Image: CWPPRA

ECOLOGICAL MANAGEMENT

Hydrologic Restoration, Management, Water Quality, and Flood Risk Reduction

The **Ecological Management** Action Plans directly address the Priority Problems identified for the estuary. As such, they are considered by many to be the most important elements of the CCMP. The plans are categorized as **Hydrologic Restoration and Management**, actions which address the issues of water and sediment flows, habitat loss, and marsh protection; **Water Quality**, actions which identify water quality problems and protect water resources; and **Living Resources**, actions which address problems associated with the plant and animal life of the estuary.

The APTs for these ecological management measures were assembled in order to provide the specific experience needed to develop executable strategies by the many partners who work in these areas. The teams included scientists from various universities and agencies, land owners, private citizens, and business owners who had expertise in restoration, water quality, and/or living resource management. This collective effort of the teams produced eighteen Action Plans to help improve the natural balance of the estuary. Because the problems are so large and interconnected, it should be noted that lead agency or agencies for many of these plans are often organizations such as the U.S. Army Corps of Engineers (USACE), CPRA, CWPPRA, Louisiana Department of Environmental Quality (LDEQ), LDWF, Louisiana Department of Natural Resources (LDNR), U.S. Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS), National Oceanographic and Atmospheric Administration (NOAA), EPA, Louisiana Department of Agriculture and Forestry (LDAF), Louisiana Oil Spill Coordinators Office (LOSCO), Louisiana Department of Health (LDH), or local governments.

The Action Plans included under **Hydrologic Restoration and Management** address the three most critical Priority Problems identified for the BTES: *Hydrologic Modification, Sediment Reduction, and Habitat Loss.* These Action Plans are possibly the most significant in the CCMP. As coastal land loss continues to be an ongoing environmental issue, the actions in this section require broad support from a variety of stakeholders and partner organizations. The Action Plans include EM-1 Hydrologic

CATEGORY 2

Restoration and Management, EM-2 River Reintroductions, EM-3 Freshwater Reintroduction into Bayou Lafourche, EM-4 Beneficial Use of Dredged Material and Dedicated Dredging, EM-5 Preservation and Restoration of Barrier Islands, EM-6 Shoreline Stabilization, Induced Sediment Deposition, and Living Shorelines, and EM-7 Flood Risk Reduction and Coastal Resiliency.

The **Water Quality** Action Plans directly address three Priority Problems identified by BTNEP: *Eutrophication, Pathogens, and Toxic Substances*. EM-8 Pollutant Identification and Assessment, EM-9 Oil and Produced Water Spill Prevention and Early Detection, EM-10 Improvement of Water Quality though Reduction of Sewage Pollution, EM-11 Improvement of Water Quality through the Reduction of Agricultural Pollution, EM-12 Improvement of Water Quality through Stormwater Management, EM-13 Urban Green Spaces, EM-14 Assessment of Harmful Algal Blooms, EM-17 Improvement of Water Quality through Reduction of Inshore and Marine Debris, and EM-18 Protection of Drinking Water Sources address water quality improvements.

The **Living Resources** Action Plans address the Priority Problem of *Changes in Living Resources*. The actions proposed in this area not only serve to protect the living resources of the BTES, but also to address the need to protect the estuaries from the negative impacts caused by non-native exotic plant and animal species. The actions include EM-15 Protection and Enhancement of Native Biological Resources and EM-16 Reduction of Impacts from Invasive Species.

EM-1 Hydrologic Restoration and Management

OBJECTIVES

- To improve wetland habitats negatively impacted by local hydrologic modifications
- To improve hydrology through the effectual use of the freshwater, sediments, and/or nutrients that already reach the basins
- To stabilize water levels and salinity to provide conditions conducive to the establishment and growth of emergent and submergent marsh plants

BACKGROUND/MAJOR ISSUES

Louisiana's historically vast wetlands have been significantly reduced and damaged through hydrologic modifications in service of anthropogenic uses and activities. Although the channelization of the Mississippi River to reduce the effects of flooding and improve navigation in the beginning of the 20th century is the chief contributor to the degradation of Louisiana's wetlands, it is but only one of many contributing factors. Levees, railways, and roadways restrict passage of water within coastal Louisiana. Thousands of miles of channels have been dug through the coastal marshes in search of and for the extraction of petroleum and gas products. Channels were dug to increase shipping routes and to extract cypress trees. Typically, dredged sediments to create the canals were placed adjacent and along the canals often caused water impoundments. Wetlands were also leveed and drained for agricultural and urban use.

Wetlands can be lost directly through the action of

extraction or indirectly as a result of these actions. The digging of the canals is an example of the direct loss of wetlands. The placement of the dredged soil along the banks of the canal is also a direct loss of wetlands as the increased elevation of the spoil changes it to upland habitat. The crisscrossing of canals in the marshes can lead to impounded wetlands as the resulting spoil banks can form an impenetrable barrier to natural water sheet flow. Impounded areas often result in marsh collapse. Even uncontiguous spoilbanks can slow and reduce sheetflow of oxygenated waters, laden nutrients, and sediments necessary for healthy marsh. Paradoxically, as sheet flow has been reduced, saltwater intrusion has increased due to all the extra canals allowing quick ingress of gulf waters up into the fresher parts of the estuary through tides and storm surge. Saltwater intrusion into fresh marshes and swamp can kill plant and animal species not adapted to saline water.

The wetlands of Barataria and Terrebonne are dependent on the free flow of water, sediment, and nutrients from the Mississippi and Atchafalya Rivers and their distributaries as well as the daily tides for their health and maintenance. Healthy wetlands provide vital habitat for our commercial and recreational fisheries as well as habitat for waterfowl and many threatened or endangered shorebirds.

Although Louisiana's wetlands provide vital services to the state and nation, the cost to Louisiana's marshes has been significant. When channels are dug, wetlands are directly removed. As the number of canals and

Hydrologic restoration can be used to repair damaged systems. Image: CWPPRA

channels crisscrossing the marshes increases, the amount of water movement also increases. Large navigation channels have been a conduit for storm surge and saltwater intrusion, while agricultural and other marsh impoundments have also stressed wetlands by altering natural hydrology. This Action Plan attempts to address these ongoing hydrologic changes to Louisiana's waterways and the associated marsh habitats. The intent of hydrologic restoration projects is to reduce impacts without disrupting the commerce that still thrives in Louisiana's coastal zone.

Hydrologic restoration can be used to repair damaged systems. The restoration techniques that are identified in hydrologic modification generally use planning strategies that have two major objectives: (1) to physically rebuild the wetlands that have been lost and/or (2) to reduce or reverse the rate of land loss by improving the ecological stability of the remaining wetlands.

Restoration projects should not happen haphazardly or with the will of just one or two user groups. Hydrologic restoration must be done with thoughtful consideration to ecological need, feasibility, impacts, and the project's support of publicly vetted federal and state restoration planning.

Hydrologic restoration can take many forms.

- Earthen and rock plugs may be used to prevent unnatural tidal flow through abandoned canals, and water-control structures help to regulate water and salinity levels.
- In some cases, large culverts are installed under roads, levees, or other obstructions to reduce wetland impoundments. Impounded wetlands can suffer from stressed vegetation, restricted access for marine organisms, and water poor in oxygen, sediment, and nutrients that feed the marsh. Without reintroduction of water, marshes will eventually succumb to these stressors.
- Through a combination of passively and actively managed structures, saltwater intrusion can be abated and water levels managed to optimize wetland growth and vitality. Wetlands are dependent on natural hydrology, and industry is dependent on access to resources in the coastal zone.

It should be noted that alterations to marsh hydrology can impact the use of Louisiana's coastal marsh habitat by estuarine fishes and macro-crustaceans. Structures in channels may prevent their movement through the marsh system and prevent the completion of their life cycle. Manipulation of water levels within managed areas, especially drawdown, can prevent access to marsh surface habitat. While some of the the promotion of submerged aquatic vegetation, are beneficial to juvenile fishes and macro-crustaceans, access must be maintained for the organisms to benefit. Responsive management strategies can be adapted to allow the ingress and egress of certain species, but if marshes are hydrologically isolated for some part of the year, access by some species will be reduced.

DESCRIPTION

Hydrologic restoration is an adaptive management tool used to manage water flows to improve marsh or swamp habitat in a particular way. Projects of this nature are used to control the flow of water, sediments, and nutrients as well as regulate salinities in the estuary. These techniques are designed to reduce marsh loss, increase vegetative growth, improve water quality, repair drainage impairments or impoundments, help to maintain currently healthy wetlands, help to maintain or improve swamp habitats, and have a positive effect on fisheries and wildlife productivity.

Hydrologic restoration requires adaptive management techniques to monitor and evaluate water flow levels. These projects generally operate with the expectation of a continuous evolution that provides benefits to animals that inhabit the ecosystem. The primary goal of hydrologic restoration projects is improved

Man-made weirs and water control devices maintain water levels. Image: CWPPRA

habitat productivity. This is achieved by increased freshwater retention within fresh and brackish marsh areas, enhanced nutrient and sediment retention in marshes, and reduced tidal exchanges. Reductions in tidal exchange and turbidity may also benefit submerged aquatic vegetation. Increased productivity of existing marshes is essential because of the high rates of coastal land loss and habitat change being experienced within the BTB.

These types of projects will vary in size, scope, and cost. Pumps, fixed-crest weirs, variable crested weirs, flap gated culverts, siphons, conveyance channels, culverts, water control structures, cutting gaps in spoil banks, and adding plugs are examples of techniques used to improve habitat in surrounding marsh or swamp areas.

Marsh management based on hydrologic restoration can be divided into two basic types: passive and active. The passive type makes use of non-adjustable structures such as fixed-crest weirs, slotted weirs, rock weirs, plugs, and levees. In passive marsh management projects, the goal is often to maintain a minimum water level inside the management area and to reduce the tidal exchange and velocity. In active management, water outfall management areas control water velocities to circulate water that bathes wetlands with oxygenated, nutrient-rich, freshwater.

The BTNEP MC notes that water control structures should be designed to address fisheries access issues; however, some unavoidable impacts may include reduced access issues in order to minimize impacts to recreational and commercial fishing access and reduction of ingress and egress of estuarine organisms.

Examples of large hydrologic projects in the estuary include:

Hydrologic Restoration and Vegetative Planting in Des Allemands Swamp (BA-34-2) is currently under construction. The lead federal agency working on the project is EPA.

Project Parish: Lafourche, St James

Project Description: The goal of this project is to reestablish historic hydrologic durations which will help maintain swamp elevation, improve swamp water quality, and increase productivity and regrowth of trees. Project features include spoil bank gapping, installing culverts, breaching of internal impediments, re-establishing natural channels, and site-specific vegetative plantings.

Estimated Cost: $6.2 million

Land Benefit: 2395 acres

South Lake DeCade Freshwater Introduction (TE-39) is currently in Operations Maintenance and Monitoring (OM&M). The lead federal agency working on the project is NRCS.

Project Parish: Terrebonne

Project Description: This project included the construction of a water control structure in the southern bank of Lake DeCade. This will increase the amount of Atchafalaya River water and sediment introduced into the marshes south of the lake. In addition, shoreline protection was implemented adjacent to the proposed structure and a weir in Lapeyrouse Bayou was removed.

Estimated Cost: $6.5 million

Land Benefit: 202 acres

Circular flap gates control water flow. Image: CWPPRA

Penchant Basin Natural Resources Plan, Increment 1 (TE-34) is currently in OM&M. The lead federal agency working on the project is NRCS.

Project Parish: Terrebonne

Project Description: The objectives of the project are to eliminate erosion and create approximately 35 acres of emergent marsh along the southern bank of Bayou Chene at its intersection with Bayou Penchant, convey Atchafalya River water, sediment, and nutrients to lower Penchant Basin tidal marshes to offset subsidence and saltwater intrusion and maintain the integrity of a deteriorated reach of the north bank of Bayou Decade to minimize encroachment of open water marine influence.

Estimated Cost: $18.9 million

Land Benefit: 675 acres

Central Terrebonne Freshwater Enhancement (TE-66) started as a CWPPRA project with NRCS as the federal sponsor. The project was transferred to the Resources and Ecosystems Sustainability, Tourist Opportunities and Revived Economies of the Gulf Coast States Act (RESTORE Act) funding stream and titled Bayou Dularge Ridge, Marsh Creation and Hydrologic Restoration.

The project will re-establish historic hydrologic and salinity conditions by reducing the artificial intrusion of Gulf marine waters via Grand Pass into the central Terrebonne marshes while also enhancing the influence of the Atchafalaya River waters on the area. The proposed planning project would include engineering and design of the Bayou Dularge Ridge. If implemented in the future, the project would re-establish hydrologic and salinity conditions, restore the ridge, and create and restore marsh to ensure the integrity of the ridge, its salinity gradient function, and the health of the marsh. Specific actions could include: data collection, oyster seed assessment, cultural resources, and easements and land rights.

Status: The Cultural Resources Assessment has been completed and all actions related to design have been cleared. Design phase is scheduled to be completed at the end of 2019.

Estimated Cost: $5.1 million.

Land Benefit: The project would result in 233 acres of hydrologic restoration, 282 acres of marsh creation, and 25 acres of ridge restoration for a total 540 acres of total direct net acres of benefit.

Note: Additional funds would be required to move this project to construction. Completion of the engineering and design is expected to take two to three years.

Houma Navigation Canal Lock Complex (TE-113) is currently in engineering and design. This CPRA project is designed to change freshwater distribution.

Project Parish: Terrebonne

Project Description: The Houma Navigation Canal Lock Complex (TE-113) is a part of the Morganza to the Gulf of Mexico Hurricane Protection Project. The structure will provide storm surge protection, increase freshwater distribution, and provide navigation along the Houma Navigation Canal (HNC). This project has multiple functions.

Estimated Cost: $366 million

LEAD AGENCY RESPONSIBLE FOR IMPLEMENTATION

To date, federal, state, and local agencies have worked on a variety of hydrologic restoration projects related to marsh management and are now moving to use the technique for swamp recovery as well. The projects vary in size and scope, and it is expected that similar activities will happen in the near future. Additionally, local landholders have also used this technique to protect some of their private lands.

CWPPRA has consistently been the lead implementer of hydrologic management in the BTES. The projects listed above are large in size and require considerable funds and commitment.

Small scale projects may be implemented in entirety by local landowners in conjunction with parish government. The cooperation of local landowners and parish governments will continue to be essential to the successful implementation of any hydrologic estoration project.

TIMELINES AND MILESTONES

The 2017 Coastal Master Plan identifies two major hydrologic restoration projects for the area. The proposed projects are in the Grand Bayou area and the LaBranche Wetlands area. The proposed implementation periods are 11 to 30 years and 1 to 10 years from 2017, respectively.

Smaller projects may be constructed by local landowners and local governments as funds become available.

POSSIBLE RANGE OF COSTS AND SOURCES OF FUNDING

The proposed projects' costs are $8.7 million in the Grand Bayou area and $80.9 million in the LaBranche Wetlands area. The exact sources of funding have not yet been identified.

PERFORMANCE MEASURES

Performance measures include:

- acres benefited from restoration activity
- acres created from the project

Data Gathered:

Data gathered may include but are not limited to:

- Accretion Data by way of Feldspar Plots/ Cryogenic Cores.
- Forested Swamp Vegetation.
- Herbaceous Marsh Vegetation.
- Hydrograph Information.
- Soil Properties.
- Surface Elevation over time.

These data points are related Coastwide Reference Monitoring System (CRMS) sites. CRMS data collection is recorded at https://www.lacoast.gov/crms2/crms_public_data/presentations/original/2006-11-004.pdf: Land to Water Ratio, Emergent Vegetation, Forested Vegetation, Vertical Accretion, Marsh Elevation Change, Porewater Salinity, Surface Water Salinity, Temp and Water Level, & Soil Characteristics.

Note: The CRMS project, under the direction and funding of CWPPRA, is one of the largest coastal habitat monitoring networks in the United States. The CRMS team effectively delivers data to a variety of audiences with roughly 60 scientists employed to go into the field to collect data from CRMS sites with additional analytical teams of scientists, computer programmers, and software engineers designing web delivery of large data sets. Monitoring data include: water level, salinity, sediment accretion, surface elevation change, composition and abundance of vegetation, ratio of land to water, and soil characteristics. The information is analyzed and summarized in maps, charts, tables, graphs, and indices and finally incorporated into interactive report cards available online. Today, about 390 CRMS sites, spread throughout coastal Louisiana, broaden the reach, increase the frequency, and expand the detail of wetland data.

Monitoring:

Parties Responsible: All responsible organizations maintain a list of ongoing and planned hydrologic restoration projects for marsh and swamp management. The State maintains a list of acres restored/protected. CWPPRA maintains acres created/restored for coastal restoration projects.

Timetable for Gathering Data: CRMS collects data annually. Project specific data may also be provided as available.

River reintroductions channel freshwater. Image: CWPPRA

How Data is Shared: via agency websites

Possible Data Gaps: none identified

Additional Funding Needed: yes, as available

EM-2 River Reintroductions

OBJECTIVE

- To use riverine resources of freshwater and sediment from the Mississippi and Atchafalaya Rivers in order to decrease salinities and preserve and/or create marshes

BACKGROUND/MAJOR ISSUES

After the devastating Mississippi River flood of 1927, Congress directed USACE to standardize and manage a system of flood protection levees along both banks of the river from Cairo, IL, to below New Orleans, LA. The Mississippi River and Tributaries Project (MR&T) also closed off distributaries and effectively eliminated sediment input from overbank flow and crevasses that contributed historically to land gain in coastal Louisiana. Starved of sediment from the river, BTES lost approximately 865 square miles of wetlands between the years 1932 and 2010. This loss is partly due to natural processes such as deltaic subsidence, sea level rise, and erosion but has been exacerbated by anthropogenic activities such as canal dredging, subsurface fluid removal, and hydrologic modification. Freshwater and sediment diversions are expected to sustain and enhance existing wetlands and rebuild some of those that were lost.

With firm belief in the premise that actions must be taken to stabilize and rebuild the coast, BTNEP generally supports the introduction of freshwater and sediments to our deteriorating coastal wetlands. If diversions are designed and operated appropriately, the benefits to the ecosystem as a whole may outweigh the adverse impacts that would occur. River reintroductions are seen as a pathway to long term sustainability for existing marshes, newly created marshes, and coastal communities.

In addition to slowing land loss rates and providing sustainability, river reintroductions have the potential to build new deltaic land in their outfall area. Generally, diversions with larger discharge will have faster rates of delta growth, so there has been a recent tendency in planning to scale diversions upward. Davis Pond is currently the largest controlled freshwater diversion at 10,650 cfs. In contrast, the CPRA's 2017 Coastal Master Plan includes proposed controlled diversions of of 2,000 cfs, 5,000 cfs, 20,000 cfs, 25,000 cfs, 30,000 cfs, 35,000 cfs, 50,000 cfs, and 75,000 cfs.

It must be acknowledged that besides the benefits that could be realized by diversions, numerous potentially important adverse impacts exist that must be considered throughout the planning and evaluation process. These impacts generally increase with scale as do user conflicts and sociopolitical opposition to implementation. The following is a brief discussion of some of these impacts.

- Induced Flood Risk

  Flooding has been a problem in coastal Louisiana throughout its history, but the problem is worsening with land loss and sea level rise. In recent years, computer modeling from various studies looking at predicted increases in water levels caused by diversion operations have shown wildly varying results. Some models indicate that the increase in flood risk to nearby communities should be minimal with a moderately-sized diversion. Other models show significant increases in water levels that would indeed increase flood risk in populated areas. Models have not yet examined the cumulative impacts of multiple proposed diversions operating simultaneously.

  Another variable that should be considered is wind, a major driver of water levels in the estuary. In winter, storm fronts generally move north to south, and water levels in the basins are typically lower, providing an opportunity for seasonal diversion operations. This is particularly true in the Barataria Basin where backwater flooding from a high river has not been a significant concern. However, in the Terrebonne Basin,

The Davis Pond river reintroduction diverts freshwater. Image: CWPPRA

backwater flooding from a high Atchafalaya River has historically been a major concern. In Terrebonne, diversion operations timed to "optimize" sediment capture would conflict directly with flood fighting efforts there. Furthermore, southerly winds begin in spring and often last through fall, causing higher water levels and coastal flooding issues regardless of river stage. It may be difficult, from both a physical standpoint of high basin-side water levels as well as a sociopolitical standpoint of the perception of flood risk, to operate large-scale diversions during these months.

The threat of community flooding obviously increases with diversion discharge and proximity to the area of outfall. Additionally, some models suggest that outfall areas will be more prone to flooding in the early years of operations and will need time for channels to evolve in order to expand capacity. If projects are properly designed and appropriately scaled, it is unlikely that water elevations will increase significantly as a result of freshwater and sediment diversions. However, this critical issue of flood risk must be addressed throughout the process from the project's conceptual phase through to its operation.

- Impacts to Commercial Fisheries

Implementing major diversions may involve some adverse impacts to living resources. Of particular concern are impacts to current oyster growing areas. The duration, seasonal timing, and degree of freshening will affect the breeding, growth, and harvesting of the eastern oyster in some areas. This serious concern must be addressed as diversions are constructed in areas where oyster leases will be impacted. In order to diminish the likelihood of litigation, renewed attention to public engagement is necessary. It is important to ensure that these oyster growers – and all other stakeholders – continue to be involved with and informed about the progress and timing of construction and operation of projects. The preferred path forward is consensus on operational plans with assurances that those plans will be rigorously adhered to post project construction.

Modeling results have suggested that a 75,000 cfs controlled sediment diversion into mid-Barataria Bay would have significant impacts on oysters, finfish, and shellfish. Some of these projected impacts would be negative (e.g., lethally low salinities for oyster beds close to the project) and some positive. Many of the modeled resources show negative trends early in the 50-year project life but a positive trend later. Models of various seasonal operations regimes show potential to mitigate some of these impacts to resources. For example, diversions limited to springtime operations (taking into account potential flooding) would allow a more successful fall oyster spat set and would more closely mimic historical freshwater introductions in the basins.

Other potential positive outcomes could be an increase in freshwater-dependent resources like waterfowl, alligators, and freshwater fish like largemouth bass which will fare well close to the project.

- Impacts to Other Living Resources

One potential biotic impact from major diversions is to resident populations of marine mammals, specifically bottlenose dolphins. Freshening of an entire estuary is possible with major sediment diversions, which could affect dolphin health as they do not readily relocate. Causing harm to the health of the resident population of bottlenose dolphins could constitute a taking, requiring a waiver under the US Marine Mammal Protection Act (MMPA). Currently, the Mid-Barataria Sediment Diversion has received an exemption under the MMPA.

Another potential biotic impact is the introduction of invasive species or the facilitation of their spread. The majority of Louisiana's most

troublesome invasive species are freshwater-dependent aquatic organisms. These species may expand their range as new diversions come online and create new freshwater habitat. These include the floating and submerged aquatic plants giant salvinia, water hyacinth, and hydrilla; mollusks such as apple snails, zebra mussels, and Asian clams; several species of Asian carp; and even the marsh-destroying nutria. Diversions could potentially be vectors for the introduction of new invaders to the estuary such as the northern snakehead, an Asian fish currently found in tributaries of the Mississippi River in Arkansas.

- Induced Shoaling

  Another diversion impact is siltation of navigable waterways and/or barge fleeting areas generating a need for increased maintenance dredging in channels near diversion structures. Waterways affected could be federally maintained navigation channels, oil field access channels, and/or natural streams. Anticipated increases in the cost of maintenance dredging induced by diversion operations must be accounted for in the early stages of diversion planning so that accurate cost-benefit ratios can be considered. Additionally, in order to reduce the likelihood of litigation, full disclosure of anticipated effects to the navigation community is required. Consensus on the question of who is responsible for induced dredging costs must be reached ahead of implementation.

- Shipping

  Water level in the Mississippi River is recognized as another critical issue that must be addressed. If multiple diversions are to be operated simultaneously or if the river experiences a period of very low stages, careful monitoring and adaptive management techniques must be used. The Port of Baton Rouge, the Port of New Orleans, and the Port of South Louisiana are three of the ten largest shipping ports in the Nation. These shipping and associated transportation industries could be impacted unless careful planning assures that critical water volumes and navigation channels are maintained.

- Nutrients and Contaminants

  Other issues to be addressed during the planning and subsequent monitoring of freshwater and sediment diversions include the impact of increased nutrient levels and the potential for increased eutrophication in coastal bays. Some debate exists as to the potential effects of increased nutrients on wetland plants and algae growth. More study is needed prior to implementing large-scale diversions to ensure that they can achieve the intended benefits without doing harm to wetlands and water quality. Additionally, introduction of other contaminants, including microplastics, must be monitored. Diversions should be designed to minimize unacceptable levels of eutrophication and contaminant introduction.

- Environmental Justice

  Executive Order 12898 (1994) addresses environmental justice in minority and low-income populations. The order acknowledges the disproportionate adverse impacts that federal actions have historically had on certain communities. It also commits the federal government to promoting nondiscrimination in future federal actions that may impact environmental quality. Communities such as the Native Americans in Grand Bayou, Vietnamese-American fishermen, and low-income residents throughout the BTES could be negatively impacted by river reintroductions.

