appendix G. In addition to species and habitats, participants in the Public Listening Sessions were given a list of 16 biological and functional components to rank in order of importance for conservation value for their watershed. The top values from the Public Listening Sessions are as follows, in order of importance:

1. Habitat for Plants and Animals
2. Stormwater Drainage
3. Scenic Value
4. Clean Water for the Watershed
5. Fishing

10.3 Habitat Assessment: Stream Health

10.3.1 Rapid Stream Assessments

RSAs were conducted at nine sites on Bayou Chicot (Appendix H). Scoring results were averaged from individual assessments, with an average score of 4.80 out of 10. This score indicates that Bayou Chicot is in fair condition as rated by the SVAPv2. This is consistent with the overall viability ranking for the stream.



Rapid Stream Assessment by kayak

The impairments identified from the RSAs are largely due to long-term management of the bayou for stormwater treatment. The most impaired areas are located in the upstream reaches where the stream has been channelized and straightened to accommodate urban development. The greatest impacts observed on the stream in these areas are poor riparian and bank conditions. A notable feature was the absence of fish passage barriers along the entire stream course and the presence of high-quality riparian and intertidal habitat (salt marsh and oyster reef) in the lower reaches of the stream.

10.3.2 Biological Sampling of Fishes

For Bayou Chicot, a few records from the 1970s exist in the collection of Tulane University. Species documented in Bayou Chicot from the Tulane collection include Gulf menhaden, sheepshead minnow, fat sleeper, ladyfish, spotfin mojarra, Gulf killifish, western mosquitofish, spot, inland silversides, Atlantic croaker, striped mullet, sailfin molly, and Atlantic threadfin.

10.3.3 Water Quality Data

The quality of the water is a critical component to the health of stream habitats. It effects estuarine and marine environments in Mississippi Sound and can be reflective of conditions upstream and over the entire watershed. Creating a baseline of water quality is important to understanding the current conditions of a stream, monitoring its health, and measuring change over time. The MDEQ Field Services Division collected water quality data on all nine streams from March 1, 2016, to August 31, 2016. Data were collected under the guidelines of the MDEQ Quality Assurance Project Plan Section 106 Monitoring Network in the State Surface Water Monitoring and Assessment Program. Two sample locations were established for each stream, except in Watts Bayou where the limited public access points allowed for only one sample site. Nineteen different sampling measures were taken twice a month, and one measure for biological oxygen demand was taken monthly. A complete list of water quality analyses performed is included in Appendix I. Data collected from this sampling were used to inform the stream's Viability Assessment.

For Bayou Chicot, no water quality impairments or potential areas of concern were identified though this sampling. It is important to recognize that this sampling took place over a limited period, and longer-term continuous monitoring is recommended. Extended monitoring would establish a more robust baseline, establish trends, and alert stakeholders to chronic or acute problems as they may develop.

10.3.4 Viability Assessment Summary Results

Bayou Chicot's overall ranking was "**Fair**" because it has no floodplain, except for a relatively small stretch above the mouth of the stream and the lower east branch. In addition, it is heavily developed with a high percentage of impervious surfaces and extensive wetland conversion. Bayou Chicot is mostly channelized, with many bulkheads throughout the majority of its length. A few fish passage barriers exist well upstream. Despite all of these threats, this is the only one of the nine coastal stream with a functioning fringing oyster reef and a small intertida, saltmarsh near the mouth of the stream. This stream's condition is also "Fair" due to occurrence of invasive species, trash, and debris in the stream and its floodplain, and relatively unstable banks. Attributes for water quality were ranked "Very Good" due to no impairments detected for nitrogen, nitrite, phosphorous, or dissolved oxygen. However, the stream riparian zone is ranked "Poor" because the majority of the residential and commercial development is built to the stream's edge.

10.4 Factors of Stream Degradation: Stresses and Threats

10.4.1 Primary Stresses

The following seven stresses were identified for Bayou Chicot during the CAP process:

1. Excessive Suspended and Bedded Sediments
2. Altered Floodplains and Wetlands
3. Altered Riparian Corridor
4. In-stream Habitat Modification
5. Altered Stream Geomorphology
6. Altered Hydrology
7. Invasive Species

Excessive Suspended and Bedded Sediments

In the lower reaches of Bayou Chicot, large sandbars develop and constantly change position, causing navigation difficulties. This is likely partially due to erosion and sediments from the upper stream reaches.

Altered Floodplains and Wetlands

The Bayou Chicot drainage includes residential and commercial areas of the eastern side of the city of Pascagoula with large areas of impervious surfaces. This includes commercial business, apartments, retail centers, and parking areas, as well as residential home sites and neighborhoods. Transportation corridors include U.S. Highway 90, numerous streets and avenues, the CSX rail line, small bridges, and large overpasses. Many neighborhoods contain large trees, canopy cover, and landscaped areas. There are few natural areas, but green spaces exist including public grounds and parks. There is also an intact tidal wetland at the mouth of the stream.

Altered Riparian Corridor

Commercial and residential development are close to the streambanks. Commercial areas are impervious up to the stream, with residential areas generally landscaped up to streambanks.

In-stream Habitat Modification

Bayou Chicot is managed primarily as stormwater receiving waters. The upper reaches of the stream are regularly maintained by sediment removal; bulkheads are also common in the upper reaches. In addition, a large stretch of the bayou is lined with concrete so that maintenance vehicles can operate for accessibility. In general, the lower part of the stream is more natural than the upper section, but there has been some dredging to allow access for boats to home sites. The Pascagoula Yacht Club is by the mouth of the bayou, which contains some stretches of tidal marsh habitat.

Altered Stream Geomorphology

Bayou Chicot appears to have been straightened and re-enforced in several areas to serve as stormwater drainage for the city of Pascagoula. These modifications include grass-lined or concrete ditches and riprap.

Altered Hydrology
Impervious surfaces in the more developed areas of the drainage have likely increased the amount and velocity of water flowing through Bayou Chicot.

Altered Connectivity
Lower stretches of the stream are absent of connectivity problems; however, upstream areas have several culverts and stream crossings which may cause wildlife passage issues and present fish passage blockages.

Invasive Species
Invasive species of concern in Bayou Chicot include plant species such as cogongrass, Chinese tallow tree, Japanese climbing fern, torpedo grass, and elephant ear. These species outcompete native plant communities—often resulting in a near monoculture with low biodiversity in comparison to a native riparian community. Giant salvinia was not observed, but should be monitored because it is a concern for resource managers. The only invasive animal species observed were domestic/feral cats, which pose a concern to native wildlife—particularly bird species. Nutria were not observed, but are likely to be present in this watershed. Nutria should be monitored as they are herbivores that can pose a threat to vegetation and small trees; their foraging activities can also directly damage bank stability. Tilapia pose a threat to native species diversity and should also be monitored.

10.4.2 Primary Threats

Primary threats were identified and ranked by stakeholders as the sources of stress for each watershed. The 12 threats for Bayou Chicot are as follows:

1. Housing and Urban Areas
2. Commercial and Industrial Areas;
3. Transportation, Utility, and Service Lines
4. Climate Change and Severe Weather
5. Invasive Species
6. Garbage and Solid Waste
7. Canals, Dredging, and Other Ecosystem Modifications
8. Dams and Water Management
9. Tourism and Recreation Areas
10. Recreational Activities
11. Fishing and Harvesting Aquatic Resources
12. Air-borne Pollutants

10.5 Taking Action

Developing effective strategic action and objectives to abate critical threats and restore function to Bayou Chicot watershed is essential to conservation planning. If successfully implemented, strong conservation strategies collectively should conserve the stream and realize the project vision.

10.5.1 Conservation Strategies

Ultimately, six strategies were developed specific to Bayou Chicot or as part of a broader basin wide approach. Figure 10-1 depicts the development of these strategies and the potential stream improvements that would occur as a result of their implementation.

1. Implement Education and Outreach Programs

As an urban-dominated drainage, there is an opportunity in Bayou Chicot to engage local residents in the conservation of their watershed. This strategy would target a broad group of stakeholders to promote opportunities to improve the condition of the Bayou Chicot watershed. Emphasis would be on demonstrating and promoting best management practices of resources to elected officials, city and county management agencies, engineers, and other practitioners. These best management practices could include alternatives to traditional infrastructure, and exploring cost, lifespan, and comparable benefits of utilizing different techniques to favor watershed function. Residential and commercial stakeholders may also be targeted for property management techniques that would enhance habitat, water quality, or watershed function.

2. Use Media Filters to Capture Nutrients and Sedimentation

The use of natural and living materials to capture nutrients and sediment prior to entering a waterway should be considered for any new water protection measures. Due to the urbanized nature of Bayou Chicot, techniques that work in small and confined areas would be ideal for demonstration. This approach would identify potential project locations, partners, and techniques that can engage the local community where appropriate. Many of these techniques also have aesthetic benefit as well as nutrient/sediment capturing and creation of natural habitat. Ultimate maintenance of these projects would depend on a combination of volunteer and partner support.

3. Protect Land Downstream

The mouth and downstream section of Bayou Chicot maintains its tidal connectivity with habitats such as intertidal oyster reefs, salt marsh, and uplands. These areas provide habitat and foraging areas for birds, mammals, Mississippi diamondback terrapins, fish, crustaceans, and other invertebrates. For downstream protection of these habitats, this could mean establishing easements, negotiating deed restrictions for future development, or fee acquisition. Fee acquisition of lands would be from willing sellers and would require an appropriate land management agency or organization to take ownership of the land. In addition to private landownership, Jackson County is also a landowner along the bayou.

4. Stabilize Streambanks

Erosion of streambanks can cause buildup of suspended sediments in the water column and create alterations to the stream channel and its flow as deposition areas build up over time. In many areas, erosional issues are obvious, but in other locations, the issue is not easily identified. Stream areas should be surveyed to identify areas of erosion for planning purposes. Efforts could then be made to identify possible solutions to slow, stabilize, or abate the threat posed to the bank. These solutions may take the form of site-based installation concepts that can be used by landowners and/or partners for implementation.

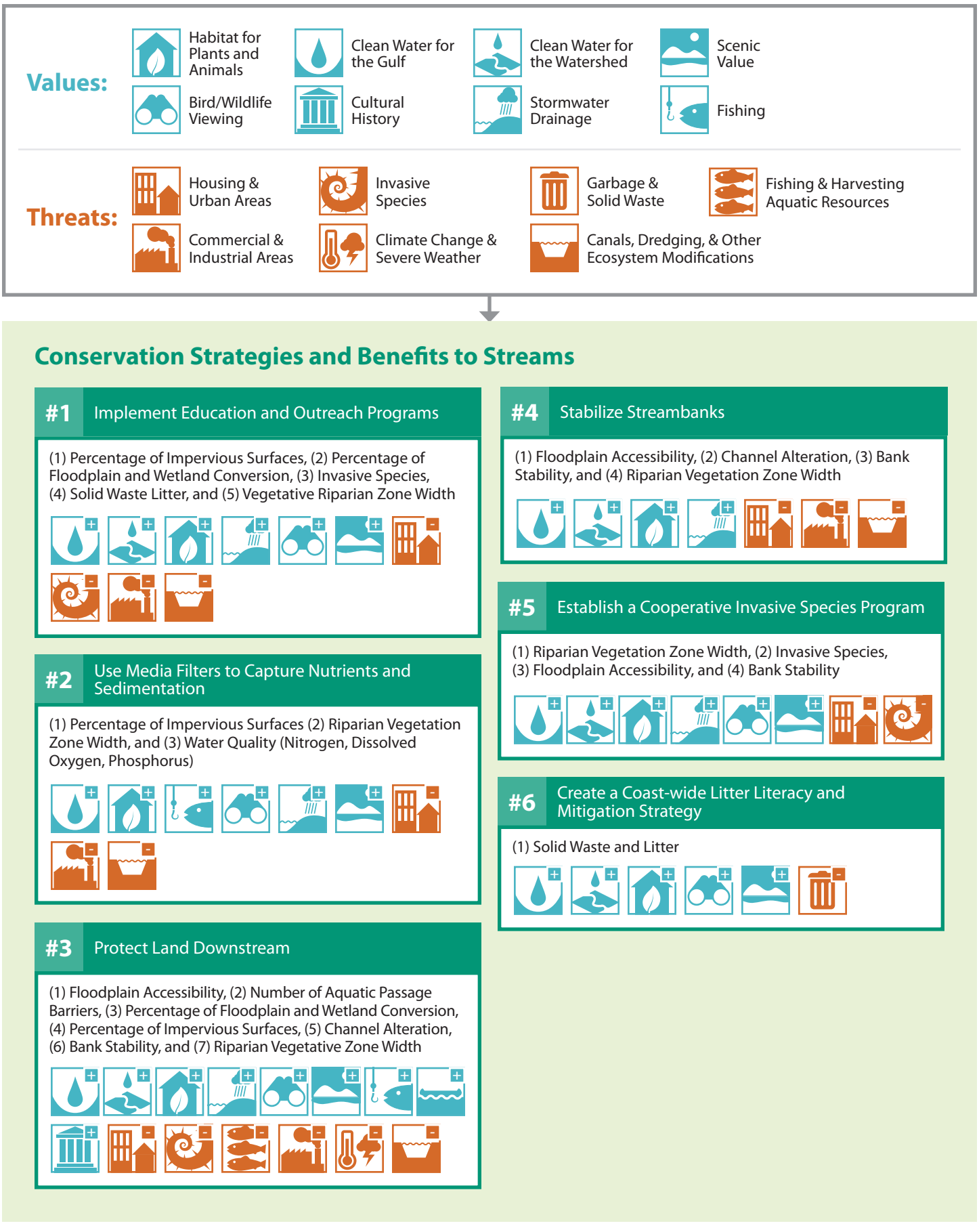
5. Establish a Cooperative Invasive Species Program

Invasive species are a problem in every target stream of this CAP. A Cooperative Invasive Species Management program will engage landowners and local government in a coast-wide effort to identify invasive species hotspots and take corrective actions.

6. Create a Coast-wide Litter Literacy and Mitigation Strategy

Litter and solid waste were identified as major problems by the attendees at every CSHI public meeting. A litter literacy and mitigation program could devise ways to reduce litter. The most important part of this effort would be a public education program.

Figure 10-1
Bayou Chicot Conservation Strategies



10.5.2 S.M.A.R.T. Objectives

The S.M.A.R.T. Objectives that apply to Bayou Chicot are provided in Table 10-1. The full list of objectives and their associated references are included in Appendix D.

Table 10-1
Bayou Chicot S.M.A.R.T. Objectives

S.M.A.R.T. OBJECTIVE	NOTES
TRANSPORTATION, UTILITY, & SERVICE LINES	
Protect stream connectivity: • By 2026, ensure that all new stream crossings use construction materials and techniques that do not alter connectivity in CSHI watersheds	*Bayou Chicot has a large number of road and rail crossings. Any future crossings should be constructed so as not to hinder aquatic species passage.*
INVASIVE SPECIES	
Restore or improve ecological balance in systems negatively affected by invasive species: • By 2026, reduce annual increase in Nonindigenous Aquatic Species to 3% annually	*Many stretches of Bayou Chicot have large stands of nonnative trees and other invasive plants. Wherever possible, invasive species should be removed and waterfront landowners educated in methods for control.*
CANALS, DREDGING, & OTHER ECOSYSTEM MODIFICATIONS	
Encourage agencies that permit shoreline stabilization to consider alternative shoreline erosion control approaches before hardened stabilization is approved: • By 2026, remove or replace hardening structures that degrade habitat in CSHI watersheds at ten sites	*Bayou Chicot has large stretches of hardened shorelines protecting f businesses, homes, and other structures. Wherever possible, engage with landowners to replace hardened structures with more ecologically acceptable methods. Provide education and information to decision-makers, regulators, contractors, and landowners on newer, more ecologically sound methods of protecting waterfront property.*
ALTERED FLOODPLAINS & WETLANDS	
Maintain and restore physical habitat in freshwater systems: • By 2026, reduce acres of altered freshwater wetlands by permitted construction by 30% • By 2026, increase the miles of streams with improved physical habitat by 15% • By 2026, reduce number of stream miles destroyed or converted to unnatural or managed development in CSHI watersheds by 25%	*Much of the upper watershed of Bayou Chicot has suffered significant alterations due to structures and infrastructure close to the streams. Wherever possible, preserve and enhance remaining wild patches.*
Reduce impact of development on the physical habitat in freshwater systems: • By 2026, reduce the number of acres of altered freshwater wetlands drained or converted through development annually in CSHI watersheds to 50% • By 2026, increase the percentage of urban and suburban natural patches (10 to 100 acres) in CSHI watersheds by 35%	*Along some stretches of Bayou Chicot, small parcels of city-owned lands could form the basis for restored natural patches. Educate the public, and especially waterfront landowners, about the benefits of natural patches in an urban area.*

S.M.A.R.T. OBJECTIVE	NOTES
Conserve, restore, and create coastal estuarine and marine habitats: • By 2026, improve overall coastal condition indices in estuarine portions of CSHI streams to 3.9 • By 2026, reduce the percentage of CSHI estuarine areas rated "Poor" for water quality to 0% • By 2026, reduce the percentage of sediment-impaired CSHI estuarine areas to 11% (CSHI streams) • By 2026, reduce the percentage of benthic habitat rated "Poor" to 14% (CSHI streams), • By 2026, reduce wetlands loss indices to 1.29 (Gulf of Mexico) • By 2026, prevent additional erosion on shorelines suffering "severe erosion" by 10% • By 2026, identify, create, restore, or enhance significant acreage of high-priority coastal wetlands	*Of special significance in Bayou Chicot are heavily sedimented areas in the lower basin, where shifting bottoms degrade habitat and block boat passage. Work with waterfront landowners to institute best management practices for reducing erosion and unwanted sediment accumulation.*
OUTREACH, EDUCATION, & STAKEHOLDER ENGAGEMENT	
Expand conservation constituency: • By 2026, develop formal partnerships with five agencies, user groups, or neighborhood associations, and propose and implement local conservation efforts with these groups	*While many residents already recognize the value of Bayou Chicot's scenic and recreational opportunities, many others may think of the stream as a drainage canal, without realizing that it is in fact a natural stream. Look for ways to link residents and local landowners to the stream, its important natural functions, and its wildlife. Formalize these efforts with Adopt-a-Stream groups, neighborhood cleanups, and other citizen science and enhancement efforts. See that local governments are involved.*

10.5.3 Other Objectives

Other objectives found to be relevant to the CAP are listed in Table 10-2.

Table 10-2
Bayou Chicot Other Objectives

OTHER OBJECTIVE	NOTES
CANALS, DREDGING, & OTHER ECOSYSTEM MODIFICATIONS	
Encourage agencies that permit shoreline stabilization to consider alternative shoreline erosion control approaches before hardened stabilization is approved: • Involve all agencies and organizations in strategies related to shoreline stabilization • Provide appropriate information on alternative shoreline erosion control approaches • Protect and enhance aquatic biodiversity • Protect and enhance terrestrial biodiversity • Maintain healthy aquatic community integrity • Protect and restore existing native fish populations • Maintain populations of native non-game fishes and aquatic invertebrates at or above present levels throughout the basin • Improve water quality for drinking water, and to protect and restore existing native fish populations	*Bayou Chicot has large stretches of hardened shorelines protecting a variety of businesses and other structures. Wherever possible, engage with landowners to replace hardened structures with more ecologically acceptable methods. Provide education and information to decision-makers, regulators, contractors, and landowners on newer, more ecologically sound methods of protecting waterfront property.*
ALTERED FLOODPLAINS & WETLANDS	
Acquire and protect coastal habitat: • Identify, acquire, and protect significant acreage of high-priority coastal wetlands through fee simple, easements, or protective agreements	*In Bayou Chicot's lower basin, areas of substantially unaltered marsh still exist. Using acquisition, conservation easements or other legal protections, preserve existing natural areas.* *Of special significance in Bayou Chicot are heavily sedimented areas in the lower basin, where shifting bottoms degrade habitat and block boat passage. Work with waterfront landowners to institute best management practices for reducing erosion and unwanted sediment accumulation.*
POLICY	
Work with cities to support, revise, and enforce city-wide tree protection ordinances	
OUTREACH, EDUCATION, & STAKEHOLDER ENGAGEMENT	
Increase public awareness and interest in the values and functions of coastal wetlands, their habitats, and the ecosystem on which they are dependent: • Develop and deliver education materials and programs to inform the public about wetlands species, their habitat, and values to humans	*While many residents already recognize the value of Bayou Chicot's scenic and recreational opportunities, many others may think of the stream as a drainage canal, without realizing that it is in fact a natural stream. Look for ways to link residents and local landowners to the stream, its important natural functions, and its wildlife. Formalize these efforts with Adopt-a-Stream groups, neighborhood cleanups, and other citizen science and enhancement efforts. See that local governments are involved.*

OTHER OBJECTIVE	NOTES
FUNDING	
Dedicate funding to support long-term restoration: • Find private funding sources • Investigate funding opportunities • Identify and create alternative funding strategies for capital projects and long-term sustainability of greenway infrastructure	*Funding for stream restoration in Bayou Chicot should have a long-term component that will maintain restoration efforts into the future, as well as a monitoring function to evaluate the long-term success of restoration efforts. Look into all possible sources for funds to maintain these efforts.*
Seek funding to expand CSHI coverage to other streams in Mississippi's coastal counties	*The City of Pascagoula has numerous other streams, including Bayou Cassette and Yazoo Bayou, that are prime candidates for restoration. Use Bayou Chicot as a demonstration of successful restoration techniques.*

10.6 Next Steps for Implementation

10.6.1 Site-specific Follow-up

Attendees at the two public meetings for Bayou Chicot identified seven sites of concern along the stream. Specific issues mentioned included litter, invasive plants, shoreline hardening, boat passage issues, and siltation. TNC staff visited all listed sites on September 30, 2015, and October 1, 2015. At the same time, TNC staff visited 13 road and rail crossings to check for fish passage issues.

10.6.2 Development of Project Design

A component of the CSHI was to take the information developed from the conservation planning process and draft conceptual designs of potential projects. These conceptual projects were designed to support future restoration efforts by identifying and describing areas of stream impairments, providing baseline data needed for more advanced planning, and, where possible, drafting a suite of possible options to improve those impairments. The number of projects considered and ultimately initiated was dependent on the amount of funding available. Efforts were made to achieve equivalency among the nine coastal streams in this project, and advance projects that would have the greatest conservation impact in future restoration efforts. For Bayou Chicot, the following projects were recommended for conceptual design development to be completed by the end of September 2016.

Stream Assessments

As previously mentioned in the Viability Assessment section, very little baseline data on stream conditions were present prior to the start of this project. The initial snapshot created by the RSAs provided a needed general overview of each stream's condition. This assessment was not designed or intended to provide the site-specific level of detail needed for conceptual projects. The stream assessments conceptual project will identify, describe, map, and rank areas of impairments on the six mid-sized project streams. Data collected on existing in-stream conditions would identify future potential restoration opportunities. A limited number of "planning areas" will be identified, with recommendations and costs for potential

improvements. The six streams included in this project include Watts Bayou, Magnolia Bayou, Coffee Creek, Oyster Bayou, Rhodes Bayou, and Bayou Chicot.

Evaluation of Land Protection Opportunities

While all streams in this project are located within urban areas, there is a limited amount of natural habitat that can be protected through standard land protection strategies. TNC would evaluate and rank areas of natural habitat as potential land protection areas. Part of this evaluation could include land appraisals of parcels when a willing landowner is identified. As mentioned in the Conservation Strategies section of this CAP, a second part of this evaluation would be to identify a potential land manager for any lands protected.

GLOSSARY

Condition	A measure of the biological composition, structure, and biotic interactions that characterize the occurrence of a target; a class of Key Ecological Attribute
Contribution	The source of stress, used in ranking a threat
Direct threat	See threat
Indicator	Measures related to a specific informational need (e.g., the status of a Key Ecological Attribute, change in a threat or progress toward an objective)
Key Ecological Attribute (KEA)	Aspects of a target's biology or ecology that, if missing or altered, would lead to the loss of that target over time; defines the target's viability or integrity
Landscape context	An assessment of a target's environment including ecological processes and regimes which maintain the target's occurrence (e.g., flooding, fire regimes, and many other kinds of natural disturbances) and connectivity (e.g., species targets having access to habitats or the ability to respond to environmental change through dispersal or migration); a class of Key Ecological Attribute
Objective	Specific and measurable statements of what one hopes to achieve with a project
Project scope	The stream and associated riparian and floodplain areas of each stream basin, which encompass the range of connected environments used by aquatic species and communities and the threats affecting those ecosystems
Project vision	A general summary of the desired state or ultimate condition of the project area that a project is working to achieve
Rapid Stream Assessment (RSA)	A 16-point quality evaluation system used to measure the current ecological status of a stream; produces a numeric score between 1 and 10 as a snapshot of a stream's current condition
Scope (stress)	For ranking a stress, most commonly defined spatially as the geographic scope of impact on a target that can be reasonably expected within 10 years
Size	A measure of the area of a target; a class of Key Ecological Attribute
S.M.A.R.T.	Specific, measurable, achievable, relevant, and time-limited; related to objectives
Stress	An impaired aspect of a target that is directly or indirectly related to human activities (e.g., low population size, reduced extent of forest system, reduced streamflow, increased sedimentation, lowered groundwater table)

Target	A group of species, ecological communities, or ecological systems chosen to represent and encompass the biodiversity found in a project area; with the Coastal Streams and Habitat Initiative, each stream is a target
The Corps Network	A youth training and service organization that provides education and experience in conservation. The Corps Network assisted The Nature Conservancy with Rapid Stream Assessments)
Threat	The activities that have caused, are currently causing, or may cause in the future, a stress that leads to the degradation, destruction, or impairment of a target.
Viability	The status or health of a conservation target, indicating the ability of the target to withstand or recover from natural or anthropomorphic disturbances and persist over time
Viability assessment	A method for measuring a target's health over time, including its status and what a "Healthy State" should be

SPECIES NAMES

The following list includes the scientific names for all species mentioned in this document:

COMMON NAME	*SCIENTIFIC NAME*	COMMON NAME	*SCIENTIFIC NAME*
American eel	*Anguilla rostrata*	Gulf sturgeon	*Acipenser oxyrinchus desotoi*
Atlantic croaker	*Micropogonias undulatus*	Hogchoker	*Trinectes maculatus*
Atlantic threadfin	*Polydactylus octonemus*	Inland silversides	*Menidia beryllina*
Bamboo	*Phyllostachys aurea*	Japanese climbing fern	*Lygodium japonicum*
Bass	*Mircropterus salmoides*	Kudzu	*Pueraria lobata*
Bay anchovy	*Anchoa mitchilli*	Ladyfish	*Elops saurus*
Bluegill	*Lepomis macrochirus*	Largemouth bass	*Micropterus salmoides*
Camphor tree	*Cinnamonum camphora*	Mississippi diamondback terrapin	*Malaclemys terrapin pileata*
Chinese privet	*Ligustrum sinense*	Mullet	*Mugil cephalus*
Chinese tallow trees	*Triadica sebifera*	Nile tilapia	*Oreochromis niloticus*
Cogongrass	*Imperata cylindrica*	Nutria	*Myocastor coypus*
Common reed	*Phragmites australis*	Pickerel	*Esox niger*
Crappie	*Pomoxis annularus*	Red drum	*Sciaenops oscellatus*
Darter goby	*Gobionellus boleosoma*	Redear sunfish	*Lepomis microlophus*
Domestic/feral cats	*Felis catus*	Sailfin molly	*Poecilia latipinna*
Elephant ear	*Colocasia esculenta*	Sheepshead minnow	*Cyprinodon variegatus*
Fat sleeper	*Dormitator maculatus*	Spot	*Leiostomus xanthurus*
Freshwater goby	*Gobionellus shufeldti*	Spotfin mojarra	*Eucinostomus argenteus*
Gar	*Lepisosteousoculatus*	Striped mullet	*Mugil cephalus*
Giant salvinia	*Salvinia molesta*	Torpedo grass	*Panicum repens*
Gulf killifish	*Fundulus grandis*	Water hyacinth	*Eichornia crassipes*
Gulf menhaden	*Brevoortia patronus*	Western mosquitofish	*Gambusia affinis*

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Note:
Thirty comprehensive plans relating to the Mississippi Gulf Coast were reviewed during the formulation of the objectives for this CAP. These plans do not appear on this list unless they were used in some other way, and are listed in Appendix D, along with the final list of objectives.