Diversions are dependent on relatively large rivers with stage heights that routinely exceed adjacent marsh elevation in order to provide gravity flow to wetlands. The Atchafalaya and Mississippi Rivers offer many potential locations to implement diversions. In addition, the Gulf Intracoastal Waterway (GIWW) provides opportunities which

Dredge working at the West Bay Sediment Diversion. Image: CWPPRA

greatly expand the potential locations, albeit with less suspended sediment and lower flow than the major rivers.

In general, upstream sites are preferred to downstream sites simply because more marsh exists for the outfall to flow through, and, therefore, more space for sediment to settle before it is lost to the open Gulf of Mexico. However, human population density also increases upstream, leading to increased potential for community flooding, user conflicts, and sociopolitical opposition.

On the Mississippi River, several locations have been extensively evaluated for suitability as sediment diversion sites. The Mid-Barataria Diversion, currently in the Engineering & Design phase, evolved from the earlier Myrtle Grove project concept and is located in the same area. Multiple studies over many years have focused on this location for its suitability.

DESCRIPTION

This action is to support the appropriate reintroduction of freshwater and sediment to the BTES as a mechanism to preserve and/or restore wetland habitat and to combat saltwater intrusion. This action could take the form of siphons drawing river water out and over the levees into the wetlands or the construction of gated or ungated structures in the levees to allow river water to flow into the basins. Several river reintroductions into the BTES already exist, and several more are proposed in various planning documents including the 2017 Coastal Master Plan authored by CPRA.

The State of Louisiana has experience with large controlled diversions to manage the River for flooding as evidenced by the Morganza Spillway and the Bonnet Carré Spillway. Additionally, the Old River Control structure diverts approximately 30 percent of the Mississippi River to generate electric power, to manage flood waters, and to provide for public recreation.

Existing diversions include siphons such as those at Naomi or West Pointe à la Hache. Siphons are small-scale projects that use pipes running from the river, over the flood protection levee, and into the adjacent wetlands. Vacuum pumps remove the air from the pipes, and water is siphoned through by gravity at a rate increasing with river stage height over the

wetlands. These siphons have had positive impacts on wetland vegetation in the immediate outfall area, but their maximum discharge is a relatively low 2,000 cfs, so effects are geographically limited.

Other existing reintroductions include freshwater diversions such as the one at Davis Pond, constructed upstream of New Orleans and completed in 2002. Davis Pond is currently one of the largest controlled diversions ever constructed, capable of flowing at 10,650 cfs. It is referred to as a "freshwater" diversion because it was designed not to build or sustain land, but to stabilize salinity regimes and increase oyster production. It uses a 9,300-acre ponding area into which the vast majority of sediments fall out with the intent of combatting saltwater intrusion farther down-basin without covering oyster grounds with sediment. The Davis Pond diversion is very effective at pushing isohalines down basin and is rarely operated at or near maximum flow. It was built by USACE and is now operated by the State of Louisiana.

Another existing reintroduction is the uncontrolled diversion at West Bay near the mouth of the Mississippi River. Building the diversion as a simple dredged channel without flow control structures saved tremendously on project cost, but this could only be accomplished under a special set of circumstances. The West Bay Sediment Diversion is sited downstream of any roads, communities, levees, or other significant infrastructure, and had consensus support for implementation. In this location, river stage rises only a few feet above sea level, and the outfall area is a shallow bay with a direct connection to the open waters of the Gulf of Mexico, so flooding is not a concern. It is unlikely that an uncontrolled diversion could safely work in any location farther up basin, and none are currently proposed.

The CPRA's 2017 Coastal Master Plan evaluated dozens of project concepts for river reintroductions and ultimately proposed 11 new diversions, five of which would discharge into the BTES. Of these five proposed diversions, two would divert water from the Atchafalaya River into the Terrebonne Basin, two would divert water from the Mississippi River into the Barataria Basin, and one would increase the

Pipes are used to convey freshwater. Image: CWPPRA

flow of Bayou Lafourche (see Action Plan EM-3 Freshwater Reintroduction into Bayou Lafourche). Bayou Lafourche is fed by pumps drawing from the Mississippi River, but the other four proposed diversions would be large-scale, controlled "sediment" diversions. Sediment diversions aim to deliver significant amounts of sediment to the estuary, maximizing sediment capture from the river through placement near sediment sources, engineering of deep intake structures, and optimized operational strategies. Such projects will usually reach their full potential only if the diverted water, once it enters the receiving area, moves across the marsh surface. This "outfall management" optimizes the delivery of nutrients and suspended sediment to the marshes. This may be achieved through the use of water control structures such as weirs, culverts, plugs, and spoil bank management.

Outfall management and the techniques used to achieve this management must play a vital role in achieving the maximum gain from river diversion projects. The goal of outfall management is to slow water velocities and to circulate diverted flows to immerse wetlands as much as possible with oxygenated, sediment-rich, freshwater in the upper reaches of the project area and allow it to slowly flow through the estuary diluting ambient salinities. It is not an effort to impound water, but rather to incorporate retention and distribution measures for better water control and to retard the rapid unidirectional drainage typically enhanced by various types of man-made channels. However, outfall management techniques are not without controversy. For instance, one of the most important techniques used in outfall management is spoil bank gapping. Under certain conditions, gapping can improve hydrologic conditions, promote sediment deposition, reduce flooding, promote marsh productivity, and increase access to the marsh for estuarine organisms. In other conditions, gapping can provide avenues for tidal export of organic sediment and saltwater inflow, both of which can cause wetland loss. Gapping should never be deeper than the adjacent marsh surface to maximize overbank flooding and minimize channelization. Outfall management plans must be developed on a project-by-project basis.

The philosophy guiding most of our controlled diversion operational management plans is to use engineered structures to mimic historic annual flooding patterns. The rationale for this is that since estuarine ecosystems and their component species are well adapted to annual freshwater inputs, as evidenced by the high productivity and diversity associated with the natural condition, a shift back towards those conditions could prove beneficial to restoring marsh. Along with dredging for marsh creation, sediment diversions are another action that can create marsh by providing coarse sediments for new marsh substrate. This action achieves the overall alliance objective of restoring fluvial inputs of sediment and water to preserve and create marshes. Major controlled sediment diversions such as those proposed in CPRA's 2017 Coastal Master Plan have the potential to offset significant areas of wetland loss.

Diversions will improve the long-term sustainability of coastal wetlands and may have benefits to wetland vegetation and habitat for fish and wildlife resources. However, possible adverse impacts include increased flood risk to populated areas from diversion and backwater sources, impacts to fisheries and related socioeconomics, induced shoaling in the river's anchoring areas or navigation channel, introduction of invasive species or facilitation of their spread, and negative impacts to some existing wetlands and soils. Weighing benefits against the adverse impacts of diversions is a critical yet complicated process depending heavily on the specifics of location, scale, operations, and time. Time, especially, is a critical component in a comprehensive assessment of the true cost-benefit of sediment diversions. Trajectory economics for assessing the flow of economic services, when compared to other means of coastal restoration, must be part of any coastal restoration plan.

As part of this action, BTNEP intends to closely follow the latest research and modeling of proposed diversions, understand and contextualize the current data from monitoring of existing diversions, and continue a comprehensive public education program to inform citizens about the probable beneficial and adverse impacts associated with river reintroductions. BTNEP is committed to using the best science, filtered through the lens of the stakeholder public, to support diversion operations regimes that are both beneficial and implementable.

LEAD AGENCY RESPONSIBLE FOR IMPLEMENTATION

- CPRA, State of Louisiana

  CPRA oversees operations of existing diversions and is currently in the implementation phase of the 2017 Coastal Master Plan. The plan includes 11 proposed river diversions statewide at a cost of $5 billion. These diversions are in various stages of planning, engineering & design, and construction.

- USACE, New Orleans District

  USACE constructed the two existing diversions at Davis Pond and Caernarvon and has partnered with the State to plan and design other diversions. They also hold permit authority under CWA Section 404 regulating discharge of dredged or fill material into waters of the United States, USC Section 408 regulating alterations of USACE Civil Works Projects, and Section 10 of the Rivers and Harbors Act prohibiting obstruction or alteration of navigable waters.

- LDNR

  LDNR has the authority to grant Coastal Use Permits (CUP), the purpose of which is to make certain that any activity affecting the Coastal Zone is performed in accordance with guidelines established in the Louisiana Coastal Resources Program (LCRP). The guidelines are designed so that activities in the Coastal Zone can be accomplished with the greatest benefit and the least amount of damage.

- CWPPRA Task Force

  CWPPRA implemented the West Bay Diversion and has proposed several other diversion projects. The scale of diversions typically proposed by CWPPRA is much smaller than many of CPRA's

River reintroductions channel freshwater. Image: CWPPRA

largest proposals in the 2017 Coastal Master Plan, but, nonetheless, these smaller diversions can have benefits on a local scale.

- Other Federal Agencies

  Federal resource agencies such as EPA, NOAA/NMFS, USFWS, and USDA/NRCS have responsibilities as commenting agencies for granting permits.

TIMELINES AND MILESTONES

CPRA will work with federal, state, and local partners to develop timelines. The 2017 Coastal Master Plan includes an implementation schedule for the 11 proposed diversions. Each project evolves through planning, engineering & design, and construction phases which can each take several years before moving to operations & maintenance.

POSSIBLE RANGE OF COSTS AND SOURCES OF FUNDING

Freshwater and sediment diversions are the most costly types of coastal restoration projects as they require extensive planning, design, and engineering; many years of construction and continued operations; adaptive management; and maintenance costs. Cost estimates for diversions into the BTES included in the 2017 Coastal Master Plan follows.

$196,100,000	Bayou Lafourche 1,000 cfs
$282,900,000	Atchafalaya River (to Penchant Basin) 30,000 cfs
$397,900,000	Increase Atchafalaya Flow to Terrebonne (via GIWW) 20,000 cfs
$882,400,000	Ama Diversion 50,000 cfs
$998,800,000	Mid-Barataria Diversion 75,000 cfs

Sources of funding will include state-only funds, CWPPRA, Coastal Impact Assistance Program (CIAP), Louisiana Coastal Area (LCA), cost-sharing programs with USACE and other federal agencies, the RESTORE Act, and other spill-related sources.

PERFORMANCE MEASURES

Performance measures include:

- acres of land created
- acres of land benefited
- decrease the rate of land loss measured in land/water ratios over time
- achieving intended salinity regimes and gradients based on ppt or isohalines USACE, New Orleans District

Data Gathered:

Data gathered may include: water levels; sediment accretion/erosion; vegetative response; habitat change; land/water ratios; operational details of the diversion itself; soil quality metrics such as bulk density and organic versus mineral content; socioeconomic effects including changes in commercial fisheries; effects on other living resources such as fish and wildlife; effects to migratory birds, marine mammals, and threatened and endangered species; impacts to navigation/boating access; and many aspects of water quality including temperature, salinity, dissolved oxygen, nutrients, suspended sediment, and contaminants.

Monitoring:

Parties Responsible: CPRA, CWPPRA, Louisiana State University (LSU) AgCenter, LA Sea Grant, and other state and federal resource agencies including EPA, NOAA/NMFS, USFWS, USDA/NRCS, USGS, LDWF, LDNR, LDEQ, LDH, etc.

Timetable for Gathering Data: Monitoring should include historical, real-time, and long-term data sets collected throughout the project life from planning through operations.

How Data is Shared: Data from the CRMS is shared via interactive website, and the recent development of the System Wide Assessment and Monitoring Program (SWAMP) promises to expand on data parameters covered by CRMS and to share the data in similar ways. Additional parameters should be shared on project-specific websites.

Possible Data Gaps: none identified

Additional Funding Needed: yes, as available

EM-3 Freshwater Reintroduction into Bayou Lafourche

OBJECTIVE

To support and encourage reintroduction of Mississippi River flow into Bayou Lafourche in order to bring freshwater and sediments to the BTB marshes to help address coastal land loss and to ensure adequate consumptive freshwater supplies by combating saltwater intrusion

BACKGROUND/MAJOR ISSUES

Bayou Lafourche, originally called La Fourche des Chetimaches (the fork of the Chitimacha), is an historic distributary of the Mississippi River that extends 106 miles from its origin in Donaldsonville to the Gulf of Mexico. The bayou is bounded on the west by Louisiana Highway 1 and on the east by Louisiana Highway 308 and is promoted as "the longest Main Street in the world." It flows through Ascension, Assumption, and Lafourche parishes and serves as a major freshwater source for their residents. Original inhabitants of the area were various Indian tribes including the Chitimacha, Chawasha, and Washa. In the late 1700s, small European settlements were built, followed shortly by the first Acadians in 1764. In addition, a small group of Canary Islanders called "Isleños" imported by the Spanish government to help settle the Louisiana territory settled in the area.

The French explorers Iberville and Bienville considered Bayou Lafourche the west fork of the Mississippi River, thus "Lafourche," the fork. In the mid-1800s, Bayou Lafourche carried roughly 12 percent (over 40,000 cfs) of Mississippi River flow. To address local flooding concerns, in 1904 a closure was constructed at Bayou Lafourche, and it ceased to function as a distributary of the Mississippi River. This major hydrologic modification resulted in devastating impacts to the BTB. To provide freshwater flow, a pump station was built on the Mississippi River at Donaldsonville in 1955 to allow water from the Mississippi River to enter Bayou Lafourche. Currently, about a quarter of one percent (200 cfs) of the Mississippi River flow is allowed down the Bayou. This flow is closed if heavy rains have caused high water in the Bayou or if monitoring stations on the Mississippi River indicate a chemical spill has occurred upriver of Donaldsonville.

Closing Bayou Lafourche prevented freshwater from reaching the marshes in the southern BTB. Navigation to the Mississippi River from Bayou Lafourche was eliminated. However, the closing allowed for increased development of the natural and man-made levees, intensified agricultural activities, and also enhanced economic opportunity, especially with the petroleum industry boom increasing the job base. Seasonal flooding of Bayou Lafourche was controlled, and farming, residential, and business development could proceed predictably. Now, the BTB are experiencing the most severe coastal land loss rates in the world. Concerns about adequate long-term consumptive water supplies continue as do concerns about possible contamination from agricultural chemicals use. Increasing Mississippi River flows into Bayou Lafourche is a reliable way to satisfy consumptive freshwater supply demands now and into the future and is a major way to benefit coastal landscapes by supplying freshwater and sediments to areas that were historically connected to freshwater flows from the river.

Increasing diversion flows down Bayou Lafourche nourishes coastal marshes both on the east and west sides of the bayou near Lockport, combats saltwater intrusion from the Gulf of Mexico, and provides more reliable freshwater consumptive supplies for residents and industry. Reintroduction of Mississippi River flow to Bayou Lafourche is a sustainable restoration technique using the established natural process that nourished and created marshes prior to the closure of the bayou. The pump's current capacity is between 420 and 450 cfs. Freshwater, nutrients, and sediment should help revitalize marsh vegetation that is stressed by saltwater increases or by sediment deprivation.

DESCRIPTION

This Action Plan will aid in addressing the major priority problem for the BTES which is habitat loss and hydrologic modification, and, as an additional benefit, it will help ensure adequate freshwater drinking supplies for nearly 300,000 Louisiana residents. Currently, the uppermost 16 miles of the channel have been cleared and dredged, and construction has recently been completed to replace the Union Pacific Railroad Bridge in Donaldsonville and the pedestrian bridge near Assumption Parish High School in Napoleonville.

Additionally, the construction of a water control structure in Lockport is also complete which will prevent saltwater migration farther north into Bayou Lafourche. The water control structure at Lockport will function as a weir if necessary. The analysis and design of improving pumping capacity have been initiated for the pump station site in Donaldsonville with an estimated (2017) cost of $41 to $70 million based on pump capacity. This project is aimed at increasing the pumping capacity from the Mississippi River into Bayou Lafourche nearly threefold by either expanding the existing pump station or constructing a new pump station. Other current ongoing projects that have begun are the Thibodaux Weir Removal Preliminary Analysis, which looks at replacing the existing permanent weir with a gate or use of a temporarily deployed weir, and the permitting of channel dredging from Napoleonville to Thibodaux.

Since BTNEP's original CCMP was formed and accepted, alternatives to accomplish the desired outcomes were evaluated, and the plan currently being implemented was selected. Successful and timely execution of this plan is critically important to the residents of BTES because of the consumptive water supply benefits and the benefits afforded the receiving marshes on the lower end of Bayou

Dredging operations to improve water flow in Bayou Lafourche. Image: BTNEP

Lafourche. BTNEP will continue to support the Bayou Lafourche Fresh Water District (BLFWD) and CPRA throughout the execution phase and during long-term O&M program.

This action will occur entirely along Bayou Lafourche. Actions at the headwaters in Donaldsonville include dredging, renovating or redesign, and constructing the pump station drawing from the Mississippi River. Additional dredging will occur from Donaldsonville to Thibodaux to increase channel capacity, and the Thibodaux weir will be redesigned or removed. Outfall management actions are possible at various locations along the entire channel.

LEAD AGENCY RESPONSIBLE FOR IMPLEMENTATION

Local: BLFWD

State: CPRA

Federal: USACE, EPA, USFWS, and NRCS

TIMELINES AND MILESTONES

The remaining components of the overall project, namely the new pump station at Donaldsonville, removal of the weir at Thibodaux, and channel dredging are expected to be complete by 2020.

POSSIBLE RANGE OF COSTS AND SOURCES OF FUNDING

As defined above, lead agencies/entities are legislatively mandated to manage issues related to this Action Plan. Furthermore, each agency/entity develops annual budgets and programmatic budgets internally to address those legislatively mandated requirements. These budgets and discussion thereof are not presented here but are available from BLFWD and/or CPRA.

BTNEP as a co-lead implementer works with other lead agencies/entities on an annual basis to define data gaps and develop partnerships with these organizations to address those data gaps. Projects are defined during this phase along with appropriate costs and budgets. These costs vary according to the size and scope of the individual projects. Funding sources vary, including possible EPA funding.

PERFORMANCE MEASURES

Performance measures include:

- the amount of freshwater flowing in Bayou Lafourche up to the project design maximum
- acres benefited
- number and duration of high chloride events in Bayou Lafourche

This increase in the flow of freshwater in the bayou will meet the appropriate demand for drinking water for 300,000 people and for industries who rely on the water.

The performance measures are directly related to an appropriate increase capacity of the bayou to accept and move water in o rder toimprove water quantity, improve water quality, improve drainage, and improve recreational uses.

Methods:

Steyer and Stewart (1992) list variables which may be measured to monitor freshwater and sediment diversions implemented under CWPPRA. It is recommended that this model be followed, regardless of the particular funding source for any component of the overall project. Measurable parameters identified by Steyer and Stewart (1992) have been prioritized by Steyer et al. (1995) into Essential Variables or Additional Variables or Substitutions. For this Action Plan, only the Essential Variables are recommended for immediate and on-going monitoring. Those include Habitat Mapping, Salinity, Water Level, and Vegetation.

Data Gathered:

BLFWD and CPRA currently post information on the project on their respective websites. Monthly

meeting minutes from BLFWD discuss:

- operational activities.
- proposed millages.
- cost estimates for upcoming work.

Monitoring:

Parties Responsible: BLFWD and CPRA

Timetable for Gathering Data: As requested by BLFWD and CPRA; currently monthly reports are made.

How Data is Shared: All materials are shared through the web on the BLFWD website or CPRA.

Possible Data Gaps: BLFWD meets regularly to evaluate data to determine any possible data gaps.

Additional Funding Needed: Yes, at current estimates, the project will require between $70 to $100 million.

EM-4 Beneficial Use of Dredged Material and Dedicated Dredging

OBJECTIVE

To make use of material when dredging activities or dedicated dredging occurs within or adjacent to the BTES in order to create, maintain, and/or restore marsh, coastal ridges, and islands.

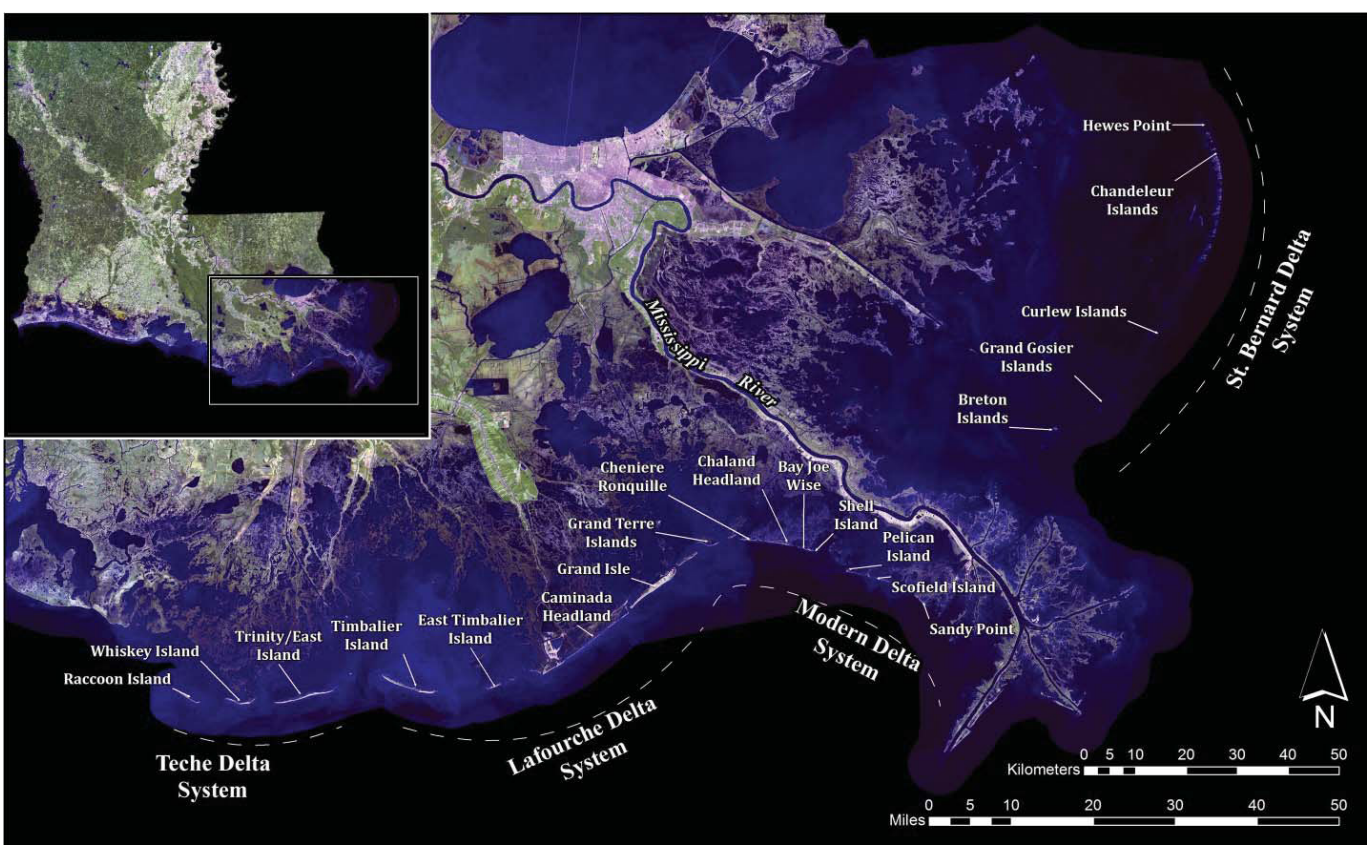


Figure EM-4.1. Dredge materials from both maintance and dredging, and dedicated dredging operations are used benefically along Louisiana's coast.

Sediment is pumped into areas for shoreline stabilization. Image: CWPPRA

BACKGROUND/MAJOR ISSUES

Dredged materials can be used for various purposes that are beneficial to society and to the environment. Numerous uses for dredged materials may be considered beneficial based on the user's perspective. Conservation uses could consist of the creation of habitat and the restoration of degraded habitat. Development uses could consist of new land for ports, infrastructure, or parks. National Environmental Policy Act (NEPA) requires consideration of project alternatives that are environmentally sound, so beneficial use should be considered for operations requiring dredged material disposal.

Two source categories for dredged material should be defined:

- Dredged material removed from new or existing navigation channels, ports, or harbors and from constructing or maintaining oil and gas pipeline and production canals may be used as a resource in a productive way.
- Dedicated dredging is the deliberate removal of material from one site to restore or enhance another site.

Historical beneficial use of maintenance dredged material within the BTES has been varied. Initial use was to establish new land for ports, airports, homes, and industries. More recently, however, use has shifted to conservation with wetland and barrier island restoration projects and the construction of upland areas, bird nesting islands, wetlands and woodland restoration projects, and aquatic and marine habitat.

Dredged materials from both maintenance dredging and dedicated dredging operations are used beneficially in Louisiana. Plans exist for using maintenance dredged materials in projects such as marsh creation, nesting habitat creation, canal filling, and barrier island restoration. Plans also exist for using dedicated dredging to accomplish barrier island breach sealing, shoreline protection, beach and dune nourishment, nesting habitat creation, and

marsh creation projects.

Implementing these actions is hampered by high costs and conflicting uses of water bottoms (i.e., the presence of oyster leases). Because of cost implications, these actions can only be accomplished economically in areas free of oyster leases, near waterways where maintenance dredging is undertaken, or where dedicated dredging is possible. However, it may be possible to use innovative technologies to transport dredged material through newly constructed pipelines for this purpose over greater distance than is currently practiced.

Permits from LCRP for coastal uses and the Department of the Army Section 404 and Section 10 permit system are required to construct or maintain oil and gas pipeline and production canals. These permits may be conditioned to require that the dredged material be used beneficially whenever possible. Due to the smaller volumes removed for these dredging operations compared to federal navigation channels, it may be more feasible from an economic and engineering standpoint to use dredged material from oil and gas canals beneficially.

DESCRIPTION

This action will take advantage of existing sediments which must be periodically removed from existing navigation channels or oil field canals. These materials will be used to restore degraded habitat and to create new habitat. Dredged material from maintenance dredging operations is periodically removed from ports, harbors, navigation channels, and oil field canals. Using dredged material beneficially is an alternative to ocean disposal of dredged material, upland disposal, or other non-beneficial disposal options. In addition, dedicated dredging represents another potential source of material for beneficial use.

Dredging oil and gas field canals occurs frequently in the BTES. The material excavated from oil and gas pipeline and production canals may be readily usable in beneficial ways. In addition, compost or sewage sludge may also be used under certain circumstances if deemed harmless and appropriate.

Although a number of factors – including logistics, grain size, and presence of contaminants – will limit materials to nourish, restore, and create coastal habitat will be encouraged. Potentially, up to 20 million yd^3 could be used annually in Louisiana to enhance coastal wetlands through marsh creation, wetland nourishment, barrier island restoration, ridge restoration, bird islands, and other techniques.

Dredged material should be used to restore and create marsh at all possible locations with available technology whenever it is cost effective to do so. Because of economic and engineering realities, this action is recommended where it is economically feasible to do.

LEAD AGENCY RESPONSIBLE FOR IMPLEMENTATION

USACE, New Orleans District

Through Fiscal Year 2015, the Corps has constructed over 61 square miles of land in Louisiana through beneficial use of dredged material obtained via the Federal maintenance dredging program. Of these 61 square miles, 26 of them are located within the BTNEP footprint. That means that about 43 percent of all the maintenance-dredged material obtained has been placed within the BTES.

For example, the Corps created approximately 815 acres of wetlands in 2013 through the beneficial placement of approximately 56 percent of Southwest Pass dredged material.

Currently, approximately 42 percent of suitable/available dredged material under the O&M program is used beneficially. Due to either the physical characteristics or the location of the dredged material, not all of the material dredged by the Corps is available for beneficial placement in the coastal ecosystem. With more funding, about 14 to 18 million yd^3 could potentially be used beneficially (most of

this material would come from the Mississippi River Deep Draft Crossings).

The 2007 Water Resources Development Act (WRDA) directed the Corps to integrate its work with coastal restoration efforts.

CWPPRA Task Force

CWPPRA uses dedicated dredges to create new marsh in both BTB. Dredges are used to pump materials from the Mississippi River into the Barataria Basin, and it is possible to get material from the Atchafalaya River as well.

CPRA, State of Louisiana

The 2017 Coastal Master Plan includes marsh creation projects that are created through the beneficial use of dredged material.

Office of Coastal Management (OCM), State of Louisiana

Through the State LCRP since 2009, the State requires private applicants who want to dredge more than 25,000 yd^3 of sediment to place the material in coastal restoration projects or pay a fee to support restoration. Table EM-4.2 lists the yd^3 used and acres created within the BTES since 2009 by OCM through its LCRP and beneficial use policy.

TIMELINES AND MILESTONES

The Beneficial Use of Dredged Material (BUDMAT) Program has identified the following BTES areas of opportunity over the next 20 years: Barataria Bay, Port Fourchon, Berwick Harbor, Atchafalaya River, Mississippi River, and the HNC.

The State of Louisiana CPRA will be implementing its 2017 Coastal Master Plan over the next 50 years which will create marsh projects via the beneficial use of dredged material.

The State's OCM continuously uses adaptive management by re-evaluating the policies and procedures of the LCRP and how to manage coastal uses among all users. Specific to this Action Plan, the OCM will review the effectiveness of its beneficial use policy and adjust it appropriately as needed over the next 20 years.

Table EM-4.2

Cubic yards and acres created

Cubic Yards	Acres Created	Year
129,134.00	77.29	2009
769,952.00	119.99	2010
839,569.24	173.73	2011
1,029,910.00	652.33	2012
1,787,526.30	230.35	2013
2,897,314.43	252.33	2014
219,428.17	125.79	2015
29,607.00	171.37	2016
7,702,441.14	1,803.18	Total

POSSIBLE RANGE OF COSTS AND SOURCES OF FUNDING

The USACE's BUDMAT Program's objective is to cost effectively increase the beneficial use of material dredged from federally maintained waterways at a total cost of $100 million over a ten-year period. The WRDA of 2007 - Section 7006(d) within the Louisiana Coastal Area Program authorizes the BUDMAT Program.

CWPPRA currently spends on average between $2.5 and $18 million on marsh creation projects that beneficially use dredged material annually. Projects are identified and funded based on a competitive wetlands value assessment. Funding for aforementioned projects will be available as the projects move through the public process.

The State of Louisiana has plans for large scale marsh creation projects laid out in the 2017 Coastal

Master Plan. It is envisioned that some portion of the $5 billion Gulf Coast Ecosystem Restoration Task Force funds will go toward this technique.

Additionally, the Natural Resource Damage Assessment and Restoration Program (NRDA) process may also provide funding under the EPA's CWA to repair damages caused by the Deepwater Horizon oil spill. Louisiana will receive approximately $500 million to implement projects for the coast under the 2017 Coastal Master Plan. It is anticipated that a portion of these funds may be used in the BTES for this type of restoration.

PERFORMANCE MEASURES

Performance measures include:

- acres/linear feet/miles of land created and/or millions of yd^3 delivered
- acres benefited

Data Gathered:

- All organizations maintain a list of acres created.
- Some organizations maintain a list of the millions of yd^3 used.

Monitoring:

- USACE completes BUDMAT reports.
- CWPPRA keeps track of acres created and maintained.
- The State of Louisiana keeps track of acres created or maintained.
- CPRA's Coastal Reference Monitoring Stations collect water quality and vegetation data on most restoration sites.

Parties Responsible: USACE, CWPPRA, State of Louisiana, and CPRA

Port Fourchon created a man-made ridge using dredge material. Image: Port Fourchon

Timetable for Gathering Data: annual report

How Data is Shared: via agency websites

Possible Data Gaps: none identified

Additional Funding Needed: yes, as available

EM-5 Preservation and Restoration of Barrier Islands

OBJECTIVE

To preserve and restore barrier islands in order to protect environmental and economic resources

BACKGROUND/MAJOR ISSUES

Louisiana's barrier shoreline is one of the fastest eroding shorelines in the world. The barrier islands of the BTES are eroding rapidly, and since the 1880s, barrier islands of the BTES have lost approximately 1.6 billion m^3 in sediment from the shoreface and have retreated landward up to three kilometers. The cross-sectional area of the tidal inlets has more than tripled during this time.

Storm-induced currents are a major driver of these changes (Miner et al., 2009). This erosion and shoreline retreat has been a contributing factor to the land loss within the BTES. These islands need to be elevated and widened to provide habitat for living resources and to prevent breaching and overwash. These problems can be addressed by importing sediments.

The restoration of Louisiana's barrier islands and barrier island systems has been a priority for a number of restoration programs over the past several decades, and more than 30 barrier island projects have been constructed to date. These projects consist of a combination of restoration techniques including beach nourishment, back barrier marsh creation, shoreline protection, vegetative plantings, and sand fencing.

Since the barrier islands serve as a vital nesting area for wading birds and sea birds and a resting area for migratory birds, unnecessary disruptions by humans should be avoided whenever possible. Shore parallel canals which have been dredged or are immediately adjacent to the barrier islands lead to the breakup of the island. These canals should be filled to the height of the barrier island when the need for the canal has ceased. Navigation canal protection jetties should have a regular program of sediment by-passing or should be shortened or removed so that the natural flow of sediments to adjacent flanking barrier islands is not disrupted.

An offshore sediment analysis is currently being conducted. Expansion of availability of sediment from Ship Shoal is a possibility, but the Shoal's importance as a hypoxia refuge for snapper, crabs, and possibly other species might complicate this issue.

DESCRIPTION

This action will preserve and restore barrier islands by pumping sand to elevate dunes, narrow tidal inlets, and provide greater island width. This action will also provide for building back-island salt marshes and filling abandoned oil and gas canals. The two main technologies to be used are beach nourishment – the addition of sediment (sand) to a beach to replace that which has been lost to erosion – and island restoration by material addition – the use of imported sediment to repair island damage or reduce future degradation by heightening and widening an island. In addition, some of the tools described in EM-6 Shoreline Stabilization, Induced Sediment Deposition, and Living Shorelines will be used on the barrier islands as appropriate.

CPRA is currently developing a barrier island Breach Management Plan to address both breach prevention and response to breaches when they occur. This plan will help to minimize the acceleration of island

Sand fencing captures wind-blown sediment. Image: CWPPRA

disintegration that commonly occurs after a breach. Prompt repair of storm-induced damages will extend the life expectancy and integrity of Louisiana's barrier shorelines.

Dredged material should be used to nourish beaches on the BTES shoreline at all possible locations with available technology whenever it is cost effective to do so. In addition, breach repair should be performed promptly whenever storms create breaches in barrier shorelines.

LEAD AGENCY RESPONSIBLE FOR IMPLEMENTATION

CPRA, State of Louisiana

The State of Louisiana currently has a 2017 Coastal Master Plan. The plan includes a barrier island/headland restoration program at a cost of $1.5 billion. CPRA is currently developing a program which intends to restore BTES islands on an as needed basis rather than naming specific islands.

USACE, New Orleans District

The USACE dredges navigation channels in the BTES, and where bar channels and the lower reaches of the channels are dredged in the vicinity of barrier islands, the dredged material is often used for beach nourishment or marsh creation on the bay side on the bay side of barrier islands such as Grand Terre. Currently, approximately 42 percent of the suitable/available material dredged under the O&M program is used beneficially. Due to either the physical characteristics or the location of the dredged material, not all of the material dredged by the USACE is available for beneficial placement in the coastal ecosystem. However, if funding were made available, much of this material could potentially be used for barrier island or headland restoration. The 2007 WRDA directed the USACE to integrate its work with coastal restoration efforts.

CWPPRA Task Force

CWPPRA has constructed numerous barrier island restoration projects from Raccoon Island to Pelican Island including breakwaters, shoreline protection, marsh creation, and vegetation planting.

TIMELINES AND MILESTONES

Over the next 50 years, the State of Louisiana CPRA will be implementing its 2017 Coastal Master Plan, which includes implementing several barrier island restoration projects on an as needed basis.

Barrier shoreline restoration projects require large funding streams. Image: CWPPRA

Over the next 20 years, the USACE's BUDMAT Program's will be working to use the dredged material from channel maintenance for marsh creation and beach nourishment where feasible.

POSSIBLE RANGE OF COSTS AND SOURCES OF FUNDING

The State of Louisiana has plans for large scale barrier island restoration projects laid out in the 2017 Coastal Master Plan. It is envisioned that some portion of the $5 billion Gulf Coast Ecosystem Restoration Task Force funds will go toward this technique. CPRA has set aside $1.5 billion for their barrier island program.

Additionally, the NRDA process might also provide funding under the EPA's CWA to repair damages caused by the Deepwater Horizon oil spill. Louisiana will receive approximately $500 million to implement projects for the coast under the 2017 Coastal Master Plan. It is anticipated that a portion of these funds may be used in the BTES for this type of restoration.

The USACE's BUDMAT Program's objective is to cost effectively increase the beneficial use of material dredged from federally maintained waterways at a total cost of $100 million over a ten-year period. Some of this material would be used on barrier shorelines in the BTES. The WRDA of 2007 - Section 7006(d) within the Louisiana Coastal Area Program authorized implementing the BUDMAT Program.

CWPPRA currently spends a large portion of its annual budget on barrier island projects. Projects are identified and funded based on a competitive wetlands value assessment and public input. Funding for aforementioned projects will be available as the projects move through the public process.

PERFORMANCE MEASURES

Performance measures include:

- acres of land created and/or millions of yd^3 delivered
- acres benefited

Data Gathered:

- the compilation of videography and photography of the 2005 hurricane impacts
- the construction of a unified historic shoreline change database for the Louisiana coastal zone
- the development of a historical bathymetric database with up-to-date 2006 bathymetric analysis that provides a current seafloor change for the shoreline extending from Sandy Point to Raccoon Island and the northern Chandeleur Islands

- Light Detection and Ranging (LiDAR)
- surveys for the sandy shorelines of the coastal zone.

Monitoring:

The Barrier Island Comprehensive Monitoring (BICM) plan has been developed as a framework for a coastwide monitoring effort. This effort includes documenting the historically dynamic morphology of the Louisiana nearshore, shoreline, and backshore zones. This aspect of the program is designed to complement other more area-specific monitoring programs that are currently underway through the support of agencies such as the Louisiana DNR and USACE.

BICM will provide long-term morphological datasets on all of Louisiana's barrier islands and shorelines rather than just those islands and areas that are slated for coastal engineering projects or have had construction previously completed. BICM also specifically provides a larger proportion of unified, long-term datasets that will be available to monitor constructed projects, plan and design future barrier island projects, develop operation and maintenance activities, and assess the range of impacts created by past and future tropical storms.

USACE maintains completed reports on all BUDMAT activities.

CWPPRA maintains public reporting to keep track of barrier island restoration projects completed as well as uses the CRMS for gathering water quality and vegetative cover data.

The State of Louisiana through CPRA keeps track of acres created or maintained.

Parties Responsible: State of Louisiana, USACE, CWPPRA

Timetable for Gathering Data: annual reports

How Data is Shared: via agency websites

Possible Data Gaps: none identified

Additional Funding Needed: yes, as available

EM-6 Shoreline Stabilization, Induced Sediment Deposition, and Living Shorelines

OBJECTIVES

- To facilitate maintaining and restoring existing marshes and swamps by reducing shoreline erosion along bays, lakes, canals, and bayous
- To trap or induce sediment deposits in order to maintain and restore existing marshes and swamps as well as build new marshes
- To construct and maintain living shorelines for shore erosion control wherever possible and feasible in order to create and enhance growth and sustain habitat that is naturally resistant to erosion

BACKGROUND/MAJOR ISSUES

Shoreline erosion occurs wherever land meets water, and people have been trying to combat it since ancient times. This Action Plan supports the overall alliance objective of maintaining and restoring existing marshes and swamps by protecting the slightly elevated shoreline rim therefore protecting marshes behind the shore from wave attack and saltwater.

Sediment trapping and inducing structures are most effective at improving deposition and preventing resuspension in lower wave energy environments where they baffle small wind-generated waves and where suspended sediment concentration is high. They are less useful in areas of high wave activity such as along canal banks, navigation channels (e.g., the GIWW), or the Gulf of Mexico shoreline where greater likelihood of adverse impacts exists such as

Shoreline stabilization projects involve construction equipment. Image: CPRA

undermining by storm wave action. While traditional structures provide hard substrates that may become colonized by reef building organisms and enhance fishing habitat, living shoreline technologies are specifically designed to promote sustainable habitat that naturally resists erosion and undermining. A possible issue at stake with induced sedimentation is the ownership of created land when projects are constructed using federal or state funds.

DESCRIPTION

Shoreline stabilization refers to measures that reduce or halt shoreline erosion. Shoreline stabilization is recommended wherever shoreline erosion is a problem. Preferred technologies and building materials for shoreline stabilization projects will vary by site due to location-specific conditions (e.g., elevations, soil strength, and exposure to wind and waves). The distance and orientation of structures relative to the shoreline can also influence their success.

Sediment inducers and sediment trappers refer to stabilization measures that also aim to build land through deposits of suspended sediment from the water column. Living shorelines stabilize shorelines (and perhaps also act as sediment inducers or trappers) using structures made from natural and man-made materials (e.g., wetland plants, submerged aquatic vegetation, oyster reefs, sand, and stone) that are designed to reduce erosion while retaining or enhancing ecological processes. Table EM-6.1 provides stabilization technologies.

This plan supports limited construction of projects of local concern that are favored by local government and landowners even though it might not affect large areas of the BTB. This action is recommended

especially in areas where blowouts exist – where erosion has occurred to the point where marshes abut canals and other water bodies as well as in areas where extensive marsh erosion may occur. Sediment inducing and trapping techniques are encouraged whenever practical based on the project locality, cost, and availability of suspended sediment. Wherever feasible, living shorelines are also recommended as they act to promote establishment and growth of habitat and organisms important to the coastal ecosystem and should also resist erosion naturally and sustainably.

LEAD AGENCY RESPONSIBLE FOR IMPLEMENTATION

CPRA and USACE

CPRA and USACE construct various shoreline stabilization projects to protect land and maintain navigation.

CWPPRA

CWPPRA has constructed various shoreline stabilization devices over its existence.

Other Likely Implementers

LDNR; LDEQ; LDWF; LDAF; Louisiana Department of Culture, Recreation, and Tourism (LDCRT); BLFWD; Bayou, Soil, and Water Conservation Districts; and other quasi state agencies, citizen action groups, parish governments, and landowners.

TIMELINES AND MILESTONES

Laying out a conceptual timeline for implementing this Action Plan is difficult. Locations where shoreline erosion is a problem have been well identified in the BTES, but other critical areas may arise, for example, if threatening a pipeline or other structure. The lack of a reliable source of funding and the general high cost of shore protection precludes setting up a timeline for implementation.

POSSIBLE RANGE OF COSTS AND SOURCES OF FUNDING

Determining costs for implementing projects in this Action Plan is also difficult. Shoreline stabilization projects can vary greatly in their scope and are often included as components of larger projects in combination with other types of ecological restoration such as marsh creation using dredged material, hydrologic restoration, or barrier island restoration (considered separately). A possible range of costs for individual projects is suggested from examples of completed projects below.

Terrebonne Bay Shore Protection Demonstration (CWPPRA, TE-45), Cost: $2.74 M

Purpose: demonstration of the cost and effectiveness of three shoreline protection methods (gabion mats, concrete onshore armor units, and foreshore triangular units) for their ability to abate erosion and develop and sustain oyster reef

Lake Salvador Shore Protection Demonstration (CWPPRA, BA-15), Cost: $2.8 M

Purpose: test four shoreline protection methods for effectiveness in reducing erosion and construct 9,000 ft of rock shoreline stabilization to protect the shoreline and adjacent marsh from wave-induced erosion

GIWW Bank Restoration of Critical Areas in Terrebonne (CWPPRA, TE-43), Cost: $13 M

Purpose: restore and armor critical lengths of deteriorated channel banks along the GIWW with construction of over 40,000 linear ft of foreshore rock dike protection

West Lake Boudreaux Shoreline Protection and Marsh Creation (CWPPRA, TE-46), Cost: $17.9 M

Purpose: reduce erosion of the west Lake Boudreaux shoreline and protect emergent marsh with over 10,000 linear ft of rock dike; Note: The cost also includes a significant marsh creation component.

Table EM-6.1 Shoreline Stabilization Technologies	
Technology	**Description and Comments**
Bulkheads	**Hard structures built at the shoreline, designed to protect land behind from erosion or to stabilize a vertical earthen embankment; may be constructed from timber, steel, plastic or concrete sheet pile, or cast-in-place concrete**
Seawalls	**Hard structures built at or behind the shoreline, usually designed to protect the land behind from erosion due to wave attack; may be constructed from timber, steel, plastic or concrete sheet piles, stones, or cast-in-place concrete**
Breakwaters+	**Barriers (typically made of stone) constructed parallel to and off a shoreline; designed to lower wave energy that reaches the shore and slow sediment movement**
Segmented Rock Breakwaters+	**Rectangular rock structures placed parallel to a shoreline at varying intervals in open water to diffract incoming waves causing them to lose energy and deposit sediment leeward of the structure; can potentially be used in sediment starved systems**
Groins+	**Barriers constructed perpendicular to the beach to trap sediment in the littoral drift on the upstream side or to prevent longshore erosion of the downstream side; not recommended due to the potential for downdrift sediment starvation**
Timber Pylons+	**Treated timber pilings driven deep into soft sediments with cross members attached such that the structure appears as a wide "V" shaped fence pointing away from land; designed to baffle wave energy and promote suspended sediment deposition on the landward side**
Revetments+	**Hardened coverings constructed on the slopes of shore faces to protect from erosion due to wave attack and current movement; usually constructed of stone, precast concrete armor units, or cast-in-place concrete; usually have a filter system so material is not washed from behind by water**

Table EM-6.1 Shoreline Stabilization Technologies (cont'd)	
Technology	**Description and Comments**
Geotextile Tubes*+	**Consist of a fine mesh pillow-shaped fabric tube that can be placed then filled with dredged material; function much like rock gabions in that they are self-contained and effective in soft sediments; easily positioned in a variety of arrangements depending upon wave climate and desired results**
Foreshore Dikes*+	**Low rock dikes placed adjacent to a channel bank to promote sediment deposition when waves break over them; useful along the banks of major navigation channels such as the HNC and the GIWW**
Foreshore Reefs*+	**Conditions favorable to oyster reef establishment and growth of biological organisms such as oysters; reefs reduce wave energy and promote deposition of suspended sediment**
Rock Gabions*+	**Diffract and baffle wave energy to protect the shoreline and promote deposition of suspended sediment; effective in soft unconsolidated sediments**
Brush Fencing*+	**Consist of treated timber cribbing filled with discarded brush material; (e.g., Christmas trees) useful in low energy environments with adequate suspended sediment to slow current velocities and promote suspended sediment deposition**
Terracing*+	**Sediment piled to an elevation at which marsh vegetation can colonize using a small dredge or plow; generally built in parallel linear or grid patterns surrounding shallow open water in order to baffle wave energy, create conditions favorable for establishment of submerged aquatic vegetation and marsh expansion, and protect adjacent marsh from wind driven wave erosion**
Vegetative Planting*+	**Usually established from sprigs or seeds; vegetation stabilizes sediments and accumulates imported sediments**
Material Replacement*+	**Filling an eroded shoreline, usually with dredged material, to a historical or other desired configuration.**

+ A plus sign indicates that structures can act as sediment inducers as well as shoreline stabilizers.

* An asterisk indicates that the technology could represent or include a living shoreline depending on the methods and materials used.

Little Lake Shoreline Protection/Dedicated Dredging Near Round Lake (CWPPRA BA-37), Cost: $29.4 M

Purpose: prevent erosion along Little Lake shoreline with construction of over 25,000 ft of foreshore rock dike protection; Note: The project also includes a significant marsh creation component.

Estimated costs for shoreline protection in the 2017 Coastal Master Plan is $800 billion or more. For example, $184.5 M is estimated for 140,000 ft of rock breakwaters along the GIWW from Bayou LaFourche to Bayou Perot, and $563.2 M is estimated for 426,000 ft from Bourg to Amelia.

PERFORMANCE MEASURES

Performance measures include:

- linear feet or linear miles of shoreline stabilized or created,
- acres created,
- acres benefited or protected

Data Gathered:

Implementing organizations should maintain design plans with project areas, expected benefits, results of geotechnical analyses, and construction documents with as-built elevations and volumes of material. Monitoring and maintenance reports should also contain data on the project effects.

Monitoring:

Implementing organizations should conduct inspections to monitor the project and its effects. For example, CWPPRA projects are typically monitored for five years. Relevant parameters to be monitored may include elevation, shoreline change, hydrology, and oysters.

Parties Responsible: implementing agency (CPRA, CWPPRA, etc.)

Timetable for Gathering Data: annual reports

How Data is Shared: via agency websites

Possible Data Gaps: none identified

Additional Funding Needed: yes, as available

EM-7 Flood Risk Reduction and Coastal Resiliency

OBJECTIVES

- To provide flood risk reduction measures for property, population centers, ecosystems, etc.
- To anticipate, prepare for, and adapt to changing conditions and withstand and recover from disruptions

BACKGROUND/MAJOR ISSUES

Historically in the vicinity of the BTES, levees and control structures have been used to reduce flooding. There are several levels of flood protection provided by the levees and control structures, which are frequently determined by legislation. Typically, the objective is to provide a 100-year level of protection to all coastal areas, but due to funding constraints and economic feasibility, such endeavors may not always be pursued. The Morganza to the Gulf of Mexico Hurricane Protection Project and the CWPPRA Program have constructed numerous restoration and protection projects and highlight work that is taking place in the BTES boundary (Pages 289-290).

The Morganza to the Gulf of Mexico Hurricane Protection Project, which was authorized in the 2007 WRDA and is contained within the BTES footprint, will provide a 100-year level of protection, if constructed, and will include approximately 98 miles of earthen levee, 22 floodgates on navigable waterways, 23 environmental water control structures and a lock complex consisting of a lock

in the HNC along with an adjoining floodgate and a dam closure. Of the 98 miles of earthen levee, the Terrebonne Levee and Conservation District (TLCD) has the responsibility of maintaining and operating approximately 75 miles, including 11 floodgates, and 90 flap or sluice gates at 24 locations. This project reduces storm surge risk to people and property as well as the remaining fragile marsh from tropical storm and hurricane storm surge in the vicinity of Houma, Louisiana. A map of the authorized features of the project is presented in Figure EM-.1.

Wetland loss, subsidence, and sea level rise are some of the major causes increasing coastal vulnerability to storm impacts. While measures are put in place to protect coastal communities from storm surge and subsequent flooding, Louisiana is losing wetlands, its natural storm buffer, at a rate equal to that of a football field an hour as calculated by USGS. In fact, some of the most rapid land loss rates are occurring in the BTB. Programs such as the CWPPRA Program are supporting coastal resiliency by identifying these coastal areas in need and executing land building projects, hydrologic modification projects, shoreline protection projects, and other types of restoration in those areas. Similarly, any wetland loss experienced in construction of a Hurricane Storm Damage and Risk Reduction System (HSDRRS) project or other flood risk reduction projects must be mitigated through construction of additional wetlands. Without land building across coastal Louisiana, flood protection measures are less effective at reducing the risk of flooding during a flood event.