Appendix A
Public Listening Sessions
Final Report

PUBLIC LISTENING SESSIONS FINAL REPORT

THE NATURE CONSERVANCY COASTAL STREAM AND HABITAT INITIATIVE ACTION PLAN

Prepared for

The Nature Conservancy

Prepared by

Anchor QEA, LLC

614 Magnolia Avenue

Ocean Springs, Mississippi 39564

December 2015

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Appendix E Presentation for Reporting Sessions

1 EXECUTIVE SUMMARY

As part of the Coastal Stream and Habitat Restoration and Initiative, The Nature Conservancy (TNC), in partnership with the National Audubon Society and Mississippi Department of Environmental Quality, held public meetings in the spring and summer of 2015 to solicit stakeholder input on watershed conservation planning efforts in nine coastal watersheds in Mississippi. The project was funded through the Gulf Environmental Benefit Fund. Based on TNC's Conservation Action Planning process, short forms were developed and distributed during public listening sessions in order to obtain written responses of scopes (or resources), threats, and potential solutions within each watershed. During the public listening sessions, input was also obtained through use of stakeholder-placed dots on watershed maps, which provided a visual method for understanding scopes, threats, and solutions.

As expected, identified scopes and threats varied by watershed. However, in general, participants in the public listening sessions identified land and water management and land and water protection activities as preferred solutions to mediate and mitigate threats for protection and restoration of their watershed. Additionally, the public listening sessions identified interested stakeholders who may participate in future planning efforts and could provide a base of volunteers to assist with outreach, education, and restoration activities within each watershed.

As a follow up to the public listening sessions, an informational meeting was held in each of the three coastal counties to report findings to participants. Findings for scope and threats were provided for each of the nine watersheds as well as lumped into coast-wide conclusions.

2 INTRODUCTION

The Nature Conservancy's (TNC's) Coastal Stream and Habitat Initiative is a collaborative effort to restore and protect nine urban coastal streams in South Mississippi. TNC is collaborating with the Audubon Society, specifically the Pascagoula River Audubon Center, and Mississippi Department of Environmental Quality Basin Management Teams to engage local communities and resource professionals to develop strategies and design restoration plans that will help alleviate threats and restore coastal habitats affected by the Deepwater Horizon oil spill.

This community-based conservation planning process will also bring recognition of the importance of these urban stream habitats as critical components of a healthy Mississippi coastal economy and environment to the local governments and citizens. Personal connections from the community planning process will help build a collaborative team focused on community stewardship, conservation outreach, and education opportunities within these watersheds.

To design a conservation strategy for the restoration and long-term stewardship of stream habitats of the nine urbanized watersheds, the following four primary objectives have been identified:

- Involve stakeholders in the Conservation Action Planning (CAP) process
- Develop restoration designs associated with CAP strategies
- Establish community monitoring and stewardship of coastal urban streams and conduct education and outreach activities
- Collect baseline water quality and ecological data on these coastal habitats

This report summarizes the findings of the public listening sessions that were conducted as part of stakeholder involvement in the CAP process.

3 PROJECT DESCRIPTION

Nine urbanized watersheds in three coastal counties were selected for this initial effort of watershed conservation planning as these tidal creeks, bayous, and spring-fed streams retain environmental and historic value and are highly altered systems in urban areas. In addition, outreach efforts within these specific watersheds provide an opportunity to engage existing, active stakeholder groups. These coastal watersheds and associated waterways are generally accessible, allowing for easier access for volunteers to monitor, and are highly visible, making them valuable to the State as demonstration projects. The selected watersheds are as follows (Figure 1):

- Hancock County
  - Magnolia Bayou
  - Watts Bayou
- Harrison County
  - Turkey Creek
  - Bear Point Bayou
  - Brickyard Bayou
  - Coffee Creek
  - Oyster Bayou
- Jackson County
  - Bayou Chicot
  - Rhodes Bayou



Figure 1

Map of Watersheds

Source: Figure provided by The Nature Conservancy

3.2 Conservation Action Planning Process

In the past, TNC has successfully implemented a two-part approach for conservation planning, which includes facilitated discussions with resource professionals and separate public listening sessions that inform the CAP process to identify conservation priorities, threats, and restoration and abatement strategies. TNC developed the CAP process as a method to gather stakeholder input and engage individuals, organizations, and agencies in the process. Stakeholders typically include local citizens and representatives from academic institutions; community organizations; state, local, and federal management agencies; and nongovernmental organizations.

The process is led by a facilitator, with each watershed stakeholder group working together through a series of workshops or meetings, as necessary, to identify conservation targets, analyze target threats, identify objectives and outcomes, develop strategic actions, and define indicators and measures to monitor success. For this project, both professional resource workshops and public listening sessions were held; however, this report does not include the findings or recommendations from the professional resource workshops.

3.3 Public Listening Sessions

The CAP process was modified for the public listening sessions from an all-day workshop-series format to a 3-hour meeting format in order to solicit information from written responses and verbal comments from the general public. Public listening sessions were held after 5 p.m. in the evenings or on Saturdays to accommodate participants' work schedules. Typically, these sessions are held prior to the professional resource all-day workshops to inform the professional stakeholders of community concerns; however, for this project, the workshops and public listening sessions were held during the same time period (spring and summer 2015).

For these nine watersheds, TNC and facilitators worked together to create short forms to collect information as 1) a reference for scope or places that are important within the watershed, 2) perceived and real environmental, habitat, historical, or cultural threats, and 3) strategies or solutions to the threats (short forms are provided in Appendix A). These three components follow TNC's CAP approach to provide a robust picture of the issues that need

to be addressed in a watershed conservation plan. Participants were solicited by a direct mail postcard, a public service announcement broadcast via radio, and personal invitations (summary of approaches are listed in Appendix B). Email reminders were also sent to key stakeholders.

3.4 Reporting Sessions

As a follow up to the public listening sessions, participants were invited to a reporting session for each county. In Hancock, Harrison, and Jackson counties, information was shared about each watershed and for the coast as part of a larger watershed. Participants were provided information about important resources, common themes related to scope and threats, and action items in process, including watershed training and monitoring, and strategy development for each watershed.

4 SYNOPSIS OF PUBLIC LISTENING SESSIONS

Public listening sessions were held throughout the nine coastal watersheds (Appendix C) during the spring and summer of 2015. Each watershed group identified scope issues important within their watersheds along with perceived and identified threats (Figure 2). Additionally, participants offered solutions for key issues within each watershed.

Within all nine watersheds, stakeholders identified development, natural systems modification, invasive species, and pollution as the most significant threats or problems for their local watersheds. On the threats ranking handout, development was identified as residential and commercial and included residential housing, commercial areas, industrial areas, suburban and urban areas, household sewage, septic tanks, and stormwater runoff. Natural systems modification referred to actions that convert or degrade habitat in service of "managing" natural or semi-natural systems. Invasive species referred to non-native and native plants, animals, pathogens, or microbes. Pollution was defined as garbage, debris, trash, or airborne pollutants.

Participants in the public listening sessions selected land and water management and land and water protection as the preferred solutions for mediating threats (Figure 3). Land and water management was defined as restoring the quality and function of land and water habitats. Land and water protection was defined as protection of key lands through acquisition, conservation, easements, scenic river designation, private reserves, or community and town nature reserves. Education and awareness—identified as improving understanding, skills, and influencing behavior—were also considered important to participants.

Individual watershed identified scopes, threats, and solutions are summarized below.

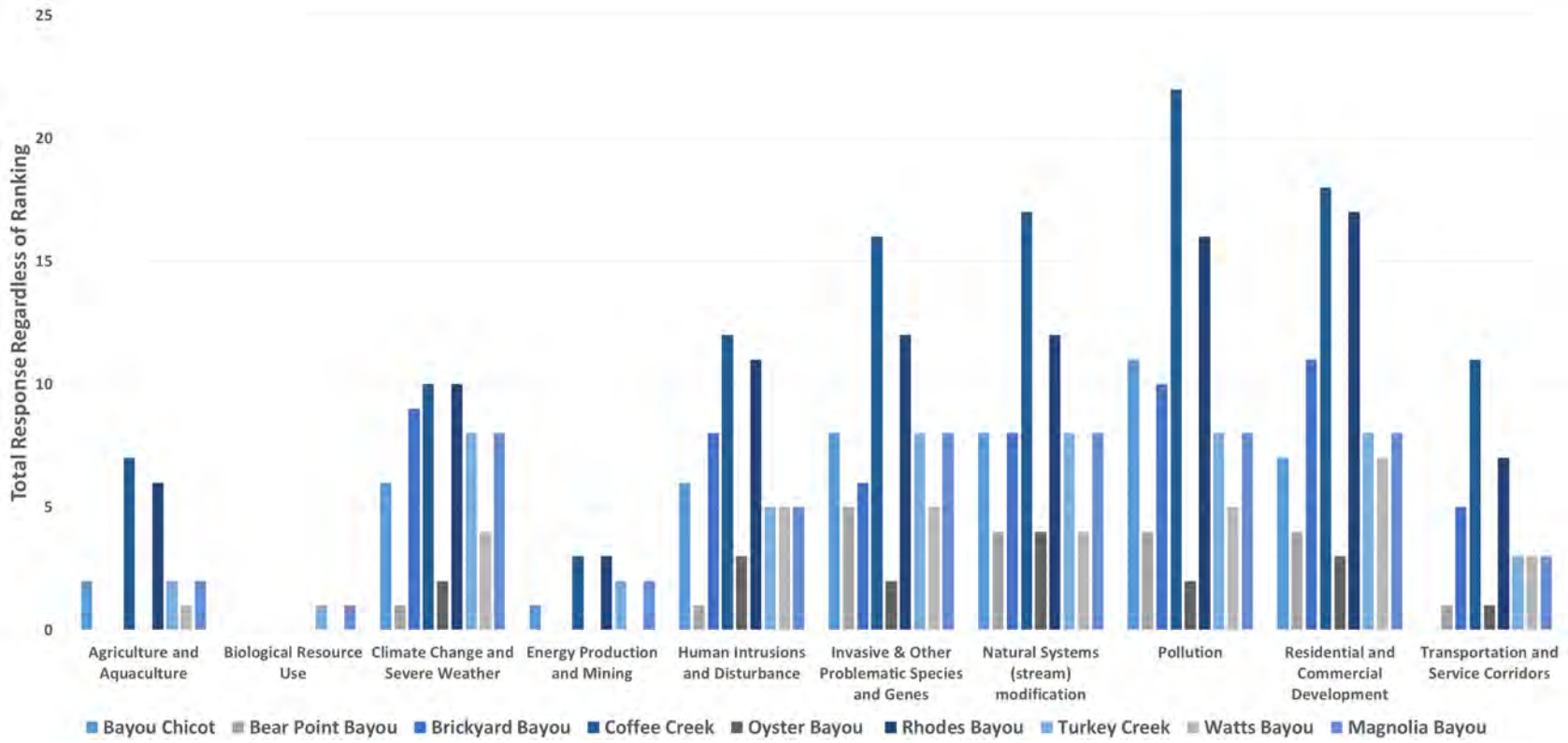


Figure 2

Identified Threats – Responses by Watershed

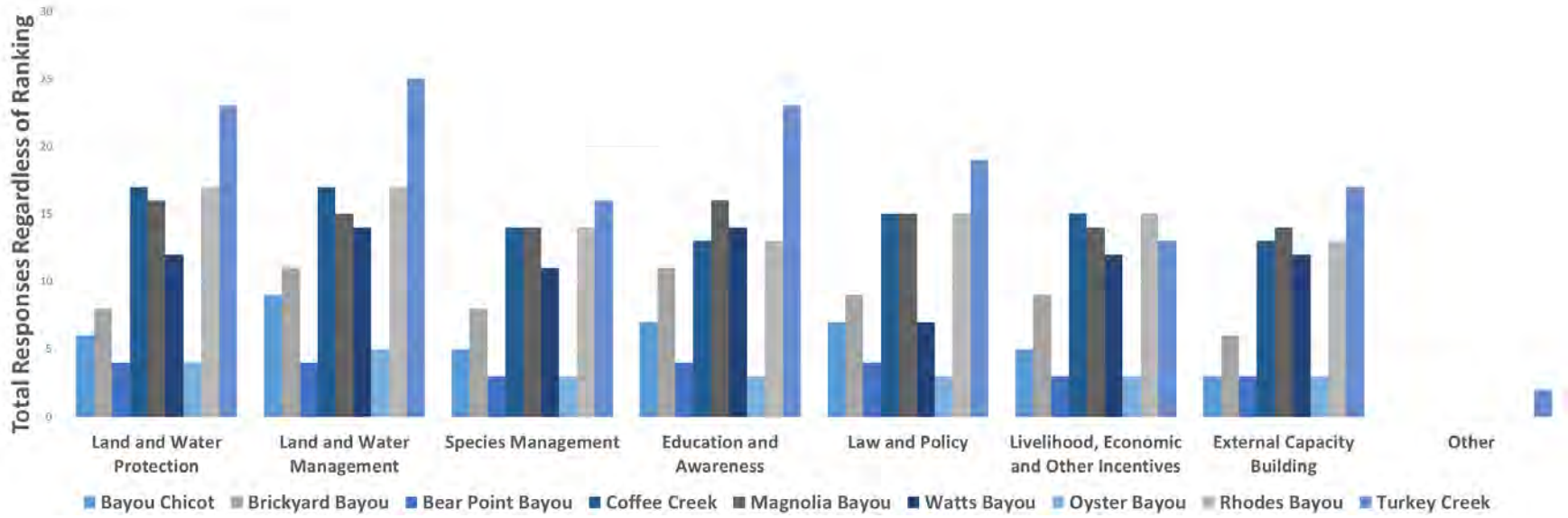


Figure 3

Solutions by Watershed

4.1.1 Magnolia Bayou

4.1.1.1 Scope

In the Magnolia Bayou watershed, stakeholders were interested in protecting cultural, historical, and natural areas. Clean water for the Gulf of Mexico (Gulf) ranked as the most important benefit of streams, with scenic value, habitat, and wildlife viewing also ranking as important.

4.1.1.2 Threats

Natural systems modification, invasive species, and pollution were all listed as the biggest threats to the Magnolia Bayou watershed (Figure 4). Residential and commercial development was also listed as a top-ranked potential threat. Comments related to perceived threats focused on water quality particularly related to stormwater. Lack of access to natural areas was also listed as a perceived problem.

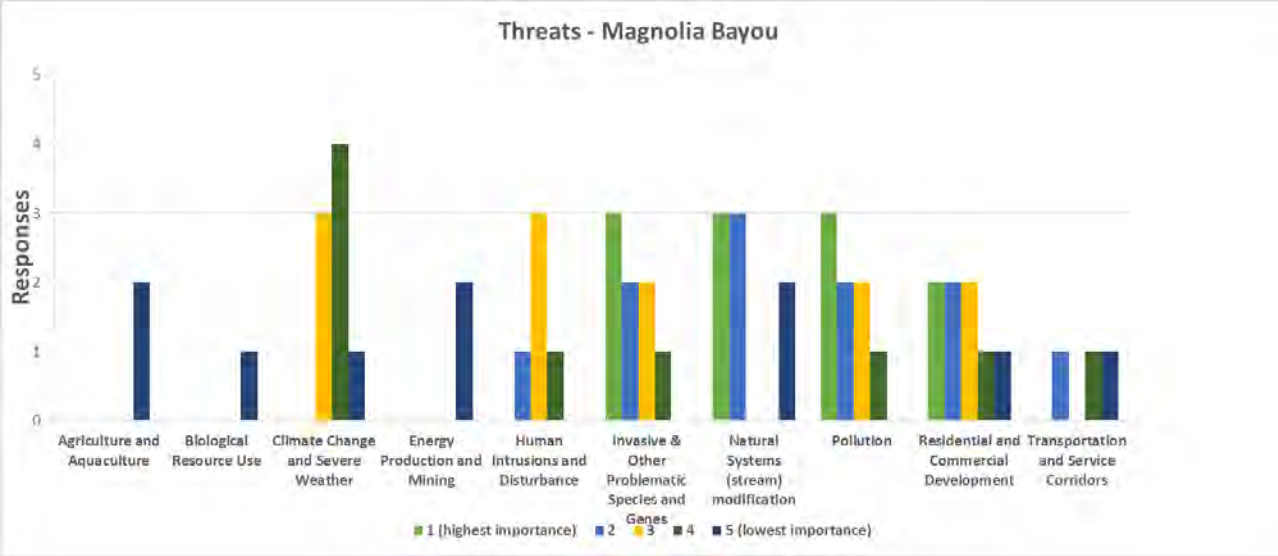


Figure 4
Threats – Magnolia Bayou

4.1.1.4 Solutions

Land and water protection and education and awareness ranked highest as potential solutions to problems within the Magnolia Bayou watershed (Figure 5). Land and water management also was ranked high as a solution. Significant comments included the idea that public education is key to good stewardship. Acquisition of key natural areas and more public access for low-impact recreation were also mentioned.

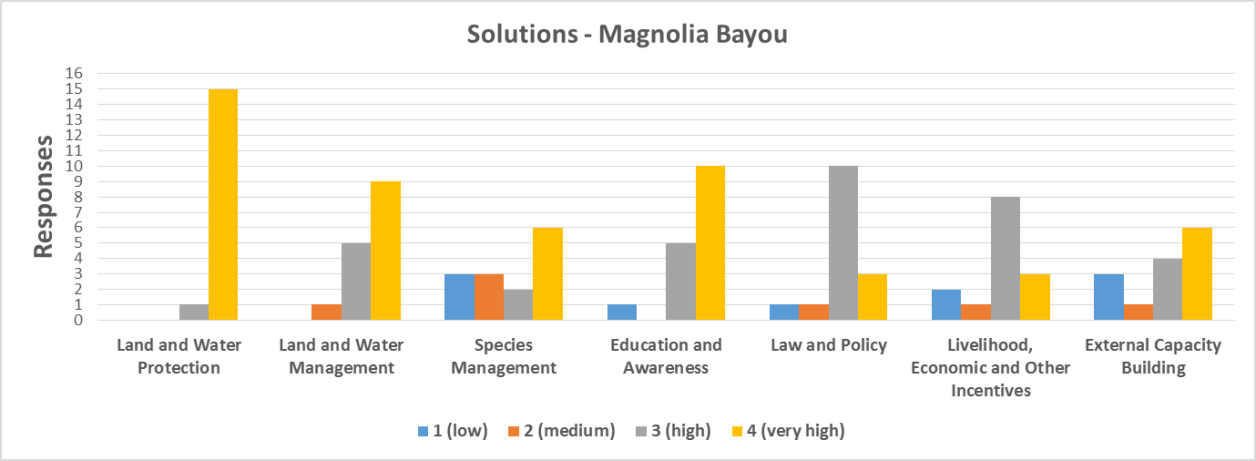


Figure 5
Solutions – Magnolia Bayou



Photograph 1
Image from Magnolia Bayou Public Listening Session

4.1.3 Watts Bayou

4.1.3.1 Scope

Natural areas in the upper portion of Watts Bayou are important, "special" places according to the participants in the Watts Bayou public listening sessions. The participants valued wildlife habitat and viewing as top benefits of streams. Clean water and scenic value also ranked as important stream benefits.

4.1.3.2 Threats

For the Watts Bayou watershed, participants responded that residential and commercial development was the biggest threat (Figure 6). Other issues of concern were invasive species, pollution, and human disturbance. Comments related to threats or problems in the watershed included concern for stormwater and wastewater in the bayou. Impacts of dredging in the lower bayou and impoundments in the upper watershed were also identified as potential problems.

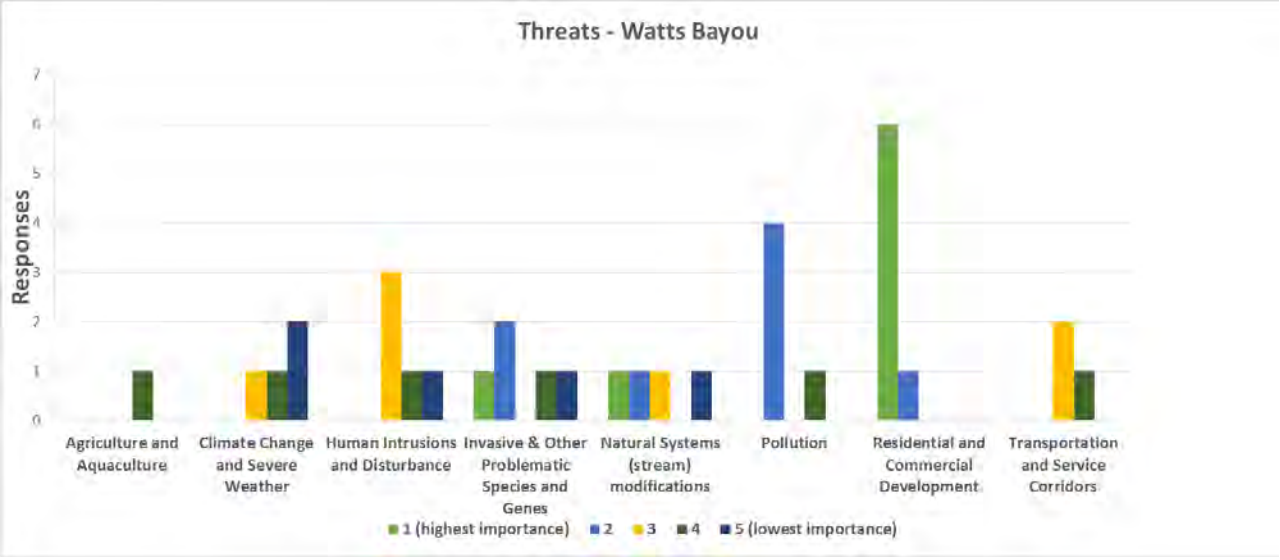


Figure 6
Threats – Watts Bayou

4.1.3.3 Solutions

Participants identified land and water management and education and awareness as the top solutions for abatement of threats within the watershed (Figure 7). Land acquisition and maintaining natural shorelines (instead of hardened shorelines) were also mentioned as potential solutions.

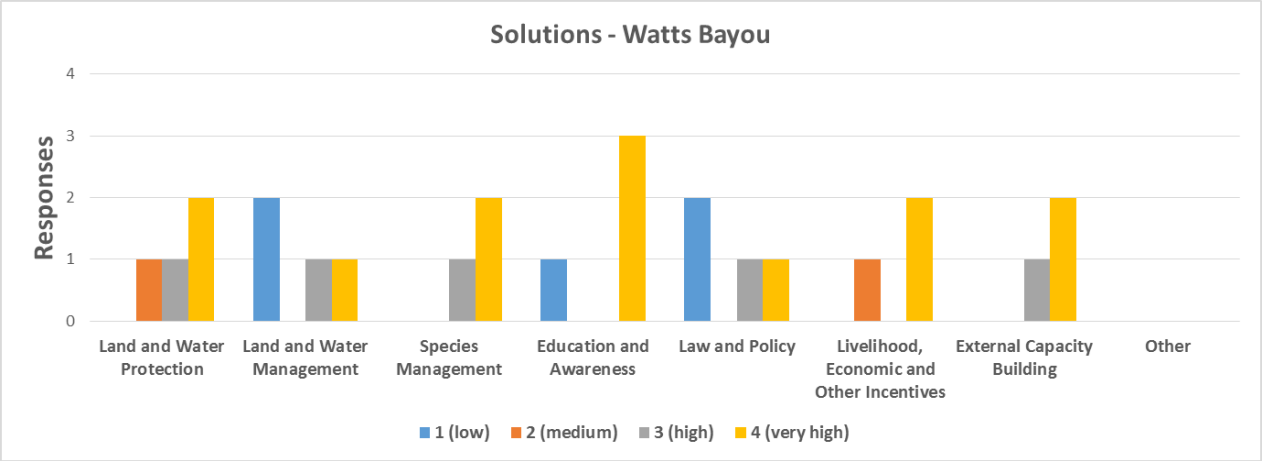


Figure 7
Solutions – Watts Bayou



Photograph 2
Image from Watts Bayou Public Listening Session

4.1.4 Turkey Creek

4.1.4.1 Scope

The participants in the Turkey Creek public listening sessions were generally interested in protecting the natural, cultural, and historical areas of the Turkey Creek watershed. The areas of particular concern are the Forest Heights community, Rippy Road, and Mt. Pleasant United Methodist Church and the natural areas occurring all along the creek.

In regards to the benefits of the stream, most respondents answered that fishing and wildlife habitat were equally important. Clean water, historic resources, recreation, and scenic value were also important benefits of streams.

4.1.4.2 Threats

Respondents concerned with threats to the Turkey Creek watershed noted natural systems modification, invasive species, pollution, and development as potential problems (Figure 8). Other issues of concern include stormwater runoff and flooding within the watershed.

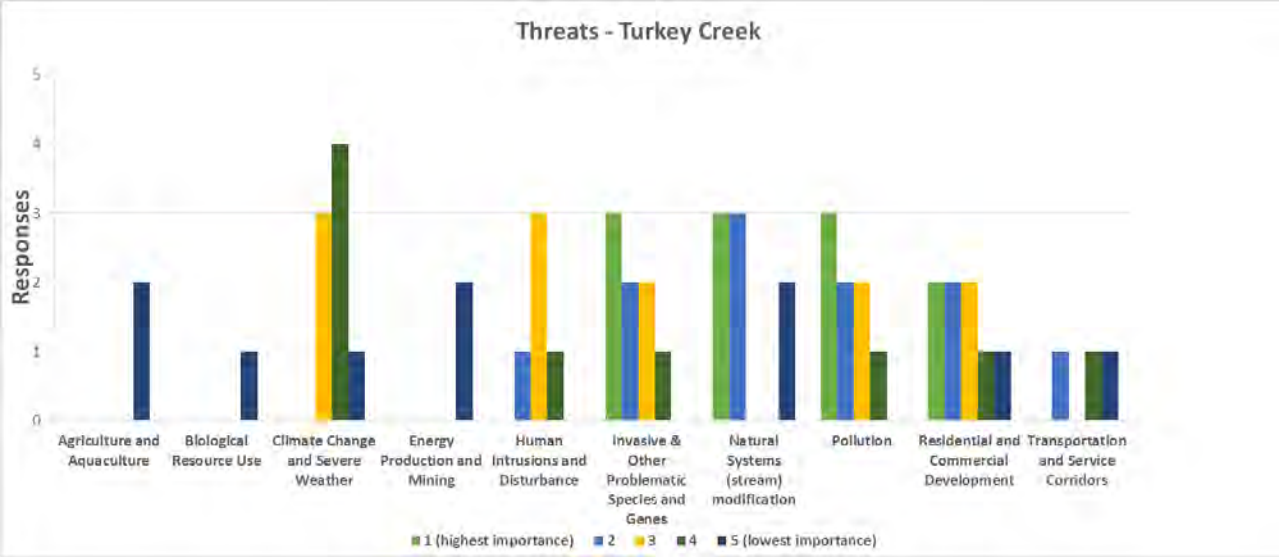


Figure 8
Threats – Turkey Creek

4.1.4.3 Solutions

Land and water management ranked the highest for potential solutions to perceived threats to the Turkey Creek watershed (Figure 9). Additionally, protection measures and education and awareness were deemed important strategies.

Many of the comments related to solutions for perceived threats to the Turkey Creek watershed were a caution to protect the resource. According to several participants, past solutions for Turkey Creek problems involved poorly designed drainage projects and a clearing of the creek bank that denuded the creek banks of all trees and increased erosion. Participants requested that any solution involve consideration for the natural system.

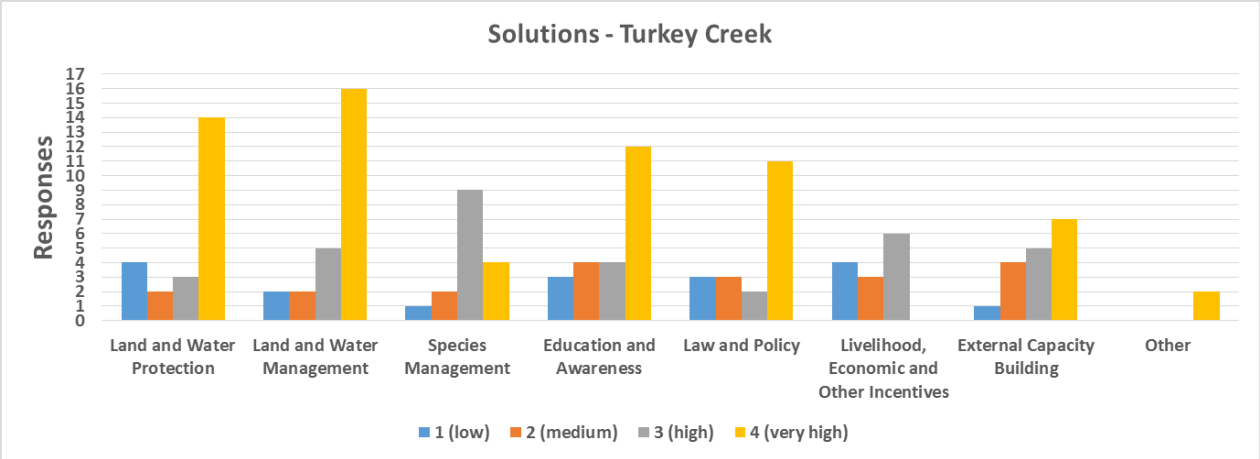


Figure 9
Solutions – Turkey Creek

4.1.5 Bear Point Bayou

4.1.5.1 Scope

In the Bear Point Bayou watershed, habitat ranked as the highest regarding benefits of streams. Clean water for the Gulf and scenic value also ranked as important to stakeholder participants.