Plans exist to construct and expand the flood protection and resiliency measures already in place. Several projects are still in construction, others still in design, and there are plans for more flood risk reduction projects provided at the federal, state, and local levels. These plans would benefit the BTES in its entirety including its populations, communities, ecosystems, and its diverse marine and aquatic habitat.

Contingent upon economic feasibility, flood risk reduction and coastal resiliency efforts should be implemented in all areas where a need exists, and any unavoidable wetlands losses can be addressed.

DESCRIPTION

This Action Plan will recommend measures that if put in place will reduce flood risk and maintain and support coastal resiliency within the BTES when and where feasible. Flood risk management seeks to reduce flood risks by *managing the floodwaters* to reduce the probability of flooding and by managing floodplains and coastal areas to reduce the consequences of flooding. Flood risk management requires integrating and synchronizing programs at various levels of government designed to reduce flood risk. Damage to infrastructure, homes, businesses, and ecosystems due to storm surge risk and rainfall events can be reduced with structural and non-structural flood protection projects.

Earthen levees, concrete walls, flood gates, or pumps are structural components of a flood risk reduction project, with earthen levees typically being the principal component. Approximately 170 miles of planned and existing levees within the BTES boundaries provide hurricane risk reduction to the populations and ecosystems in the BTB. These levee projects include the St. Mary Backwater Flooding project, Morganza to the Gulf of Mexico Hurricane Protection Project, Valentine to Larose, Larose to Golden Meadow, Cut-off/Point Aux Chene Levee, Kraemer Bayou Boeuf Levee Lift, St. Charles West Bank Hurricane Protection Levee, East Harvey Canal Interim Flood Protection, West Bank and Vicinity, Rosethorne Tidal Protection, Jean Lafitte Tidal Protection, Lafitte Area Levee Repair, and the New Orleans to Venice project. The HSDRRS, which was authorized in 2005 following Hurricanes Katrina and Rita, provides risk reduction against a 100-year level of storm surge through construction of levees, floodwalls, locks, and pumping stations. Currently, two HSDRRS projects (the West Bank and Vicinity and the New Orleans to Venice Hurricane Risk Protection projects) within the BTES are being

constructed and will provide flood risk reduction to the BTB.

If implemented, non-structural flood protection, consisting of elevating and flood proofing homes and businesses, is an indicator of resilience. The 2012 Coastal Master Plan developed 116 conceptual non-structural projects for areas inhabited along coastal Louisiana. The number of non-structural projects across coastal Louisiana is expected to increase the plan recommends 26,569 structures for mitigation at a cost of $6.06 billion. The program is expected to grow in the coming years if funding can be identified. In addition, communities can also enact procedural and programmatic changes such as enactment of building codes and ordinances to help reduce flood risk and support coastal resiliency within the BTES boundary.

Some of the issues experienced in implementing flood risk reduction measures and coastal resiliency efforts include induced development and the potential for some levee alignments to increase flood population at risk.

There is a potential to reduce flood risk and increase coastal resiliency in Louisiana by maintaining current knowledge of our existing and proposed levee systems, our flood control structures and their operations, and taking advantage of a wide range of resiliency measures, structural and non-structural. The definition of resiliency as used in this document is based on Executive Order, 13653 of November 1, 2013 (Preparing the U.S. for the Impacts of Climate Change), in which the President defined resilience as "the ability to anticipate, prepare for and adapt to changing conditions and withstand and recover from disruptions."

Resilience represents a comprehensive, systems-based, life-cycle approach to both acute hazards and changes over time, and the concept of resilience is used to convey a broad-based, collaborative approach to finding creative solutions to such challenges. USACE has divided resilience into four key principles: prepare, absorb, recover, and adapt. USACE supports this definition of resilience and believes the four principles convey the elements of the President's definition as a step-wise framework for action.

LEAD AGENCY RESPONSIBLE FOR IMPLEMENTATION

USACE, New Orleans District

To date, USACE has completed the engineering and design on two HSDRRS projects located within the BTES boundary (the West Bank and Vicinity and the New Orleans to Venice Hurricane Risk Protection projects), which together of 129 miles of earthen levees. These levees provide reduction of risks from flooding to the surrounding area in the BTES.

CPRA, State of Louisiana

The 2017 Coastal Master Plan recommends 124 projects that build or maintain more than 800 square miles of land and reduce expected damage by $8.3 billion annually by year 50 or by more than $150 billion over the next 50 years. It includes 79 restoration projects, 13 structural risk reduction projects, and 32 nonstructural risk reduction projects that will be implemented throughout coastal Louisiana. Restoration projects build or maintain land and support productive habitat for commercially and recreationally important activities coastwide. Structural risk reduction projects reduce flood risk by acting as physical barriers against storm surge. Nonstructural risk reduction projects elevate and floodproof buildings and help property owners prepare for flooding or move out of areas of high flood risk. Specifically, nonstructural mitigation measures may include non-residential structure floodproofing, residential structure elevation, or voluntary residential structure acquisition. The nonstructural risk reduction projects include a total of 26,000 structures recommended for mitigation at a cost of $6 billion. The program includes 1,400 floodproofings, 22,000 elevations, and 2,400 voluntary acquisitions.

Local residents raise their homes to prevent flood damage. Image: Lane Lefort Photography

TLCD

TLCD is currently responsible for 70 miles of levees, 11 navigable floodgates, and 9 locations with either flap or sluice gates. In addition, TLCD is working on the Morganza to the Gulf Hurricane Risk Reduction System. When completed, the Morganza to the Gulf system will extend from Gibson, Louisiana to Lockport, Louisiana in Lafourche Parish. This levee alignment protects most of the five bayou communities (Pointe-aux-Chenes; Montegut; Chauvin, Robinson Canal, and Cocodrie; Dulac; Dularge and Theroit) located in the southern portion of Terrebonne Parish.

As of August 2016, TLCD currently operates two pump stations, one of which serves a flood protection purpose (Bayou LaCache marsh management pump station located on the north bank of Bush Canal between Bayou Terrebonne and Bayou Petit Caillou).

TIMELINES AND MILESTONES

Over the next several years, USACE will continue with construction of the West Bank and Vicinity and the New Orleans to Venice Hurricane Risk Protection projects.

CPRA will be implementing its 2017 Coastal Master Plan and continue constructing flood risk reduction projects in the BTES as funding allows. The State of Louisiana plans on expanding its non-structural flood risk reduction program in the future if funding allows.

Currently, TLCD is performing the engineering and design for two drainage projects in the Petit Caillou and the Chachoula areas that will pump water out of the levee system to protect the area from flooding. TLCD is seeking funding from the state to complete the two drainage projects.

POSSIBLE RANGE OF COSTS AND SOURCES OF FUNDING

USACE's objective is to cost effectively reduce flood risk. Currently, the estimated cost of the West Bank and Vicinity and the New Orleans to Venice Hurricane Risk Reduction projects is roughly $5.5 billion combined. Implementation of these projects is funded through the HSDRRS program.

The Morganza to the Gulf of Mexico Hurricane Protection Project was reauthorized for construction in WRDA 2014 at a cost of $10.3 billion. No Federal funds have been provided at this time.

The State of Louisiana will implement flood risk reduction projects as provided for in the 2017 Coastal Master Plan and will continue to implement as well as cost share on federal projects that reduce flood risk.

TLCD is performing the engineering and design for two drainage projects and plans to apply for state money to complete those projects. In addition, the TLCD won voter approval for two local sales tax initiatives for the Morganza to the Gulf system; 50 miles of the 98 mile levee system has been constructed using only local and state funding.

One example of successful funding opportunities is the Louisiana Department of Housing and Urban Development (HUD) who, in response to National Disaster Resilience Competition (NDRC), received $92,629,249 in NDRC funding to support its Louisiana Strategic Adaptations for Future Environments Program (LA SAFE). LA SAFE seeks to protect coastal wetlands in and around southeast Louisiana, retrofit communities to withstand increased flooding risk, and reshape high-ground areas to maximize their use and safety. The NDRC funds will also enable a tribal community on the Isle de Jean Charles, which has experienced a 98 percent loss of land since 1955, to relocate to a resilient and historically-contextual community. The Isle de Jean Charles, home to the Band of Biloxi-Chitimacha-Choctaw tribe located in Terrebonne Parish is being recognized as one of the first communities in the United States to be moved in response to sea level rise and coastal land loss, making them a model for future response to improving resilience.

With a focus on coastal resiliency, CWPPRA annually provides about $15 million in funding for the engineering and design and around $60 million for the construction, operation, maintenance, and monitoring of coastal restoration projects. These types of projects help improve resiliency by reinforcing the natural storm buffer of coastal Louisiana. Funding for CWPPRA comes from the Sports Fish Restoration and Boating Safety Trust Fund, which is supported

South Lafourche floodgate conversion. Image: South Lafourche Levee District

by various fuel taxes and taxes collected on a variety of sport fishing related goods. Program funds are made available to projects as they move through the selection process.

PERFORMANCE MEASURES

Performance measures include:

- communities, infrastructure, population centers, and assets protected
- change in flood damage costs based on insurance claims

Data Gathered:

- All responsible organizations maintain a list of ongoing and planned flood risk reduction projects and corresponding fact sheets.
- The State and USACE maintain a list of acres restored/protected for HSDRRS mitigation projects.
- TLCD maintains an up-to-date emergency contingency plan for operations of structural flood protection components during storms or flood events.
- CWPPRA maintains acres created/restored for coastal restoration projects.

Monitoring:

All organizations monitor levee systems and other flood protection structures regularly.

Parties Responsible: USACE, State of Louisiana, and TLCD

Timetable for Gathering Data: annual Levee Inspection Reports

How Data is Shared: via agency websites

Possible Data Gaps: none identified

If Additional Funding is Needed: yes, as available.

EM-8 Pollutant Identification and Assessment

OBJECTIVES

- To facilitate access to accurate and timely water quality data for the BTES by the public, researchers, and governmental agencies
- To facilitate access to Geographic Information System (GIS) data and mapping for hydrology, land use, permitted facilities discharging to BTES water bodies, and other related topological parameters that will promote better identification of current or potential water quality impacts

BACKGROUND/MAJOR ISSUES

Based on the draft *2016 Water Quality Integrated Report* (IR), currently, LDEQ monitors and assesses 94 separate basin subsegments (water quality assessment units) in the BTES. Assessments occur every even numbered year as required by the CWA. Most assessments are based on a percentage of ambient data results that meet water quality standards. The typical period of for each IR is the four years prior to report development; however, due to the four-year rotating monitoring cycle, most subsegments only have one year of data (October – September) available for each IR assessment. Suspected causes of impairment for each subsegment are reported in the IR. A limited number of suspected causes of impairment are based not on ambient data but on other available information such as fish consumption advisories and non-native aquatic plants. Table EM-8.1 summarizes the different suspected causes of impairment found in the BTB.

In order to address the reported impairments, accurate and up-to-date water quality data and topological information is important to target actions that are most likely to result in water quality improvements and protection. A number of local, state, federal, BTNEP, and academic institutions are

currently engaged in a variety of water quality and GIS data acquisition. By identifying these sources, BTNEP and its partner agencies can promote better coordination between researchers and water quality protection agencies to avoid costly resampling or reanalysis of data that have already been collected.

While not identified as such in Table EM-8.1, eutrophication is a known priority problem in the Gulf of Mexico and within the bayous, lakes, and estuaries of the BTES. Through the development of a comprehensive GIS, linking land uses to nutrient concentrations, identification of point source and any other source loadings within the basins and estimating movement of water from interbasin discharge (e.g., the Mississippi River) could be accomplished. Similarly, knowledge of the density of fecal coliform bacteria and concentrations of toxic contaminants will assist managers in addressing and evaluating identified problems related to public health and aquatic toxicity. Without such a system, managers will be faced with the task of redeveloping such estimates for each individually proposed project or any management changes within the BTB. Additionally, speculation concerning the eutrophication and contaminant impacts by project opponents may be difficult or impossible to successfully dispute if a systematic quantitative approach for loading projection is not put in place prior to specific project evaluations. Long delays in project implementation may result in the absence of such an approach.

In addition to the potential contaminants described above, a significant legacy of contamination is likely to exist from the past practice of discharging produced water directly into BTES water bodies. Effective in 1995, State regulation banned the practice of discharging produced water into coastal waterbodies (LAC 33:IX.708.C.2.b). However, prior to this time, the practice was widespread and resulted in heavily contaminated sediments in the vicinity of the discharges. Boesch and Rabalais (1989) looked at outer continental shelf discharges and concluded that the total volume of produced water entering estuarine and coastal waters in the Gulf of Mexico

Table EM-8.1

Suspected cause of impairment in the BTB based on the Draft 2016 Water Quality Integrated Report and the number of impaired segments for each suspected cause.

Suspected Causes of Impairment	Number of Impaired Subsegments
Non-Native Aquatic Plants	27
Fecal Coliform	25
Oxygen, Dissolved	20
Nitrate/Nitrite (Nitrite + Nitrate as N)	11
Phosphorus (Total)	11
Turbidity	8
Total Dissolved Solids	7
Residual Surface and Sub-surface Oil/Tar Balls/Tar Mats	6
Sulfates	6
Chloride	4
Enterococcus	2
Mercury in Fish Tissue	2
pH, High	2

was estimated to be approximately 435,000 barrels per day and mainly located in the BTES region. St. Pẻ (1990) reported that an estimated 530,000 barrels per day were released into the BTES based on 1987 estimates. This volume was generated from over 300 individual discharges from oil and gas production facilities. Limited information is available at this time to identify all of these former discharge points; therefore, it may not be possible or feasible to locate and remediate these areas.

Identification and assessment of potential pollutants in the BTES is critical to understanding where water quality concerns may exist. This understanding will permit a more targeted effort to maintain and restore water quality in the BTES. In particular, excess

nutrients from regional agriculture poses a potential risk to area water bodies. As such, efforts should be made to coordinate with the Louisiana Nutrient Management Strategy to identify and mitigate excess nutrient sources. Other targeted parameters include oxygen demanding substances, fecal coliforms, and toxic pollutants such as organic compounds and metals. Existing sources of data and information include but are not limited to those found in Table EM-8.2.

DESCRIPTION

Whenever possible, direct links to the various data sources are provided in Table EM-8.2. If direct data links are not available, then links to agency or university or NGO websites are provided to facilitate contacting these entities to determine the scope and availability of their data. All identified data sources are based on monitoring and/or research in the BTES.

LEAD AGENCY RESPONSIBLE FOR IMPLEMENTATION

Lead agencies or entities are those listed in Table EM-8.2. Links to these entities are also provided where available.

TIMELINES AND MILESTONES

All timelines and milestones for this management plan are based on the requirements of the agencies or entities identified above. Timelines and milestones for filling in data gaps will be based on requirements of the agencies or entities with a potential for gathering additional data under existing or yet-to-be developed monitoring programs.

POSSIBLE RANGE OF COSTS AND SOURCES OF FUNDING

Agencies and entities collecting data and working to solve problems project varing costs.

Agencies and entities identified above have existing limited sources of funding for their programs. Any additional monitoring to fill in data gaps will have to be funded from yet to be identified grants or other program resources.

PERFORMANCE MEASURE

Performance measure is the number of impaired subsegments. In order to ensure the integrity and accuracy of the data made available through this management plan, all data, assessments, and information should be collected or developed with the best possible Quality Assurance/Quality Control (QA/QC) measures. QA/QC requirements are frequently a requirement of the funding source for most sampling programs.

Data to be shared via:

- website links on BTNEP website to agency data
- website links to GIS apps
- data types listed in Table EM-8.2

Data Gathered:

Data may be gathered by the organizations identified in Table EM-8.2 but are not limited to those found in Table EM-8.2. To the extent permitted by the data gathering agency or entity, all data will be made available to the public, researchers, and governmental agencies through websites or direct contact with the data gathering organization. Table EM-8.3 provides possible data parameters.

Monitoring:

Monitoring programs are based on data gathering requirements of the agencies and entities listed in Table EM-8.2.

Parties Responsible: Responsible parties are those listed in Table EM-8.2.

Timetable for Gathering Data: Timelines for gathering data are based on data gathering requirements of the agencies and entities listed in Table EM-8.2.

Table EM-8.2. Website links to agencies and entities either collecting or with the potential for collection of water quality and other data or information in the BTES.

State Agencies	Data Type	Description of Available Website Information	Website Link
LDEQ	Ambient Water Quality Monitoring Program	Water sample and meter readings from Statewide ambient monitoring sites typically sampled monthly for 12 months.	http://www.deq.louisiana.gov/portal/tabid/2739/Default.aspx
	Water Quality Integrated Reports	Water quality assessment reports mandated by the Clean Water Act produced in April of even numbered years.	http://www.deq.louisiana.gov/portal/DIVISIONS/WaterPermits/WaterQualityAssessment/WaterQualityInventorySection305
	NPS Program's WIPS and NPS Management Plans	Special project water quality data collected in support of Nonpoint Source WIPs or other pollution reduction efforts.	http://nonpoint.deq.louisiana.gov/
	Aquifer Evaluation and Protection	Groundwater data collected to assess and protect drinking water aquifers.	http://www.deq.louisiana.gov/portal/tabid/108/Default.aspx
	Source Water Assessment Program	Surface or groundwater data collected as part of drinking water source protection efforts.	http://www.deq.louisiana.gov/portal/Default.aspx?tabid=1744
	Mercury in fish, vegetation, sediment, water	Mercury and related data from fish tissue and other matrices used to assess the need for fish consumption advisories related to mercury.	http://www.deq.louisiana.gov/portal/tabid/2733/Default.aspx (fish) http://www.deq.louisiana.gov/portal/tabid/2734/Default.aspx (vegetation) http://www.deq.louisiana.gov/portal/tabid/2735/Default.aspx (sediment) http://www.deq.louisiana.gov/portal/tabid/2732/Default.aspx (water)

State Agencies	Data Type	Description of Available Website Information	Website Link
LDEQ (cont'd)	Enforcement actions	Effort by the LDEQ Inspections and Enforcement Divisions to identify and correct illicit discharges to water or other media.	http://www.deq.louisiana.gov/portal/DIVISIONS/Enforcement.aspx
	Permitted facilities and other data or information in GIs	Primarily locational information for facilities permitted by LDEQ for water discharges.	http://map.ldeq.org/Default.aspx
	Nutrient Management Strategy	Contains information and reports on multi-agency coordination of nutrient management strategies.	http://www.deq.louisiana.gov/portal/DIVISIONS/WaterPermits/WaterQuality StandardsAssessment/NutrientManagement Strategy.as
	Fish kill investigations or other incidents may be available through LDEQ's EDMS	Reports by LDEQ's Inspections Division on fish kill or other incident investigations that may or may not be water related.	http://www.deq.louisiana.gov/portal/ONLINESERVICES/ElectronicDocument ManagementSystem.aspx ElectronicDocument ManagementSyst
CPRA	SWAMP	Coast-wide and basin-wide monitoring plans for Louisiana's SWAMP, Version III	http://coastal.la.gov/ http://cims.coastal.la.gov/RecordDetail.aspx?Root=0&sid=11464 aspx?Root=0&sid ElectronicDocument ManagementSystem.aspx
	CRMS (CPRA and USGS)	Monitoring of the effectiveness of individual projects as well as monitoring the cumulative effects of all projects in restoring, creating, enhancing, and protecting the coastal landscape.	https://lacoast.gov/crms2/Home.aspx

State Agencies	Data Type	Description of Available Website Information	Website Link
LDH	BEACH monitoring program for Enterococcus	Tests water at 24 beach sites along the Louisiana coast to determine whether the water quality meets EPA criteria. Water samples are collected weekly during Louisiana's beach season between the months of May and October.	http://www.dhh.louisiana.gov/index.cfm/page/288 (Data available upon request) https://watersgeo.epa.gov/beacon2/ (EPA data repository for BEACH monitoring information)
	Molluscan shellfish program	The Molluscan Shellfish Program is the regulatory agency for the oyster harvesting waters along Louisiana Gulf Coast. The harvesting areas are set forth by the Louisiana Sanitary Code and the National Shellfish Sanitation Program.	http://www.ldh.louisiana.gov/index.cfm/page/629 (Data available upon request)
	Harmful algal bloom monthly monitoring for *Karenia brevis* as part of molluscan shellfish program	Part of Molluscan shellfish program.	http://www.ldh.louisiana.gov/index.cfm/page/629 (Data available upon request)
LDNR	LDNR Home Page	State natural resource agency.	http://dnr.louisiana.gov/
	Office of Coastal Management	The Office of Coastal Management is responsible for the maintenance and protection of the State's coastal wetlands. The main function of the Office of Coastal Management is the regulation of uses in the Louisiana coastal zone, especially those which have a direct and significant impact on coastal waters.	http://dnr.louisiana.gov/index.cfm?md=pagebuilder&tmp=home&pid=85&ngid=5

State Agencies	Data Type	Description of Available Website Information	Website Link
LDNR (cont'd)	Office of Conservation	The Office of Conservation is charged with conserving and regulating oil, gas, and lignite resources of the State.	http://dnr.louisiana.gov/index.cfm?md=pagebuilder&tmp=home&pid=46&ngid=4
	SONRIS	Multifaceted data repository for natural resource data and information.	http://sonris.com/
LOSCO	Identification of oil spill sites	LOSCO's primary function is to ensure effective coordination and representation of the State's interests in all matters related to spill response and prevention.	http://www.losco.state.la.us/
LDWF	LDWF home page	State wildlife and fisheries resource agency	http://www.wlf.louisiana.gov/
	Marine Fisheries Management Plans	PDF reports for a variety of marine fisheries management plans	http://www.wlf.louisiana.gov/fishing/fishery-management-plans-marine
	Inland Fisheries Management Plans	PDF reports for a variety of inland fisheries management plans	http://www.wlf.louisiana.gov/fishing/waterbody-management-plans-inland
	Creel Surveys	LA Creel gives managers more confidence in their data and a better foundation for management of our fisheries.	http://www.wlf.louisiana.gov/about-la-creel
	Fish kill investigations		
	Aquatic Vegetation Control Plans	PDF reports for a variety of aquatic invasive species control plans.	http://www.wlf.louisiana.gov/fishing/aquatic-vegetation-control-plans

State Agencies	Data Type	Description of Available Website Information	Website Link
LDAF	LDAF home page	State agriculture and forestry resource agency.	http://www.ldaf.state.la.us/
	Soil and Water Conservation Districts	The Office of Soil & Water Conservation provides financial assistance, administrative support, centralized direction and coordination to SWCDs which provide conservation planning services to landowners within their individual districts.	http://www.ldaf.state.la.us/conservation/soil-water-conservation-districts/
	Conservation Programs	Provides links to a variety of State conservation programs.	http://www.ldaf.state.la.us/conservation/conservation-programs/
	Information and Education	Provides links to a variety of State water, soil, wetland, farming, and forestry education programs.	http://www.ldaf.state.la.us/conservation/conservation-information-education/
	Pesticide and Environmental Programs	LDAF is the State's lead agency in regulation of pesticide use and application. LDAF's Pesticide and Environmental Programs Division is responsible for all aspects of pesticide use to minimize unnecessary impacts by pests to agriculture and society in general while protecting human health, the environment, and endangered and threatened species as mandated by the federal law.	http://www.ldaf.state.la.us/ldaf-programs/pesticide-environmental-programs/
BTNEP	BTNEP home page	A partnership of government, business, scientists, conservation organizations, agricultural interests, and individuals for the preservation, protection, and restoration of the BTES in southeast Louisiana.	www.btnep.org
	Invasive species studies	Promotes awareness of invasive species in the BTES in order to promote reductions in the spread of these species.	http://invasive.btnep.org/InvasiveHome.aspx
	BTNEP Projects	BTNEP develops projects that help better understand the ecological, social, and geologic processes that all play a role in the restoration of the BTES.	http://www.btnep.org/BTNEP/projects/ProjectList.aspx

Federal Agencies	Data Type	Description of Available Website Information	Website Link
USEPA	STORET and WQX	EPA's primary water quality data storage and retrieval tool. Compiles data from multiple agencies and private research groups.	https://www.epa.gov/waterdata/storage-and-retrieval-and-water-quality-exchange
	WATERS	WATERS unites water quality information previously available only from several unconnected databases.	https://www.epa.gov/waterdata/waters-watershed-assessment-tracking-environmental-results-system
	ATTAINS	ATTAINS is an online system for accessing information about the conditions in the Nation's surface waters.	https://www.epa.gov/waterdata/assessment-and-total-maximum-daily-load-tracking-and-implementation-system-attains
	NEP	The NEP is a collaborative, effective, efficient, and adaptable coastal ecosystem-based network.	https://www.epa.gov/nep
NOAA	Home Page	NOAA enriches life through science. NOAA's reach goes from the surface of the sun to the depths of the ocean floor keeping citizens informed of the changing environment.	http://www.noaa.gov/
	Oceans and Coasts	NOAA's National Ocean Service is positioning America's coastal communities for the future	http://www.noaa.gov/oceans-coasts
	Fisheries	NOAA Fisheries provides science-based conservation and management for sustainable fisheries and aquaculture, marine mammals, endangered species, and their habitats.	http://www.noaa.gov/fisheries
	HAB monitoring	HAB monitoring and research information	http://oceanservice.noaa.gov/hazards/hab/
	NOAA Environmental Response Management Application	An online mapping tool that integrates key information to support environmental and severe weather responses in the Gulf of Mexico.	http://response.restoration.noaa.gov/maps-and-spatial-data/environmental-response-management-application-erma/gulf-mexico-erma.html
USDA	NRCS	Provides farmers and ranchers with financial and technical assistance to voluntarily put conservation on the ground.	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/ technical/nra/dma/

Federal Agencies	Data Type	Description of Available Website Information	Website Link
USDA (cont'd)	Research and Science	Fosters continued economic growth, adapting to the effects of climate change and addressing food security in the United States.	http://www.usda.gov/wps/portal/usda/usdahome?navid=research-science
	Conservation	USDA recognizes that conservation by farmers, ranchers, and forest owners means thriving and sustainable agriculture.	http://www.usda.gov/wps/portal/usda/usdahome?navid=conservation
	Natural Resources Assessment	The USDA NRCS documents the effects of conservation practices and systems at various geographic levels so better decisions can be made initially and risk is managed more effectively.	https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/nra/
	ARS	USDA Agricultural Research Service, a premier scientific organization,coordinates research that solves problems affecting Americans daily.	https://www.ars.usda.gov/
USGS	Streamflow data	Historical instantaneous stream flow data portal.	http://waterdata.usgs.gov/la/nwis/uv/?referred_module=qw
	NWIS	Streamflow and water chemistry data portal.	http://maps.waterdata.usgs.gov/mapper/index.html
	International Charter "Space and Major Disasters"	The International Charter "Space and Major Disasters"(Charter) serves as an important source of satellite imagery for response to major natural and man-made disasters worldwide.	http://hdds.usgs.gov/international-charter
	EROS	Satellite imagery portal.	http://eros.usgs.gov/

Other	Data Type	Description of Available Website Information	Website Link
LUMCON	Bayouside Classroom	Student and teacher educational opportunities.	http://www.lumcon.edu/education/K-12/StudentDatabase/
	Teacher Education & Resources	Student and teacher educational opportunities.	http://www.lumcon.edu/education/Teacher.asp
LPBF	HydroCoast	Maps of Pontchartrain & Barataria Basins showing salinity, habitat, weather, water quality, and biological information.	http://saveourlake.org/coastal-hydromap.php
TNC	Grand Isle, Louisiana	Information on TNC's Grand Isle conservation areas.	http://www.nature.org/ourinitiatives/regions/northamerica/unitedstates/louisiana/placesweprotect/grand-isle.xml

Table EM-8.3

Possible data parameters collected by organizations monitoring in the BTES. Other organizations may collect additional parameters.

Dissolved Oxygen	pH	Chlorides
Sulfate	Total Dissolved Solids	Nitrate/Nitrite Nitrogen
Total Phosphorus	Conductivity	Water Temperature
Metals	Total Kjehldahl Nitrogen	Ammonia
Total Organic Carbon	Salinity	Hardness
Alkalinity	Stream Discharge (Cubic Feet per Second)	Fecal Coliform
Enterococcus	Total Suspended Solids	Total Dissolved Solids
Turbidity		

How Data is Shared: Data is to be shared either by accessing agencies' websites or entities in Table EM-8.2 or by contacting those organizations directly to determine data availability and means of access.

Possible Data Gaps: Sediment contaminant data is likely to be unavailable or dated due to lack of routine sediment monitoring. It may be possible to identify sediment data associated with the LOSCO/NRDA programs. Historical, greater than 20 years old, data may be available from LDEQ's produced water data study conducted in early 1990s. However, this data may be of limited value due to its age, and it is most likely available only as hardcopy.

Harmful Algal Blooms (HAB) continue to be a potential risk in the BTES and across Louisiana. LDH's Molluscan Shellfish Program samples for *Karenia brevis* on a monthly basis in order to help ensure oyster harvesting areas are safe for harvest. Additional sampling or the creation of a quick response team from among interested agencies would be helpful in protecting the public from the risks of HABs. Several groups, including the Gulf of Mexico Program (GOMP), Gulf of Mexico Alliance (GOMA), and the Gulf of Mexico Research Initiative (GOMRI) may be potential sources for additional HABs monitoring.

It is difficult to calculate loads from much of the field data being collected because flow measurements are not being collected as part of routine LDEQ ambient monitoring or other sampling programs.

Additional Funding Needed: Additional funding is always helpful to agencies and entities engaged in environmental data collection efforts; however, these organizations are responsible for obtaining their own funding sources largely through existing federal, state, or private grants.

REFERENCES

Boesch, D. F. & Rabalais, N. N. (Eds.). (1989). *Produced Waters in Sensitive Coastal Habitats: An Analysis of Impacts, Central Coastal Gulf of Mexico.* OCS Report/MMS 89-0031. New Orleans, LA: U.S. Dept. of the Interior, Minerals Management Service, Gulf of Mexico OCS Regional Office.

St. Pè, K.M. (Ed.). (1990). *An Assessment of Produced Water Impacts to Low-Energy, Brackish Water Systems in Southeast Louisiana.* Baton Rouge, LA: Louisiana Department of Environmental Quality Water Pollution control Division.

EM-9 Oil and Produced Water Spill Prevention and Early Detection

OBJECTIVES

- To reduce the number, volume, and impact of petroleum and related fluid spills in the BTES

- To place an emphasis on the prevention and early detection of petroleum and oilfield produced water spills in the BTES

BACKGROUND/MAJOR ISSUES

Petroleum is a complex mixture of hydrocarbons which can be toxic to the plants and animals impacted from a release or spill. Oilfield produced water, in addition to being highly saline, also contains petroleum hydrocarbons and, in oil-bearing formations common to those found in the BTES, is usually associated with high concentrations of radionuclides such as radium 226. These radionuclides often occur naturally in subsurface formations but at far greater concentrations than levels found in unimpacted surface waters.

The BTES is especially at risk to releases of oilfield and injection lines located within its borders. The petroleum industry, along with its supporting infrastructure, constitutes an enormous presence within the BTES compared to other estuaries in the Nation. Much of this infrastructure is located within the sensitive coastal wetlands of the southern BTES, that spill impacts may be increasing in magnitude exist.

Many spills are classified as accidental or due to failures. Many of these incidents are either totally avoidable or could be significantly reduced in impact simply through a more effective enforcement of existing federal and state spill prevention regulations. Clearly, it is preferable to prioritize prevention over response when considering spills of produced water and petroleum products. Additionally, by altering future flowline placement practices in marshlands where possible, early detection of spills could be enhanced.

As an example of one possible beneficial change in current practices, flowlines could be placed along canal spoil banks whenever possible rather than across vegetated wetlands. Then, in the event of a flowline failure, spilled fluids would be noticed more quickly. Corrective actions could then be initiated more expeditiously, reducing the magnitude of the spill and resulting impacts.

Some of the more damaging and monetarily expensive spills of petroleum are those which occur from flowlines and transfer lines running through internal wetland areas. A leak can go unnoticed for weeks or longer before enough oil has been released to flow through thick wetland vegetation into an adjacent water body where the telltale sheen might be observed.

Perhaps the most ecologically damaging types of oilfield related spills are those which involve releases of produced water from buried injection lines. Since there is often no petroleum-related sheen associated with spills of these highly saline fluids, they can go unnoticed initially, only becoming evident much later when overlying vegetation shows signs of stress or dies.

Either of these types of spills usually results in lengthy and labor-intensive response efforts by agency and industry personnel. The remediation efforts required by the responsible parties in these cases are usually very expensive.

Unfortunately, petroleum and produced water spills are frequent occurrences in the BTES. Exact numbers of petroleum and produced water releases are difficult to obtain since no single agency maintains spill data for the area within the program boundaries. However, the National Response Center (NRC) database provides an avenue to better quantify the number of petroleum related releases within the BTES but not the volume released since many release reports do not contain a reported volume.

DESCRIPTION

The intent of this Action Plan is to encourage developing and implementing a strategy to reduce the number, volume, and impacts of petroleum and related fluid spills into the BTES. This is not a plan which is intended to address oil spill response. Rather, it is a plan to emphasize prevention and early

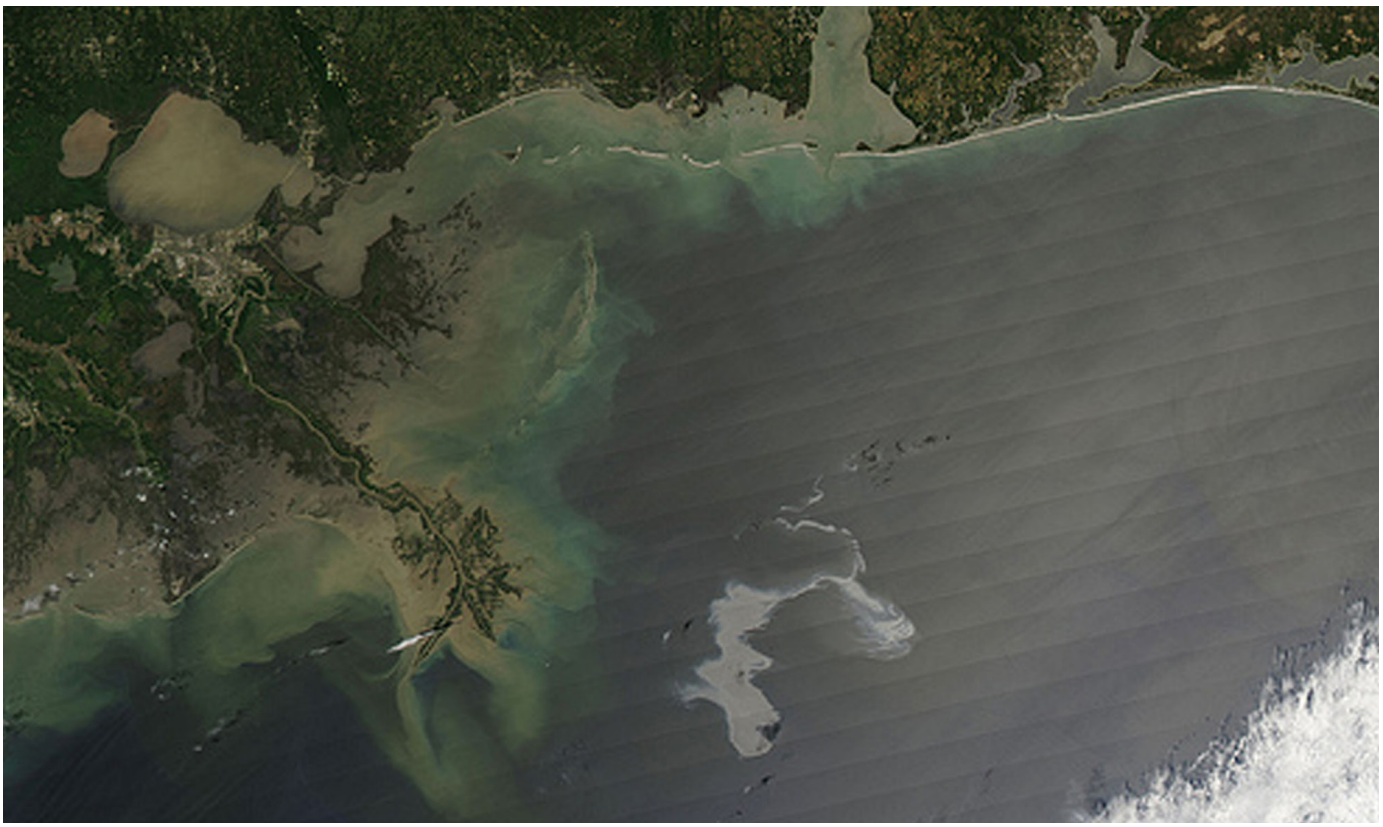


Image of Deepwater Horizon oil spill in the Gulf of Mexico. Image: NOAA

detection of petroleum and produced water spills because several federal and state agencies along with numerous private groups already have extensive spill response programs. This Action Plan seeks to build upon existing programs which emphasize the premise that preventing spills of petroleum and related oil production fluids would be less environmentally damaging and less costly to industry than reacting to them once they occur.

Implementing this Action Plan supports most of the programmatic goals established by the BTNEP MC in November of 1992. Spills of petroleum and related fluids are sources of toxins in the BTES. Prevention of these incidents will maintain the health of diverse biological communities.

Certain components of petroleum products, particularly the lighter, more volatile fractions, are toxic to wetland plants. Additionally, many spills of oil are also associated with releases of produced water which can result in the loss of impacted vegetation. As the plant community is lost, the loosely consolidated sediments may be quickly eroded and can revert to less productive open water systems. The successful implementation of this Action Plan could effectively lessen impacts to those areas where spills are occurring.

An accessible, comprehensive database will ensure that the general public as well as agency and industry personnel are better informed of the magnitude and impacts of oilfield related spills. This awareness is a critical first step in developing a truly effective spill prevention program for the BTES. Also, this database is essential in forming a system to monitor the success of the overall program.

Generally, the location of spills and related fluids are not well defined. In contrast, the source of the release, in many cases, may be well defined. For example, oil wells, storage tanks, flares, and process/pressure

vessels may be well defined using Global Positioning System (GPS) units. However, once the product is on the water, the discharge may be distributed in a heterogeneous manner over a wide geographic area. For larger volume petroleum releases, spill trajectories and/or direct observations may be used to determine spill impact locations. Note: The source may originate within the BTES or from an offshore facility as in the case of the Deepwater Horizon oil spill.

The goals of this Action Plan can be accomplished under existing programs administrated by federal and state agencies. On the federal level, the U.S. Coast Guard (USCG) and the U.S. Environmental Protection Agency (USEPA) have responsibilities for responding to spills of petroleum and other oilfield products. Facilities having spills are required by federal law to report those incidents to the NRC (see Section E.c. United States Coast Guard).

From the NRC release reports, spills located within the BTES area and below the GIWW are jurisdictionally assigned to the USCG. Those spills which occur above the GIWW are jurisdictionally assigned to the USEPA. The current policy of the USCG limits their response to spills of oil in sufficient quantities which will cause the formation of an oil sheen. These include sheens created from the discharge of produced water.

The USEPA responds to spills of oil but their responsibilities also require them to be involved in any violation of the 1972 CWA which includes spills of oil field produced water. Both the USCG and the USEPA maintain databases through the NRC which are being used in this Action Plan. Currently, the NRC contains historical release reports dating back to 1990. Many of the release reports do not have a precise latitude/longitude coordinate to pinpoint the release source location. In many cases, only a reference to a physical landmark, surface feature, river mile marker or offshore mineral lease block is provided as a location reference. Once the release reports are spatially enabled (geocoded latitude/longitude) within the boundary of the BTES, the historical reports may be used to determine the number of releases reported, the frequency over time intervals, and other statistics. The 1990-2015 NRC database within Louisiana's territorial limit contains approximately 43,197 oil related release reports, and of those reports, the BTES area contains approximately 19,958 oil related release reports. The Chemical Hazards Response Information System (CHRIS) codes used to identify oil related spills include: GOC, ODS, OFR, OFV, OHY, OIL, OLB, OMT, OOD, OON, ORD, OSX, OSY, OTB, OTD, OTF, OTH, OTW, OUN and NCT. Figure EM-9.1 spatially represents the locations of NRC release reports.

Table EM-9.1

Summary of NRC Oil Related Release Reports from 1991 through 2015.

Five-Year Interval	Number of Release Reports
1991-1995	4,717
1996-2000	4,270
2001-2005	3,332
2006-2010	3,343
2011-2015	3,193
25 Year Total	18,855

Table EM-9.1 summarizes the number of oil related release reports by five-year intervals beginning with year 1991. On the state level, several agencies have responsibilities which are pertinent to this action. All spills of petroleum as well as those of produced water are legislatively required to be reported to LDEQ.

LDEQ has specific regulations (similar to USEPA's) dealing with spill prevention and containment

safeguards, such as yearly flowline pressure testing and impervious decking requirements. However, the resources required to maintain an effective spill prevention program are not available.

In 1991, the Louisiana legislature passed the Louisiana Oil Spill Prevention and Response Act (Act No. 7) which was intended to complement the Oil Pollution Act of 1990, a federal law commonly known as OPA'90. The Louisiana Oil Spill Prevention and Response Act (LOSPRA) created LOSCO within the Department of Public Safety and Corrects (DPS). LOSPRA also created the LOSCO Interagency Council to assist the Coordinator in the development of a statewide oil spill prevention and contingency plan. The Act also specifically authorizes the Interagency Council to assist "... the coordinator in preparing and approving an annual work plan, identifying state agency needs which must be met in order to comply with the state oil spill contingency plan." It is important to note that LOSPRA does not include authority over produced water spill prevention.

The Office of Conservation, under the Louisiana Department of Natural Resources (LDNR OC) is also a key state agency with oil spill prevention responsibilities. The LDNR OC has specific regulations dealing with containment structures, operational safeguards during the drilling process, and oilfield waste disposal.

LEAD AGENCY RESPONSIBLE FOR IMPLEMENTATION

As discussed above, several state and federal agencies share varying degrees of responsibilities primarily pertaining to the prevention of petroleum spills.

LDEQ

The LDEQ is the state lead response agency with regulatory authority pertaining to spill prevention which includes petroleum as well as produced waters. LDEQ, therefore, would be a logical choice for lead implementer of this Action Plan on the state level. Support implementers should include USEPA, USCG, LOSCO, and LDNR OC.

USEPA

As a co-lead implementer, USEPA uses Spill Prevention, Control and Countermeasures (SPCC) and Facility Response Plan (FRP) rules to assist facilities in preventing unauthorized discharges of oil or hazardous materials into inland waters or adjoining shorelines. Increased emphasis on inspections to verify SPCC plans and FRPs could assist in preventing or significantly reducing unauthorized discharges.

USCG

The USCG is the federal lead response agency for unauthorized discharges of oil into coastal waters and deep water ports. The USCG houses the NRC. The NRC is tasked with recording all oil, chemical, radiological, biological and etiological discharges into the environment from reports received by the national hotline at 1-800-424-8802 or from web reports (http://nrc.uscg.mil). The NRC release reports are stored in a national database and are provided to the public via yearly spreadsheets. Unfortunately, produced water releases, typically associated with oil production activities, go unreported in the NRC database unless the release creates a sheen.

LOSCO/DPS

The LOSCO in the DPS is tasked with and has developed a statewide oil spill prevention and response plan, taking into account rules developed under the federal Oil Pollution Act of 1990 (OPA'90). LOSCO is authorized to administer and direct all state discharge response and cleanup operations resulting from an unauthorized discharge of oil or threatened unauthorized discharge of oil in coastal waters, the land, or any other waters of Louisiana. As a co-lead implementer in spill response, LOSCO provides assistance with spatial information developed for contingency planning under the Environmental Baseline Inventory (EBI) mandate.

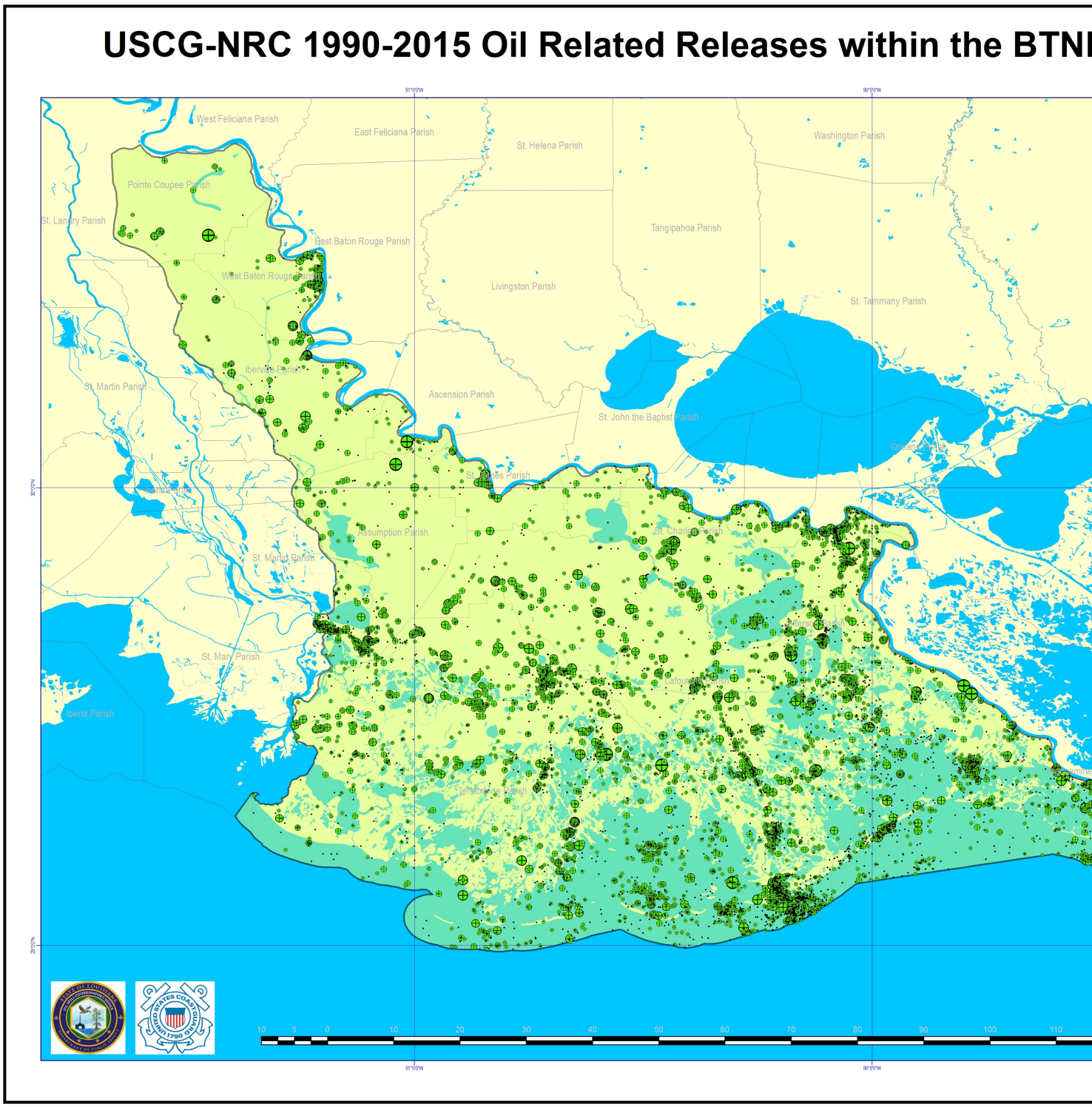
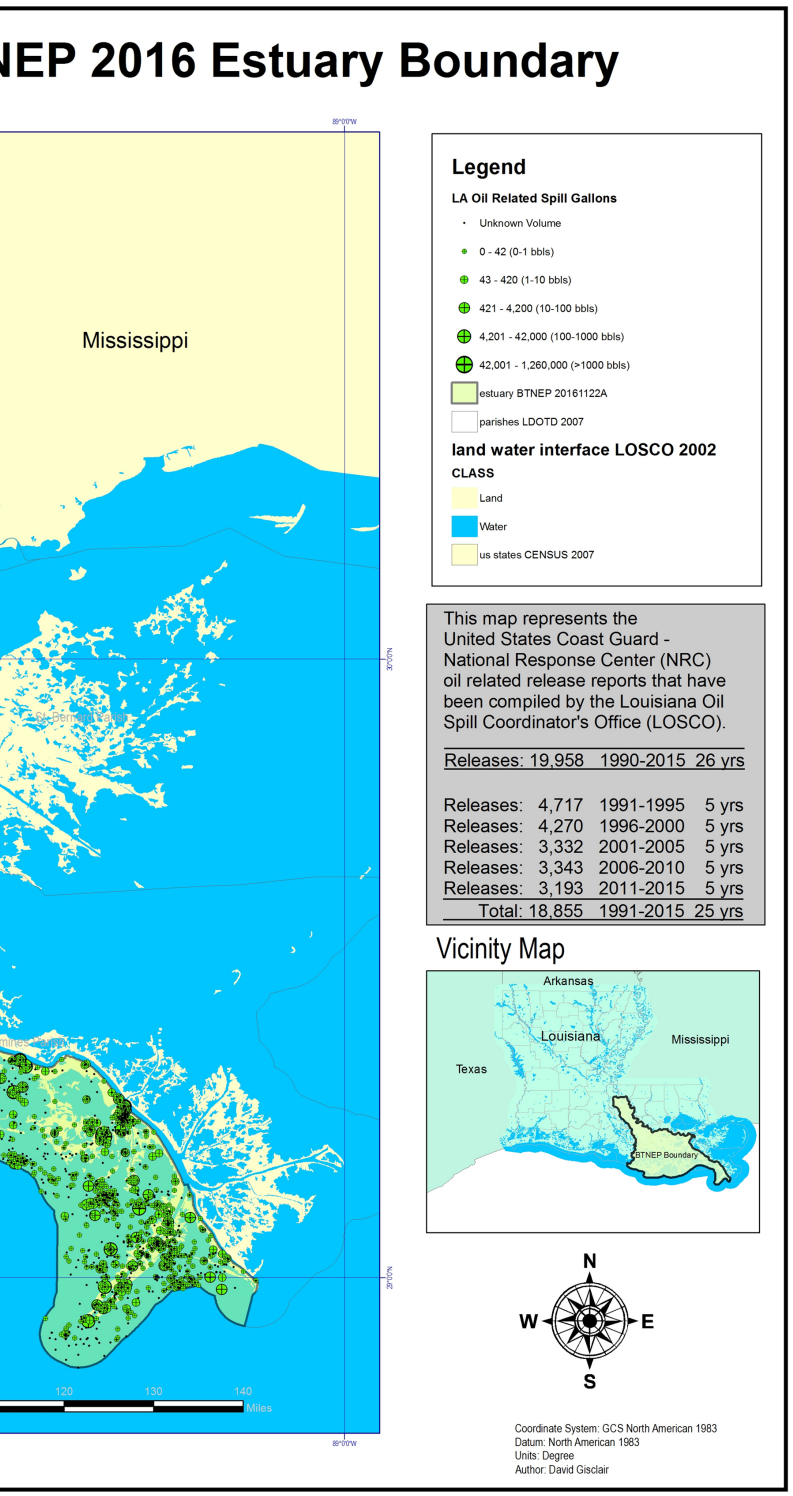


Figure EM-9.1 This map spatially represents the locations of NRC release reports from 1990 to 2015.