4.1.5.2 Threats

Invasive species are perceived as the biggest threat to the Bear Point watershed (Figure 10). In addition, residential and commercial development were considered threats or problems to the watershed. Culverts and other engineered structures are a problem for fish passage.

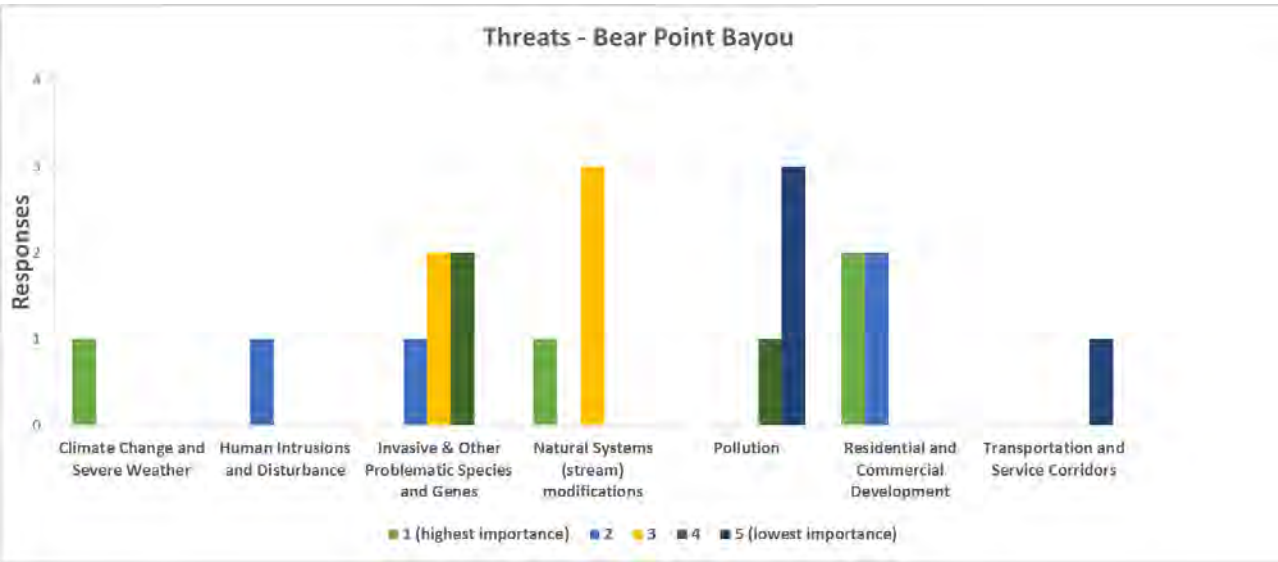


Figure 10
Threats – Bear Point Bayou

4.1.5.3 Solutions

Land and water management and law and policy were listed as the top choices for solutions to threats within the Bear Point Bayou watershed (Figure 11). Specifically, removal of culverts and restoration of the floodplain in certain areas of Bear Point Bayou would provide more scenic views and allow for fish passage. Partnership opportunities with large landowners, including the St. Thomas Church and University of Southern Mississippi (USM), would be an important component of this process.

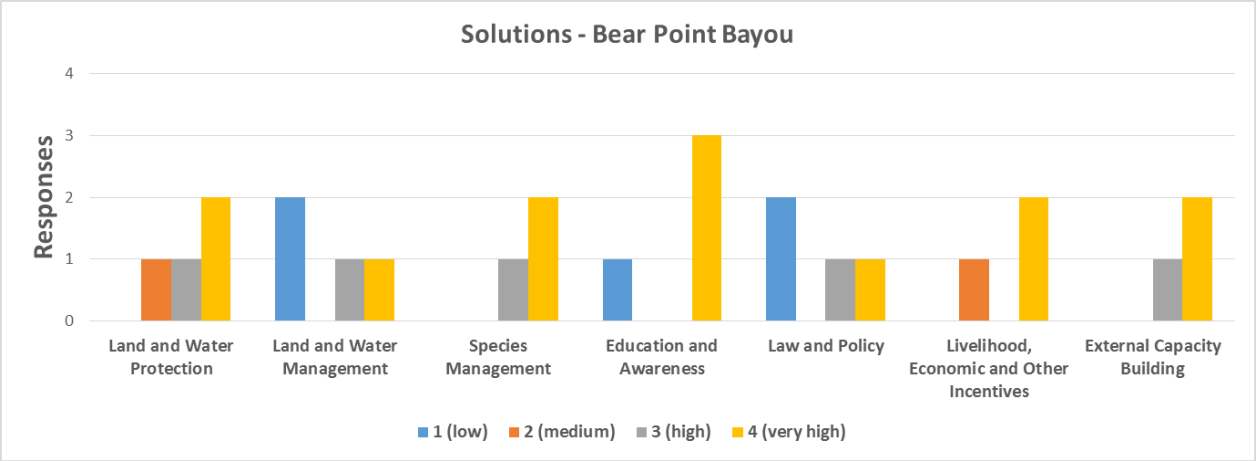


Figure 11
Solutions – Bear Point Bayou

4.1.6 Brickyard Bayou

4.1.6.1 Scope

Within the Brickyard Bayou watershed, areas of cultural significance and habitat were listed as "special" by stakeholder participants. Stormwater drainage was named the most significant benefit of streams, and scenic value was another important benefit. Habitat and clean water were also listed.

4.1.6.2 Threats

Residential and commercial development and pollution were regarded as the most significant threats to the Brickyard Bayou watershed (Figure 12). Trash, including litter and dumping, was listed several times as threats within comments. Flooding and erosion (bank caving) were also listed as perceived threats within the watershed.

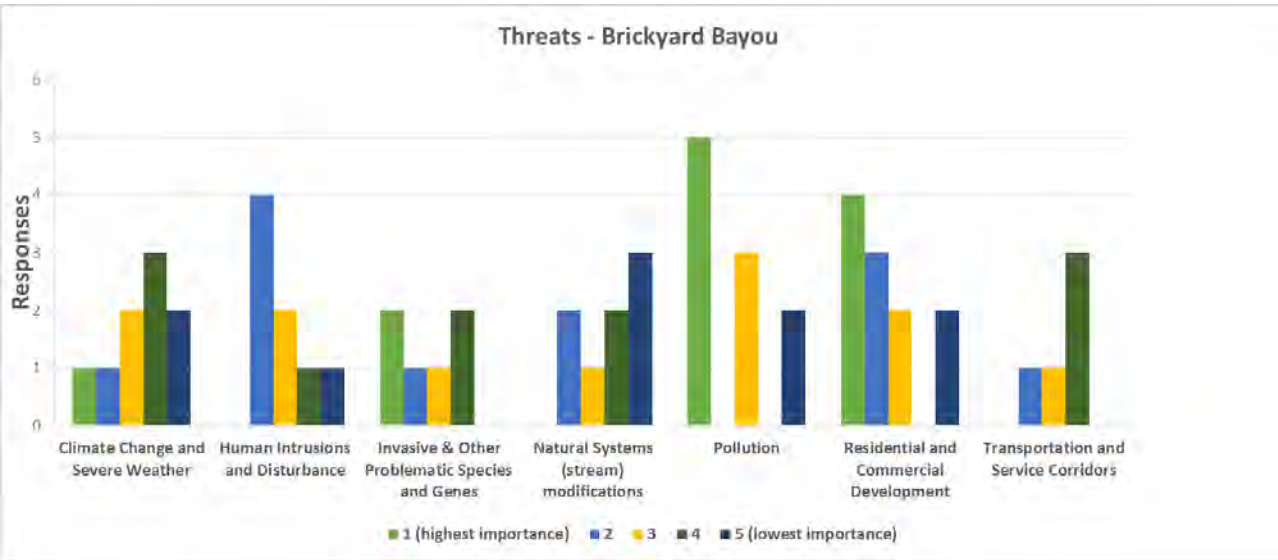


Figure 12
Threats – Brickyard Bayou

4.1.6.3 Solutions

Education and awareness and land and water management ranked the highest as solutions for threats within the Brickyard Bayou watershed (Figure 13). Picking up litter and working with government entities to develop better drainage solutions were additional comments.

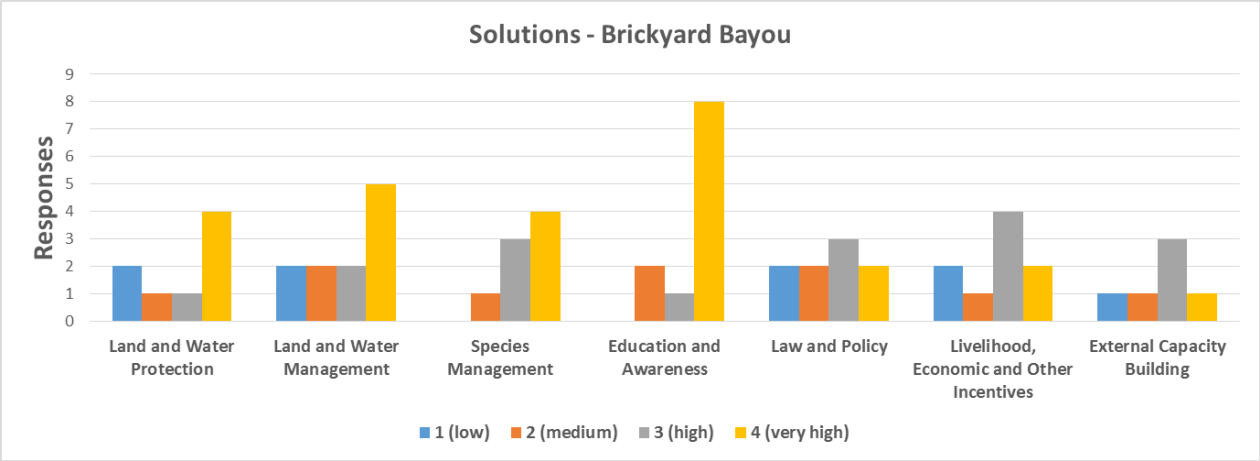


Figure 13
Solutions – Brickyard Bayou

4.1.7 Coffee Creek

4.1.7.1 Scope

In the Coffee Creek watershed, participants valued the Clower Thornton Nature Trail, Centennial Plaza (old Veterans Affairs property), and local community centers as "special" places because they enjoy wildlife watching (primarily birding) and other recreation in these areas. Clean water for the Gulf and watershed were considered the most important benefit of streams.

The second most important benefit of streams was for stormwater drainage. Habitat and wildlife viewing were also listed as important stream benefits within the Coffee Creek watershed.

4.1.7.2 Threats

Pollution was considered the biggest threat to the Coffee Creek watershed; water quality was a significant concern (Figure 14). Residential and commercial development and natural systems modifications were also considered potential problems, particularly related to stormwater and erosion of streambanks. Safety in the watershed was listed as a concern; people camp in the woods, and some of the natural areas are perceived as unsafe.

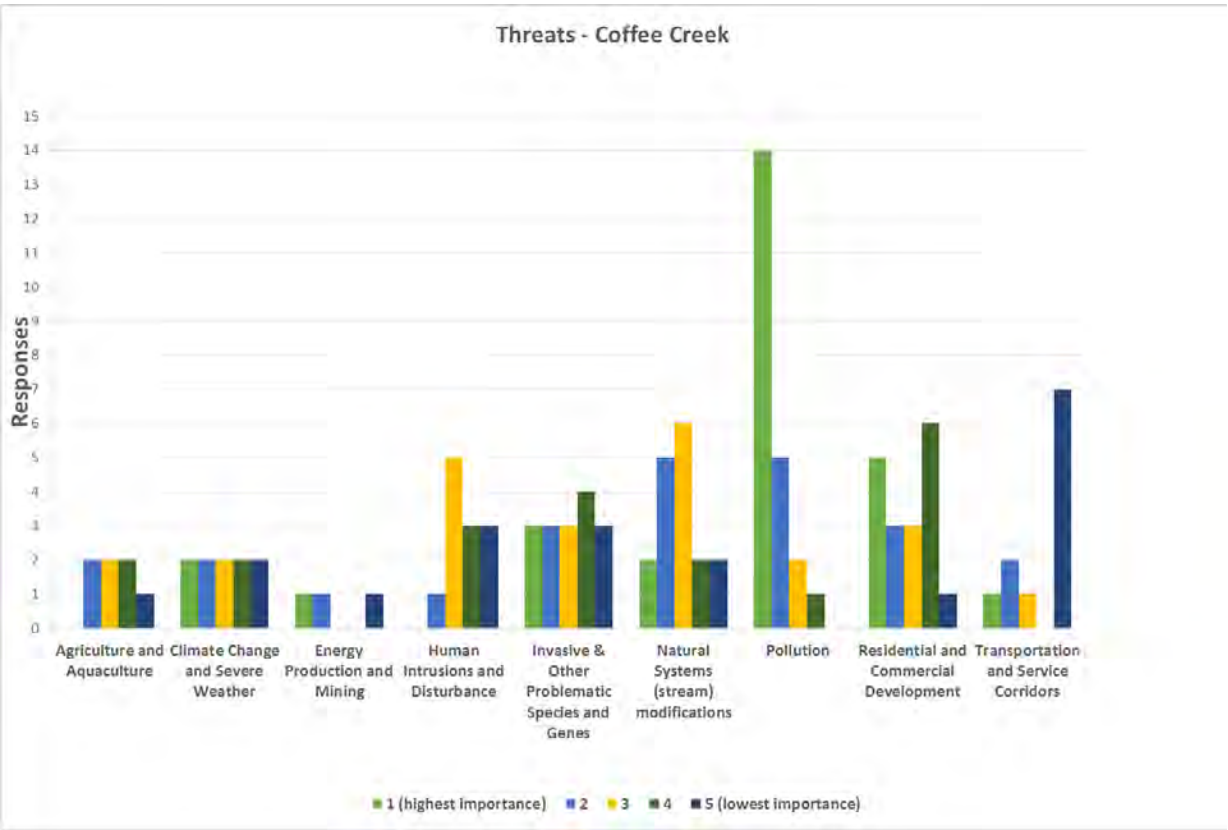


Figure 14
Threats – Coffee Creek

4.1.7.3 Solutions

Land and water management was the top-ranked solution for the Coffee Creek watershed followed by land and water protection (Figure 15). Comments included discussing management of Coffee Creek as a drainageway with the City of Gulfport and better management of Clower Thornton. The City of Gulfport has received a grant to implement a lighted nature trail on Coffee Creek; other safety features will be included.

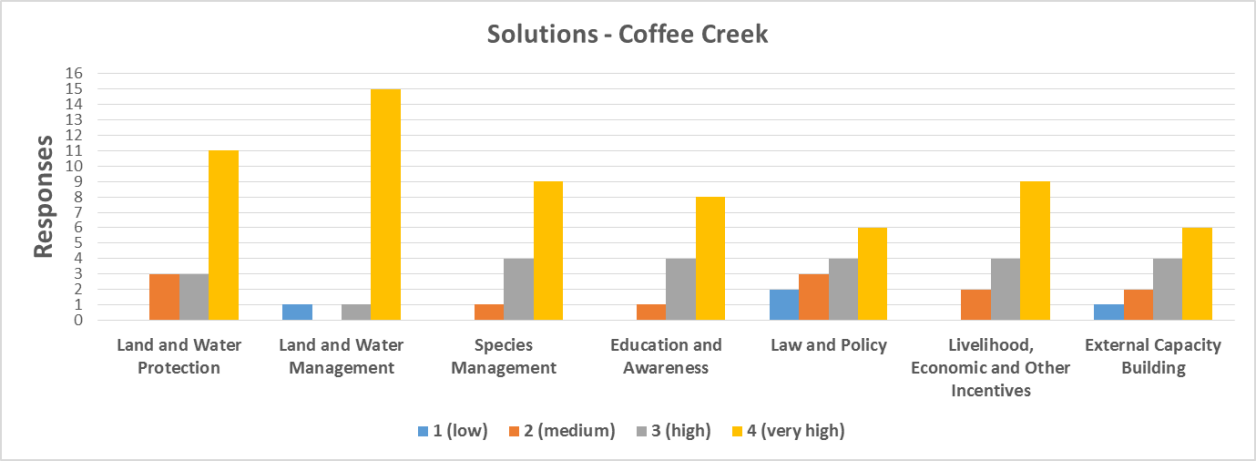


Figure 15
Solutions – Coffee Creek



Photograph 3
Image from Coffee Creek Public Listening Session

Source: Photo courtesy Tom Mohrman, TNC

4.1.8 Oyster Bayou

4.1.8.1 Scope

Participants in the Oyster Bayou watershed meeting stated the Beauvoir and golf course properties (north of Beauvoir) are special places within the watershed. Migrating birds and other wildlife, as well as native plant communities, rated a mention for special plants and animals. As an urban forest, Beauvoir has been an important habitat for migrating birds. The beaches to the south of Beauvoir are also important to migrating least terns. Habitat and Clean Water (for the Gulf) ranked highest in regards to benefit of streams.

4.1.8.2 Threats

Modifications to Natural Systems was the highest ranked potential problem within the Oyster Bayou watershed (Figure 16). Residential and commercial development also ranked high as a perceived problem. Comments related to threats or problems primarily considered flooding on Pass Road and adjacent to the Beauvoir property.

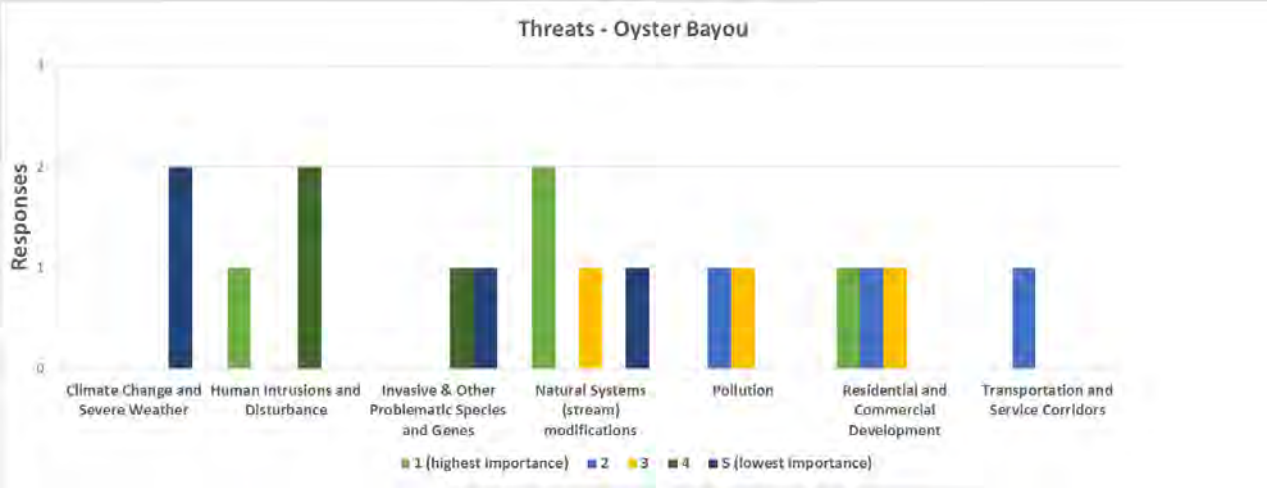


Figure 16
Threats – Oyster Bayou

4.1.8.3 Solutions

Participants suggested land and water management and land and water protection as the primary tools for alleviating threats within the Oyster Bayou watershed (Figure 17). Specifically, acquisition of the golf course property and restoring the floodplain west of Beauvoir were proposed. Other suggestions included help for Beauvoir with land and water management, removing the culverts underneath Beauvoir Road, and replacing with a bridge.

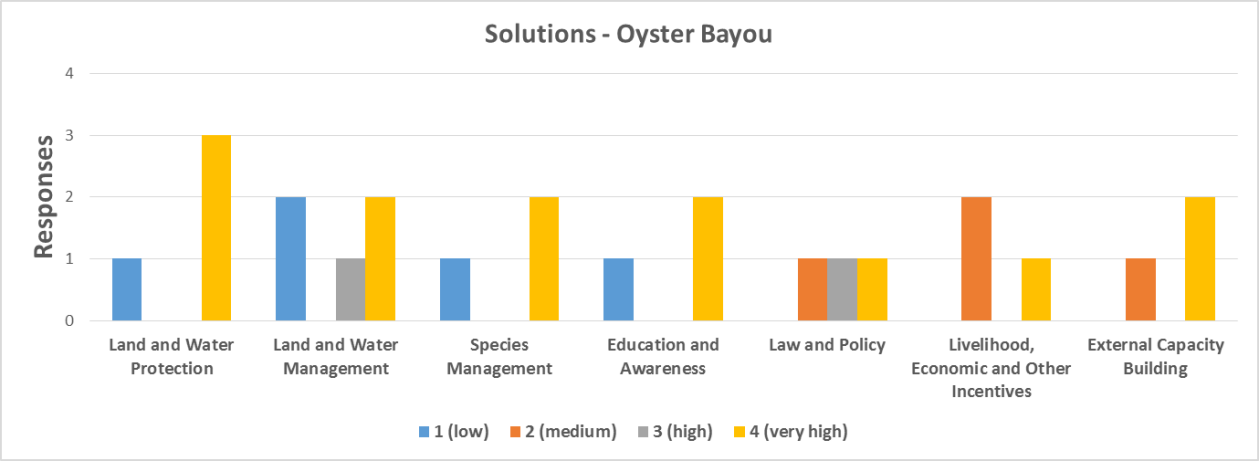


Figure 17
Solutions – Oyster Bayou

4.1.9 Bayou Chicot

4.1.9.1 Scope

The Bayou Chicot watershed is known for its heavy industrial area. Participants in the public listening sessions would like to see special historical areas, such as Greenwood Island, protected. Participants also value natural and recreational areas such as area parks (e.g., I.G. Levy) and beaches.

Habitat for plants and animals ranked as the highest benefit of streams to the watershed. Scenic value and stormwater drainage were also noted as providing benefits.

4.1.9.2 Threats

Participants responded that pollution is the primary threat to the Bayou Chicot watershed (Figure 18). Modifications to the stream or natural systems and invasive species were also ranked highly as potential problems. Other comments received included the issue of culverts restricting flow, trash and litter in the bayou, and silting. The problem with silt and sand is perceived to come from drainage improvements performed by the City of Pascagoula.

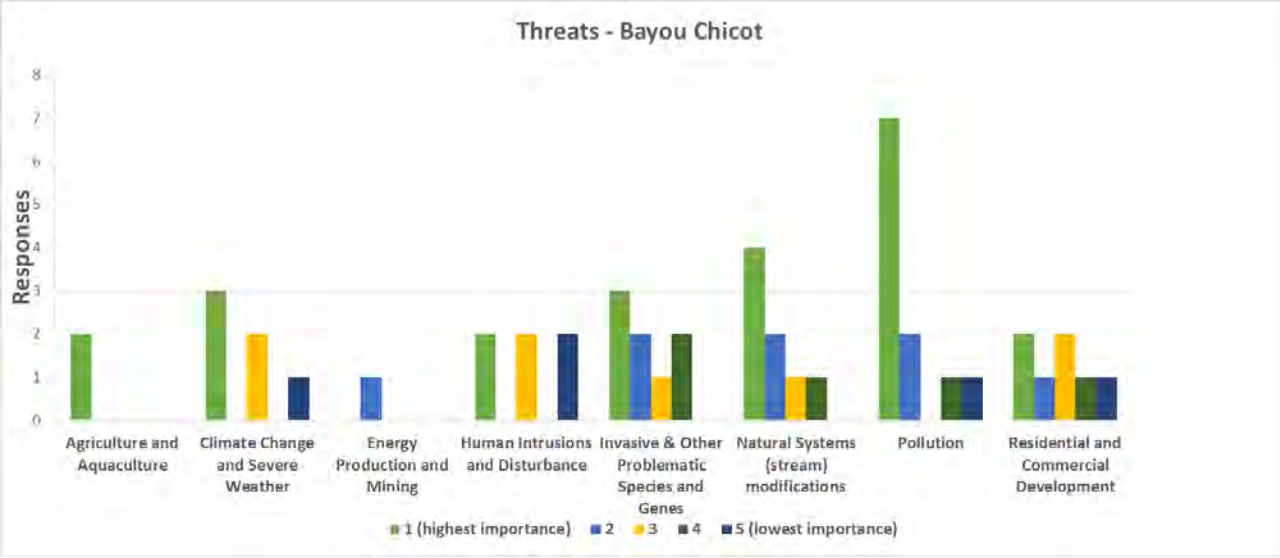


Figure 18
Threats – Bayou Chicot

4.1.9.3 Solutions

Land and water management ranked high for the Bayou Chicot participants (Figure 19). Suggestions include replacing culverts and holding the City of Pascagoula and Harrison County accountable for poor management practices. Education and awareness also ranked high as a solution. Participants suggested forming a group to clean up litter in hard to reach areas and enforcing the law for litter violations.

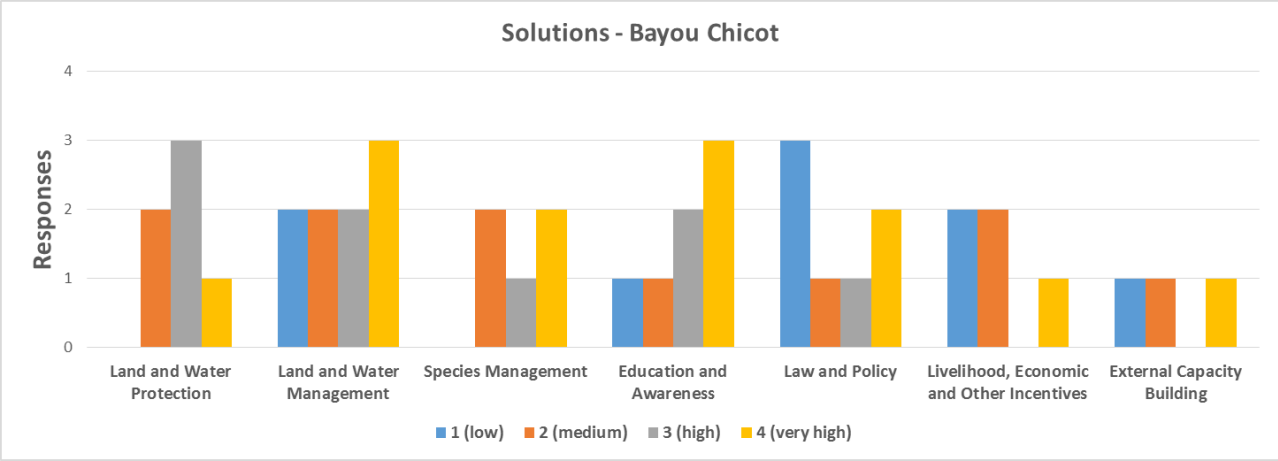


Figure 19
Solutions – Bayou Chicot

4.1.10 Rhodes Bayou

4.1.10.1 Scope

Rhodes Bayou watershed stakeholders are interested in protecting the trolley trestle, sand pit that is now a lake in the southern portion of the watershed, and way of life and culture of the watershed. Marsh, coastal live oaks, and cypress trees were significant plants and habitats listed as important to participants. Wildlife, such as wading birds and osprey, were also noted. Scenic value was ranked as the highest benefit of streams within the Rhodes Bayou watershed. Habitat and fishing were also listed as important benefits of streams.

4.1.10.2 Threats

Pollution was ranked the greatest threat to the Rhodes Bayou watershed (Figure 20). Participants ranked residential and commercial development as a potential problem. Specific comments concerning threats to the watershed included sewage in the bayou and the potential for a leak with the sewage pipe(s) under Bellview Bridge. In addition, boat access is limited in the bayou, primarily due to heavy siltation and low bridges. Trash was considered a problem; participants believed drainage issues (perhaps related to culverts) have increased flooding within the watershed in recent years.

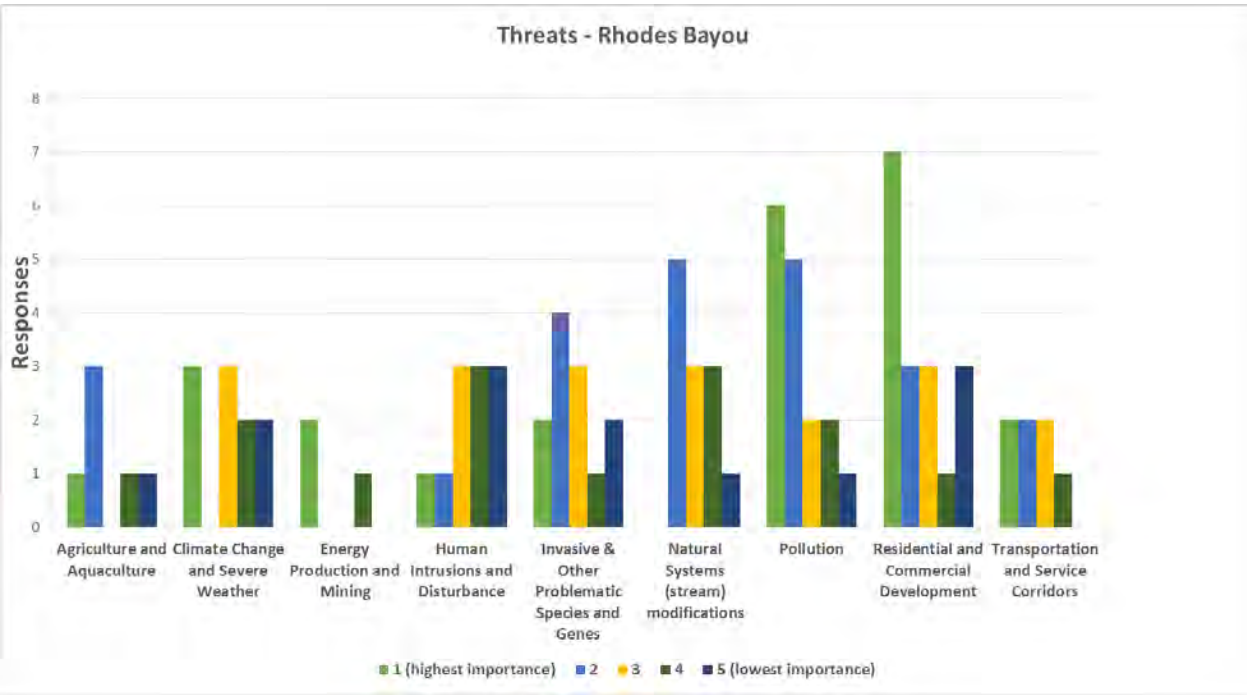


Figure 20
Threats – Rhodes Bayou

4.1.10.3 Solutions

Land and water management was the highest ranked solution for the Rhodes Bayou watershed (Figure 21). The second highest ranked solution was land and water protection. Participants suggested assisting plans for marsh restoration or increasing the amount of restoration. Another potential solution was replacing sewer pipes over water.

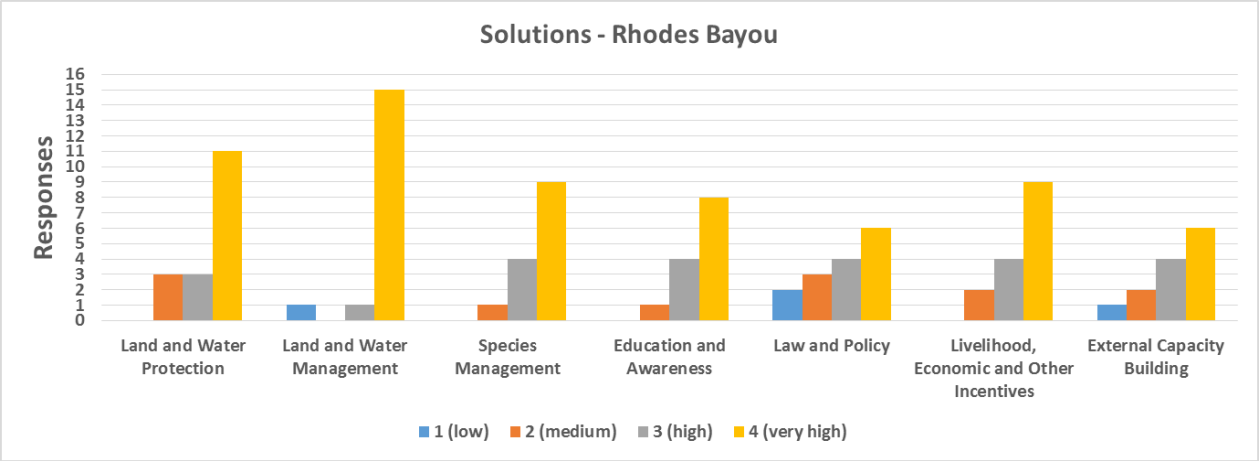


Figure 21
Solutions – Rhodes Bayou

5 SYNOPSIS OF STAKEHOLDER-PLACED DOTS ON WATERSHED MAPS

Throughout the public listening sessions, participants were encouraged to map their personal experience and exposure for the three major topics (i.e., scope, problems or threats, and solutions) by placing an initialed, numbered color dot on their particular watershed map. These color dots (yellow for scope, orange for problems or threats, and green for solutions) were initialed and numbered by the stakeholder. The color dots were recorded and referenced into each watershed report along with the associated comments. These dots and comments are important because they provided an opportunity for dialog among the participants as well as valuable information to TNC for future needs and opportunities.

While the vast majority of the dots were placed to denote problems and threats, there was a reasonable balance of scope and solutions dots as well. In addition to citing specific areas within scope, problems or threats, and solutions, stakeholders also pointed out issues in areas just outside of the watersheds that contributed to the value, injury, or recovery of the watershed. For practical purposes, these types of dots and comments were labeled "outliers." These outliers offer input that TNC can further pursue for overall restoration and action planning.

5.1 Areas of Greatest Consensus of Information Depicted by Stakeholder Dots

5.1.1 Scope

Green Space – Stakeholders identified and valued parcels of green space within their watersheds. They were consistent in their concern for limiting development of green space for ecological reasons, wildlife, human dimensions, native vegetation, and general habitat.

Significant Historical Places – Stakeholders in each watershed shared the unique history and the "threads" of historical fiber (buildings, churches, statuary, parks, and neighborhoods) they believed are critically important to conserve for future generations. These threads are included in Table 1.

Table 1
Historic Places and Watersheds

Historic Place	Watershed
Divine World	Magnolia Bayou
Beauvoir	Oyster Bayou
Greenwood Island	Bayou Chicot
Forest Heights Community	Turkey Creek
Mt. Pleasant United Methodist Church	Turkey Creek
USM Campus	Bear Point
Bellview Street Bridge	Rhodes Bayou
Brickyard on Mill Road	Brickyard Bayou
Clower Thornton Nature Park	Coffee Creek
Sand Pits	Rhodes Bayou
Cemetery on Hancock Avenue	Coffee Creek

Habitat and wildlife – Stakeholders in each watershed recorded their concern for local habit and wildlife. In most cases, this referred to wetlands and streams that needed ongoing protection from development and pollution and wildlife conservation to ensure birding areas were not disturbed or destroyed. Very specific bird nesting areas were designated by dots, and bird species were also identified.

Water – Stakeholders valued water. They consistently supported maintaining "clean water," reducing stormwater runoff and damage, and preserving fishing and swimming areas.

5.1.2 Problems and Threats

Pollution – Stakeholders ranked various types of pollution as a major threat to their watersheds, including non-point pollution, trash and debris, biological sources from industry and community citizens, and erosion.

Residential and Commercial Development – Concerns regarding capacity and lack of impact studies with respect to residential and commercial development represented many dots on the maps. Participants indicated their concerns by pointing out specific areas that have continued to increase storm flooding and erosion. Their concerns also represented their

discontent with how cities are managing ditches, road sides, and stormwater management. Turkey Creek participants were most vocal about poorly managed stormwater.

Natural Stream Modifications – In several of the watersheds, the stream had been engineered to meet the needs of development, stormwater management, or drainage. Participants believe that these modifications increase the problems of the stream by increasing flooding, reducing natural vegetation, reducing the presence of wildlife, and eliminating or reducing natural wetlands within the scope of the stream. Many dots represented stakeholder issues along major highway and transportation corridors, over-developed areas, and the Gulfport International Airport.

Invasive and Other Problematic Species and Genes – Stakeholders consistently noted that each time a natural area is disturbed by development, poor habitat maintenance, limited monitoring, and invasive species management, native species and the habitat are severely impacted.

5.1.3 Solutions

Land and Water Management along with Land and Water Protection – These two solutions for stream and watershed improvements rose consistently as the top solutions for mitigating threats to the watersheds. Participants valued land acquisition for greenspace and wetland protection and land protection from development. Comments concerning these two solutions also addressed restoring quality and function within the wetland habitats and drainage control and improvements (e.g., natural flow and stormwater management). The dots on the maps indicate where participants believed these solutions should be implemented. Generally, the dots were placed on residents' streets, public areas with drainage issues, and engineered stormwater control areas.

Education and Awareness – Stakeholders valued the use of ongoing education and awareness as methods to improve their watersheds. This included making city and county leaders and other decision-makers aware of ongoing issues. Stakeholders wanted a voice that produced results for their areas. They indicated the need to educate neighborhood residents regarding the use of fertilizers, littering within the streams, need for residential support for initiatives

to improve watersheds, and increased efforts to educate young people within school programs.

Law and Policy –Stakeholders continually expressed their concerns throughout all three topic areas over the lack of enforcement of rules and regulations from city and county agencies and offices.

They noted the general lack of attendance from city and county officials at the public listening sessions and the lack of interest when a citizen would call with an issue. Often it appears questionable as to whose responsibility it is to respond to a complaint or concern from a citizen.

5.1.4 Outliers

Beaches – Stakeholders included dots and comments regarding areas outside of the watershed. Public beaches were cited several times for numerous reasons, including the following:

- Detrimental look of the drainage culverts along the beaches from which the streams empty into the Mississippi Sound
- Litter and poor water quality along the beaches
- Lack of appropriate oversight with respect to cleanliness of beaches
- Continuous erosion issues at various places along the beaches

Politics - Stakeholders were concerned with the lack of consistent commitment from city, county, and other governmental officials to ensure water quality testing and remediation, erosion control, storm-water and drainage management. They also cited their frustration with a lack of follow-through from the numerous public meetings and plans for conservation, restoration and improvement over the years, particularly since Hurricane Katrina.

6 REPORTING SESSIONS

Information from the public listening sessions was compiled and assessed for common themes related to scope and threats for each of the nine watersheds. A follow-up meeting was held for each of the three coastal counties (Hancock, Harrison, and Jackson) to provide participants the findings of the CAP process.

An overview of the project including stream assessments and monitoring was shared with each group. Important stream components were identified as habitats, species, and function. Understanding of these components will help to direct action steps for future watershed projects and monitoring. Common themes for all watersheds related to scope include the following:

- Importance of healthy habitats
- Human connection to nature
- Functional importance of streams (e.g. wetlands absorbing/filtering water, natural stream flow for drainage)

Common threats include the following:

- Altered stream function (storm water runoff)
- Habitat (lack of stream buffers, loss of wetlands)
- Streambank erosion and sedimentation
- Water quality
- Invasive species
- Trash and debris

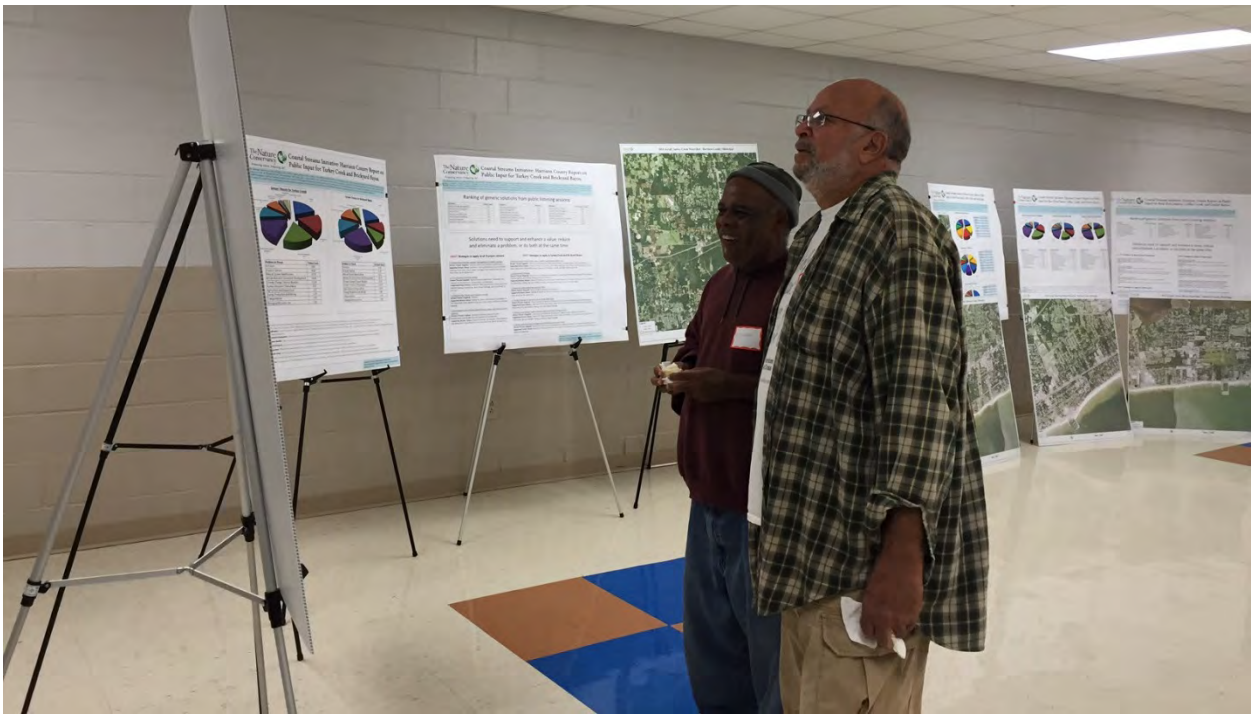


Photograph 4

Jackson County Reporting Session



Photograph 5
Harrison County Reporting Session



Photograph 6
Harrison County Reporting Session (Participants)

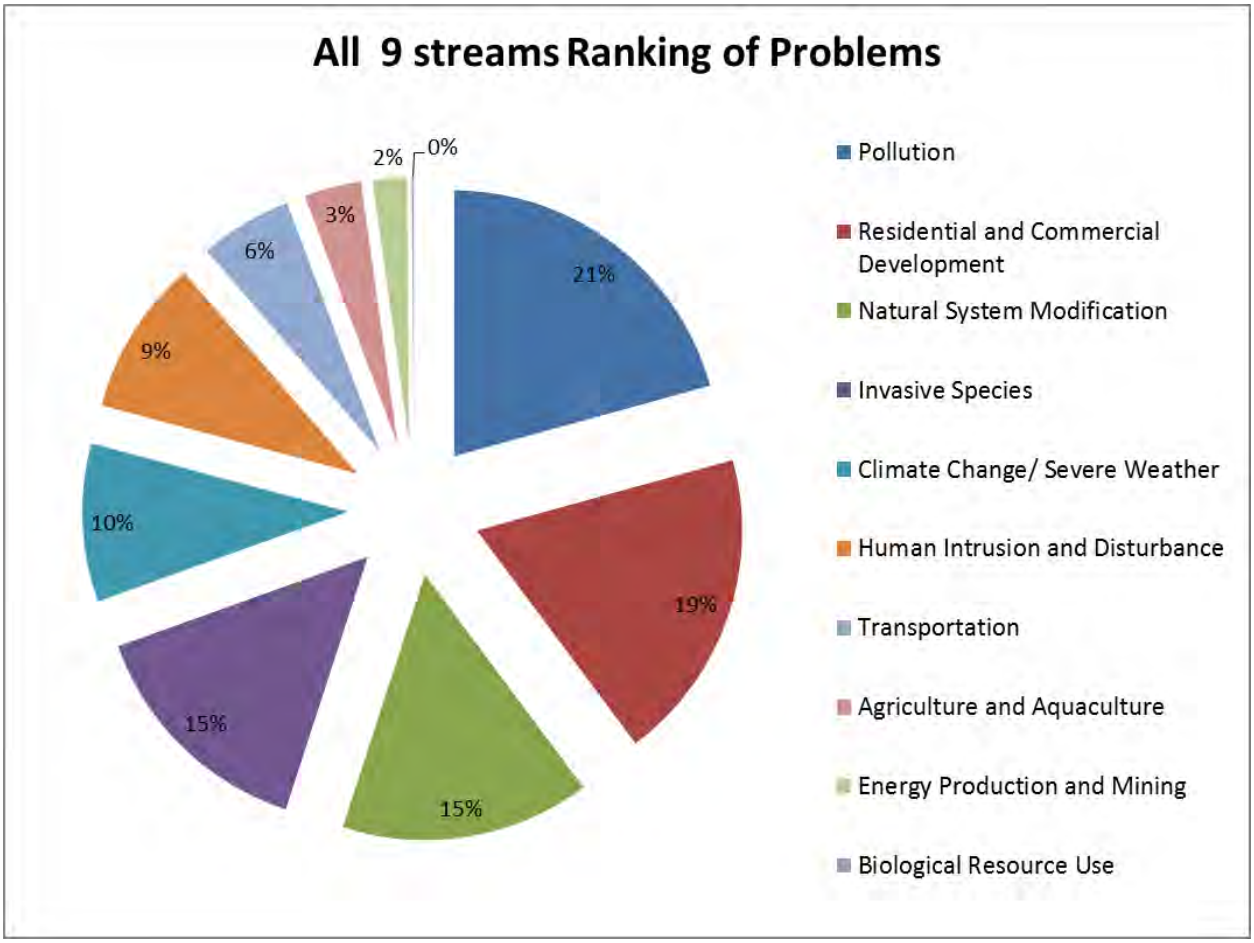


Figure 22
Ranking of Problems (Threats) for All Nine Watersheds

TNC staff shared the CAP process for developing strategies for threat abatement and stream enhancement. Specific strategies presented at the reporting sessions can be found in Appendix D. The following information is determined to develop a strategy (solution):

- Number of problems addressed
- Duration (short or long term solution)
- Lead (individual or institution)
- Leverage
- Ability to motivate decision-makers
- Cost

Currently, TNC is developing recommended projects to fit strategies to abate threats or enhance habitat and species function. The following outreach and stewardship activities are ongoing:

- Training for water quality monitoring
- Invasive species identification workshops
- Rain garden installation
- Oyster gardening
- Wetland restoration demonstration
- Citizen science monitoring (bird surveys and water quality monitoring)

Additional meetings are scheduled for spring 2016 in each of the three coastal counties to share specific restoration plans and designs with the public.

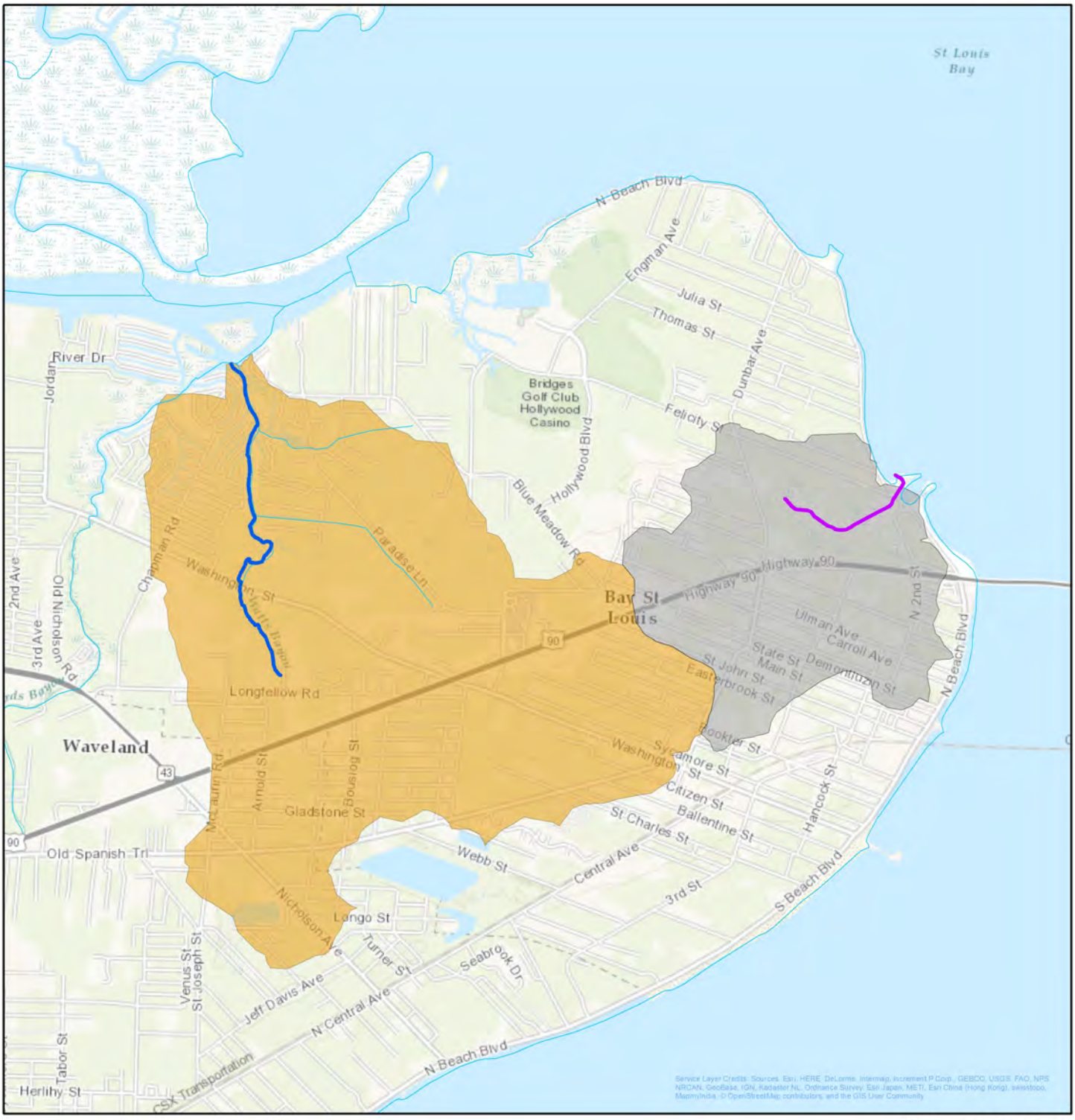
7 SUMMARY

The public listening sessions provided valuable information and community buy-in to the conservation planning process known as CAP. Once the CAP process is completed and restoration plans are designed based on stakeholder input, county-wide meetings will be held to solicit feedback from stakeholders concerning the restoration design.

Stakeholders who participated in the CAP process will continue to be a source of volunteers to provide local monitoring and maintenance of stream projects as strategies are identified and developed.

Appendix B
Watershed Maps

Figure B-1
Magnolia and Watts Bayous Watershed Map



Map Created by: Baton Rouge, Louisiana Field Office (JA)
Date: 8/24/2016

Magnolia Bayou
Watts Bayou
Streams
Magnolia Watershed
Watts Watershed

N
W
E
S

3,000 1,500 0 3,000
Feet

1:36,000

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Figure B-2
Bear Point Bayou Watershed Map



Bear Point Bayou
Streams
Bear Point Bayou Watershed

N
W E
S

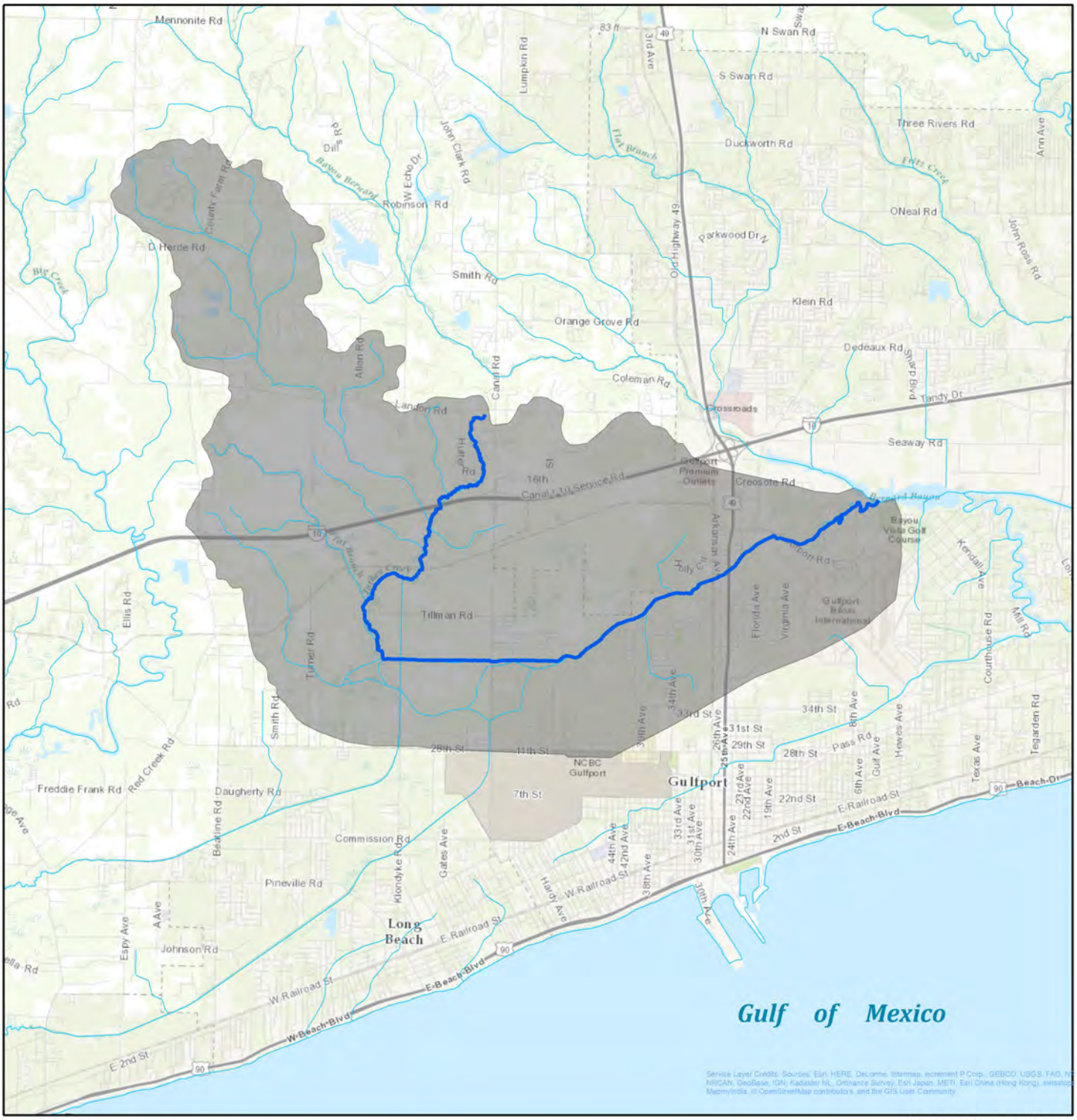
1,500 750 0 1,500
Feet

Map Created by: Baton Rouge, Louisiana Field Office (JA)
Date: 8/24/2016

1:18,000

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Figure B-3
Turkey Creek Watershed Map