LDNR OC

The OC is charged with conserving and regulating oil, gas, and lignite resources of the state. This statutory responsibility is to regulate the exploration and production of oil, gas, and other hydrocarbons and lignite; to control and allocate energy supplies and distribution; and to protect public safety and the environment from oilfield waste, including regulation of underground injection and disposal practices. The OC is tasked with public safety and protection of the environment. The Engineering Regulatory Division is responsible for inspecting oil and gas wells and the associated facilities to ensure compliance with regulatory requirements. Increased inspections may assist in the prevention and reduction of unauthorized discharges.

TIMELINES AND MILESTONES

- Form a work group to examine and evaluate the currently-used spill database maintained by the LDEQ, Surveillance Section and the NRC (LDEQ, LOSCO, LDNR, USEPA, USCG) database.
- Design a database which would: 1) maintain accumulated spill data such as source of spill, volumes lost, habitats affected, magnitude of impact, reason for spill, costs associated with clean-up, etc. (Database Work Group) and 2) cross-reference spill unique record identifiers from each reporting source (USCG/NRC, USEPA, DPS, LDEQ, LDNR, and LDWF).
- Construct a database form using an appropriate, widely-used database program and install it on the LDEQ ORACLE system (Database Work Group).
- Maintain database by relying on the LDEQ field offices responsible for responding to these spills to enter data from regional offices via computer links to the LDEQ Oracle system (LDEQ).
- Develop and implement educational programs

which would serve to inform industry, federal, state, and local entities of the seriousness of the spill issue (BTNEP MC, USEPA, USCG, and LDEQ).

- Form a work group to address the LOSCO Interagency Council to inform them of agency needs which must be met in order to comply with the state oil spill contingency plan (BTNEP MC, USEPA, USCG, and LDEQ).
- Encourage effective and fair enforcement of spill prevention regulations throughout the BTES (BTNEP MC, USEPA, USCG, LDEQ, LDNR, and LOSCO).
- Maintain the spill database and use accumulated data to measure the success of this Action Plan (LDEQ).
- Continue educational efforts and incorporate figures on the costs associated with clean-up of spills into educational programs in order to demonstrate the sensibility of effective preventative maintenance programs (even without considering the usually-unquantifiable ecological costs).
- Effectively and fairly enforce spill prevention regulations (USEPA, USCG, LDEQ, and LDNR).
- Encourage federal and state agencies with oil and produced water spill prevention responsibilities to increase inspections of applicable facilities within the BTES (BTNEP MC, USEPA, USCG, LDEQ, and LDNR).
- Use the spill database to identify areas in which success is apparent and those in which further efforts are needed (LDEQ).
- Adjust or redirect the spill prevention program efforts into those areas in which the spill database figures indicate continuing problems (USEPA, USCG, LDEQ, and LDNR).
- Dedicate state resources specifically to oil and oilfield produced water spill prevention.

POSSIBLE RANGE OF COSTS AND SOURCES OF FUNDING

Costs will be associated with the level of effort that the BTNEP MC deems necessary or appropriate to accomplish the above described activities. Acceptance of this plan by the agencies or entities listed as lead or support implementer does not commit that agency or entity to implement the plan. At a later date, parties identified as potential plan implementers will work with the BTPO, the BTNEP MC, and other plan implementers to formalize all commitments concerning implementation.

Estimate one person-month per year for monitoring all the aspects of the Action Plan and the cooperative efforts of each agency, including salary, fringe, incidental costs, and indirect costs of approximately $8,000 for each year with no inflation. Costs of statistical analyses are estimated at four person-months ($32,000 every five years). A statistical consultant should also be used at the beginning to help design the statistical analysis to be employed at five-year intervals to determine the suitability of existing data and what baseline data are needed ($16,000 in the beginning). Modifications in monitoring plan (see below) should result in modifications of cost.

PERFORMANCE MEASURE

Performance Measure is:

- number, volume, and impact of petroleum and related fluid spills in the BTES

Monitoring for this Action Plan includes assessing the timely implementation of the components of the Action Plan and the eventual success of implementation (i.e., oil spill prevention increased and petroleum-source contaminants decreased). The first component is not conducive to monitoring in the traditional sense of data collection and analysis (e.g., water quality monitoring), but a tracking system. Monitoring implementation is designed to determine

whether such a spill database was developed, whether it was used in interpretation of information to the public, and whether a better informed public (including agencies and industry) resulted. Eventual project success can be monitored with an analysis of data that shows a reduction of petroleum-related spills (see Table EM-9.1. Summary of NRC Oil Related Release Reports from 1991 through 2015), and a reduction in petroleum-source contaminants in the water, sediments, and biota of BTES. The success of various Action Plans that target reduced sewage pollution, reduced oil related spills, and stormwater management may all be manifested in similar improvements in water quality.

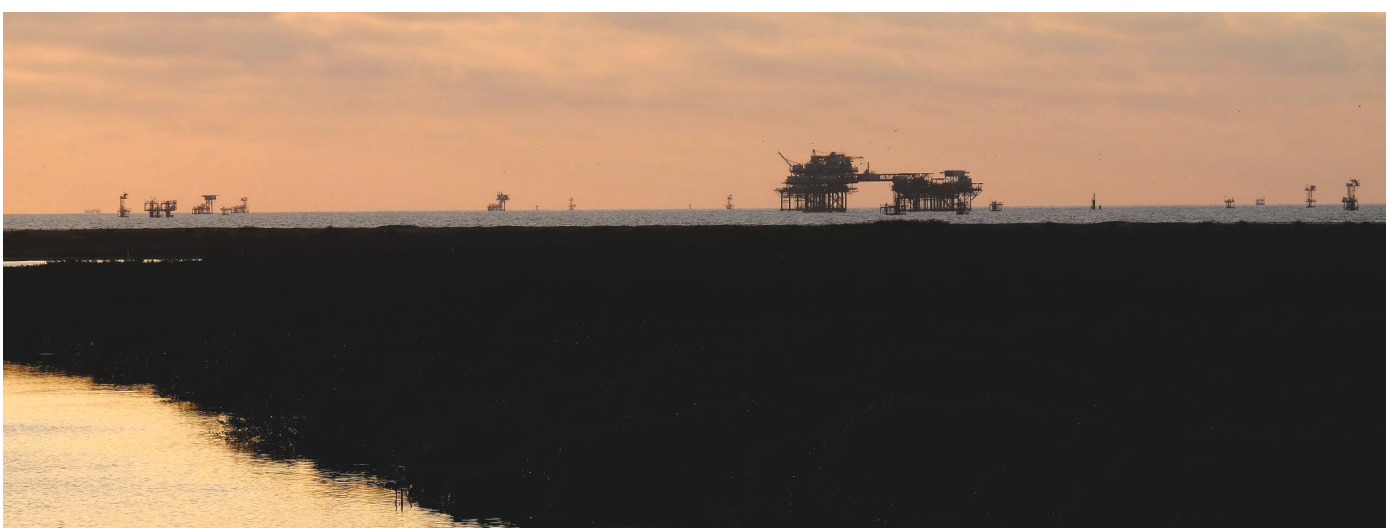
If all Action Plans are working in parallel and water quality improves, it will be difficult to determine the cause and effect. Since the scale of implementation will vary among Action Plans, the level of success in improved water quality will also vary. The probability is high that implementation of any single management scenario may have varying effects in different environments. It is also possible that no single indicator may indicate program success, but success will be seen in a combination of indicators. The end result of multiple actions to improve water quality, however, will be noticeable in indicators of basin-wide ecosystem-level health. Specific examples of project success are proposed below. They can be expanded or modified. They should be reviewed periodically and amended as appropriate.

Data Gathered:

- EM-9 establishes an accessible, comprehensive computerized spill database of petroleum and related fluids spills in the BTES.
- Interpretive information from the database will be provided to agency and industry personnel and the public to keep them informed of the magnitude and impacts of oilfield related spills. The usefulness of the database and transfer of information will be evident in increased awareness of the impacts of such spills and eventually increased prevention of such spills in BTES.
- Recorded number and volume of spills should be reduced along with petroleum-related contaminants in the BTES.

Monitoring:

Because of the heightened attention on environmental impacts due to the BP oil spill of 2010, the following monitoring strategies are intended to serve as a



Oil platforms off the Gulf Coast of Louisiana. Image: Lane Lefort Photography

statement of the most comprehensive and effective mechanisms to assess the effectiveness of projects implemented under the Action Plans. The monitoring strategies outlined here do not override or replace project monitoring that would be done by an agency related to specific agency-sponsored projects.

A monitor selected by the BTNEP MC will prepare reports to be submitted to the BTNEP MC. Although individuals involved in implementing the Action Plan may prefer a team member to monitor the project, usually a third party offers the best option as the responsible individual for the monitoring. Independent reviewers should be free of vested interests, historic commitments, unrestrained by mission statements, and free from personnel or budgetary actions. The implementer and cooperating agencies will provide the project monitor with data products listed above for subsequent assessment of accuracy and incorporation into reports. The monitor should interact directly with each cooperating agency to determine their level of commitment and activities for the various reports. Success of the monitoring strategy depends on the commitment of participating agencies and individuals to make monitoring an integral part of the CCMP and to provide the Action Plan monitor with the data required to develop reports to the BTNEP MC. An additional outside monitor (i.e., statistician) should be contracted by the BTNEP MC in years one, five, and ten. The results of the statistical analysis should be provided to the overall monitor of the Action Plan for presentation to the BTNEP MC.

The monitor will prepare quarterly reports. Reports will be submitted not less than 15 days prior to a regularly scheduled meeting of the BTNEP MC. The party responsible for the monitoring should be available to discuss the report at the meeting if requested to do so by the BTNEP MC. Monitoring reports will also be provided to the agencies or institutions participating in implementation. Interim reports can be prepared by the monitor at any time to draw the BTNEP MC's attention to significant problems, delays, etc. Statistical analysis of petroleum and related spills data will be conducted at the end of years five and ten.

Guidance for Monitoring Reports

Quarterly reports to the BTNEP MC shall provide suitable components such as:

- check-off of project landmarks according to the project time line.
- assessment of cooperating agency contributions.
- description of educational programs.
- compilation of recipients of educational programs and their comments.
- assessment of petroleum spill database (accessibility and usefulness).
- statistical analyses.

Technical details may be included in the report in a presentation suitable for the Scientific Technical Committee and/or the BTNEP MC. A summary of the report shall be less than one page and be suitable for presentation to and understanding by the general public.

In addition to the evaluation of the technical accomplishments of the project, the monitor shall:

- identify problems observed during the reporting period and their potential causes.
- predict the short- and long-term consequences of the problems.
- recommend actions to address the problems as well as a potential implementer(s).
- identify a time frame for accomplishment of the recommendations.

Data collected as part of statistical analyses shall be submitted in DIMS compatible format.

BTNEP MC shall receive the quarterly reports. BTNEP MC shall discuss the monitoring document and take actions it feels appropriate with regard to the

implementation of the Action Plan.

BTNEP MC may at the end of any annual cycle change the periodicity or components of the monitoring reports if it feels the frequency or components of reports are inappropriate to keep abreast of the project. Changes in the independent reviewer can be made after any annual cycle but only with the knowledge and participation of the implementer and cooperating agencies, the independent reviewer, and the BTNEP MC.

Parties Responsible: Existing databases are housed in LDEQ (both petroleum and oilfield produced water spills) and the NRC, oil spill data from the USCG and USEPA. The Oil Spill Prevention and Response Act created an Interagency Council which is to assist LOSCO in the development of a statewide oil spill prevention and contingency plan (finished in 1995). The LDNR OC is one of several state agencies with responsibilities for oil spill prevention. The responsibilities and authorities of the above-named agencies are outlined in the Action Plan.

LDEQ is the suggested lead implementer with assistance from each of the above-named agencies. LOSCO has the authority under the Oil Spill Prevention and Response Act to: 1) use funds from the Oil Spill Contingency Fund for oil spill prevention and response purposes and 2) delegate responsibility to implement an oil spill prevention program. LOSCO is identified as the source of funding; the designated implementer would logically be LDEQ.

The development of this database overlaps with the objectives of EM-8 (Nutrient, Bacteria, and Toxic Contaminant Load Evaluation) and EM-13 (Contaminated Sediment Database).

Timetable for Gathering Data: A timeline developed jointly by the funding agency and the implementer will provide the basis for the monitor to assess plan implementation. Because of the multiple components, interactions of components, and involvement of many agencies, a more detailed timeline should be developed to track the progress of the plan development. Examples of time landmarks follow.

- A lead agency is selected as implementer; a project work group is identified and responsibilities outlined, and a detailed timeline for the project is established.
- Source of funding is identified and secured.
- Appropriate, current databases for spills are identified and assessed.
- A database is developed to compile appropriate data from the various sources that meets the information needs of the Action Plan and a preventative oil spill program and is installed on the LDEQ computer system.
- A database is maintained by relying on LDEQ field offices and by LDEQ obtaining data from NRC.
- Educational programs to inform industry, federal, state and local entities of the seriousness of petroleum and related fluid spill issues are developed and implemented.
- A work group of LDEQ, USEPA, USCG, and BTNEP MC is formed and informs the LOSCO Interagency Council of agency needs which must be met to comply with the state oil spill contingency plan.
- A work group of LDEQ, USEPA, USCG, LOSCO and BTNEP MC develops plan for encouraging effective and fair enforcement of spill prevention regulations and implements plan.
- A plan is developed and implemented for encouraging relevant agencies to increase inspections of applicable facilities within BTES.
- Additional personnel are assigned to inspect oil production facilities.
- A database is updated by relying on LDEQ field offices and by LDEQ obtaining data from NRC.

- Inspections for potential sources of petroleum spills are conducted by relevant agencies.
- A work group of LDEQ, USEPA, USCG, LOSCO and BTNEP MC continues encouraging effective and fair enforcement of spill prevention regulations and implements plan.
- Educational programs to inform industry, federal, state and local entities of the seriousness of petroleum and related fluid spill issues are modified to include costs associated with cleanup vs. costs of prevention.
- Educational programs are disseminated to agency and industry personnel and the public.
- A work group of LDEQ, USEPA, USCG, LOSCO and BTNEP MC works to adjust and/or redirect spill prevention program into areas with continuing problems.
- State funds and resources are dedicated specifically to petroleum related spill prevention.
- A better informed public and agency personnel is created.
- Increased petroleum and related spills prevention exists.

Project Success Metrics:

- reduction in the number and volume of spills reported and responded to
- reduction in contaminants from petroleum and related spills in BTES

Measurable Parameters:

The activities of various agencies outlined above in implementing the plan will be monitored for indicators as follows.

- existence of spill database
- functional spill database (i.e., Data can be accessed, used, and analyzed and is entered into database in acceptable formats, etc.)
- increased personnel assigned to oil production facility inspections
- increased personnel assigned to and participating in educational program development and dissemination
- increased public, agency, and industry awareness of petroleum and related spill problems, causes, and preventative measures
- problem areas for spills addressed and efforts redirected

Project Success:

Any reductions in petroleum and related spills will be assessed by a statistical analysis of:

- spill number and volume.
- petroleum spills and related fluids contaminants in water, sediments, and biota of BTES.
- classification of non-compliance of water subsegments for 305(b) reports due to petroleum-related contamination.

Data Collection Methods:

Plan Implementation - The monitor will contact the various agencies involved in the implementation to gather data (examples below) that will be incorporated into a monitoring project.

- check-off system according to timeline of project developed between funding agency and implementer as landmark dates are encountered and project objectives are met
- list and descriptions of educational programs developed
- list of recipients of educational programs, including dates, types of programs, and comments made by recipients of educational programs as to usefulness of the program

- project monitor accesses spill database and uses the data in examples of data analysis listed above

Project Success - The monitor will access appropriate databases and conduct statistical analyses. Examples:

- petroleum and related spills database
- relevant agency personnel records
- water, sediment, and biota contaminant data [e.g., LDEQ, USEPA Environmental Monitoring & Assessment Program (EMAP), NOAA Status and Trends]
- 305(b) Water Quality Inventory reports designation of water subsegments

Sample design and statistical methods:

Relevant sample designs or statistical analyses do not exist to evaluate implementing the plan.

Project Success - Suitable baseline data may be available in LDEQ, NRC, the proposed spill database, USEPA EMAP, and NOAA Status and Trends. Trends may not be identifiable after five years; however, the analysis should be conducted. At a minimum, a determination of the usefulness of the database will be made. Identification of any long-term trends needs to be within the context of the variability of the system. Several statistical methods applicable to analysis of trends may be suitable. Data may be normalized and standard linear regression models can be used to detect trends once sufficient data points have been obtained (e.g., 15 years is considered the minimum for similar trend analyses conducted by Rabalais et al. 1995). If data cannot be normalized, nonparametric trend analysis techniques should be employed (e.g., modified Mann-Kendall tau tests and seasonal Kendall slope estimator tests; see Hirsch et al. 1982). Seasonal Kendall tau test is a nonparametric trend test that is appropriate for detecting monotonic trends in "time series" data, i.e., data routinely collected over time (or space). Differences can also be assessed geographically by an analysis of variance on transformed data for site differences. Where sites differ significantly, post-hoc comparisons are run to determine which sites differ from others. Power analysis will estimate the probability of detecting trends of a certain magnitude given a certain number of observations (see Appendix D in Regional Monitoring Program for The Galveston

Boom is deployed to protect fragile marshland during an oil spill. Image: NOAA

Bay Plan, Lane 1994). N.B. Identification of trends or correlations does not provide cause and effect relationships.

How Data is Shared: Data will be shared with appropriate digital media and outreach venues.

Possible Data Gaps: As discussed previously USCG data gaps exist for produced water spills. Difficulty in detecting produced water spills during produced water disposal injection operations makes it nearly impossible to capture these events. The produced water spills have no telltale signs like oil spill sheens unless the produced water contains sufficient residual oil to create a sheen.

Additional Funding Needed: Yes. Initial funding of $80,000 is needed to initiate the project. Additional funding will be needed to maintain the database and associated outreach.

EM-10 Improvement of Water Quality through Reduction of Sewage Pollution

OBJECTIVE

To reduce fecal coliform counts, pathogens, nutrients, and organic matter in the BTES waterbodies attributable to discharges of human waste from inadequate or poorly-maintained sewage treatment plants, rural homesites, unsewered communities, commercial and recreational vessels, and waterfront camps

BACKGROUND/MAJOR ISSUES

Throughout the BTES, improper disposal and inadequate treatment of sewage results in poor water quality in many of the BTB's bayous, lakes, and bays. The primary parameter for monitoring sewage pollution is fecal coliform count as it indicates the possible presence of pathogens which can cause human illnesses. Fecal coliform bacteria, including the most common species E. coli, are a group of bacteria that live in digestive tracts of all warm blooded animals. When counts exceed a threshold level in oyster grounds, harvesting of the oyster is halted to prevent the spread of disease through consumption of contaminated seafood. Such closures are occurring frequently within the BTES.

Other pollutants associated with sewage include nutrients and organic matter. Excessive nutrient loads stimulate algal growth and can lead to increased algal production. This, in turn, leads to oxygen depletion as the algae die, and the decaying organic matter draws upon the dissolved oxygen in the water during decomposition. This process can cause severe depletion of dissolved oxygen in the sluggish bayous of the BTES which may cause fish kills. This process is called eutrophication. Over-production of algae in the bayous, canals, and lakes can also result in impaired fisheries.

The 1994 *National Water Quality Report to Congress* shows that fecal coliform is at least a suspected or potential problem in 33 of 55 assessed waterbodies in the Terrebonne Basin and 18 of 27 assessed in the Barataria Basin. Analysis of LDEQ's ambient water quality monitoring data revealed that 8 of 18 sampling sites in BTES are not meeting the fecal coliform criterion for primary contact recreation. Additionally, 9 of the 18 sampling sites are not meeting the dissolved oxygen criterion.

The LDEQ 2016 IR shows fecal coliform impairment in 2 of 28 Barataria subsegments and 11 of 58 Terrebonne subsegments. Dissolved oxygen impairment was shown in 2 of 28 Barataria subsegments and 2 of 58 Terrebonne subsegments.

DESCRIPTION

The action will build on existing educational activities, incentive programs, regulation development, inspection and enforcement mechanisms, and capital improvement programs that work in unison to

produce a regional reduction in both accidental and intentional releases of sewage into the waters within and bounding the BTES.

The primary source of sewage pollution in the BTES is runoff or discharge from inadequate or poorly maintained sewage treatment plants, rural homesites, unsewered communities, commercial and recreational vessels, and waterfront camps.

The BTES is largely rural with many unsewered communities. Rural residents use septic tanks, cesspools, mechanical sewage plants, or camp systems for treatment of their wastewater. Some of the camp and mechanical sewage plant owners discharge directly to waterways. Many septic tanks are placed in soils that are not suitable, and even properly installed systems are not adequately maintained. Improper placement and poor maintenance of septic systems lead to runoff of untreated sewage.

Discharges from vessels, both commercial and recreational, also contribute to the fecal coliform pollution problem as does runoff from pastureland and dense animal populations such as nutria, overwintering waterfowl, and feral hogs.

LEAD AGENCY RESPONSIBLE FOR IMPLEMENTATION

LDH

All parishes in the BTES, except Plaquemines, have adopted ordinances to include the State Sanitary Code with LDH sanitarians inspecting, issuing permits, and conducting enforcement on residential, commercial, and vessel sewage systems. The following areas maintain a database of residential type plants:

- Region 1: Jefferson and Orleans
- Region 2: Point Coupee, West Baton Rouge, and Ascension
- Region 4: Iberia and St Martin

Region 3: Assumption, Lafourche, St. Charles, St. James, St. John, St. Mary, Terrebonne, and Jefferson (Grand Isle only) maintain databases of size and types of sewage plants, both community and residential-type; Plaquemines Parish is parish-operated and does not maintain a database of community or residential-type sewage plants.

LDH has regulations requiring perpetual maintenance on community and residential plants. Beach monitoring is conducted at 24 sites along the coast to determine whether the water quality meets LDEQ criteria for enterococci. The Molluscan Shellfish program collects samples at designated stations to determine whether the water quality meets National Shellfish Sanitation Program (NSSP) criteria for fecal coliform and *Karenia brevis* (red tide). LDH participates in educational workshops for property owners, oyster fishermen, and wastewater treatment system installers. The Beach Monitoring general public to provide information on sampling protocols and locations along with health concerns due to the potential exposure of enterococci bacteria. The following agencies are involved in assessing pathogenic bacteria levels along coastal beaches.

LDEQ

- annual inspections of 50 percent of permitted Major Dischargers (greater than 100,000gpd) and 20 percent of permitted Significant Minor Dischargers (greater than 50,000gpd)
- investigates citizen complaints and spill release incidents
- Watershed Based Inspection Projects target impaired watersheds
- Enforcement Program for dischargers that are not in compliance with regulations
- Ambient Water Quality Program
- educational outreach programs
- stream and swimming advisories postings

LDWF

- cosigns shellfish harvesting closures with LDH and enforces closures
- Scenic Rivers Program: involved in regulation of camp systems on designated streams/rivers
- Scenic Streams Program: regulates point source discharges which have the potential to impact these streams, including sanitary discharges from houseboats and camps

LDNR

- CUP: applicants with residential, commercial, or industrial activity must ensure that sewage systems meet requirements of State Sanitary Code
- Clean Marina/Vessels Program: encourages sewage pump out and dump stations at marinas in the BTES

USCG

- verifies compliance with 33 Code of Federal Regulations (CFR), Part 159, Marine Sanitation Devices, on all CG inspected vessels (domestic and/or foreign)

Local Governments

- MS4 Permit Program: deals with comingling of stormwater runoff and sewage, combined sewage overflow system, and overloading sewage treatment systems. Municipalities must seek and eliminate elicit discharges.
- All parishes in BTES, except Plaquemines, have adopted the State Sanitary Code; however, parishes may also have more stringent regulations than the code.

South Central Planning & Development Commission (SCPDC)

- SCPDC and LDH are currently working on adding LDH permit applications to SCPDC's "My Permit" online program. The program will potentially be statewide and include other agencies.