Turkey Creek
Streams
Turkey Creek Watershed

N
W E
S

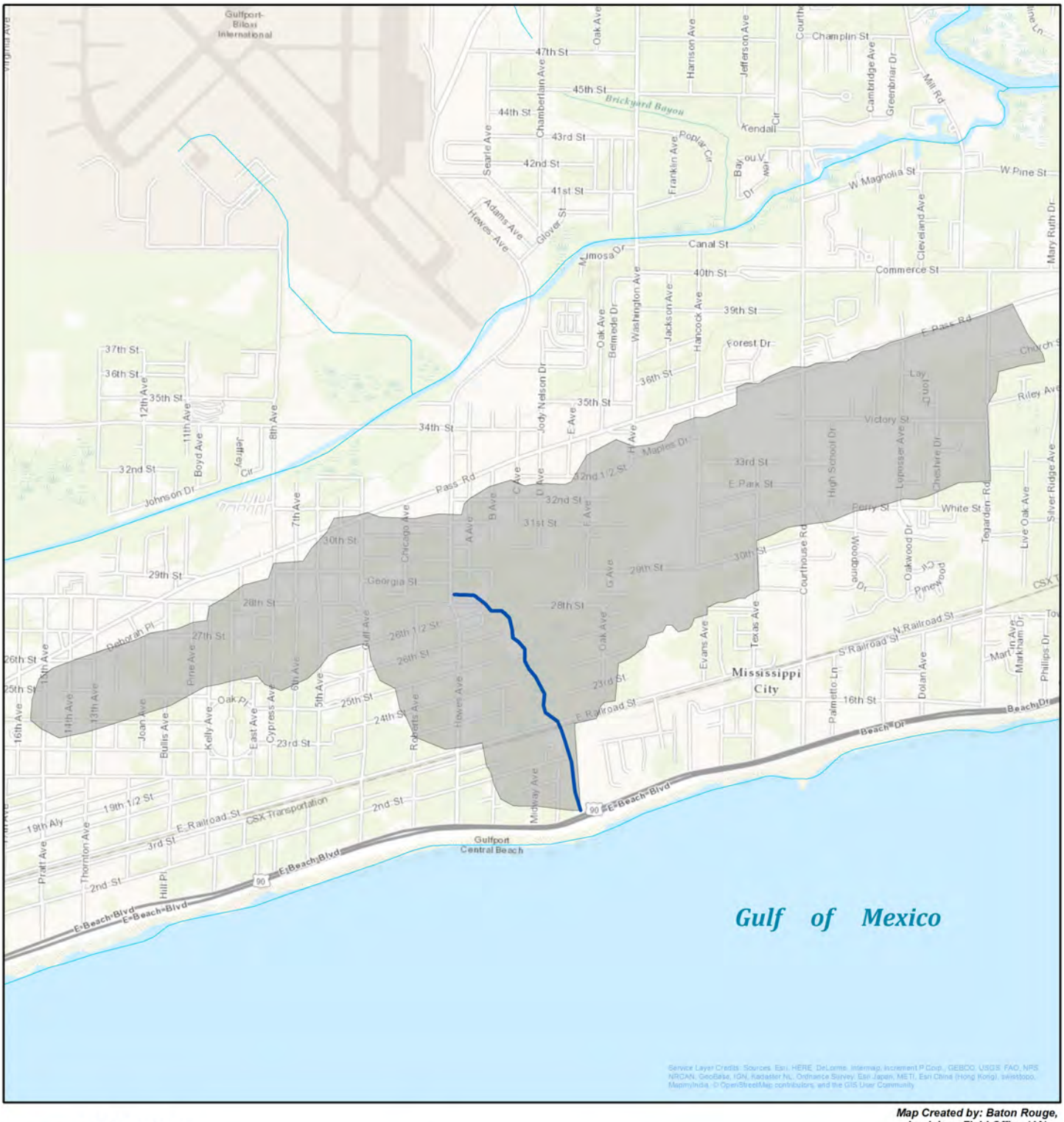
1.5 0.75 0 1.5
Miles

Map Created by: Baton Rouge, Louisiana Field Office (JA)
Date: 8/24/2016

1:95,040

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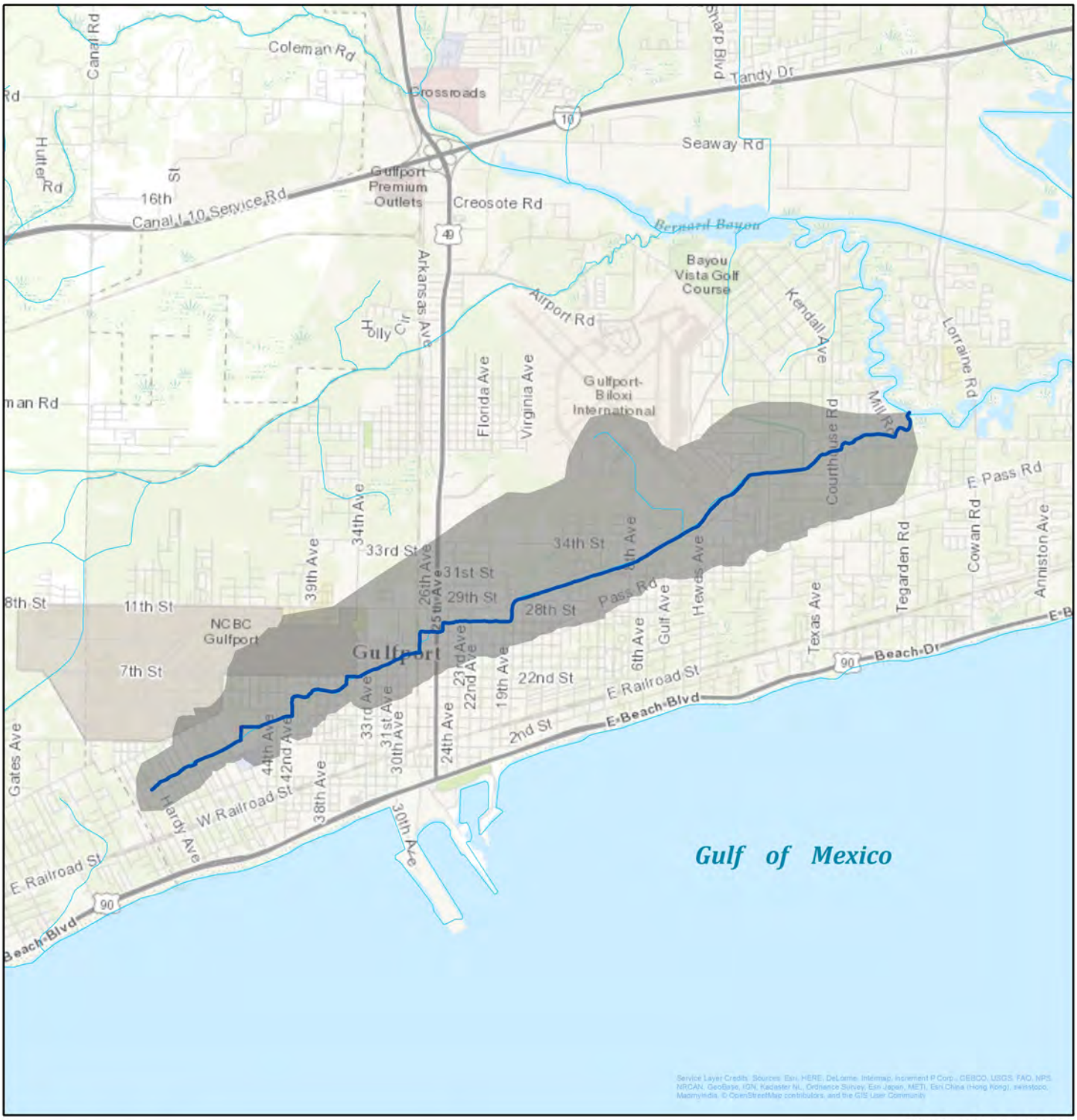
Figure B-4
Coffee Creek Watershed Map



Map Created by: Baton Rouge, Louisiana Field Office (JA)
Date: 08/24/2014

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Figure B-5
Brickyard Bayou Watershed Map



Brickyard Bayou
Streams
Brickyard Bayou Watershed

N
W E
S

1 0.5 0 1
Miles

Map Created by: Baton Rouge, Louisiana Field Office (JA)
Date: 8/24/2016

1:63,360

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Figure B-6
Oyster Bayou Watershed Map

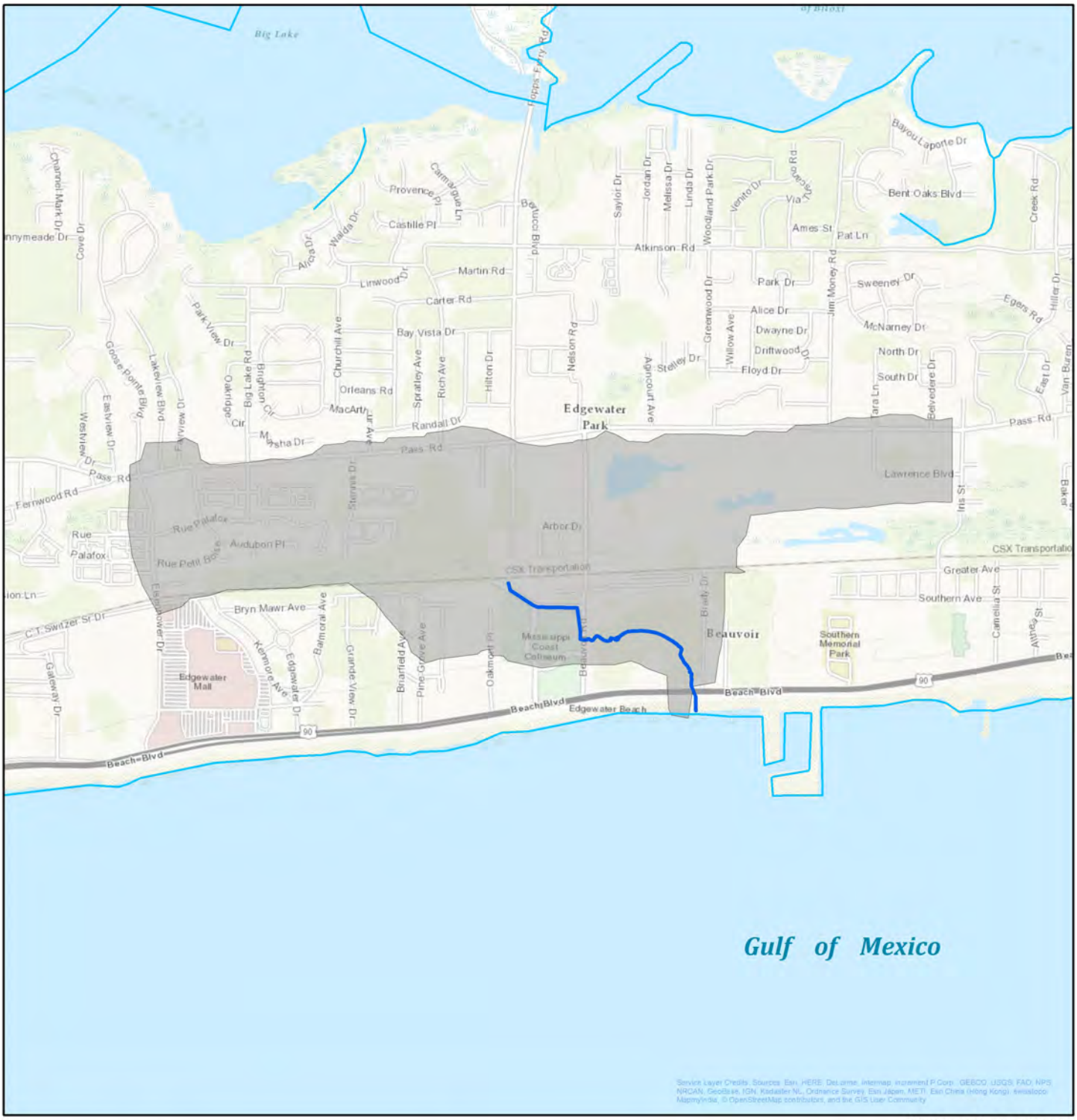
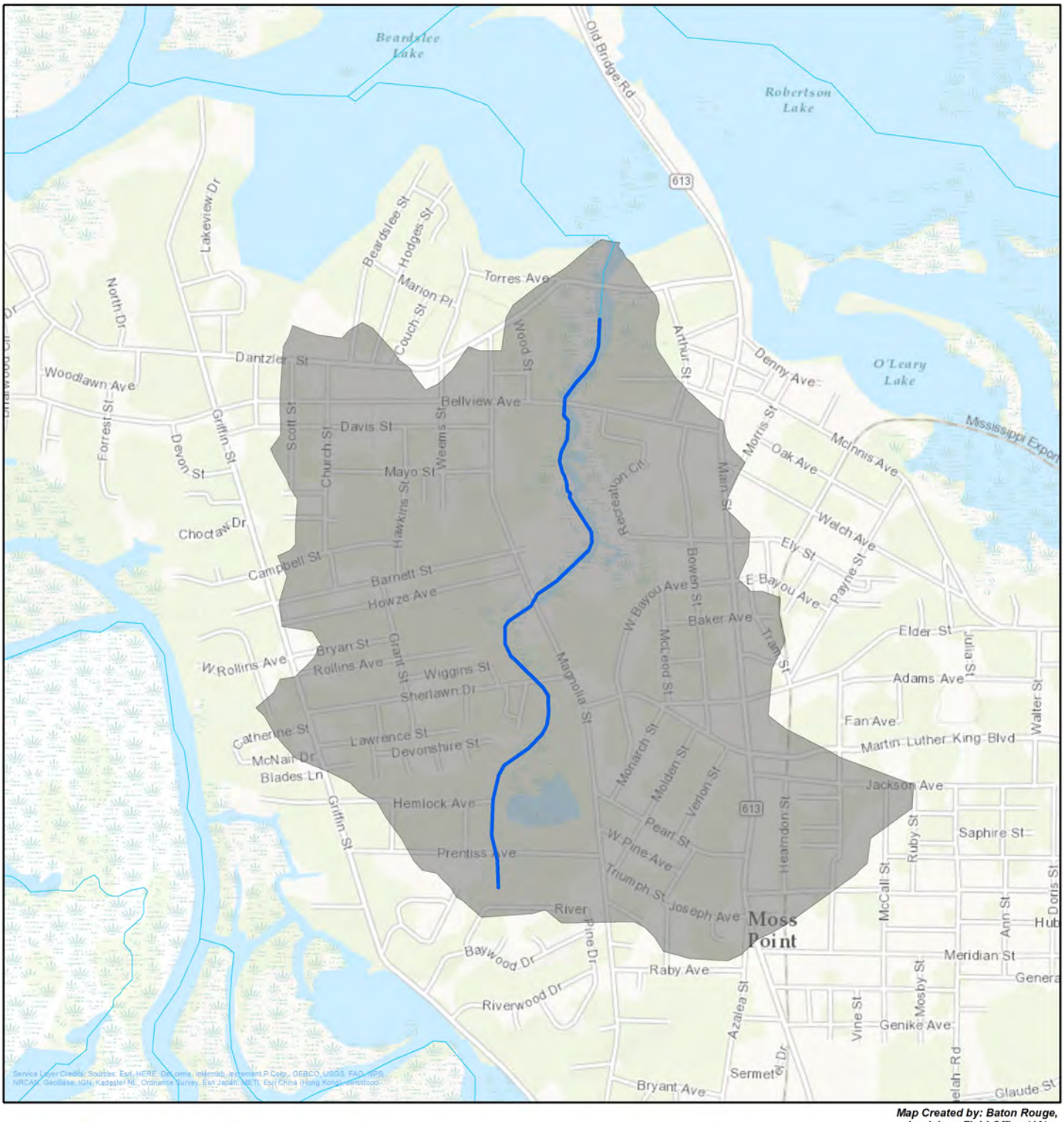


Figure B-7
Rhodes Bayou Watershed Map



Rhodes Bayou
Streams
Rhodes Bayou Watershed

N
W
E
S

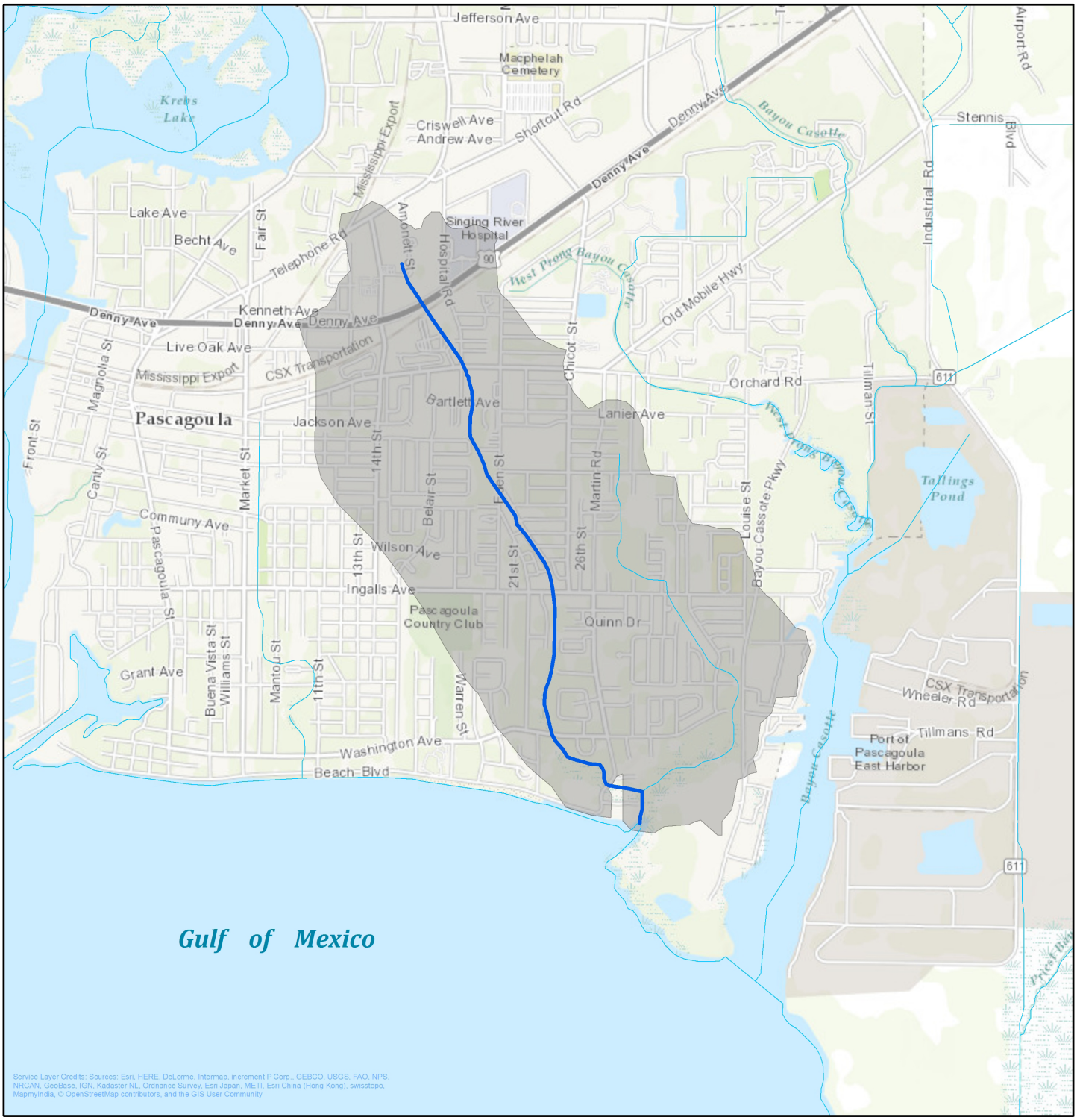
1,500 750 0 1,500
Feet

Map Created by: Baton Rouge, Louisiana Field Office (JA)
Date: 8/24/2016

1:18,000

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Figure B-8
Bayou Chicot Watershed Map



Map Created by: Baton Rouge, Louisiana Field Office (JA)
Date: 8/24/2016

Bayou Chicot
Streams
Watershed Boundary

N
W E
S

3,000 1,500 0 3,000
Feet

1:36,000

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Appendix C
Rapid Stream Assessment Protocols and Sample Data Sheet

RAPID STREAM ASSESSMENT PROTOCOLS AND SAMPLE DATA SHEET

This appendix includes the procedures followed by The Corps Network crews while completing the Rapid Stream Assessments, along with the data sheet used to record information. Rapid Stream Assessments are outlined in the Stream Visual Assessment Protocol, version 2 (SVAPv2) from the U.S. Department of Agriculture, Natural Resources Conservation Service. This easy-to-use tool is used to qualitatively evaluate the condition of aquatic ecosystems associated with wadeable streams, that is, those shallow enough to be sampled without the use of a boat. Such wadeable streams include those modified to improve drainage on agricultural lands, especially if these systems are part of an ecologically functional stream and/or river network. While the protocol does not require users to be experts in aquatic ecology, it does require they read the protocol's user guidance thoroughly before beginning an assessment.

The SVAP and SVAPv2 are tools that work best when users first identify local stream reference conditions that can effectively provide a standard for comparison. The original SVAP is designed to be conducted with the landowner. SVAPv2 can be completed with a landowner or conservation planning team. Field conservationists are encouraged to use SVAPv2 in those situations where more detail is needed to critically score these elements and their relative contribution to the condition of the stream. This version lends itself to tracking trends in stream conditions over time, as well as identifying resource concerns and their potential causes.

It should be noted that one parameter (salinity as a pollutant) was eliminated. Not all streams have an estuarine zone where some salinity is normal. During the 2016 sampling, an additional parameter (riffle embededness) was also eliminated, reflecting the fact that gravel and cobble riffles are virtually not existent in South Mississippi streams.

1. Channel Condition

Natural, stable channel with established bank vegetation	If channel is incising (appears to be downcutting or degrading), score this element based on the descriptions in the upper section of the matrix		
No discernible signs of incision (such as vertical banks) or aggradation (such as very shallow multiple channels)	Evidence of past incision and some recovery; some bank erosion possible Active channel and flood plain are connected in most areas, inundated seasonally	Active incision evident; plants are stressed, dying or falling in channel Active channel appears to be disconnected from the flood plain, with infrequent or no inundation	Headcuts or surface cracks on banks; active incision; vegetation very sparse Little or no connection between flood plain and stream channel and no inundation
Active channel and flood plain are connected throughout reach, and flooded at natural intervals	Streambanks may be low or appear to be steepening Top of point bars are below active flood plain	Steep banks, bank failures evident or imminent Point bars located adjacent to steep banks	Steep streambanks and failures prominent Point bars, if present, located adjacent to steep banks
Streambanks low with few or no bank failures	Stage I: Score 8 Stage V: Score 7–8 Stage IV: Score 6	Stage IV: Score 5 Stage III: Score 4 Stage II: Score 3	Stage II or III, scores ranging from 2 to 0, depending on severity
Stage I : Score 10 Stage V: Score 9 (if terrace is visible)	8 7 6	5 4 3	2 1 0
	If channel is aggrading (appears to be filling in and is relatively wide and shallow), score this element based on the descriptions in the lower section of the matrix		
	Minimal lateral migration and bank erosion A few shallow places in reach, due to sediment deposits	Moderate lateral migration and bank erosion Deposition of sediments causing channel to be very shallow in places	Severe lateral channel migration, and bank erosion Deposition of sediments causing channel to be very shallow in reach
No more than 1 bar forming in channel	Minimal bar formation (less than 3)	3–4 bars in channel	Braided channels (5 or more bars in channel)
10 9	8 7 6	5 4 3	2 1 0

2. Hydrologic Alteration

Bankfull or higher flows occur according to the flow regime that is characteristic of the site, generally every 1 to 2 years and No dams, dikes, or development in the flood plain[1/], or water control structures are present and natural flow regime[2/] prevails	Bankfull or higher flows occur only once every 3 to 5 years or less often than the local natural flow regime Developments in the flood plain, stream water withdrawals, flow augmentation, or water control structures may be present, but do not significantly alter the natural flow regime[2/]	Bankfull or higher flows occur only once every 6 to 10 years, or less often than the local natural flow regime Developments in the flood plain, stream water withdrawals, flow augmentation, or water control structures alter the natural flow regime[2/]	Bankfull or higher flows rarely occur Stream water withdrawals completely dewater channel; and/or flow augmentation, stormwater, or urban runoff discharges directly into stream and severely alters the natural flow regime[2/]
10 9	8 7 6	5 4 3	2 1 0

1/ Development in the flood plain refers to transportation infrastructure (roads, railways), commercial or residential development, land conversion for agriculture or other uses, and similar activities that alter the timing, concentration, and delivery of precipitation as surface runoff or subsurface drainage.

2/ As used here, "natural flow regime" refers to streamflow patterns unaffected by water withdrawals, flood plain development, agricultural or wastewater effluents, and practices that change surface runoff (dikes and levees) or subsurface drainage (tile drainage systems).

3. Bank Condition

Banks are stable; protected by roots of natural vegetation, wood, and rock [1/] No fabricated structures present on bank No excessive erosion or bank failures [2/] No recreational or livestock access			Banks are moderately stable, protected by roots of natural vegetation, wood, or rock or a combination of materials Limited number of structures present on bank Evidence of erosion or bank failures, some with reestablishment of vegetation Recreational use and/or grazing do not negatively impact bank condition			Banks are moderately unstable; very little protection of banks by roots of natural wood, vegetation, or rock Fabricated structures cover more than half of reach or entire bank Excessive bank erosion or active bank failures Recreational and/or livestock use are contributing to bank instability			Banks are unstable; no bank protection with roots, wood, rock, or vegetation Riprap and/or other structures dominate banks Numerous active bank failures Recreational and/or livestock use are contributing to bank instability		
Right bank	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Left bank	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**

1/ Natural wood and rock does not mean riprap, gabions, log cribs, or other fabricated revetments.
2/ Bank failure refers to a section of streambank that collapses and falls into the stream, usually because of slope instability.

4. Riparian Area Quantity

Natural plant community extends at least two bankfull widths or more than the entire active flood plain and is generally contiguous throughout property			Natural plant community extends at least one bankfull width or more than 1/2 to 2/3 of active flood plain and is generally contiguous throughout property Vegetation gaps do not exceed 10% of the estimated length of the stream on the property			Natural plant community extends at least 1/2 of the bankfull width or more than at least 1/2 of active flood plain Vegetation gaps do not exceed 30% of the estimated length of the stream on the property			Natural plant community extends at least 1/3 of the bankfull width or more than 1/4 of active flood plain Vegetation gaps exceed 30% of the estimated length of the stream on the property			Natural plant community extends less than 1/3 of the bankfull width or less than 1/4 of active flood plain Vegetation gaps exceed 30% of the estimated length of the stream on the property		
Right bank	**10**	**9**	**8**	**7**		**6**	**5**		**4**	**3**	**2**	**1**	**0**	
Left bank	**10**	**9**	**8**	**7**		**6**	**5**		**4**	**3**	**2**	**1**	**0**	

Note: Score each bank separately. Scores should represent the entire stream riparian area within the property. Score for this element = left bank score plus right bank score divided by 2. If the score of one bank is 7 or greater and the score of the other bank is 4 or less, subtract 2 points from final score.

5. Riparian Area Quality

	Natural and diverse riparian vegetation with composition, density and age structure appropriate for the site No invasive species or concentrated flows through area		Natural and diverse riparian vegetation with composition, density and age structure appropriate for the site: Little or no evidence of concentrated flows through area Invasive species present in small numbers (20% cover or less)			Natural vegetation compromised Evidence of concentrated flows running through the riparian area Invasive species common (>20% <50% cover)			Little or no natural vegetation Evidence of concentrated flows running through the riparian area Invasive species widespread (>50% cover)		
Right bank	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**
Left bank	**10**	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**

Notes: Score should represent the entire stream riparian area within the property.
Score for this element = left bank score plus right bank score divided by 2.

6. Canopy Cover

(a) Cold-water streams

>75% of water surface shaded within the length of the stream in landowner's property		75–50% of water surface shaded within the length of the stream in landowner's property			49–20% of water surface shaded within the length of the stream in landowner's property			<20% of water surface shaded within the length of the stream in landowner's property		
10	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**

(b) Warm-water streams

50–75% of water surface shaded within the length of the stream in landowner's property		>75% of water surface shaded within the length of the stream in landowner's property			49–20% of water surface shaded within the length of the stream in landowner's property			<20% of water surface shaded within the length of the stream in landowner's property		
10	**9**	**8**	**7**	**6**	**5**	**4**	**3**	**2**	**1**	**0**

7. Water Appearance

Water is very clear, or clarity appropriate to site; submerged features in stream (rocks, wood) are visible at depths of 3 to 6 feet No motor oil sheen on surface; no evidence of metal precipitates in streams	Water is slightly turbid, especially after storm event, but clears after weather clears; submerged features in stream (rocks, wood) are only visible at depths of 1.5 to 3 feet No motor oil sheen on surface or evidence of metal precipitates in stream	Water is turbid most of the time; submerged features in stream (rocks, wood) are visible at depths of only .5 to 1.5 feet **and/or** Motor oil sheen is present on water surface or areas of slackwater **and/or** There is evidence of metal precipitates in stream	Very very turbid water most of the time; submerged features in stream (rocks, wood) are visible only within .5 feet below surface **and/or** Motor oil sheen is present on the water surface or areas of slackwater
10 9 8	**7 6 5**	**4 3 2**	**1 0**

8. Nutrient Enrichment

Clear water along entire reach Little algal growth present	Fairly clear or slightly greenish water Moderate algal growth on substrates	Greenish water particularly in slow sections Abundant algal growth, especially during warmer months **and/or** Slight odor of ammonia or rotten eggs **and/or** Sporadic growth of aquatic plants within slack water areas	Pea green color present; thick algal mats dominating stream **and/or** Strong odor of ammonia or rotten eggs **and/or** Dense stands of aquatic plants widely dispersed
10 9	**8 7 6**	**5 4 3**	**2 1 0**

9. Manure/Human Waste

Livestock do not have access to stream No pipes or concentrated flows discharging animal waste or sewage directly into stream	Livestock access to stream is controlled and/or limited to small watering or crossing areas No pipes or concentrated flows discharging animal waste or sewage directly into stream	Livestock have unlimited access to stream during some portion of the year Manure is noticeable in stream **and/or** Pipes or concentrated flows discharge treated animal waste or sewage directly into stream	Livestock have unlimited access to stream during entire year Manure is noticeable in stream **and/or** Pipes or concentrated flows discharge untreated animal waste or sewage directly into stream
10 9	8 7 6	5 4 3	2 1 0

10. Pools

More than two deep pools separated by riffles, each with greater than 30% of the pool bottom obscured by depth, wood, or other cover Shallow pools also present	One or two deep pools separated by riffles, each with greater than 30% of the pool bottom obscured by depth wood, or other cover At least one shallow pool present	Pools present but shallow (<2 times maximum depth of the upstream riffle) Only 10–30% of pool bottoms are obscured due to depth or wood cover	Pools absent, but some slow water habitat is available No cover discernible **or** Reach is dominated by shallow continuous pools or slow water
10 9	8 7 6	5 4 3	2 1 0

11. Barriers to Movement

No artificial barriers that prohibit movement of aquatic organisms during any time of the year	Physical structures, water withdrawals and/or water quality seasonally restrict movement of aquatic species	Physical structures, water withdrawals and/or water quality restrict movement of aquatic species throughout the year	Physical structures, water withdrawals and/or water quality prohibit movement of aquatic species
10	9 8 7	6 5 4 3	2 1 0

12. Fish Habitat Complexity

Ten or more habitat features available, at least one of which is considered optimal in reference sites (large wood in forested streams)	Eight to nine habitat features available	Six to seven habitat features available	Four to five habitat features available	Less than four habitat features available
10 9	8 7	6 5	4 3	2 1 0

Note: Fish habitat features: logs/large wood, deep pools, other pools (scour, plunge, shallow, pocket) overhanging vegetation, boulders, cobble, riffles, undercut banks, thick root mats, dense macrophyte beds, backwater pools, and other off-channel habitats

13. Aquatic Invertebrate Habitat

At least 9 types of habitat present A combination of wood with riffles should be present and suitable in addition to other types of habitat (If nonforested stream, consider reference site's optimal habitat type needed for this high score)	8 to 6 types of habitat Site may be in need of more wood or reference habitat features and stable wood-riffle sections	5 to 4 types of habitat present	3 to 2 types of habitat present	None to 1 type of habitat present
10 9	8 7 6	5 4	3 2	1 0

Note: Aquatic invertebrate habitat types, in order of importance: Logs/large wood, cobble within riffles, boulders within riffles. Additional habitat features should include: leaf packs, fine woody debris, overhanging vegetation, aquatic vegetation, undercut banks, pools, and root mats.

14. Aquatic Invertebrate Community

Invertebrate community is diverse and well represented by group I or intolerant species One or two species do not dominate	Invertebrate community is well represented by group II or facultative species, and group I species are also present One or two species do not dominate	Invertebrate community is composed mainly of groups II and III **and/or** One or two species of any group may dominate	Invertebrate community composition is predominantly group III species **and/or** only one or two species of any group is present and abundance is low
10 9 8	7 6 5	4 3 2	1 0

15. Riffle Embeddedness

Gravel or cobble substrates are <10% embedded	Gravel or cobble substrates are 10–20% embedded	Gravel or cobble substrates are 21–30% embedded	Gravel or cobble substrates are 31—0% embedded	Gravel or cobble substrates are >40% embedded
10 9	8 7	6 5	4 3	2 1 0

16. Salinity

No wilting, bleaching, leaf burn, or stunting of riparian vegetation No streamside salt-tolerant vegetation present	Minimal wilting, bleaching, leaf burn, or stunting of riparian vegetation Some salt-tolerant streamside vegetation	Riparian vegetation may show significant wilting, bleaching, leaf burn, or stunting Dominance of salt-tolerant streamside vegetation	Severe wilting, bleaching, leaf burn, or stunting; presence of only salt tolerant riparian vegetation Most streamside vegetation is salt tolerant
10 9 8	7 6 5	4 3	2 1 0

Note: Do not assess this element unless elevated salinity levels caused by people are suspected.

Rapid Assessment Of Coastal Streams

NAME _____ DATE _____ TIME _____

STREAM _____ SITE _____ GPS _____

	ASSESSMENT	SCORE		COMMENTS
1	Channel Condition			
2	Hydrologic Alteration		*List developments in floodplain or structures that alter flow.*	
3	Bank Condition		*Describe problems (hardened shorelines, riprap, livestock, etc.)*	
4	Riparian Quantity			
5	Riparian Quality		*List all invasive species and abundance levels*	
6	Canopy Cover			
7	Water Appearance		*Note presence of motor oil or metal precipitates*	
8	Nutrient Enrichment			
9	Manure/Human Waste			
10	Pools		*List size and number of pools*	
11	Barriers To Movment		*Describe Type and Size*	
12	Fish Habitat Complexity		*List different types of fish habitat*	
13	Aquatic Invertebrate Habitat		*List different types of invertebrate habitat*	
14	Aquatic Invertebrate Community		*How many aquatic invertebrates were found?*	
15	Riffle Embebedness			
16	Salinity		*Only at Bear Pt., Coffee creek and Oyster Bayou*	

*** Mark "X" in score box if measurement not taken.

Rapid Assessment Of Coastal Streams

WATER QUALITY MEASUREMENTS			List Other Significant Problems Below (riprap, bulkheads, storm drains,litter, etc)
Dissolved Oxygen		ppm	
Phosphate		ppm	
Nitrate		ppm	
Turbidity		TU	
Salinity		ppt	
pH			
Temperature		C	
Tide Stage			

WILDLIFE DATA

Common Name	Number	Life Stage	Description (Especially if Unknown)

*** Mark "X" in score box if measurement not taken.

Appendix D
Master List of Objectives

MASTER LIST OF OBJECTIVES

The Nature Conservancy (TNC) compiled and analyzed 30 federal, regional, state, local, academic, and stakeholder conservation plans, policies, and publications relevant to Coastal Stream and Habitat Initiative (CSHI) watersheds. TNC extracted the following goals, objectives, and strategies from the references, and sorted them into categories of "Threat Abatement," "Maintaining/Enhancing Target Viability," and "Other." Once sorted, we developed objectives that synthesized the various, often-overlapping intent of the original references. The result was 17 unified objectives for conserving aquatic resources in the CSHI streams and watersheds. Other objectives from conservation plans associated with the nine watersheds are noted where considered important to the CAP. Tables D-1 through D-3 include the full list of objectives sorted by category.

Table D-1
Threat Abatement Objectives

CATEGORY	OBJECTIVE
Water Quality	Improve or maintain water quality (SARP 2008; MGMC 2010; NFHP 2013; Manlove et al. 2002; TCC 2011): • By 2026, reduce the number of sites in Turkey Creek exceeding Total Maximum Daily Load (TMDL) guidelines by 100% (SARP 2008) • By 2026, reduce to 10% urban sites exceeding 2 parts per million (ppm) nitrates (SARP 2008; TCCI 2011) • By 2026, reduce to 60% urban stream sites exceeding .1 ppm phosphorus (SARP 2008) • By 2026, take action to meet or exceed TMDL for coliforms on Turkey Creek (LTMCP 2006)
	Eliminate potential sources for biological pathogen contamination: • By 2026, implement repairs of failing on-site wastewater systems or connect them to wastewater collection systems to 90% compliance (Governor's Oyster Council 2015)
	Eliminate failing infrastructure sources of biological pathogen contamination: • By 2026, identify and plan for elimination and repair of 100% of failing public sewer lines in CSHI watersheds
Transportation, Utility, & Service Lines	Protect stream connectivity: • By 2026, ensure that all new stream crossings use construction materials and techniques that do not alter connectivity in CSHI watersheds (SARP 2008; MMNS 2005; NFHP 2012)
Invasive Species	Restore or improve ecological balance in systems negatively affected by invasives (SARP 2008; MGMC 2010; Manlove et al. 2002; Turkey Creek Community Initiative 2011): • By 2026, reduce annual increase in Nonindigenous Aquatic Species to 3% annually (SARP 2008)
Canals, Dredging, & Other Ecosystem Modifications	Encourage agencies that permit shoreline stabilization to consider alternative shoreline erosion control approaches before hardened stabilization is approved (Sutter and Hayes 2011): • By 2026, remove or replace hardening structures that degrade habitat in CSHI watersheds at ten sites
	Support compatible management of natural habitats: • By 2026, ensure that beach management plans and techniques are revised to protect CSHI streams and watersheds

CATEGORY	OBJECTIVE
	Support implementation of best management practices (BMPs) at stream outfalls: • By 2026, remove one concrete stream outfall channel and allow the streams to "renaturailze" where they cross the Harrison County beaches in either Bear Point Bayou, Coffee Creek, or Oyster Bayou *Note: This may not be possible in Bear Point because it does not currently have the support of the Harrison County Sand Beach Commission.*
Outreach, Education, & Stakeholder Engagement	Expand conservation constituency: • By 2026, develop formal partnerships with five agencies, user groups, or neighborhood associations, and propose and implement local conservation efforts with these groups
Recreational Activities	Reduce impact of water-borne or shoreline recreational activities; discourage incompatible recreational uses (MMNS 2005): • By 2026, implement BMPs for on-site erosion, sediment, stormwater, and debris management for 100% of new water-borne or shoreline recreational areas • By 2026, implement BMPs for on-site erosion, sediment, stormwater, and debris management for all pre-existing water-borne or shoreline recreational areas

Table D-2
Maintaining/Enhancing Target Viability Objectives

CATEGORY	OBJECTIVE
Hydrology	Establish, improve, or maintain appropriate sediment flow (SARP 2008): • By 2026 stabilize or restore 5 miles of unstable shoreline along CSHI streams • By 2026, reduce the miles of CSHI streams impaired by excessive sedimentation by 25%
Riparian Corridor	Establish, improve, and maintain riparian zones (SARP 2008; MGMC 2010; Sutter and Hayes 2011; MMNS 2005; Manlove et al. 2002; LTMCP 2006): • By 2026, ensure that 15% of all lands within 100 feet of a stream have adequate riparian protection
	Restore, enhance, manage, and protect Mississippi's remaining coastal habitat functional riparian/floodplain habitat: • By 2026, increase the area of functional floodplain in CSHI watersheds by 5% • By 2026, stabilize or restore 10% of degraded riparian lands in CSHI watersheds • By 2026, ensure that BMPs that protect riparian corridors are implemented on 50% of all construction projects on private land
Altered Floodplains & Wetlands	Maintain and restore physical habitat in freshwater systems (SARP 2008; MGMC 2010; Sutter and Hayes 2011; MMNS 2005; Manlove et al. 2002; Kushlan et al. 2002): • By 2026, reduce the acres of altered freshwater wetlands by permitted construction by 30% (SARP 2008) • By 2026, increase the miles of streams with improved physical habitat by 15% (SARP 2008) • By 2026, reduce the number of stream miles destroyed or converted to unnatural or managed development in CSHI watersheds by 25% (SARP 2008)
	Reduce impact of development on the physical habitat in freshwater systems: • By 2026, reduce the number of acres of altered freshwater wetlands drained or converted through development annually in CSHI watersheds to 50% (SARP 2008) • By 2026, increase the percentage of urban and suburban natural patches (10 to 100 acres) in CSHI watersheds by 35% (SARP 2008)
Connectivity	Improve or maintain watershed connectivity: • By 2026, restore fish access to 100% of stream miles formerly blocked (SARP 2008)

Table D-3
Other Objectives

CATEGORY	OBJECTIVE
Water Quality	Establish, maintain, or improve appropriate sediment flows (SARP 2008; MGMC 2010): • Target CSHI: reduce sediment impaired stream miles by 10% (SARP 2008)
	Protect, restore, maintain, and improve water quality by financing wastewater treatment infrastructure (USEPA 2010)
	Identify and mitigate all pollution sources for Turkey Creek and establish regular monitoring to ensure water quality (TCCI 2011)
Stormwater	Implement state-of-the-art stormwater management plans to maintain or restore hydrology on two new or in-progress projects on private land: • Ensure that basin streams meet state water quality standards • Improve water quality
Canals, Dredging, & Other Ecosystem Modifications	Encourage agencies that permit shoreline stabilization to consider alternative shoreline erosion control approaches before hardened stabilization is approved (Sutter and Hayes 2011): • Involve all agencies and organizations in strategies related to shoreline stabilization (Sutter and Hayes 2011) • Provide appropriate information on alternative shoreline erosion control approaches (Sutter and Hayes 2011) • Protect and enhance aquatic biodiversity • Protect and enhance terrestrial biodiversity • Maintain healthy aquatic community integrity • Protect and restore existing native fish populations • Maintain populations of native non-game fishes and aquatic invertebrates at or above present levels throughout the basin • Improve water quality for drinking water, and to protect and restore existing native fish populations
Altered Floodplains & Wetlands	Acquire and protect coastal habitat (MDMR 2012; PGLP 2014; Sutter and Hayes 2011; Manlove et al. 2002; Kushlan et al. 2002; TCCI 2011; LTMCP 2006; general support from Task Force Plan): • Identify, acquire, and protect significant acreage of high-priority coastal wetlands through fee simple, easements, or protective agreements (MDMR 2012)
Outreach, Education, & Stakeholder Engagement	Increase public awareness and interest in the values and functions of coastal wetlands, their habitats, and the ecosystem on which they are dependent (MDMR 2012): • Develop and deliver education materials and programs to inform the public about wetlands species, their habitat, and values to humans (MMNS 2005)
Policy	Reduce wetlands filling and encourage/ensure local, compatible mitigation for wetlands loss
	Work with cities to support, revise, and enforce city-wide tree protection ordinances (LTMCP 2006)
Funding	Dedicate funding to support long-term restoration (TNC 2010): • Find private funding sources • Investigate funding opportunities • Identify and create alternative funding strategies for capital projects and long-term sustainability of greenway infrastructure
	Seek funding to expand CSHI coverage to other streams in Mississippi's coastal counties

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Appendix E
Site-specific Problems Identified in Watersheds

SITE-SPECIFIC PROBLEMS IDENTIFIED IN WATERSHEDS

During the Public Listening Sessions, participants identified site-specific problems in each watershed. The Nature Conservancy staff followed up on these issues with field trips, the dates of which are included in Table E-1. Some of the identified problems were resolved, while a few were not. During the trips, staff also evaluated all road and rail crossings on each stream for fish passage issues. Full lists of site-specific problems for each watershed are included in Tables E-2 through E-10.

Table E-1
TNC Field Trips

WATERSHED	DATES VISITED
Magnolia Bayou	October 27, 2015
Watts Bayou	October 28, 2015
Bear Point Bayou	October 6, 2015
Turkey Creek	November 4, 2015 November 9, 2015 December 1, 2015
Coffee Creek	October 6, 2015 December 1, 2015
Brickyard Bayou	October 23, 2015
Oyster Bayou	October 6, 2015
Rhodes Bayou	September 30, 2015 October 1, 2015
Bayou Chicot	September 30, 2015 October 1, 2015

Table E-2
Magnolia Bayou Site-specific Problems

IDENTIFIED PROBLEM	ACTION	TNC FIELD TRIP NOTES
Yacht club	Confirm phragmites	• Common reed (*Phragmites australis*) present in large numbers, covering several acres along north shore of Magnolia Bayou at Yacht Club
Seminary	Confirm bamboo	• Bamboo (*Phyllostachus aurea*) present in significant numbers, particularly along northern shore of Magnolia Bayou
Seminary	Confirm Chinese tallow tree	• Chinese tallow (*Sapium sebifera*) present in moderate numbers, also present are elephant ears (*Colocasia esculenta*) in large numbers
Dunbar Avenue culvert	Confirm	• New flat-bottom, concrete culvert • Put in since the start of this project • Not a fish passage issue
Highland Avenue culvert	Confirm	• Round culvert • Probably not a fish passage issue
Esplanade Avenue culvert	Confirm	• One iron and one concrete culvert, both round • Fish passage issue
U.S. Highway 90 culvert	Confirm	• Three large, round, concrete culverts • Fish passage issue • Water hyacinth (*Eichornia crassipes*) infestation on an area of perhaps .25 acres on both sides of U.S. Highway 90
Possible leaking septic tank at Piazza property	Sample and confirm	• Site previously identified was dry • No seepage
A previously unidentified tributary, which crosses Highway 90 just east of main channel, was located. It was extremely overgrown and it was not possible to determine the size or nature of road crossing, but it is probably a round, concrete culvert.		

Table E-3
Watts Bayou Site-specific Problems

IDENTIFIED PROBLEM	ACTION	TNC FIELD TRIP NOTES
Stream crossing at Perniciaro	Confirm	• Corrugated plastic culvert • Fish passage issue
Safari tract	Evaluate for acquisition	• Three residential tracts near the mouth of Watts Bayou, totaling 8 acres • Sites were developed for homes and may have had homes on them before Hurricane Katrina • There are several artificial boat channels and one concrete boat launch • There is a wooden bulkhead along the bayou that is in poor condition • There are invasive plants including cogongrass (*Imperata cylindrical*) and Chinese tallow tree (*Sapium sebifera)* growing on site • Road access is good • With a site this small, ecological restoration would be highly limited • A more logical acquisition scenario would be for public recreation access
	Evaluate as site for living shoreline	• Safari tract is fronted by a failing bulkhead and would seem to present an opportunity for a living shoreline demonstration project • Safari tracts are listed for sale and have been for about a year

Table E-4
Bear Point Bayou Site-specific Problems

IDENTIFIED PROBLEM	ACTION	TNC FIELD TRIP NOTES
Railroad track	Confirm	• Large, round, concrete culvert • Fish passage issue
Railroad Street	Confirm	• Large, flat-bottom, concrete culvert • Flows underground for about 150 feet diagonally across the road • Culvert itself is not a fish passage issue, but the extended underground pipe stretch probably is
Gulf Park Drive on University of Southern Mississippi (USM) campus below turtle pond	Confirm	• Round, concrete culvert • Approximately an 18-inch drop from the culvert through a gravel area, which will preclude fish movement except on high flow • Fish passage issue
Dam on turtle pond	Confirm	• Low-head, concrete dam with footer of riprap • At low flow, there is no water flowing over dam • Fish passage issue • Also a heavy infestation of invasive elephant ears (*Colocasia exculenta*) at dam site
St. Thomas Church west access road	Confirm	• Large, round, concrete culvert • Fish passage issue at low water
St. Thomas Church east access road	Confirm	• Round, concrete culvert • Not a fish passage issue
USM parking lot foot bridge	Confirm	• Round, concrete culvert • Not a fish passage issue
U.S. Highway 90 bridge	Confirm	• Square, box culverts • Not a fish passage issue, large enough to allow tidal flow north of U.S. Highway 90
Stream north of Railroad Street	Confirm	• Stream is straightened and has very slow flow
Possible additional tributary north of railroad, west of known channel	Confirm	• This branch exists crossing McCaughan Street west to east north of Railroad Street • Stream is straightened and very small • Almost no water present today • Not certain where it enters main stream

Table E-5
Turkey Creek Site-specific Problems

IDENTIFIED PROBLEM	ACTION	TNC FIELD TRIP NOTES
Airport Road	Confirm	• Crossing is a high bridge • No fish passage issue • No safe or legal way to approach this crossing
KCS Railroad	Confirm	• Crossing is a good bridge • No fish passage issue • Not possible to safely or legally access the bridge
Ohio Avenue	Confirm	• Good bridge • No fish passage issue
Canal Road	Confirm	• Crossing is a bridge • No fish passage issue • Heavy cogongrass (*Imperata cylindrical)* and Chinese tallow tree (*Sapium sebifera)* infestation
Arkansas Avenue	Confirm	• Crossing is a bridge • No fish passage issue • There is a water level pipe that would end easy kayak access here • This was a sampling point for The Corps Network
Landon Road – east of Landon Lake Estates	Confirm	• Crossing are three round, concrete culverts • Fish passage issue • This branch of the stream is very small
Landon Road – west of Landon Lake Estates	Confirm	• Crossing is a bridge • Not a fish passage issue • This is the main branch of the stream • Good floodplain with natural trees • No invasive species noted
Interstate 10: numerous crossings flowing south	Confirm	• No safe or legal way to evaluate these crossings
Landon Road	Confirm	• Streams crossing Landon Road appear to be in very good condition with connected flood plains and natural trees
Klondike Road	Confirm	• Could not find a crossing • Klondike Road is not continuous through this area
Rippy Road	Confirm	• Light to moderate litter along road • Not worse than the surrounding areas
End of Creosote Road west of Outlet Mall (said to be landscaping debris)	Confirm	• Not apparent on December 1, 2015, visit • There was only very light road litter
Cogongrass at Head Start Center	Confirm	• Cogongrass (*Imperata cylindrical*) confirmed • Estimate .25 acres in field southwest of center, also Chinese tallow tree (*Sapium sebifera)* there
Cogongrass infestations along utility rights-of-way	Confirm	• Visited one gas pipeline and two power lines north of Interstate 10, found very minor cogongrass *(Imperata cylindrical)* infestations only along roads • Visited an additional two power lines south of Interstate 10 and west of the outlet mall, found light to moderate cogongrass (*Imperata cylindrical)* infestations again, usually along the road sides • It may be that utility companies work on invasives control

IDENTIFIED PROBLEM	ACTION	TNC FIELD TRIP NOTES
Cavenham site	Research history and status	• Phone contact with project engineer also project brochure obtained and on file
Cavenham site erosion	Confirm	• Erosion not visible from Rippy Road • Not evaluated from Bayou Bernard side
Naval base	Research Agent orange storage, disposition, and current status	• Report located, read, summarized and on file
Development plans along Interstate 10 from Exit 34 to Exit 31 (Ward tract)	Research	• Report located, read, and on file
Dirt pit west of Canal Road – increased groundwater flow into Turkey Creek		• No dirt pit located on ground or on aerial photos or maps west of Canal Road • There is a dirt pit east of Canal Road, but it does not appear to hold water
Log jam in stream above Forest Heights neighborhood – likely on Land Trust property	Call to confirm	• Referred to Land Trust • On December 2, 2015, Land Trust reported that this jam has been cleaned up and they no long believe it to be a problem

Table E-6
Coffee Creek Site-specific Problems

IDENTIFIED PROBLEM	ACTION	TNC FIELD TRIP NOTES
Clower-Thornton Wildlife Area	Evaluate severity	• Light to moderate invasive problems • Extensive removal has been done by the Land Trust for the Mississippi Coastal Plain • Species visible were Chinese tallow trees (*Sapium sebifera)*, primarily small, and at least one camphor tree (*Cinnimonum camphora*)
2606 Kelly Avenue	Confirm kudzu	• Kudzu (*Pueraria lobata*) *is* present at this site in the streambed and associated forest areas. • Extent is about .25 acres
U.S. Highway 90	Confirm	• Concrete bridge • Not a fish passage issue • Also will not restrict tidal flow above U.S. Highway 90 • No clogging
Railroad Street	Confirm	• Bridge • Not a fish passage issue • No clogging
CSX railroad bridge at Clower-Thornton Wildlife Area	Confirm	• Good bridge • Not a fish passage issue • Some litter including tires
Hewes Avenue	Confirm	• Good bridge • Not a fish passage issue • No clogging noted • Heavy infestation of kudzu *(Pueraria lobata)*, particularly downstream of bridge, also heavy elephant ear (*Colocasia esculenta*) infestation and heavy litter, primarily street trash
Gulf Avenue	Confirm	• Bridge • Not a fish passage issue • No clogging • This is a trailer park site used by The Corps Network during fall Rapid Stream Assessments
5th Avenue	Confirm	• Concrete box culvert • Not a fish passage issue • No clogging • Heavy invasives including cogongrass • Local resident confirms that this site does not flood, except during Hurricane Katrina • This is one of our designated sampling sites, on city owned tract.
6th Avenue	Confirm	• Concrete box culvert • Not a fish passage issue • No clogging • Very heavy litter, including mattresses and numerous tires
Pine Avenue	Confirm	• Good bridge • Not a fish passage issue • No clogging • Stream here looks stagnant and polluted, but no odor
13th Ave	Confirm	• Appears to be a round culvert, but not clearly visible • Not certain whether this is a fish passage issue • Much growth in stream, clogging is a possibility

IDENTIFIED PROBLEM	ACTION	TNC FIELD TRIP NOTES
14th Avenue	Confirm	• Round, concrete culvert • Fish passage issue • No clogging visible, but not easy to see
Broadmoor	Confirm	• Dead-end street • Stream does not cross
7th Street	Confirm	• Dead-end street • Stream does not cross
24th Street	Confirm	• Stream does not appear to cross above ground
15th Avenue	Confirm	• Stream does not appear to cross above ground
218 25th Street – snags causing flooding	Need access to confirm	• Home is on the small eastern tributary of Coffee Creek • The yard is not visible or accessible, but stream here is very choked with vegetation • Stream is also very small and was completely dry on December 1, 2015, when visited
2606 Kelly Avenue	Confirm erosion	• No access at this site
Hewes and Gulf – erosion behind houses	Confirm and evaluate as possible living shorelines site	• This is a two-block stretch of stream, which is not easily visible or accessible • There is an area of significant erosion immediately west of Gulf Avenue, where the stream is very close to homes in a mobile home park • The stream in this stretch is narrow and deep and runs through several backyards
Broadmoor Place and 28th – possible sewer leak	Confirm	• Not detected by sight or smell
27th and Gulf Avenue – "unkempt"	Confirm that this is an environ-mental problem	• Very serious litter area, including numerous tires and some construction debris • Should be identified as a litter site in Coast wide litter plan • Invasives present, primarily elephant ears *(Colocasia esculenta)*
1009 27th Street – flooding	Look for cause	• Stream flows closely behind house and has a lot of growth in it, including full size trees • The area was not accessible enough to make a clear determination

Table E-7
Brickyard Bayou Site-specific Problems

IDENTIFIED PROBLEM	ACTION	TNC FIELD TRIP NOTES
Mill Road	Evaluate	• Bridge • No fish passage issue • Hardened shoreline and extensive shoreline development in this area
Courthouse Road	Evaluate	• Bridge • No fish passage issue • Extensive close shoreline development including an artificial boat access channel to waterfront homes
Hewes	Evaluate	• Bridge • No fish passage issue
Washington Avenue	Evaluate	• Bridge • No fish passage issue • Channelized, moderate Chinese tallow tree (*Sapium sebifera*) infestation • Moderate road source litter • The Corps Network sampling site
Small tributary heading on Bayou View Middle School, crosses Washington	Evaluate	• Round, concrete culvert • Fish passage issue • Moderate cogon infestation
34th Street	Evaluate	• Bridge • No fish passage issue
8th Avenue	Evaluate	• Bridge • No fish passage issue • This site is slightly upstream from KC Hall, which is one of The Corps Network's sampling sites • Bridge does not restrict kayak access, although stream channel is small and full of snags and trees here • Bald eagle spotted here
28th Street	Evaluate	• Bridge • No fish passage issue • Extensive kudzu (*Pueraria lobata*), cogon *(Imperata cylindrica)* and elephant ears (*Colocasia esculenta*)
22nd Avenue	Evaluate	• Bridge • No fish passage issue • The Corps Network sampling site • Water-level pipes end kayak access here
24th Avenue	Evaluate	• Bridge • No fish passage issue • Channelized, levees closely mowed
25th Street	Evaluate	• Bridge • No fish passage issue • Channelized, very heavy road litter, levees closely mowed
KCS Railroad	Evaluate	• Bridge • No fish passage issue • No access without trespassing
30th Avenue	Evaluate	• Bridge • No fish passage issue • Utility crews on site, close access was not possible