TIMELINES AND MILESTONES

LDH and LDEQ will continue with annual and need-based inspections, enforcement, and monitoring along with public education to improve water quality. BTNEP and the BTNEP MC will continue to support these ongoing state and federal programs and activities that protect and promote human health and the environment. BTNEP will also continue to look for opportunities to implement projects that support these activities.

POSSIBLE RANGE OF COSTS AND SOURCES OF FUNDING

LDEQ

- administers the Clean Water State Revolving Fund (CWSRF) Program which provides financial assistance in the form of low interest loans to finance eligible projects, bringing them into compliance with the requirements of the CWA
- CWA Section 106
- CWA Section 319
- permit fees and enforcement

LDH

- State General Fund/retail permit fee collection
- EPA: beach monitoring program
- fees for installation of each residential-type sewage plant
- fees for sewage installer certification

Capital Resource Conservation and Development Council, Inc (CRC&D)

- administers the Home Waste System Initiative for low income households in the following BTES parishes: Pointe Coupee, West Baton Rouge,

Fish floating in water near Point a la Hache. Image: LDWF

Iberville, Assumption, St James, and Ascension

USDA Rural Development

- administers Single Family Housing Repair Loans & Grants in Louisiana which provides loans to very low-income homeowners to repair, improve, or modernize their homes or grants to elderly very low-income homeowners to remove health and safety hazards
- has a Community Facility Direct grant/loan program for local governments for public infrastructure including sewerage. The program is directed towards rural areas and is based on the size and income of the community

Louisiana Community Development Block Grant Program

- helps communities provide a suitable living environment and expand economic opportunities for their residents, particularly in low to moderate income areas. The Block Grants are awarded to the State annually by the U.S. Department of Housing and Urban Development, and the State's program awards and administers the funds to units of local government for improvements to public facilities, economic development, demonstrated needs projects, and Louisiana Small Town Environmental Program (LaSTEP) projects, which funds materials for local community projects while citizens provide a portion of the labor

SCPDC

- assists communities in applications for and administration of grants and partners with BTNEP to apply for grants to offer education, infrastructure, etc.

USEPA

- handles grants for wastewater treatment

United States Economic Development Agency (Department of Commerce)

- offers grants to communities to extend sewer collection lines or increase treatment capacities when a new industry locates or when it becomes necessary to retain existing jobs

PERFORMANCE MEASURE

Performance measure is:

- number of impaired subsegments related to pathogens, nutrients, and organic matter in the BTES waterbodies

Data Gathered:

- LDH maintains sewage system databases, beach monitoring, and molluscan shellfish data
- LDEQ collects water samples associated with the Ambient Water Quality Network Program, conducts ecoregion surveys, Total Maximum Daily Load (TMDL) Monitoring, Special Watershed Project monitoring, incident investigations, and compliance sampling projects

Monitoring:

Parties Responsible: LDH, LDEQ

Timetable for Gathering Data:

- LDH: Sewage system databases are updated daily. Beach monitoring is collected weekly from April 1st through October 31st. Molluscan Shellfish sampling is collected weekly year round.
- LDEQ: Monitors all active Ambient Water Quality Network sites monthly within a four-year rotation while other monitoring occurs as required. The department periodically conducts Ecoregion surveys, TMDL monitoring, special watershed project monitoring, incident investigations, and compliance sampling projects on an as-needed basis.

How Data is Shared:

- LDH: Beach monitoring information is on the EPA website. Molluscan Shellfish Program data must be currently obtained from staff in LDH Headquarters. Aerobic treatment plant and community sewage system databases are maintained at state and regional levels and are not currently available online.
- LDEQ: All monitoring data are available on the LDEQ public website.

Possible Data Gaps: Wherever monitoring is not taking place, data gaps exist.

Additional Funding Needed: yes

EM-11 Reduction of Agricultural Pollution

OBJECTIVE

To maintain water quality standards that adequately protect estuarine resources from agricultural nonpoint source pollutants

BACKGROUND/MAJOR ISSUES

Bayous and lakes throughout the BTES are impaired because of excess nitrogen, phosphorus, pathogens, and sediment from urban areas, industries, farms and ranches, and other sources. Throughout the BTES, partners will work with producers and landowners to implement voluntary conservation practices that improve water quality while maintaining agricultural productivity.

In the BTES, agriculture is a major land use. Sugarcane production totals over 203,000 acres, soybeans over 80,000 acres, and pastureland over 135,000 acres (obtained from the 2015 USDA Cropland Statistics data base). Water quality data from LDEQ's IR indicate that nonpoint agricultural sources in the Barataria Basin contribute to the degradation of 10 waterbody subsegments either not meeting or only partially meeting their designated use while in the Terrebonne Basin, 16 subsegments are not fully or only partially meeting their designated use.

This action will involve implementing conservation practices and Best Management Practices (BMP)

in sufficient quantity in a concentrated area so that agriculture no longer contributes to the impairment of water bodies within the BTES. To achieve these goals, the conservation partnership will work with landowners and individual agricultural producers to implement conservation practices such as nutrient management, integrated pest management, land shaping, prescribed grazing, cover crops, conservation cropping systems, and filtering wetlands.

Implementing these BMPs will work to decrease contaminants including nutrients (nitrogen and phosphorus), sediments, animal waste (fecal coliform), pesticides, herbicides, fungicides, insecticides, etc. from agricultural runoff that lead to eutrophication, decreased production, and plant or animal mortality within the BTES.

Implementing this plan will require coordination with local and state agencies, conservation districts, nongovernmental organizations, and others. Partners will play a crucial role in encouraging and supporting producer participation. Conservation investments in the BTES is good for all residents because well-managed farms limit pollution from runoff, produce food and fiber, sustain rural economies, and provide food security to the nation. Communities benefit by having clean waterways, safer drinking water, and healthy habitat for fish and wildlife.

DESCRIPTION

This action will follow already developed BMPs as recommended in the LDEQ statewide nonpoint program. These BMPs meet, enhance, or exceed state and federal guidelines and are consistent with continued agricultural production in the area. Employing these management practices will ensure that the BTES waters shall have a good ecological balance of nutrients and be free of harmful concentrations of toxic contaminants. These BMPs were developed from user group and coalition input and are based on the direct involvement of such

BTNEP and LDEQ sampling water. Image: Lane Lefort Photography

groups. The location of implementing conservation activities will center on active agricultural lands within the impaired subsegments of the BTES.

LEAD AGENCY RESPONSIBLE FOR IMPLEMENTATION

LDEQ

LDEQ is in charge of water quality monitoring and obtains program funds from the EPA CWA 319 program to restore impaired watersheds within the State of Louisiana.

LDAF

LDAF funds the Office of Soil and Water Conservation projects from the EPA CWA 319 program and works with NRCS to implement conservation practices to restore watersheds impaired by agricultural uses.

USDA-NRCS

NRCS has been the lead conservation agency in charge of implementing conservation practices on agricultural land and providing technical and financial assistance to private landowners and producers. The Environmental Quality Incentives Program (EQIP) funds this assistance and, in some cases, is leveraged by funds from local and state partners.

Targeted watershed initiatives provide a means to accelerate voluntary, private lands conservation investments to improve water quality with dedicated financial and technical assistance and to focus water quality monitoring and assessment funds where they are most needed. Water quality-related conservation practices enhance agricultural profitability through reduced input and enhanced soil health that results in higher soil organic matter, increased infiltration and water-holding capacity, and nutrient cycling.

Water sampling. Image: Lane Lefort Photography

TIMELINES AND MILESTONES

Over the next twenty years, LDEQ will continue ambient water quality monitoring in subsegments as well as increase sampling in special initiative watersheds within the BTES. Concentrated efforts will occur in subsegments identified by LDEQ and NRCS to achieve the objective. The LDAF and NRCS will continue implementing BMPs on private agricultural land through various programs including the EPA CWA 319 program, EQIP, Mississippi River Basin Healthy Watersheds Initiative (MRBI), GOMRI, National Water Quality Initiative (NWQI), Regional Conservation Partnership Program (RCPP), etc. Data from the most recent IR is used to determine where BMPs are needed the most in a particular watershed. The agencies work together to restore impaired watersheds. All agencies contribute to outreach activities.

In order to develop and implement solutions to the problems in the BTES, the proposed plans consist of forming common ground solutions and establishing a database program. Specific plans follow.

- Implementing comprehensive education and awareness programs that enhance public involvement is needed in the initial stages of the plan and will include workshops, seminars, etc. This will increase involvement plus the adherence to regulations and, in the case of agriculture, will include the awareness of and following of BMPs.
- Promoting regional pride and long-term stewardship of the BTB is also needed. Promoting the pride and stewardship goes hand in hand with the aforementioned education and coalition of government agencies and user groups. In the area of agriculture, involvement of individual farmers and their families can help promote the quality of the BTES.
- Developing strategies using input from the user groups and established coalitions to ensure that the water quality standards as set forth above will be met and maintained. In the case of agriculture, the appropriate user groups will be directly involved.
- Creating an accessible, comprehensive database including GIS data with interpreted information for the public will be accomplished. Such a database should include all pollution source types, including information on quantification and distribution of agricultural pollutants in the ecological system and hydrologic system. Included is the formulation of indicators of estuarine ecosystem health and balance use of estuarine resources. The definition of limiting characteristics and indicators of ecosystem well-being must take into account all sources of pollution including agriculture. The overall view of the BTES will insure a better balanced use of the resources.

The focus of the following plans is to provide the basis for review of the effectiveness of the planned actions. Periodic monitoring and review of the program effectiveness will be conducted, including a review of the overall program as well as individual areas, plans, and/or methods.

- Initiating a three year monitoring phase based on the structure of the BMPs will provide monitoring data. Changes in the BMPs and/or addition of other such measures may be required in order to meet the goal of improving water quality as determined from analysis of monitoring data.
- Monitoring the amount and distribution of agricultural pollution is needed. Monitoring will be conducted in association with the monitoring of other sources and types of pollutants addressed in the CCMP Action Plans. Monitoring must include measurements of agricultural pollutants including nutrients, pesticides (including herbicides, fungicides, insecticides, etc.), sediment loads, salts, and animal wastes.

The final plan is to develop solutions to the agricultural pollution and sources of the pollution in the BTES. In

order to maintain and/or restore the BTB's biological communities, the sources of agricultural pollution must be reduced to acceptable levels in order to realistically support diverse biological communities. This includes the development and maintenance of multi-level, long term planning. Such planning must be conducted using all groups, coalitions, and political jurisdictions. Specific plans include:

- establishing close working relationships with the agricultural user groups to establish a means of determining valuation of the ecological resources.
- forming coalitions with other involved state and parish agencies to ensure a complete basis for setting resource priorities in the BTES. The appropriate agencies include LDNR, LDEQ, LDAF, Louisiana Cooperative Extension Service (LCES), USACE, USFWS, NMFS, NRCS, and local coastal management programs.
- meeting water quality standards that adequately protect estuarine resources. The water quality programs established under the CCMP should meet all state/federal guidelines. To accomplish this, the agricultural sources should be reduced to levels that ensure a good ecological balance of the BTES. Such levels are dependent on the assessments of distribution and quantities of pollutants as determined during initial studies.
- promoting environmentally responsible economic activities that sustain current agricultural activities and protect estuarine resources to reduce agricultural pollutants. The sustained use of agricultural methods that help maintain the viability of the BTES should be one of the main points of emphasis in promoting environmentally responsible activities.
- preserving the wetlands and barrier islands as a related focal point. The sediments, salts, and herbicides associated with agricultural source pollutants can directly impact wetland vegetation leading to erosion and loss of the affected wetlands. Reduction in the amounts of these substances in the BTES waters will help in preservation of the associated wetlands.
- creating a plan compatible with natural processes. Flooding can pose problems if fields are flooded, and the resulting waters discharge sediment and/or pesticides into the watershed area. This discharge should be taken into account in the planning of future and present agricultural activities in the area.

POSSIBLE RANGE OF COSTS AND SOURCES OF FUNDING

The LDEQ conducts an ambient water quality monitoring program from state funds and also obtains federal funds from the EPA CWA 319 program to monitor special projects in impaired watersheds. The LDAF Office of Soil and Water Conservation implements conservation practices on agricultural land with special federal project funds from the EPA CWA 319 program in the amount of $1.9 million a year. The NRCS also implements conservation practices via field offices through technical assistance around the state.

PERFORMANCE MEASURE

Performance measure is:

- number of impaired subsegments related to agricultural runoff.

Data Gathered:

- acres of conservation practices, types of conservation practices, water quality data, and watershed impairments

Monitoring:

Data from LDEQ water quality monitoring are collected via grab samples which are tested by an accredited laboratory for specific parameters. LDAF and NRCS report implemented practices.

Parties Responsible: LDEQ, LDAF

Fecal coliform bacteria can come from farm animals. Image: BTNEP

Timetable for Gathering Data: LDEQ and LDAF complete annual and semi-annual reports. LDEQ updates the integrated report of impaired watersheds every two years.

How Data is Shared: agency websites, group meetings, teleconferences, field days, training workshops

Possible Data Gaps: critical acres within impaired watersheds needing treatment

Additional Funding Needed: yes

EM-12 Improvement of Water Quality through Stormwater Management

OBJECTIVES

- To reduce the negative impacts on water quality that current stormwater disposal practices may produce
- To reduce loadings of nutrients, fecal coliform bacteria and pathogens, and other pollutants in waterways

Sugar mill in full operation. Image: Lane Lefort Photography

- To enhance wetland vegetation with inputs of nutrients, sediments, and freshwater from stormwater runoff

BACKGROUND/MAJOR ISSUES

Stormwater pumps exist throughout the BTES. A Center for Louisiana Inland Water Studies (CLIWS) report for BTNEP states that 256 identified pumps exist within the BTB. Stormwater pumps account for 215 of these, and 41 are classified as agricultural pumps. The majority of stormwater pumps drain residential, commercial, or industrial areas. The agricultural pumps drain crop agriculture, pasture land, and cattle operations. The large area of the BTES provides an opportunity to actively manage all or part of stormwater runoff that would not be provided by gravity-based drainage systems alone.

Much of the developed and impounded wetlands (fast lands) for residential, commercial, and agricultural use in the BTES complex are under pump to remove stormwater. The stormwater pumps move water off the fast lands into receiving waterbodies which move water rapidly into shellfish producing areas. As a result, inadequate detention time exists to reduce coliform bacteria levels before oyster beds are impacted. The intent of the pumping is to alleviate flooding in developed lands. Per the CLIWS report, most of the water bodies receiving the pumped waters could not be classified by type. However, of the few receiving waterbodies that could be classified (48 total), 44 percent were canals flowing through some type of wetland, 25 percent were canals through other areas, and 31 percent were wetlands. The pumped water including all of the pollutants and nutrients that may be present enters these waterbodies directly.

The stormwater pumping system that exists in the BTES complex directly or indirectly impacts all residents of the BTB. The direct impact of the existing system is the removal of stormwater from developed or agricultural areas to receiving waters that should be able to shunt the storm flows away to reduce the incidence and duration of flooding. Indirect impacts of the existing system are the potential and actual impairment of water quality in the receiving water bodies and the impact this impairment has on drinking water supply, fisheries, and recreation. The Stormwater Action Plan will impact all residents of the BTES complex by reducing negative impacts

through reducing loadings of nutrients, fecal coliform bacteria and pathogens, and other pollutants in waterways and enhancing wetland vegetation with inputs of nutrients and freshwater.

BTNEP has implemented two projects that could be used to decrease stormwater being delivered to receiving waterbodies and fisheries growing areas. In 2016, BTNEP implemented Stormwater Infiltration Basin and Pétanque Terrain in Peltier Park in Thibodaux, LA. The project constructed a stormwater infiltration basin that also has a surface for playing the game of pétanque. This project was designed as an alternative way to decrease stormwater discharge to streams, increase groundwater recharge, provide a double use of greenspace, provide recreational benefits to the community, and provide local economic benefits. It is estimated that the feature can hold approximately 8,600 gallons of stormwater.

In 2010, BTNEP, in partnership with Terrebonne Parish Consolidated Government (TPCG) and LSU, completed a two-phase study entitled "Wetland Response to Stormwater Discharge at the Pointe au Chien Pumping Station, Pointe aux Chenes Wildlife Management Area, Terrebonne Parish, LA," which collected pre-pumping data and post-pumping data for loading of nutrients, fecal coliform bacteria and sediments, and wetland response at the Pointe au Chien Pumping Station. The study found that a significant decrease existed with distance of nutrients, fecal coliform bacteria, and sediments with distance from the pumping station outfall and a significant increase in wetland areal coverage near the outfall of the pumping station.

This Action Plan complements several BTNEP programmatic goals. It uses existing infrastructure, with some modifications, to adjust, offset, or be compatible with natural processes. This Action Plan helps to provide a common ground solution to several estuarine problems including water quality and helps to revitalize wetland areas.

This plan will provide several benefits to the BTES complex residents. Improved coordination and sharing of information and ideas among local, state, and federal agencies and the public should result. Flexible stormwater disposal can help strengthen local governments' ability to identify and reduce local problems like flooding, water quality, and wetland and resource health through their own initiatives. More long-term benefits will be improved water quality for drinking, agriculture, fisheries, and recreation. Enhanced wetland areas should result in being able to provide the functions of water storage, water quality improvement, and ecological values that wetlands impart.

DESCRIPTION

This plan will establish alternatives to current stormwater pump outfall management. Specifically, this plan will:

- encourage, develop, and implement a series of stormwater treatment and wetland enhancement projects in representative areas throughout the BTES.
- sponsor additional information collection that would assist in local stormwater management planning.
- encourage local governments to adopt ordinances that improve stormwater disposal practices.
- ensure that to the extent possible, stormwater management improvements make use of equipment that is already in place.

Stormwater disposal alternatives will be planned where they can help reduce flooding, where existing pumps and appropriate alternative disposal sites coexist, and where fecal coliform impacts on oyster beds or other negatives are unlikely. Most importantly, alternative stormwater management will be implemented only where the water quality of the stormwater is acceptable for the wetland to assimilate its pollutant load over an adequate residence time.

LEAD AGENCY RESPONSIBLE FOR IMPLEMENTATION

Stormwater Redirection Projects

Co-lead implementers will be BTNEP and local parish governments. Either the BTNEP or local parish governments would be able to apply for large grants. Local parish governments would be responsible for construction and maintenance.

- New Pumping Stations: For new pumping stations, no drainage canal for collecting pumped stormwater would be dug. The stormwater outfall would go directly into receiving wetlands.
- Existing Pumping Stations: An earthen dam would be constructed across the existing outfall canal to force stormwater to sheet flow over adjacent wetlands. The outfall pipe would be relocated so that stormwater would flow directly into wetlands adjacent to the original outfall canal.

Stormwater Infiltration Basin Projects

Co-lead implementers will be BTNEP, local city governments, and local parish governments. Either BTNEP or local governments would be able to apply for large grants. Local governments would be responsible for construction and maintenance.

Urban Green Space

See EM-13 Action Plan on Urban Green Spaces.

Urban Stream Restoration Projects

Co-lead implementers will be BTNEP, local city governments, and local parish governments. Either BTNEP or local governments would be able to apply for large grants. Local governments would be responsible for construction and maintenance.

TIMELINES AND MILESTONES

These efforts will be ongoing throughout the program life based on funding opportunities. Each project will have different achievements and milestones. Project milestones will be reported to the BTNEP MC, EPA, invested partners, and the community through various media sources.

POSSIBLE RANGE OF COSTS AND SOURCES OF FUNDING

The total range of funding necessary annually for EM-12 is variable depending on the size and scope of the project(s) which will include but will not be limited to:

- salaries.
- operating services.
- supplies.
- equipment.

Sources of funding include local, state, federal, individual, industrial, institutional, NGO, and private organizations.

PERFORMANCE MEASURE

Performance measure is:

- quantitative improvements in water quality from project-specific data

Possible Data Gathered:

Stormwater Redirection Projects – sediment elevation, water quality data, and vegetative cover; Infiltration Basin - total volume water retained; Urban Stream Restoration - pre- and post-data: water quality data, number of animal species, number of plant species

Parties Responsible: BTNEP and local parish and city governments

Timetable for Data Gathering: pre- and post-project

How Data is Shared: BTNEP MC meetings and online through current online technologies where

appropriate

Possible Data Gaps: how various vegetative communities respond and adapt

Additional Funding needed: yes

EM-13 Urban Green Spaces

OBJECTIVES

- To encourage the creation and growth of wildlife habitats in urban areas
- To provide additional recreational space for visitors and residents of the Estuary to improve quality of life
- To augment economic development
- To improve urban flood control
- To reduce urban flooding from runoff
- To augment the natural processes that will help to improve air and water quality in the Estuary

BACKGROUND/MAJOR ISSUES

Many areas of south Louisiana are sparsely populated, lush, and green. The bayous in the BTES are among some of the most beautiful and naturally scenic along the Gulf Coast. In addition to their importance as navigation systems for the area, the bayous and waterways of south Louisiana contribute to the culture, ecology, and economy of the region. However, with modernization and growing populations, much of these natural areas are under stress or are being lost, and the diversity of wildlife enjoyed in the region is being threatened. This, in turn, impacts the complex and delicate ecosystem affecting air and, particularly, water quality and also hampers the tourism industry in this part of the state.

Urban green spaces can serve multiple uses, including enhancing the natural beauty and overall attractiveness of urban areas, improving air and water quality, encouraging tourism and growth of local economies by enhancing the quality of life, as well

Stormwater pumping stations can be used to revitalize wetlands. Image: BTNEP

as aiding in flood control. Urban green space design that is incorporated into a drainage system not only adds to the enjoyment of a natural setting but also helps to clean and polish runoff before it is ultimately discharged into a receiving stream thus improving the quality of the water in the stream. Such facilities also serve as runoff storage which reduces urban flooding while nourishing habitat within the urban setting.

The runoff storage abilities of urban green spaces can also characterize small water gardens and other pervious spaces throughout the urban environment and can have application in places such as surface parking lots. Not only do water gardens better handle runoff from these facilities but they also remove pollutants from the water that would otherwise be carried directly to receiving streams and add an attractive visual green space that breaks up the stark, unattractive appearance of most surface parking lots.

Properly designed urban green spaces contribute considerably to the overall sustainability and resiliency of the community by not only reducing flooding but also by improving water quality as well. As they clean and polish runoff, they help to improve the water quality of the receiving streams which, more often than not, are Louisiana's scenic bayous. In doing so, they enhance the ability of these bayous to contribute to the preservation of various wildlife species as well as our enjoyment through recreational pursuits of residents and visitors alike that may include fishing, boating, and swimming. In this sense, urban green spaces also contribute directly to the economic health of our communities.

Developing urban green spaces that also function to store and clean urban runoff requires a high level of coordination among local government planning, engineering/drainage, recreation agencies, and private entities such as landscape design firms. Such coordination is needed because a properly functioning urban green space must consider how plant materials (trees, flowers, bushes, etc.), recreational facilities (nature trails, parks, etc.), and drainage must work together to produce the desired result. The green space must retain enough water to promote growth of wetland species yet allow for the storage of runoff during storm events so that water can be carefully "treated" within the green space before being released into the receiving stream. Urban green spaces thus become an attractive and multi-functional alternative to stark, unattractive, concrete-lined drainage ditches.

While the concept of urban green spaces is often included in the development of a community's comprehensive plan, such facilities can be developed independently. The multi-functional aspect of urban green spaces, recreation, quality of life, economic growth, flood protection, water quality improvement, and wildlife habitat enhancement, may allow capital funding to be pursued from multiple sources. These outdoor areas allow residents to highlight their culture, the beauty of their natural resources, and the contribution of the land and waterways to the livelihood and lifestyles of their area. Such aspects of the community can also be very attractive to visitors in addition to providing easy access to attractive water features in small and large communities. Careful design and coordination will allow urban green spaces to also provide needed feeding and resting places for migrating birds and other wildlife.

DESCRIPTION

This action will encourage communities within the BTES to plan and develop urban green spaces that feature native plantings, nature trails, parks, and water features incorporated into drainage systems and bayous that provide wildlife habitats, recreational opportunities, runoff storage and cleaning, and bank stabilization where appropriate.

Urban green spaces can be incorporated into virtually any urban drainage facility or waterway with careful planning, design, and engineering. Specific features can be incorporated into underutilized urban green spaces that have a drainage element. This concept can also be integrated into the design of surface parking lots.

LEAD AGENCY RESPONSIBLE FOR

IMPLEMENTATION

While individual municipalities and communities within the BTES should take primary responsibility for the development of such urban spaces, BTNEP should endeavor to encourage and lend its expertise to the design of such facilities.

TIMELINES AND MILESTONES

Over the next three to five years, suitable locations for urban green spaces within communities in the BTES should be identified and designed. A few of these should be funded and constructed. The first milestone, therefore, will be identifying suitable locations for such facilities. This should be accomplished within the first five years. Afterwards, funds will need to be dedicated for design and engineering with construction funding sources to be identified soon after.

After construction funding has been identified and secured, some of these facilities should be able to be completed. Given funding cycles, this may take an additional 10 to 15 years. At the end of 15 years, several urban green space facilities should be constructed, as described herein, in communities in the BTES.

POSSIBLE RANGE OF COSTS AND SOURCES OF FUNDING

Depending on the level of complexity involved, location, and size of the urban green space, costs could range from thousands of dollars to hundreds of thousands of dollars and possibly higher. Incorporating such pervious design features into an urban surface parking lot adds only a relatively small amount into the overall cost of the parking lot. Retrofitting in both cases would tend to be more expensive.