IDENTIFIED PROBLEM	ACTION	TNC FIELD TRIP NOTES
31st Avenue	Evaluate	• Flat-bottom, concrete culvert • No fish passage issue • Recently dug out
32nd Avenue	Evaluate	• Flat-bottom, concrete culvert • No fish passage issue
24th Street, 36th Avenue, and 20th	Evaluate	• No visible stream crossing • Stream must run underground here
38th Terrace	Evaluate	• Stream crosses road, but no access, either physically or visibly • Uncertain of fish passage issues
42nd Street	Evaluate	• Round, concrete culvert • No fish passage issue • Underground flow between 42nd and 45th streets
45th Street	Evaluate	• Flat-bottom, concrete culvert • No fish passage issue
Broad Avenue culverts	Evaluate	• Flat-bottom, concrete culvert • No fish passage issue • Recently dug out
Woodward	Evaluate	• Round-bottom, concrete culvert • Likely fish passage issue • Moderate Chinese tallow tree infestation
Mills Avenue	Evaluate	• Flat-bottom, concrete culvert • No fish passage issue • Underground flow part of distance between Mills and Genevieve
Genevieve	Evaluate	• Flat-bottom, concrete culvert • No fish passage issue
Dixie	Evaluate	• Flat-bottom, concrete culvert • No fish passage issue
Beach	Evaluate	• Corrugated, round, steel culvert. • No fish passage issue • Recently dug out
Stewart	Evaluate	• Round, concrete culvert • Fish passage issue • Recently dug out • Heavy litter
Rohrer	Evaluate	• Round, concrete culvert • No fish passage issue • Recently dug out, very polluted-looking but lots of fish visible
Old Pass Road	Evaluate	• Stream does not visibly cross Old Pass Road
Gaston Point – stream narrows	Confirm that this causes a problem	• This concern is valid • Width of stream channel declines by about 50% from Genevieve, west of Gaston Point to the crossing at Mills, at Gaston Point
42nd and 21st – erosion		• Not plainly obvious at the site • In addition, the site is a long way from the actual stream, but is probably still in the watershed
283 Bayview or Bayou View Drive – erosion on tributary	Confirm	• Location not found • Searches of 283 Bayview and 283 Bayou View do not turn up addresses in Brickyard Bayou watershed
Courthouse Road where Bayou crosses – flooding		• No obvious evidence of flooding at this site

IDENTIFIED PROBLEM	ACTION	TNC FIELD TRIP NOTES
Spring-fed pond, owner attempting to drain – at mouth of stream	Find	• Not found on map • Attempted to find on the ground • Area where this is likely to be is private and there is no obvious access
Flooding on stream from Hewes to U.S. Highway 49 due to snags	Confirm whether an issue	• Stream is full of vegetation • Probably not an ecological issue • Stream upstream from Hewes Avenue has not been cleared • There are many fallen and living trees in the stream, which would create kayak passage issues and might cause localized flooding
Erosion and Galloway and Jody Nelson	Find and confirm	• Only one small area of erosion visible at this street corner • About 50 square feet on drainage ditch in front of apartments • Ditch drains into Brickyard Bayou
Debris buildup at 22nd Avenue		• Confirmed • Cause is water-level pipes which also block further kayak access
Debris buildup at 8th Avenue		• None visible • As noted elsewhere, there has been no snag clearing here and this may contribute to it periodically
Kayak access above KC Hall		• Bridge at 8th Avenue does not restrict kayak access, although stream is narrower here, with snags and trees

Table E-8

Oyster Bayou Site-specific Problems

IDENTIFIED PROBLEM	ACTION	TNC FIELD TRIP NOTES
U.S. Highway 90 bridge	Evaluate	• Appears to be a large, round culvert • Not a fish passage issue • There may be an additional culvert or pipe in an area that was unable to be seen
Beauvoir Avenue culvert	Confirm	• Round culverts • Fish passage issue • Culverts are covered with large mesh screen, which would seem to be a litter trap • Culverts are also heavily silted • Stream flows underground for a long way upstream from here • Extensive areas of elephant ears nearby
Small coastal streams between Beauvoir and Edgewater Mall	Confirm existence and whether they are Oyster Bayou or independent	• Could not locate any streams here • There are no stream channels across the sand beach
Underground drainage on Beauvoir from north	Try to confirm source	• Requested assistance from Biloxi Water Department and am awaiting their call
Look for origin of springs	Changes caused by urban construction and development prevent a clear solution from maps and aerial photographs	

Table E-9
Rhodes Bayou Site-specific Problems

IDENTIFIED PROBLEM	ACTION	TNC FIELD TRIP NOTES
Sherlawn Avenue	Confirm Chinese tallow tree	• Fairly extensive Chinese tallow tree (*Sapium sebifera*) areas along both sides of stream in both directions
Sherlawn Avenue culverts	Confirm	• Crossing is a culvert • Does not appear to be fish passage issue • Water was flowing freely
East tributary fish passage at Martin Luther King Drive	Evaluate	• Crossing is a bridge • Not a fish passage issue • Stream is very small and channel has been lined with rock
Magnolia Avenue bridge	Evaluate	• Not a fish passage issue
East tributary – crossing at Bayou Avenue	Evaluate	• Crossing is a bridge • Excellent fish passage • Stream here is highly tidal influenced • Significant infestation with torpedo grass (*Panicum repens*)
Ward 6 stormwater issues	Confirm stream presence in Ward 6	• Ward 6 extends into the watershed at the northwest corner, south to Barnett Street

Table E-10
Bayou Chicot Site-specific Problems

IDENTIFIED PROBLEM	ACTION	TNC FIELD TRIP NOTES
Bridge at Ingalls Ave (east fork)	Evaluate	• Stream flows through a large round pipe (likely a fish passage issue) • Also flows underground for at least 60 meters
Old Mobile Highway and Hospital Road (west fork)	Confirm culvert is fish passage issue	• Stream crossing is a concrete bridge • Not a fish passage issue
Bridge at Bartlett (west fork)	Evaluate	• Not a fish passage issue
Ingalls Avenue Bridge (west fork)		• Large, concrete bridge • Not a fish passage issue • Stream bottom here is flat mud with a fair amount of litter • Steel bulk heading in both directions, replaced by wooden bulk heading south
Washington Street Bridge (west forks)		• High bridge • Not a fish passage issue • Kayak accessible
Crossing at CSX railroad an U.S. Highway 90 (west fork)		• Not a fish passage issue
Enger and St. Mary Street – siltation	Confirm whether habitat or boat passage issue	• Central fork of stream branches into two channels, both of which are entirely occupied with high-value homes with boat slips and extensive hardening • Likely that these forks are artificially maintained for boat passage • Low tide today revealed the sand bar, which is probably the source of the dredging concerns • Does have the potential to close off the mouth of the central branch of Bayou Chicot from boat traffic, but does not appear to be an environmental issue
West fork from Washington to Ingalls – snags	Confirm whether this is primarily a boat passage issue	• Not obvious looking north from the Washington Avenue Bridge • TCN kayaks have ventured north of this bridge
East fork of Bayou at Washington Avenue	Confirm and evaluate as a possible site for work	• Invasive species are present, primarily Chinese tallow tree (*Sapium sebifera*) in moderate density
Fringing oyster reefs north of Yacht Club	Confirm whether they are alive	• Live oysters are confirmed here
Evaluate Yacht Club as possible oyster garden site		• Based on geography and salinity, Yacht Club would be an ideal site for oyster gardening and should be contacted • The presence of live oysters nearby is another positive indicator
Bridge on Cherokee Avenue (east fork)		• Bridge is currently under construction and not available for viewing
Bridge at Scovell Avenue (east fork)		• Stream crossing is a small, concrete, round pipe • Stream essentially ends at Scovell Avenue
Concrete ditch at 22nd and 21st – hardening		• Stream flows for some distance between high concrete walls • Area is fenced on both sides, and is very close to the road

IDENTIFIED PROBLEM	ACTION	TNC FIELD TRIP NOTES
Hardened shorelines below Washington Avenue	Look for possible living shorelines project site	• Extensive hardening exists on stream below Washington Avenue • All lands are privately owned
East Fork – land protection	Evaluate properties for land purchase or easement	• Property list has been made, and photos taken • Significant opportunity exists for land preservation in this area
Stream north of U.S. Highway 90 to Mississippi Power		• Stream is first visible at the medical center, where it is a dry, straight grassy ditch – Area from medical center to Highway 613 is small, but is a potential restoration area • At Mississippi Power office, stream is a straight ditch running along the east side of the property – It is crossed by several roads and drives, which are flat-bottom, concrete culverts and are not fish passage issues – Stream is crossed by numerous utility rights-of-way, but may still be a potential restoration site • South of Mississippi Power to U.S. Highway 90, stream is a small grassy ditch with several culverts, some flat-bottom concrete and others corrugated steel – The steel culverts may be fish passages issues at low water levels, but were adequate when observed • At U.S. Highway 90, stream flows through a hardened straight ditch between two fast food restaurants – There is a lot of standing water in the creek here.
Stream at end of cul de sac south of CSX Railroad		• Stream is channelized and straightened, and rip rapped on both side.

Appendix F
Watershed Heritage Species

WATERSHED HERITAGE SPECIES

Heritage species include state and federally listed species, species of greatest conservation need (SGCN), and other iconic species. Tables F-1 through F-9 include the heritage species, SGCN rankings, listings, and state and global conservation rankings for each watershed. The source of these lists, as well as a key for the listings and rankings for all of the tables is located at the end of this appendix.

Table F-1
Magnolia Heritage Species

COMMON NAME	*SCIENTIFIC NAME*	SGCN RANK	LISTED	STATE RANK	GLOBAL RANK
American kestrel	*Falco sparverius*	1		S3?B	G5
River frog	*Rana heckscheri*	1		S1?B, SZN	G5
Pine woods snake	*Rhadinaea flavilata*	1		S3	G4
Seaside sparrow	*Ammodramus maritimus*	2		S2B,S4N	G4
Mottled duck	*Anas fulvigula*	2		S2N	G5
Piping plover	*Charadrius melodus*	2	FLE, SLE	S4N	G5
Little blue heron	*Egretta caerulea*	2		S3N	G4
Eastern coral snake	*Micrurus fulvius*	2		S3	G5
Mud salamander	*Pseudotriton montanus*	2		S4N	G5
King rail	*Rallus elegans*	2		S4N	G5
Black skimmer	*Rynchops niger*	2		S2	G5
Brown-headed nuthatch	*Sitta pusilla*	2		S2N	G3
American black duck	*Anas rubripes*	3		S3S4	G5
Lesser scaup	*Aythya affinis*	3		S2	G3G4
Gulf coast toad	*Bufo nebulifer*	3		S4	G5
Dunlin	*Calidris alpina*	3		S2B	G5
Western sandpiper	*Calidris mauri*	3		S4B,S1N	G5
Northern bobwhite	*Colinus virginianus*	3		S2B,S1N	G5
Chicken turtle	*Deirochelys reticularia*	3		S2	G5
Snowy egret	*Egretta thula*	3		S1	G1G3
Tricolored heron	*Egretta tricolor*	3		S3B,S4S5N	G5
Red-headed woodpecker	*Melanerpes erythrocephalus*	3		S1B,S3S4N	G5
Black-crowned night-heron	*Nycticorax*	3		SX	G2
American white pelican	*Pelecanus erythrorhynchos*	3		S4	G5T5
Cooper's hawk	*Accipiter cooperii*			S2	G5
Sharp-shinned hawk	*Accipiter striatus*			S4S5	G5
American bittern	*Botaurus lentiginosus*			S3S4	G5
Amanda's pennant	*Celithemis amanda*			S3B,S4N	G5
Rafinesque's big-eared bat	*Corynorhinus rafinesquii*			S3N	G4
Florida bluet	*Enallagma pollutum*			S1S2	G5T3?
Bay St. Louis skipper	*Euphyes bayensis*			S1	G3G4
Gull-billed tern	*Gelochelidon nilotica*			S2S3	G5
Southern hognose snake	*Heterodon simus*			S3B,S3N	G4
Scarlet kingsnake	*Lampropeltis triangulum elapsoides*			S1	G5
Marl pennant	*Macrodiplax balteata*			S3?	G4

COMMON NAME	*SCIENTIFIC NAME*	SGCN RANK	LISTED	STATE RANK	GLOBAL RANK
Sandhill bean	*Phaseolus polystachios* var. *sinuatus*			S3B,S3N	G5
Georgia milkwort	*Polygala leptostachys*			S4B	G5
Royal tern	*Thalasseus maximus*			S1B,S4N	G5
Gulf coast ribbon snake	*Thamnophis proximus orarius*			SNR	G5T4

Table F-2
Watts Bayou Heritage Species

COMMON NAME	*SCIENTIFIC NAME*	SGCN RANK	LISTED	STATE RANK	GLOBAL RANK
American kestrel	*Falco sparverius*	1		S3?B	G5
River frog	*Rana heckscheri*	1		S1?B, SZN	G5
Pine woods snake	*Rhadinaea flavilata*	1		S3	G4
Seaside sparrow	*Ammodramus maritimus*	2		S2B,S4N	G4
Mottled duck	*Anas fulvigula*	2		S2N	G5
Piping plover	*Charadrius melodus*	2	FLE, SLE	S4N	G5
Rafinesque's big-eared bat	*Corynorhinus rafinesquii*	2		S3N	G4
Little blue heron	*Egretta caerulea*	2		S3	G5
Eastern coral snake	*Micrurus fulvius*	2		S4N	G5
Mud salamander	*Pseudotriton montanus*	2		S4N	G5
King rail	*Rallus elegans*	2		S2	G5
Black skimmer	*Rynchops niger*	2		S2N	G3
Royal tern	*Thalasseus maximus*	2		S4N	G5
American black duck	*Anas rubripes*	3		S3S4	G5
Lesser scaup	*Aythya affinis*	3		S2	G3G4
American bittern	*Botaurus lentiginosus*	3		S4	G5
Gulf coast toad	*Bufo nebulifer*	3		S2B	G5
Dunlin	*Calidris alpina*	3		S4B,S1N	G5
Western sandpiper	*Calidris mauri*	3		S2B,S1N	G5
Northern bobwhite	*Colinus virginianus*	3		S2	G5
Chicken turtle	*Deirochelys reticularia*	3		S3B,S4S5N	G5
Snowy egret	*Egretta thula*	3		S1B,S3S4N	G5
Tricolored heron	*Egretta tricolor*	3		S2B,S2N	G5
Red-headed woodpecker	*Melanerpes erythrocephalus*	3		SX	G2
Black-crowned night-heron	*Nycticorax*	3		S4	G5T5
American white pelican	*Pelecanus erythrorhynchos*	3		S2	G5
Brown-headed nuthatch	*Sitta pusilla*	3		S4S5	G5
Northern harrier	*Circus cyaneus*			S3S4	G5
Cooper's hawk	*Accipiter cooperii*			S3B,S4N	G5
Sharp-shinned hawk	*Accipiter striatus*			S3N	G4
Amanda's pennant	*Celithemis amanda*			S1S2	G5T3?
Florida bluet	*Enallagma pollutum*			S1	G3G4
Gull-billed tern	*Gelochelidon nilotica*			S2S3	G5
Bald eagle	*Haliaeetus leucocephalus*			S3B,S3N	G4
Southern hognose snake	*Heterodon simus*			S1	G5
Scarlet kingsnake	*Lampropeltis triangulum elapsoides*			S3?	G4
Marl pennant	*Macrodiplax balteata*			S3B,S3N	G5

COMMON NAME	*SCIENTIFIC NAME*	SGCN RANK	LISTED	STATE RANK	GLOBAL RANK
Sandhill bean	*Phaseolus polystachios* var. *sinuatus*			S4B	G5
Georgia milkwort	*Polygala leptostachys*			S1B,S4N	G5
Gulf coast ribbon snake	*Thamnophis proximus orarius*			SNR	G5T4

Table F-3

Table Bear Point Bayou Heritage Species

COMMON NAME	*SCIENTIFIC NAME*	SGCN RANK	LISTED	STATE RANK	GLOBAL RANK
American kestrel	*Falco sparverius*	1		S3N	G5
Pine woods snake	*Rhadinaea flavilata*	1		S4N	G5
Bewick's wren	*Thryomanes bewickii*	1		S4N	G5
Nelson's sharp-tailed sparrow	*Ammodramus nelsoni*	2		S2N	G3
Piping plover	*Charadrius melodus*	2	FLE, SLE	S3S4	G5
Reddish egret	*Egretta rufescens*	2		S2N	G4
Black rail	*Laterallus jamaicensis*	2		S3B,S4S5N	G5
Brown pelican	*Pelecanus occidentalis*	2		S4	G5T5
King rail	*Rallus elegans*	2		S2N	G4
Black skimmer	*Rynchops niger*	2		S2S3	G3G5
Least tern	*Sternula antillarum*	2		S4S5	G5
Northern pintail	*Anas acuta*	3		S1N	G4
Lesser scaup	*Aythya affinis*	3		S3B,S3N	G4
Northern bobwhite	*Colinus virginianus*	3		S3?	G4
Red-headed woodpecker	*Melanerpes erythrocephalus*	3		S3B,S3N	G5
Brown-headed nuthatch	*Sitta pusilla*	3		S4B	G5
Scarlet kingsnake	*Lampropeltis triangulum*			S3B	G4
Carolina lilaeopsis	*Lilaeopsis carolinensis*			S1B,S4N	G5
Royal tern	*Thalasseus maximus*			S2B,S3N	G5

Table F-4

Turkey Creek Heritage Species

COMMON NAME	*SCIENTIFIC NAME*	SGCN LIST	LISTED	STATE RANK	GLOBAL RANK
Black rail	*Laterallus jamaicensis*	1		S4N	G5
Pine woods snake	*Rhadinaea flavilata*	1		S2S3	G3G4
Bewick's wren	*Thryomanes bewickii*	1	FLSAT, SLE	S4	G5
Nelson's sharp-tailed sparrow	*Ammodramus nelsoni*	2		S1	G5
Piping plover	*Charadrius melodus*	2		S3N	G5
Brown pelican	*Pelecanus occidentalis*	2		S4N	G5
King rail	*Rallus elegans*	2		S4N	G5
Black skimmer	*Rynchops niger*	2		S2	G5
Reddish egret	*Egretta rufescens*	2		S2N	G3
Northern pintail	*Anas acuta*	3		S3S4	G5
Lesser scaup	*Aythya affinis*	3		S2N	G4
Northern bobwhite	*Colinus virginianus*	3		S2	G4

COMMON NAME	*SCIENTIFIC NAME*	SGCN LIST	LISTED	STATE RANK	GLOBAL RANK
Red-headed woodpecker	*Melanerpes erythrocephalus*	3		S2	G4
Brown-headed nuthatch	*Sitta pusilla*	3		S1S2	G3
Coastal plain false-foxglove	*Agalinis aphylla*			S4	G5T5
American alligator	*Alligator mississippiensis*			S2N	G4
Southern amaranth	*Amaranthus australis*			S2S3	G3G5
Coast sedge	*Carex exilis*			S4S5	G5
Cherry bluet	*Enallagma concisum*			S4	G5
Green-fly orchid	*Epidendrum conopseum*			S4	G5
Gulf rockrose	*Helianthemum arenicola*			S1N	G4
Juneberry holly	*Ilex amelanchier*			S1S2	G4?
Scarlet kingsnake	*Lampropeltis triangulum elapsoides*			S1S2	G3
Carolina lilaeopsis	*Lilaeopsis carolinensis*			S3B,S3N	G4
Coastal shiner	*Notropis petersoni*			S3?	G4
Stalked adders-tongue	*Ophioglossum petiolatum*			S3B,S3N	G5
Crenate milkwort	*Polygala crenata*			S1	G4
Hooker's milkwort	*Polygala hookeri*			S4B	G5
Reticulated nutrush	*Scleria reticularis*			S2	G3
Giant spiral ladies'-tresses	*Spiranthes longilabris*			S1B,S4N	G5
Royal tern	*Thalasseus maximus*			S2B,S3N	G5

Table F-5

Coffee Creek Heritage Species

COMMON NAME	*SCIENTIFIC NAME*	SGCN RANK	LISTED	STATE RANK	GLOBAL RANK
American kestrel	*Falco sparverius*	1		S3N	G5
Black rail	*Laterallus jamaicensis*	1		S4N	G5
Pine woods snake	*Rhadinaea flavilata*	1		S4N	G5
Bewick's wren	*Thryomanes bewickii*	1	SLE FLSA	S2N	G3
Nelson's sharp-tailed sparrow	*Ammodramus nelsoni*	2		S3S4	G5
Piping plover	*Charadrius melodus*	2		S2N	G4
Reddish egret	*Egretta rufescens*	2		S2	G4
Brown pelican	*Pelecanus occidentalis*	2		s3B, S4S5N	G5
King rail	*Rallus elegans*	2		S2S3	G4
Black skimmer	*Rynchops niger*	2		S1S2	G3
Northern pintail	*Anas acuta*	3		S4	G5T5
Lesser scaup	*Aythya affinis*	3		S2N	G4
Northern bobwhite	*Colinus virginianus*	3		S2S3	G3G5
Red-headed woodpecker	*Melanerpes erythrocephalus*	3		S4S5	G5
Brown-headed nuthatch	*Sitta pusilla*	3		S4	G5
Cherry bluet	*Enallagma concisum*			S1N	G4
Dangleberry	*Gaylussacia nana*			S2	G4G5
Gulf rockrose	*Helianthemum arenicola*			S1S2	G3
Scarlet kingsnake	*Lampropeltis triangulum elapsoides*			S2	G5
Carolina lilaeopsis	*Lilaeopsis carolinensis*			S3B,S3N	G4
Coastal shiner	*Notropis petersoni*			S3?	G4
Large white fringed orchid	*Platanthera blephariglottis*			S3	G3

COMMON NAME	*SCIENTIFIC NAME*	SGCN RANK	LISTED	STATE RANK	GLOBAL RANK
Hooker's milkwort	*Polygala hookeri*			S3B,S3N	G5
Myrtle-leaf oak	*Quercus myrtifolia*			S4B	G5
Large beakrush	*Rhynchospora macra*			S1B,S4N	G5
Royal tern	*Thalasseus maximus*		SLE	S2B,S3N	G5

Table F-6

Brickyard Heritage Species

COMMON NAME	*SCIENTIFIC NAME*	SGCN RANK	LISTED	STATE RANK	GLOBAL RANK
Black rail	*Laterallus jamaicensis*	1		S3N	G5
Pine woods snake	*Rhadinaea flavilata*	1		S4N	G5
Bewick's wren	*Thryomanes bewickii*	1	SLE, FLSAT	S4N	G5
Nelson's sharp-tailed sparrow	*Ammodramus nelsoni*	2		S2N	G3
Piping plover	*Charadrius melodus*	2	SLE, FLE	S3S4	G5
Reddish egret	*Egretta rufescens*	2		S2N	G4
Brown pelican	*Pelecanus occidentalis*	2		S2	G4
King rail	*Rallus elegans*	2		S3B,S4S5N	G5
Black skimmer	*Rynchops niger*	2		S2S3	G4
Royal tern	*Thalasseus maximus*	2		S1S2	G3
Northern pintail	*Anas acuta*	3		S4	G5T5
Lesser scaup	*Aythya affinis*	3		S2N	G4
Northern bobwhite	*Colinus virginianus*	3		S4S5	G5
Red-headed woodpecker	*Melanerpes erythrocephalus*	3		S4	G5
Brown-headed nuthatch	*Sitta pusilla*	3		S1N	G4
Gulf rockrose	*Helianthemum arenicola*			S2	G4G5
Cherry bluet	*Enallagma concisum*			S3	G5
American kestrel	*Falco sparverius*			S1S2	G4?
Dangleberry	*Gaylussacia nana*			S1S2	G3
Scarlet kingsnake	*Lampropeltis triangulum elapsoides*			S2	G5
Coastal shiner	*Notropis petersoni*			S3B,S3N	G4
Large white fringed orchid	*Platanthera blephariglottis*			S3?	G4
Crested fringed orchid	*Platanthera cristata*			S3	G3
Crenate milkwort	*Polygala crenata*			S3B,S3N	G5
Hooker's milkwort	*Polygala hookeri*			S4B	G5
Myrtle-leaf oak	*Quercus myrtifolia*			S1B,S4N	G5
Large beakrush	*Rhynchospora macra*			S2B,S3N	G5

Table F-7

Oyster Bayou Heritage Species

COMMON NAME	*SCIENTIFIC NAMES*	SGCN RANK	LISTED	STATE RANK	GLOBAL RANK
Gulf sturgeon	*Acipenser oxyrinchus desotoi*	1	FLT, SLE	S1	G3T2
American oystercatcher	*Haematopus palliatus*	1		S3N	G5
Black rail	*Laterallus jamaicensis*	1		S4N	G5

COMMON NAME	*SCIENTIFIC NAMES*	SGCN RANK	LISTED	STATE RANK	GLOBAL RANK
Kemp's or atlantic ridley	*Lepidochelys kempii*	1	SLE, FLE	S4N	G5
River frog	*Rana heckscheri*	1		S2	G4
Pine woods snake	*Rhadinaea flavilata*	1		S2N	G3
Reticulated nutrush	*Scleria reticularis*	1		S3S4	G5
Nelson's sharp-tailed sparrow	*Ammodramus nelsoni*	2		S2S3	G5T3T4
Piping plover	*Charadrius melodus*	2		S2N	G4
Reddish egret	*Egretta rufescens*	2		SH	G5?
Brown pelican	*Pelecanus occidentalis*	2		S2	G4
Eastern brown pelican	*Pelecanus occidentalis carolinensis*	2		S1	G5
King rail	*Rallus elegans*	2		S1S2	G3
Royal tern	*Thalasseus maximus*	2		S2N	G4
Northern pintail	*Anas acuta*	3		S1N	G1
Lesser scaup	*Aythya affinis*	3		S2	G4T3Q
Snowy plover	*Charadrius alexandrinus*	3		S4S5	G5
Mississippi diamondback terrapin	*Malaclemys terrapin pileata*	3		S4	G5
Red-headed woodpecker	*Melanerpes erythrocephalus*	3		S1N	G4
Brown-headed nuthatch	*Sitta pusilla*	3		S1N	G4TU
Northern bobwhite	*Colinus virginianus*			S4N	G5
Pine barrens prairie clover	*Dalea carnea var. gracilis*			S2	G4G5
Pan american balsamscale	*Elyonurus tripsacoides*			S1S2	G3
Cherry bluet	*Enallagma concisum*			S3B,S3N	G4
Gulf rockrose	*Helianthemum arenicola*			S1	G5
Coastal shiner	*Notropis petersoni*			S3?	G4
Double-crested cormorant	*Phalacrocorax auritus*			S2	G2
Large white fringed orchid	*Platanthera blephariglottis*			S3B,S3N	G5
Hooker's milkwort	*Polygala hookeri*			S1	G4
Night-flowering ruellia	*Ruellia noctiflora*			S4B	G5
Black skimmer	*Rynchops niger*			S1B,S4N	G5

Table F-8

Rhodes Heritage Species

COMMON NAME	*SCIENTIFIC NAME*	SGNC RANK	LISTED	STATE RANK	GLOBAL RANK
American kestrel	*Falco sparverius*	1		S3	G4
Mississippi sandhill crane	*Grus canadensis pulla*	1	SLE, FLE	S2N	G5
Seaside sparrow	*Ammodramus maritimus*	2		S4N	G5
Red knot	*Calidris canutus*	2		S3N	G4
Least crayfish	*Cambarellus diminutus*	2		S4N	G5
Piping plover	*Charadrius melodus*	2		S2N	G4
Little blue heron	*Egretta caerulea*	2		S4N	G5
Tricolored heron	*Egretta tricolor*	2		S2	G3
Bald eagle	*Haliaeetus leucocephalus*	2		S2N	G3
King rail	*Rallus elegans*	2		S4N	G5
Black skimmer	*Rynchops niger*	2		S3S4	G5
Brown-headed nuthatch	*Sitta pusilla*	2		SNR	G5
American black duck	*Anas rubripes*	3		S2B	G5

COMMON NAME	*SCIENTIFIC NAME*	SGNC RANK	LISTED	STATE RANK	GLOBAL RANK
Lesser scaup	*Aythya affinis*	3		S4B,S1N	G5
American bittern	*Botaurus lentiginosus*	3		S2B,S1N	G5
Dunlin	*Calidris alpina*	3		S1N	G4
Western sandpiper	*Calidris mauri*	3		S3B,S4S5N	G5
Northern bobwhite	*Colinus virginianus*	3		S1	G5
Snowy egret	*Egretta thula*	3		S1	G5T1
Osprey	*Pandion haliaetus*	3		S2B,S2N	G5
American white pelican	*Pelecanus erythrorhynchos*	3		S3B,S1N	G5
American woodcock	*Scolopax minor*	3		S3B,S1S2N	G5
Northern harrier	*Circus cyaneus*			S3N	G4
Hammock prairie-clover	*Dalea carnea*			S3B,S3N	G4
Peregrine falcon	*Falco peregrinus*			S3B,S3N	G5
Sandhill crane	*Grus canadensis*			SNR	G5
Yellow-crowned night-heron	*Nyctanassa violacea*			S4B	G5
Spanish ambersnail	*Succinea luteola*			SNR	G4
Royal tern	*Thalasseus maximus*			S1B,S4N	G5

Table F-9

Bayou Chicot Heritage Species

COMMON NAME	*SCIENTIFIC NAME*	SGCN RANK	LISTED	STATE RANK	GLOBAL RANK
American kestrel	*Falco sparverius*	1		S3	G4
Mississippi sandhill crane	*Grus canadensis pulla*	1	SLE, FLE	S2N	G5
Seaside sparrow	*Ammodramus maritimus*	2		S4N	G5
Dunlin	*Calidris alpina*	2		S3N	G4
Red knot	*Calidris canutus*	2		S4N	G5
Least crayfish	*Cambarellus diminutus*	2		S2N	G4
Piping plover	*Charadrius melodus*	2	SLE, FLE	S4N	G5
Little blue heron	*Egretta caerulea*	2		S2	G3
Bald eagle	*Haliaeetus leucocephalus*	2		S2N	G3
Eastern brown pelican	*Pelecanus occidentalis carolinensis*	2		S4N	G5
King rail	*Rallus elegans*	2		S3S4	G5
Black skimmer	*Rynchops niger*	2		SNR	G5
Least tern	*Sternula antillarum*	2		S2B	G5
Royal tern	*Thalasseus maximus*	2		S4B,S1N	G5
American black duck	*Anas rubripes*	3		S2B,S1N	G5
Lesser scaup	*Aythya affinis*	3		S1	G4G5
American bittern	*Botaurus lentiginosus*	3		S1N	G4
Western sandpiper	*Calidris mauri*	3		S3B,S4S5N	G5
Northern bobwhite	*Colinus virginianus*	3		S1B,S3S4N	G5
Snowy egret	*Egretta thula*	3		S1	G5
Tricolored heron	*Egretta tricolor*	3		S1	G5T1
Yellow-crowned night-heron	*Nyctanassa violacea*	3		S2B,S2N	G5
Osprey	*Pandion haliaetus*	3		SNR	GNR
American white pelican	*Pelecanus erythrorhynchos*	3		S2S3	G3G5
American woodcock	*Scolopax minor*	3		S3B,S1N	G5
Brown-headed nuthatch	*Sitta pusilla*	3		S3B,S1S2N	G5

COMMON NAME	*SCIENTIFIC NAME*	SGCN RANK	LISTED	STATE RANK	GLOBAL RANK
Northern harrier	*Circus cyaneus*			S3N	G4
Hammock prairie-clover	*Dalea carnea*			S1N	G4TU
Tall prairie-gentain	*Eustoma exaltatum*			S3B,S3N	G4
Peregrine falcon	*Falco peregrinus*			S3B,S3N	G5
Gull-billed tern	*Gelochelidon nilotica*			SNR	G5
Sandhill crane	*Grus canadensis*			S4B	G5
Least tern	*Sternula antillarum*			S3B	G4
Carolina lilaeopsis	*Lilaeopsis carolinensis*			SNR	G4
Spanish ambersnail	*Succinea luteola*			S1B,S4N	G5

NOTES:

Global Rank = The global or world-wide rank of a species which is a non-legal rank indicating the rarity and vulnerability of a species

G1 = Critically Imperiled Extremely rare and critical imperiled in the world with five or fewer occurrences, or very few remaining individuals, or because of some special condition where the species is particularly vulnerable to extinction

G2 = Imperiled Very rare and imperiled within the world, six to twenty occurrences, or fewer remaining individuals, or because of some factor(s) making it vulnerable to extinction

G3 = Vulnerable Rare and uncommon in its range or found locally in a restricted range, generally from 21 to 100 occurrences

G4 = Apparently Secure Widespread, abundant, and apparently secure globally, but with cause for long-term concern.

G5 = Secure Demonstrably widespread and secure globally

GH = Possibly Extinct Missing; known only from historical occurrences but still some hope of rediscovery

GU = Unranked Cannot be ranked using available information

GX = Presumed Extinct Not located despite intensive searches; virtually no likelihood of rediscovery

Federal Status = Federal legal listing under the U.S. Endangered Species Act

C = Candidate Species: Species for which the U.S. Fish and Wildlife Service has sufficient information to support proposals to list a species as threatened or endangered, and for which the service anticipates a listing proposal

E/SA or T/SA = Listed Endangered or Threatened by Similarity of Appearance: Species treated as threatened or endangered due to similarity of appearance to a species which is federally listed such that enforcement personnel have difficulty in attempting to differentiate between the listed and unlisted species

LE = Listed Endangered: Species is threatened by extinction throughout all or a significant portion of its range

PDL = Proposed for Delisting

PE or PT = Proposed Endangered or Proposed Threatened Species currently proposed for listing as endangered or threatened

PS = Partial Status: Indicates "partial status" - status in only a portion of the species' range

TE = Listed Threatened: Species is likely to become endangered in the foreseeable future throughout all or a significant portion of its range

State Status = Legal listing in Mississippi

LE = Listed Endangered: Species is threatened by extinction throughout all or a significant portion of its range

SC = Species of Special Concern: Any species or subspecies of plant that is uncommon in Mississippi, or has unique or highly specific habitat requirements or scientific value and therefore requires careful monitoring of its status

State Rank =This is a non-legal rank of a species in Mississippi indicating the rarity and vulnerability of a species at the state level

S1 = Critically Imperiled Extremely rare and critical imperiled in the world with five or fewer occurrences, or very few remaining individuals, or because of some special condition where the species is particularly vulnerable to extinction

S2 = Imperiled Very rare and imperiled within the world, six to twenty occurrences, or fewer remaining individuals, or because of some factor(s) making it vulnerable to extinction

S3 = Vulnerable Rare and uncommon in its range or found locally in a restricted range, generally from 21 to 100 occurrences

S4 = Apparently Secure Widespread, abundant, and apparently secure globally, but with cause for long-term concern

S5 = Secure Demonstrably widespread and secure globally

SH = Possibly Extinct Missing; known only from historical occurrences but still some hope of rediscovery

SNA = Rank not Applicable State Rank is not applicable because the element is not a suitable target for conservation

SNR = Not Ranked Element not yet ranked

SU = Unranked Cannot be ranked using available information

SX = Presumed Extinct Not located despite intensive searches; virtually no likelihood of rediscovery

SOURCE:

Mississippi Natural Heritage Program, 2011. *Listed Species of Mississippi.* Jackson, MS: Museum of Natural Science, Mississippi Department of Wildlife, Fisheries, and Parks.

Appendix G
Natural Habitats Present in Streams

NATURAL HABITATS PRESENT IN STREAMS

Habitats found in the nine target streams of this Conservation Action Plan are listed in Tables G-1 and G-2 by habitat and by stream. These habitats are identified in the *East Gulf Coastal Plain Ecoregional Plan* (TNC 1999) and the *Identification of Priority Sites for Conservation in the Northern Gulf of Mexico: An Ecoregional Plan* (Beck et al. 2000). Additional classifications, including sub-classifications, can be found in *Mississippi's Comprehensive Wildlife Conservation Strategy, 2005-2015* (MMNS 2005) and draft update (MMNS 2015).

Table G-1

East Gulf Coastal Plain Ecoregion Habitats

HABITAT	LOCATION
WET PINE SAVANNA	
Slash pine flatwoods	Turkey Creek, Watts Bayou
URBAN	
Buildings, bridges, overpasses	All streams
Utility rights of way	Turkey Creek
Pasture lands	Turkey Creek
Shrub lands	Turkey Creek
Artificial ponds	Bear Point Bayou, Oyster Bayou, Rhodes Bayou
Parklands	Coffee Creek
Landscaped yards	All streams
Vacant lots	All streams
Gardens	All streams
Wooded patches along drainages	All streams
STREAMS	
Artificial beaches	Coffee Creek, Oyster Bayou, Bear Point Bayou
Perennial freshwater streams	Bear Point Bayou, Magnolia Bayou, Coffee Creek, Oyster Bayou, Bayou Chicot

Table D-2

North Gulf of Mexico Ecoregion Habitats

HABITAT	LOCATION
MARITIME FORESTS	
Slash pine flatwoods	Turkey Creek, Watts Bayou
CREEKS	
Freshwater tidal creeks	Rhodes Bayou
Tidal marsh creeks	Watts Bayou, Magnolia Bayou, Turkey Creek, Rhodes Bayou, Bayou Chicot
ESTUARINE MARSH	
Regularly flooded salt marsh	Watts Bayou, Magnolia Bayou, Brickyard Bayou, Rhodes Bayou, Bayou Chicot
Irregularly flooded salt marsh	Watts Bayou, Magnolia Bayou, Brickyard Bayou, Rhodes Bayou, Bayou Chicot
Brackish marsh	Watts Bayou, Magnolia Bayou, Brickyard Bayou, Rhodes Bayou, Bayou Chicot
Tidal freshwater marsh	Magnolia Bayou, Bayou Chicot
REEFS	
Mollusk reef	Magnolia Bayou, Bayou Chicot

References

Beck, M. W., M. Odaya, J. J. Bachant, J. Bergan, B. Keller, R. Martin, R. Mathews, C., Porter, G. Ramseur, 2000. *Identification of Priority Sites for Conservation in the Northern Gulf of Mexico: An Ecoregional Plan*. Arlington, VA: The Nature Conservancy.

MMNS (Mississippi Museum of Natural Science), 2005. *Mississippi's Comprehensive Wildlife Conservation Strategy, 2005-2015*. Jackson, MS: Mississippi Department of Wildlife, Fisheries, and Parks, Mississippi Museum of Natural Science.

MMNS, 2015. *Mississippi's State Wildlife Action Plan, 2015-2025.* Draft. Jackson, MS: Mississippi Department of Wildlife, Fisheries, and Parks, Mississippi Museum of Natural Science.

TNC (The Nature Conservancy), 1999. *East Gulf Coastal Plain Ecoregional Plan.* Revised 2001. Durham, NC: The Nature Conservancy.

Appendix H
Sampling Points for Watersheds

SAMPLING POINTS FOR WATERSHEDS

Figures H-1 through H-9 depict the sampling points from each watershed. Sampling points were selected to reflect areas of different habitats or conditions on each stream. An attempt was made to locate a sampling point on each tributary. From a practical point of view, access was also a consideration. A few sampling points were added or deleted during the field sessions. Sample locations on these maps include points for Rapid Stream Assessments and water quality sampling conducted by the Mississippi Department of Environmental Quality.

Figure H-1
Magnolia Bayou Sampling Points



Water Quality Sample Locations (DEQ)

Rapid Stream Assessment Sites

Magnolia Bayou

Watershed Boundary

N W E S

700 350 0 700

Feet

1:8,400

Map Created by: Baton Rouge, Louisiana Field Office (JA)
Date: 8/24/2016

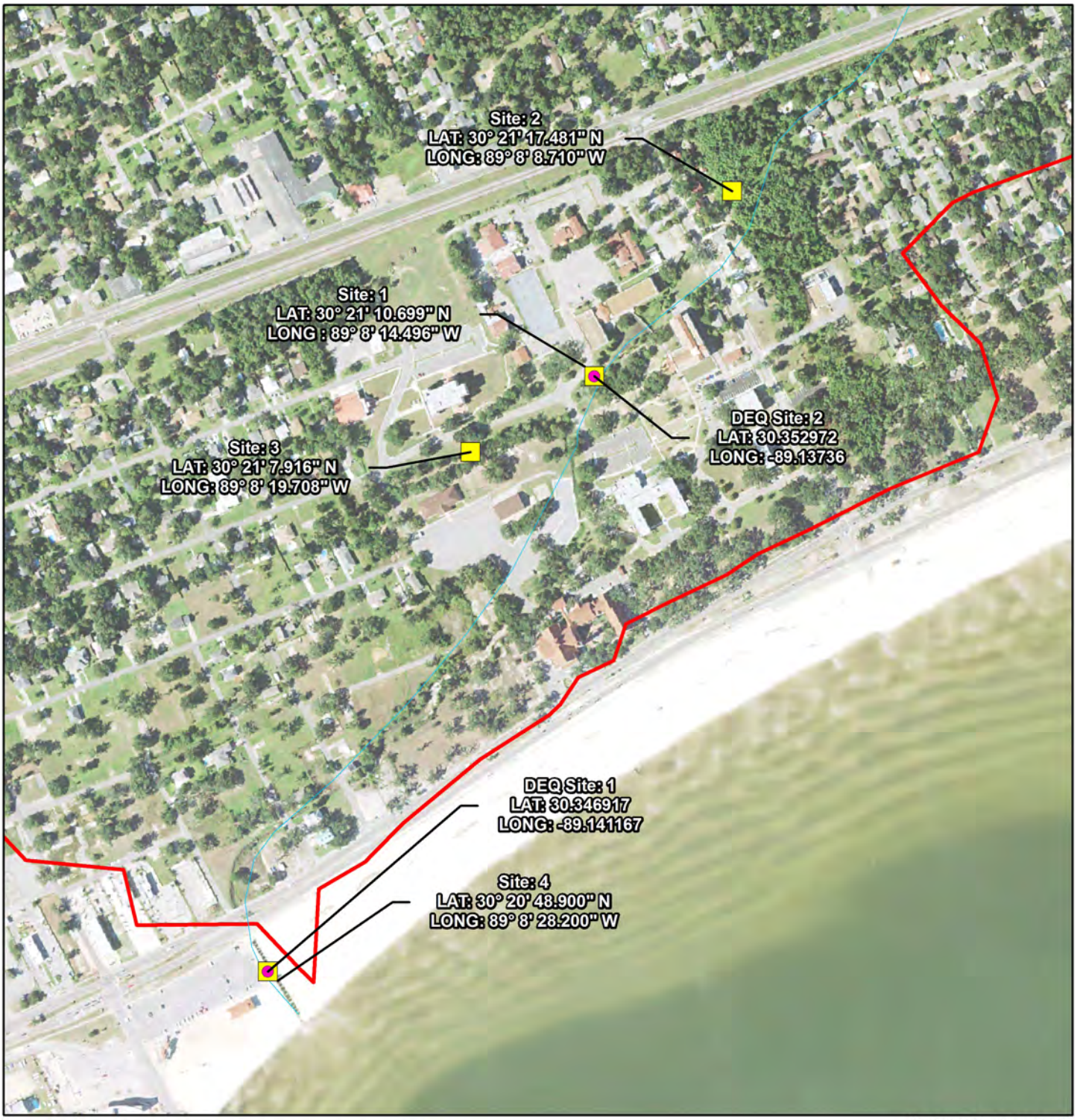
Source: 2014 NAIP Imagery (USDA

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Figure H-2
Watts Bayou Sampling Points



Figure H-3
Bear Point Bayou Sampling Points



Water Quality Sample Locations (DEQ)

Rapid Stream Assessment Sites

Bear Point Bayou

Watershed Boundary

N W E S

500 250 0 500

Feet

1:6,000

Map Created by: Baton Rouge, Louisiana Field Office (JA)
Date: 8/24/2016

Source: 2014 NAIP Imagery (USDA

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Figure H-4
Turkey Creek Sampling Points



Water Quality Sample Locations (DEQ)

Rapid Stream Assessment Sites

Turkey Creek

Watershed Boundary

N W E S

3,500 1,750 0 3,500

Feet

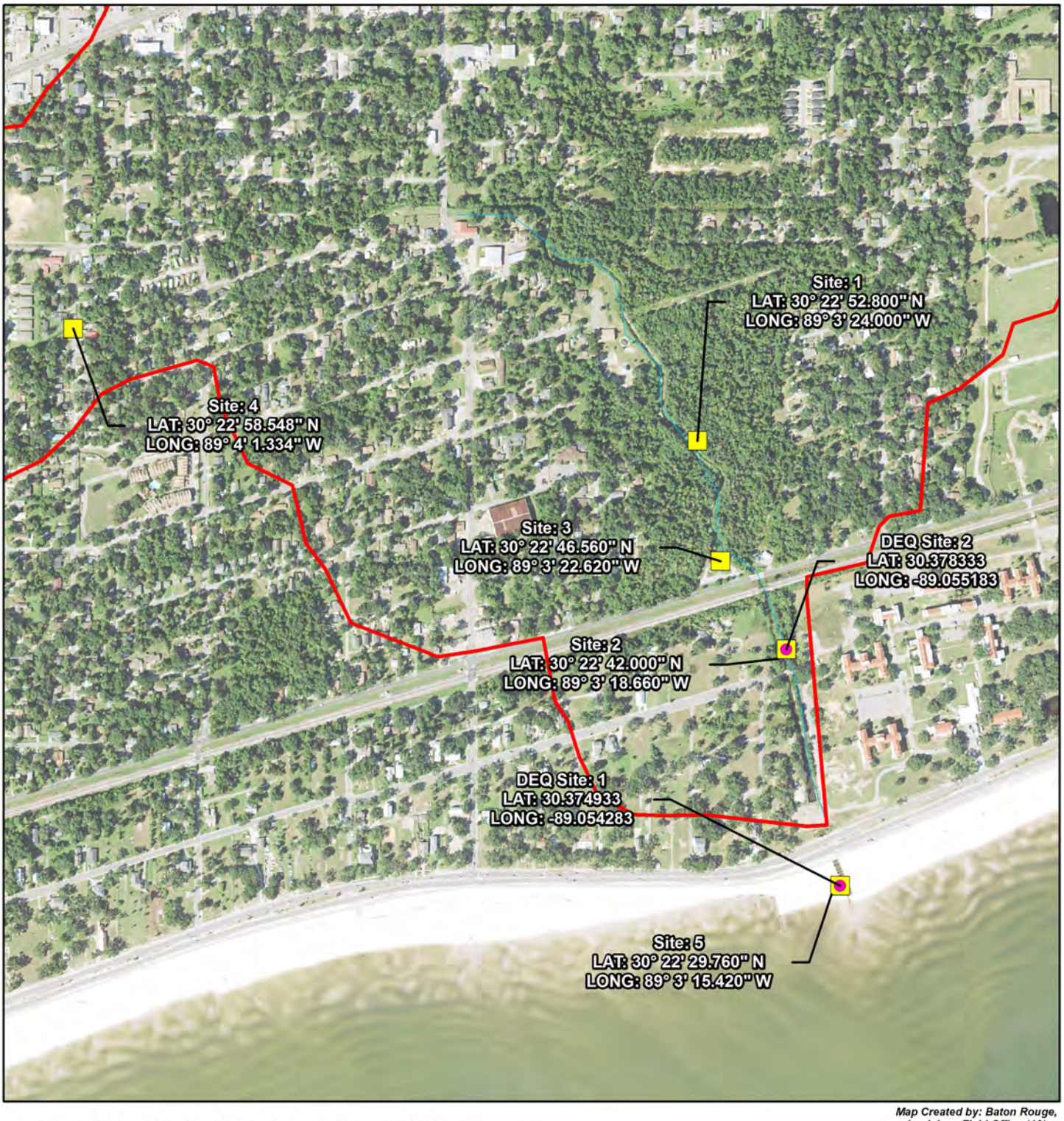
1:42,000

Map Created by: Baton Rouge, Louisiana Field Office (JA)
Date: 8/24/2016

Source: 2014 NAIP Imagery (USDA

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Figure H-5
Coffee Creek Sampling Points



Water Quality Sample Locations (DEQ)
Rapid Stream Assessment Sites
Coffee Creek
Watershed Boundary

N
W E
S

700 350 0 700
Feet

1:8,400

Map Created by: Baton Rouge, Louisiana Field Office (JA)
Date: 8/24/2016

Source: 2014 NAIP Imagery (USDA

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Figure H-6
Brickyard Bayou Sampling Points



Water Quality Sample Locations (DEQ)

Rapid Stream Assessment Sites

Brickyard Bayou

Watershed Boundary

N
W E
S

2,750 1,375 0 2,750
Feet

1:35,750

Map Created by: Baton Rouge, Louisiana Field Office (JA)
Date: 8/24/2016

Source: 2014 NAIP Imagery (USDA

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Figure H-7
Oyster Bayou Sampling Points



Water Quality Sample Locations (DEQ)
Rapid Stream Assessment Sites
Oyster Bayou
Watershed Boundary

N
W
E
S

300 150 0 300
Feet

1:3,600

Map Created by: Baton Rouge, Louisiana Field Office (JA)
Date: 8/24/2016

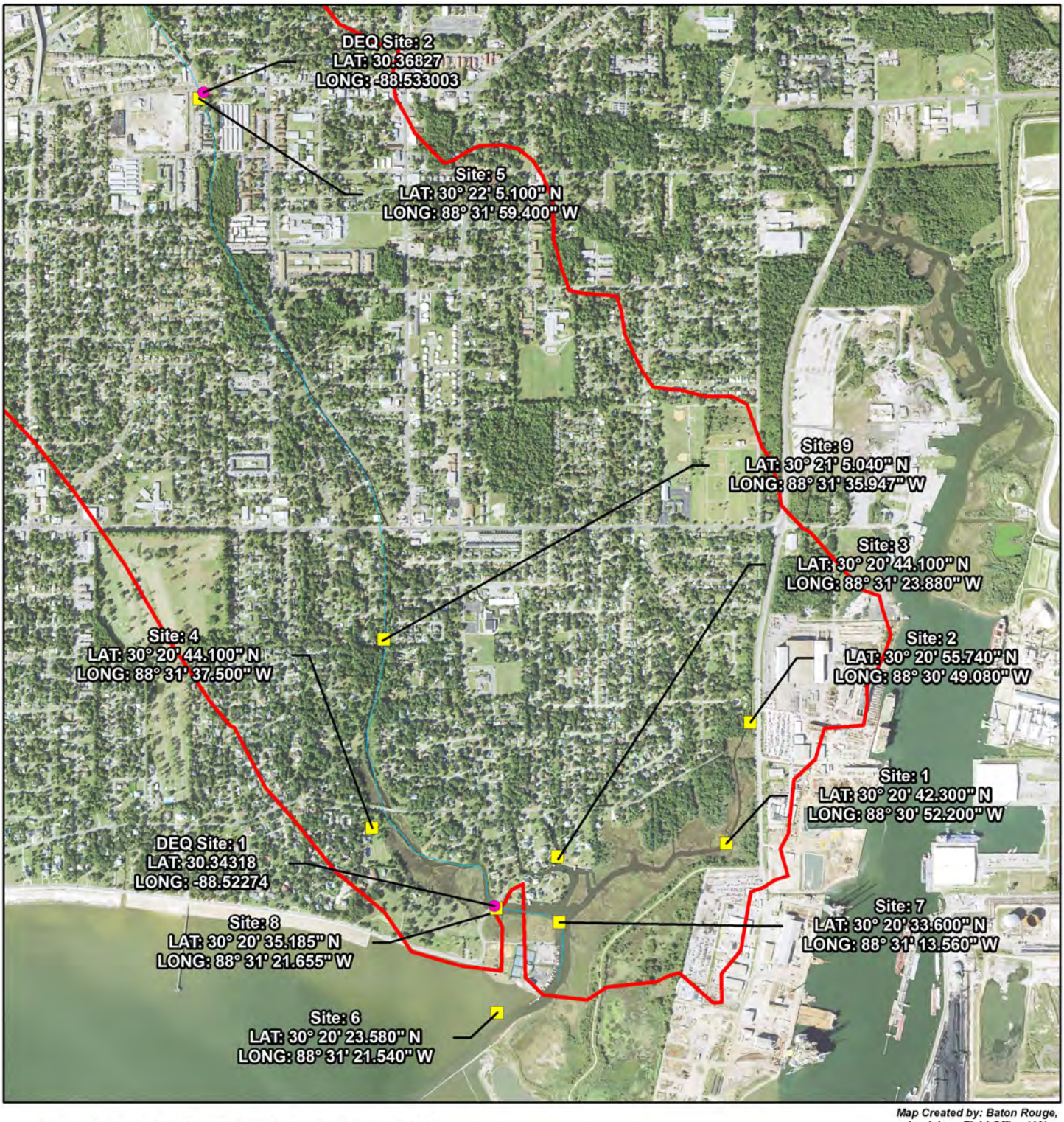
Source: 2014 NAIP Imagery (USDA

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Figure H-8
Rhodes Bayou Sampling Points



Figure H-9
Bayou Chicot Sampling Points



Map Created by: Baton Rouge, Louisiana Field Office (JA)
Date: 8/23/2016

Water Quality Sample Locations (DEQ)
Rapid Stream Assessment Sites
Bayou Chicot
Watershed Boundary

N
W E
S

1,500 750 0 1,500
Feet

1:18,000

Source: 2014 NAIP Imagery (USDA

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Appendix I
Water Sampling Parameters and Testing Sites

WATER SAMPLING PARAMETERS AND TESTING SITES

Water samples were collected twice a month from March 2016 to August 2016, with the exception of biological oxygen demand and chlorophyll- *a*. The following parameters were used by Mississippi Department of Environmental Quality Field Services Department staff, and testing was conducted in accordance with the Mississippi Department of Environmental Quality's Quality Assurance/Quality Control standards:

- Specific conductance (umbros)
- pH (standard units)
- Water temperature (°C)
- Dissolved oxygen (mg/l)
- Dissolved oxygen (% saturation)
- Conductivity (mMho/cm)
- Total dissolved solids (mg/l)
- Salinity (ppt)
- Turbidity (NTU)
- Alkalinity (mg/l)
- Total suspended solids (mg/l)
- Chemical oxygen demand (mg/l)
- Total phosphorus (mg/l)
- Total Kjeldahl nitrogen (mg/l)
- Ammonia (mg/l)
- Hardness (mg/l)
- Total chlorides (mg/l)
- Biological oxygen demand (mg/l)
- Chlorophyll-*a* (mg/l)

The specific water sampling locations for the streams are listed in Table I-1.

Table I-1
Water Sampling Locations

enSPIRE ID	STREAM	DESCRIPTION	LATITUDE	LONGITUDE	COUNTY
02481252	Turkey Creek	At Gulfport at (Airport Rd) Cresote Rd	30.42380556	-89.07027778	Harrison
CS221	Turkey Creek	At Gulfport at Old Hwy 49 Bridge	30.41238889	-89.09477778	Harrison
02481240	Turkey Creek	Near Long Beach at Canal Rd Bridge 2.5 Miles North of Long Beach	30.39805556	-89.13666667	Harrison
111D73	Rhodes Bayou	At Torres Avenue	30.41596667	-88.54375000	Jackson
111D74	Rhodes Bayou	At Bellview Avenue	30.41245000	-88.54500000	Jackson
111D75	Bayou Chicot	Bayou Chico Near Beach Boulevard	30.34266667	-88.52043333	Jackson
111D76	Bayou Chicot	At Old Mobile Highway	30.36826983	-88.53300283	Jackson
111D77	Oyster Bayou	At U.S. 90 Beach Boulevard	30.39128333	-88.96745000	Harrison
111D78	Oyster Bayou	At Beauvoir Road	30.39377694	-88.97161583	Harrison
111D79	Coffee Creek	At E Beach Boulevard Us 90	30.37493333	-89.05428333	Harrison
111D80	Coffee Creek	At 2nd Street	30.37833333	-89.05518333	Harrison
111D81	Coffee Creek	At East Railroad Street	30.37960000	-89.05628333	Harrison
111D82	Bear Point Bayou	U.S. 90 East at Long Beach	30.34691667	-89.14116667	Harrison
111D83	Bear Point Bayou	Near East 3rd Street	30.35297194	-89.13736000	Harrison

enSPIRE ID	STREAM	DESCRIPTION	LATITUDE	LONGITUDE	COUNTY
111D84	Brickyard Bayou	At Mimosa Drive and Washington Avenue	30.39916667	-89.05270000	Harrison
111D85	Brickyard Bayou	At 22nd Avenue	30.38293333	-89.08886667	Harrison
111D86	Magnolia Bayou	At North Beach Boulevard	30.32468306	-89.32803361	Hancock
111D88	Magnolia Bayou	At Dunbar Ave Bridge	30.32348500	-89.33749000	Hancock
111D87	Watts Bayou	At Washington Street	30.31805900	-89.37410683	Hancock