Funding sources for such facilities may include local capital budgets, state capital outlays, grants from such agencies such as the EPA, etc., and the RESTORE Act if the community is in a coastal parish eligible to receive such funds. Such projects could be eligible under one or more RESTORE Act funding categories. However, the use of RESTORE Act funds requires incorporating the project into the parish's Multiyear Implementation Plan which is submitted to the U.S. Treasury Department for pre-approval and a prescribed public comment period before final Treasury approval. If the particular parish has already submitted and received approval for its Multiyear Implementation Plan, it will need to be amended in order to be approved by the Treasury using the same process.

PERFORMANCE MEASURE

Performance measures include:

- acre or square footage of project footprint
- number of native plant species

Data Gathered:

Measurement of the success and/or performance of urban green space of the type envisioned here can be based on the number of visitors to the new facility, visitor surveys designed to collect data on use and acceptability in the community, and likes and dislikes, etc. In addition, after the facility has been constructed and in operation for at least 8 to 12 months, water quality samples downstream of the drainage course and in the receiving stream could be taken and compared to baseline data collected before the facility was constructed. Surveys of facility visitors would be primarily of a qualitative nature since the facility is designed to enhance quality of life, but water quality surveys would be more quantitative.

Monitoring:

Parties Responsible: Individual communities with guidance and assistance from BTNEP should take responsibility for the qualitative aspects of monitoring. For the quantitative aspects of monitoring, coordinating agencies such as LDEQ

Volunteers help create an urban garden. Image: BTNEP

and EPA with BTNEP should take responsibility.

Timetable for Gathering Data: Some of the quantitative data may already exist in the records of the state/federal agencies mentioned above. The collection of new water quality data does not need to begin until after the project(s) have been constructed and in operation for at least one year. The qualitative data gathering effort should begin after the project has been constructed and in operation for about six months. The individual communities with assistance from BTNEP should hold public meetings to discuss the benefits of each project prior to construction during the planning process.

How Data is Shared: Quantitative and qualitative data collected for this effort should be shared with other communities thinking about constructing similar facilities. The data should show the positive community benefits to quality of life and improvement to water quality in the area.

Possible Data Gaps: It is not known if the collection of quantitative water quality data 12 months after the completion of such a project will show the intended improvements. A longer time period may be required.

Additional Funding Needed: yes

EM-14 Assessment of Harmful Algal Blooms

OBJECTIVES

- To minimize the human health impacts of HABs in the BTES
- To reduce the frequency and intensity of HABs within the BTES by supporting BMPs of watershed nutrient management
- To build partnerships between research scientists and agency resource managers to help prepare for and respond to some HABs whose sources can and cannot be managed from within BTES to help reduce threats to marine organisms, human health, and economic well-being
- To increase public awareness of HABs' threats

to human health and the economic well-being of shellfish and fish industries in the context of increasing or changing nutrient pollution, climate change, coastal land loss, and restoration actions

BACKGROUND/MAJOR ISSUES

HABs in Coastal Louisiana

HABs include those that are dangerous to humans, those that are toxic (poisonous), and those that are very unpleasant. This document uses the term "HABs" as the most inclusive term, recognizing that some species vary in the level of toxicity both spatially and temporally. HABs are commonly observed in fresh, brackish, and marine areas of the Louisiana estuaries, including the BTES (Dortch et al., 1999; Bargu et al., 2011; LUMCON, 2016; Roy et al., 2016). HABs are not always toxic but may prevent fish from feeding or lead to increased organic loading that supports hypoxia development.

At the fresher end of the BTES (e.g., salinities less than eight ppt) potentially toxic cyanaobacteria species of *Anabaena*, *Cylindrospermospsis*, and *Microcystis* are likely to be observed (Ren et al., 2009; Garcia et al., 2010; Riekenberg et al., 2014).

The diatom *Pseudo-nitzschia* spp. is a concern in the more saline coastal waters (Dortch et al., 1997; Parsons et al., 2013; Bargu et al., 2016), but there are currently no recorded cases in the BTES. They have increasingly contributed to the primary production in the surface waters of the northern Gulf of Mexico (Parsons & Dortch, 2002; Bargu et al., 2016) and worldwide (Silver et al., 2010). They are a concern to living resources, including humans, because they can produce the neurotoxin domoic acid (DA) which is responsible for amnesic shellfish poisoning in humans (Bates et al., 1989) and death in marine organisms (Bargu et al., 2016).

The dinoflagellate *Karenia brevis* is also a concern as it is widely distributed in the northern Gulf of Mexico and is typically associated with neurotoxic shellfish poisoning (Brown et al., 2006) although it is observed less frequently in coastal Louisiana waters because of lower salinity across the BTB. When higher salinity conditions occur due to southerly winds, low river flows, and tropical storms or hurricanes, such as in the Breton Sound estuary in the winter of 2015, they can be abundant, resulting in oyster bed closures. Another *Karenia brevis* bloom occurred in the winter of 1996-1997 within lower salinity waters east of the Mississippi River that caused oyster bed closures during a long period of the harvest season (Brown et al., 2006). Even when the numbers of *Karenia* decrease, the toxins may persist.

Other blooms of less frequency do produce toxins and persist for long periods such as the bloom of *Heterosigna akashawi*, a raphidophyte, that produces brevitoxins (Rabalais unpubl. data). In March 2011, satellite imagery (N. Walker, Earth Scan Lab, LSU) clearly showed the intrusion of this bloom into the lower BTES. Several studies indicate that toxin production from HABs is higher in lower salinities where the phytoplankton are stressed (Bourdelais et al., 2002; Brown et al., 2006; Bargu et al., 2016).

HABs in the BTE

In areas of the BTE that are more fresh (e.g., salinities less than eight ppt) and during the spring and summer months when nutrient and temperature water conditions are optimal for growth (Ren et al., 2009), the toxic species of cyanobacteria *Anabaena*, *Cylindrospermospsis*, and *Microcystis* may be observed at bloom concentrations (Garcia et al., 2010). These different species of cyanobacteria can produce hepatotoxins, neurotoxins, dermatoxins, and endotoxins, which may harm human health directly or be assimilated into the food web via foraging higher trophic levels such as shellfish, crabs, and fish. For example, in Lac des Allemands, some blue crab microcystin toxin levels have exceeded human consumption standards set by the World Health Organization (Garcia et al., 2010). Other benthic grazers that use these low salinity habitats such as the recreational and commercially important species of blue catfish, flathead catfish, and white shrimp

may also be impacted by these toxins. BMPs of watershed nutrient management would help reduce the frequency and intensity of these phytoplankton blooms and reduce vulnerability of humans and fisheries to the phytoplankton produced toxins.

At salinities greater than 15 ppt, the neurotoxin producing diatom P*seudo-nitzschia* spp. is of concern (Dortch et al., 1997; Parsons et al., 2013; Bargu et al., 2016). *Pseudo-nitzschia* spp. collected in Louisiana coastal waters and estuaries are commonly observed year round but are most abundant in the spring (Del Rio et al., 2010; Parsons et al., 2013; Bargu et al., 2016). Detectable demoic acid concentrations have been documented in BTES, such as in the estuarine and coastal Louisiana water samples (Parsons et al., 1999; Bargu et al., 2016) and gulf menhaden (Del Rio et al., 2010). Overall, few studies (e.g., N. Rabalais, unpublished data) have characterized the phytoplankton communities and related toxins along a salinity gradient in the BTES.

In summary, building partnerships between research scientists and agencies to prepare and respond to these blooms is critical. An increase in public awareness and understanding of HAB dynamics would also help address the future threats to human health and the economic well-being of shellfish and fish industries (Smith et al., 2014), especially in the face of nutrient pollution, climate change, coastal land loss, and restoration actions.

DESCRIPTION

To implement BMPs in the watersheds of BTES, the team will:

- promote spatial analysis of the occurrences of HABs and local watershed sources of nutrients and implement BMPs.
- promote minimizing human impacts from HAB events.
- recommend including the following in the existing response system through LDEQ incident investigation and reporting and LDH beach monitoring program.
- develop a protocol among phytoplankton (HAB) experts and Louisiana and federal agencies for proper collection, storage, and transfer of samples of suspected HABs, not just for incidents but also for routine sampling.
- update key expert contacts in Louisiana and along the Gulf coast.
- locate sample analysis facilities for different algal toxins.
- follow safe and appropriate sampling protocols for the most likely bloom species.
- maintain a system for community members to lodge a notification of suspected HABs.

To Promote Public Awareness and Understanding, the team will:

- promote an informational network of scientists and managers on harmful algal issues within coastal Louisiana.
- promote a common webpage for essential informational resources and key contacts.
- promote core information on different species that can be used at educational events during non blooms and during blooms (safe seafood handling) to increase awareness.

This action applies to the entire BTES watershed.

LEAD AGENCIES RESPONSIBLE FOR IMPLEMENTATION

The lead agencies' responsibilities are divided by task as identified below.

Implementing BMPs in Watersheds of BTES: LDAF, LDEQ, NRCS, EPA, and BTNEP

Preparedness to Minimize Human Impact from Toxic or HAB event: LDAF, LDH, LDEQ - incident

responders, LDWF, USDA, and U.S. Food and Drug Administration (FDA)

Promoting Public Awareness and Understanding: BTNEP, LDAF, LDH, LDEQ, Louisiana Environmental Education Commission (LEEC), LDWF, LUMCON, The Water Institute of the Gulf (WIG), Louisiana Department of Education (LDOE), Louisiana Sea Grant College Program, and EPA/National Environment Programs/Gulf of Mexico Program/Gulf of Mexico Alliance-Private aquariums along Gulf Coast (e.g., Audubon)

TIMELINES AND MILESTONES

Timelines and milestones are divided by task as outlined below.

Implementing BMPs in Watersheds of BTES: as per relevant timelines for watershed management with relevant agencies, ongoing

Preparedness to Minimize Human Impact from Toxic or HAB event: through available opportunities and synergistic activities:

- establish network of scientists and agencies in Louisiana
- collate base knowledge and develop key messages
- develop core web materials for dissemination

Public Awareness and Understanding: through available opportunities and synergistic activities:

- establish network among citizens, agencies, and environmental education resources
- collate base knowledge and develop key messages
- develop core web materials for dissemination

POSSIBLE RANGE OF COSTS AND SOURCES OF FUNDING

Costs and funding streams are divided by tasks as outlined below.

Implementing BMPs in Watersheds of BTES: EPA funds through LDEQ for nutrient reduction strategies/BMPs, CPRA nutrient reduction strategies using coastal restorations strategies, LDAF, LDEQ, and LDH

Preparedness to Minimize Human Impact from Toxic or HAB event: LDEQ, NOAA, Louisiana Sea Grant, LDH, and GOMA – Priority Issue Team (PITs)

Public Awareness and Understanding: LDEQ, NOAA-Louisiana Sea Grant, LDH, BTNEP, RESTORE Act funds, GOMA – PITs, and GOMP/USEPA

PERFORMANCE MEASURES

Performance measures include:

- monitoring of HABs,
- frequency and intensity of HABs,
- public awareness and understanding of HABs

Data Gathered:

- identify: taxonomic and toxin experts; number of experts engaged in an advisory capacity in the panel of experts; number of web pages developed and of times updated; number of fliers, brochures, and informational advisory outputs developed; and number of community submissions/reports of potential HAB events
- employ: spatial analysis system, mapping reports of HABs, NOAA – National Estuarine Eutrophication Assessment and reporting events to the national HAB reporting system (LUMCON)

Monitoring:

Parties Responsible: central host of materials and web page

Timetable for Gathering Data: annual data summary (collected regularly on web page)

How Data are Shared: summarized on the web page and in public communications using the information collated through this mechanism

Possible Data Gaps: basic data on current occurrence and abundance of HAB species within BTES, environmental factors controlling toxicity of HAB species known to occur within BTES, predictions of possible future threat from HABs under increasing water temperature, increasing nutrient concentrations, and alterations to salinity with restoration actions.

Additional Funding Needed: dedicated agency funds for monitoring, assessing, and informing the public. Significant knowledge gaps exist in the science of HABs within coastal Louisiana as, historically, they have not resulted in large numbers of reports of human health impacts. Increasing water temperatures, increasing nutrient loading, and altered sources of freshwater within BTES have the potential to alter the risk to human health of harmful algal blooms. For these reasons, additional funding to increase knowledge of potential future human health risk is needed. Raising public awareness through effective communication of current knowledge would benefit greatly from some additional funds to support this effort.

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Agricultural engineer Jim Fouss observing an algal bloom on Alligator Bayou near Baton Rouge. Image: USDA

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EM-15 Protection and Enhancement of Native Biological Resources

OBJECTIVES

- **Plants** - To support conservation efforts for ecological succession patterns of plant diversity from up-basin to down-basin within each of the habitat zones of the BTB delta ecosystem

The American Beautyberry is a native plant to the estuary. Image: Jonathan Traviesa

- **Pollinator**s - To build a framework that encourages landowners to manage their land in a way that maximizes its suitability as habitat for pollinators
- **Fish and Shellfish** - To support conservation efforts to maintain the diverse recreational and commercial invertebrate and vertebrate species harvested for pleasure and profit
- **Birds** - To support conservation measures that maximize available natural habitats that maintain healthy populations of migratory and resident birds across the BTB system
- **Wildlife** - To support conservation efforts to maintain the diverse amphibian, reptile, and mammal populations
- **Threatened and Endangered Species** - To support recovery and conservation efforts for threatened and endangered species

BACKGROUND/MAJOR ISSUES

(1) Plants - A delta's ecosystem is composed of specific habitats found in succession from up-basin to down-basin and is defined largely by the vegetative species found within each which are dependent on three primary interacting environmental parameters: elevation above sea level, soil moisture content, and salinity.

(2) Pollinators - Pollinators and pollinated plants are critical to our nation's economy and food security, ecological diversity, wildlife, and environmental health (National Strategy to Promote the Health of Honey Bees and Other Pollinators, Pollinator Health Task Force, The White House, 2015). Pollinators are a keystone species group and include honeybees, native bees, other insect pollinators, birds, and bats. About 75 percent of flowering plants on the earth rely on pollinators to set seed, and about one third of human food depends on pollinators. Honeybee pollination alone is worth $15 billion to our agricultural crops each year. Pollinator insects provide many other ecosystem services as well; 90 percent of birds depend on insects during at least one stage of their lives; many flower-visiting beetles are also decomposers, and many flower-visiting insects have larvae that provide pest control. Pollinator populations are struggling. In 2014, beekeepers reported that approximately 40 percent of their honeybee colonies were lost. With this loss of bee colonies, the essential pollination service that bees provide to agriculture is also lost which threatens our nation's agriculture. Monarch butterflies, another pollinator, have declined by 90 percent or more over the past two decades in their overwintering grounds in Mexico.

(3) Fish and Shellfish - Louisiana is the second largest producer of fisheries in the United States behind Alaska. In 2015, commercial landings equaled 1,070,317,980 pounds with a dockside value of $373,680,966. In 2015, Louisiana contributed 68 percent of all Gulf States' pounds landed and 42 percent of its dockside value with the BTB as a significant contributor. A few of the dominant freshwater and estuarine species contributing to Louisiana's production in 2015 were the bowfin (colloquially known as choupique, 98 percent of the National poundage), black drum (65 percent of the National poundage), white shrimp (63 percent of the National poundage), eastern oyster (58 percent of the National poundage), menhaden (55 percent of the National poundage), wild-caught channel catfish (29 percent of the National poundage), brown shrimp (26 percent of the National poundage), and blue crab (26 percent of the National poundage). Those listed, along with many more commercial species, are extensively found within the BTB. Some of the commercial species listed above are also important recreational species such as blue crab, white and brown shrimp, channel catfish, bowfin, and black drum. Additional recreational species are the estuarine species: red drum (colloquially known as redfish), spotted sea trout (colloquially known as speckled trout), and the freshwater species of the Centrarchidae (sunfish) family (largemouth bass, blue gills, redears, crappies). These species are exceedingly popular for recreational fishers.

(4) Birds – Because of the significant number of migratory species as well as native species, birds have their own separate profile and are not discussed in Wildlife. Over 400 species of birds are known to the BTB. While many are considered "residents," the majority are migratory in nature, passing through southeast Louisiana twice each year during their long migratory journeys. The BTB are uniquely located along the migratory path of many species of birds. Trans-gulf migrants crossing between the Yucatan Peninsula and North America use the BTB as a landfall for northbound migrants or the final point of departure for southbound ones. Although trans-gulf migrants reach the Gulf Coast from west of Houston, Texas, to Florida, a large proportion of the migrant population uses the upper Texas coast and coastal Louisiana around to Mississippi. The BTB are, therefore, important areas for the trans-gulf migrants because they cover a significant part of this important section of Gulf Coast. For over 100 years, but especially since the work of Dr. George Lowery in the 1940s and 1950s on Grand Isle (1946, for example), the area of the BTB has been recognized as a very heavily used stopover by Neotropical trans-gulf migrant birds. It is especially critical when foul weather in spring causes migrating birds to reach land exhausted or in fall when bad weather forces the birds to abort their southward migration at the last moment before leaving land.

Although habitats in the BTB are important for transient Neotropical migrant birds, the region is also important for wintering and breeding species as well, whether they are Neotropical migrants or not. Large flocks of waterfowl winter in the BTB as well as significant portions of the populations of some passerine species such as swamp sparrow and yellow-rumped warbler. Some seabird species have major breeding populations on the barrier islands of the BTB, and a few Neotropical migrant passerines such as prothonotary warbler also have significant fractions of their total populations breeding in the swamps of southeast Louisiana.

Review of long term data sets and various scientific studies suggest declines for many species of birds from Neotropical migrant songbirds to forest and marsh dependent residents, to Arctic nesting shorebirds, and to prairie nesting waterfowl. The causes of these declines are, of course, various, complex, and, in many cases, not completely understood. However, a common theme linking these various species is that they have suffered serious loss of habitat necessary to sustain them over some stage of their life cycle.

(5) Wildlife - Wildlife species are abundant and inhabit the swamps, bays, bayous, and marshes of the

BTB. Wildlife for this report are separated into four broad categories: amphibians, reptiles, birds, and mammals. Amphibians found in the BTB include frogs, newts, and salamanders and reptiles include snakes, turtles, and lizards. Mammals consist of bats; small rodents such as mice, rats and shrews; furbearers such as muskrat, mink, otter, opossum, raccoon, bobcat, coyote and black bear; and game species such as white tail deer, grey squirrels, and rabbits. With a mid-1970s survey of the Barataria Basin, investigators identified at least 30 species of mammals and 70 species of amphibians and reptiles. The LDWF identified four major influences on terrestrial wildlife: habitat destruction or conversion, habitat fragmentation, habitat disturbance, and altered habitat composition and structure. LDWF also identified similar threats to aquatic wildlife species: modification of water levels/changes in natural flow patterns, sedimentation, habitat disturbance, nutrient loading, and altered composition and structure.

(6) Threatened and Endangered Species - Approximately 735 species of birds, finfish, shellfish, reptiles, amphibians, and mammals spend all or part of their life cycle in the BTES. Approximately 40 animal species and approximately 50 plant species in the BTES are threatened or endangered. Many factors contribute to declines in animal populations, particularly changes in habitat. Pollution can also have a negative impact on the health of species and their ability to reproduce, and over-harvesting can harm animal populations. Section 4 of the Endangered Species Act directs USFWS and NOAA's NMFS to develop and implement recovery plans for threatened and endangered species unless such a plan would not promote conservation of the species. BTNEP is actively engaged in projects such as the Piping Plover Survey to monitor the distribution and abundance of target threatened and endangered species.

DESCRIPTION

(1) Plants - This action is implemented by protecting, conserving, and creating habitats conducive to preserve the vascular vegetation associated with the 4.2 million acres of wetlands, ridges, forests, and farmlands between the Mississippi and Atchafalaya Rivers that comprise the BTB.

(2) Pollinators - Pollinator habitat can range in size from small residential gardens to larger plots of land and still offer cumulative benefits to nearby agriculture. This action is recommended wherever it is economically and logistically feasible to do so. In 2014, President Obama issued a Presidential Memorandum directing an interagency task force to create a Strategy to Promote the Health of Honey Bees and Other Pollinators. The USEPA and USDA led this task force with the following three main goals.

- Reduce honey bee colony losses to economically sustainable levels
- Increase monarch butterfly numbers to protect the annual migration
- Restore or enhance millions of acres of land for pollinators through combined public and private action

Increasing the quantity and quality of habitat for pollinators was a major part of the Task Force's Strategy and Action Plan to better understand pollinator losses and improve pollinator health.

(3) Fish and Shellfish – This action is implemented by preserving the salinity gradients that exist within the estuaries from fresh to saline. At least 80 percent of the coastal species landed commercially and recreationally in the northern Gulf of Mexico are estuarine-dependent for part or all their life.

(4) Birds - The intent is to build a framework in the BTB for the conservation of bird populations that use the area. This framework will include components to educate the public about bird issues, monitor bird populations, and encourage private, corporate, and government landowners to protect critical areas and manage land under their care in such a way as to maximize its suitability as habitat for migratory and resident birds. Furthermore, this framework

Forested wetlands provide important habitat for migratory birds. Image: Keri Turner

promotes avian tourism and the infrastructure to support public access.

(5) Wildlife – In Louisiana, 90 percent of the land is privately owned. Although the exact statistic is not known, the great majority of land in the BTB is privately owned. Therefore, conservation and maintenance of wildlife diversity requires that landowners be actively engaged in the process. In its 2005 and draft 2015 wildlife Action Plans, the LDWF recognized the following as the greatest threats to maintaining species diversity.

- habitat destruction or conversion
- habitat fragmentation
- habitat disturbance
- altered habitat composition and structure

(6) Threatened and Endangered Species - The Endangered Species Act (ESA) requires that threatened and endangered animal and plant species be identified at the federal and state level. To be considered for federal listing, the species must meet one of the five following criteria.

- the present or threatened destruction, modification, or curtailment of its habitat or range
- an over use for commercial, recreational, scientific, or educational purposes
- declining species due to disease or predation
- inadequate existing regulatory mechanisms
- other natural or man-made factors affecting its continued existence

LOCATION

(1) Plants - Within the BTB, dominant plant species by habitat are based on their location from up-basin to down-basin (fresh to saline) as listed below:

- Bottomland Hardwoods: These areas occasionally flood but are usually dry. Prominent are overcup oak, water hickory, sugarberry, swamp dogwood, privet, water elm, water oak, sweet gum, box

elder, and winged elm, hawthorns, red mulberry, pecan, hackberry, honey locust, and elderberry.

- Swamp: Trees and shrubs that dominate this ecosystem have evolved to tolerate prolonged flooding. Key species are bald cypress and tupelo-gum; others are swamp red maple, black willow, pumpkin ash, green ash, water locust, and buttonbush.

- Freshwater Marsh: This habitat supports the greatest plant diversity of all marsh habitats. Common plants of freshwater marshes include maidencane, spikesedge, bulltongue, alligatorweed, giant cutgrass, pickerelweed, pennywort, cattail, southern wildrice, coontail, common duckweed, waterlilies, irises, and bullwhip.

Much of BTB freshwater marsh is "flotant," which means that it is buoyant during certain times of the year.

- Intermediate Marsh: This is a unique habitat zone characteristic of delta regions that are influenced by freshwater and slight oceanic processes that produce a mixture of plants that have some osmotic tolerance to salinity. The two dominant plants that can tolerate salinity are wiregrass and widgeongrass alongside freshwater species such as cattails, bulltongue, giant bulrush, common threesquare, deer pea, switch grass, Walter's millet, alligator weed, and southern naiad.

- Brackish Marsh: Mostly wiregrass thrive in this habitat with few other plant species. Other species in this habitat are olney bulrush, leafy threesquare, and widgeongrass.

- Salt Marsh: Relatively few species can tolerate the salinity stress from being in the closest proximity to the Gulf; this habitat is dominated by smooth cordgrass (oystergrass) and black mangroves. Other species are saltgrass, black needlerush, and saltwort.

- Beach Dunes: The dunes of Louisiana's barrier islands are exposed to moderate to high amounts of salt spray. In addition, limited nutrient availability and substrate instability also affect coastal dune vegetation. A few of the species are wiregrass, sea oats, beach panic, saltwort, morning glory, and seaside goldenrod. If dunes remain stable, allowing natural succession to progress, then coastal dune shrub thickets are formed.

- Maritime Ridges: This habitat can be natural stranded beach ridges ("Cheniere" - French for "place of oaks") or anthropogenic to create elevation above the surrounding marsh. These ridges are mostly four to five feet above sea level. Live oak and hackberry are the dominant canopy species.

(2) Pollinators - Pollinator habitat can range in size from small residential gardens to larger plots of land and still offer cumulative benefits to nearby agriculture. This action is recommended wherever it is economically and logistically feasible to do so.

(3) Fish and Shellfish - An estuary is defined by its prevailing and changing salinity patterns that occur yearly, seasonally, and daily, producing habitats that require fish and shellfish to adapt or perish. This dependence is manifested in the important balance of freshwater and ocean waters mixing within the estuaries producing salinity gradients that create the ideal habitat for each respective species. The major habitat influence of salinity is certainly not a static gradient from up-estuary to down-estuary, due to freshwater influences from increased river and bayou discharges, as well as precipitation, and from increased salinities from southerly winds and tidal currents bringing in Gulf ocean waters. This dynamic salinity flux creates the ideal habitats for those species that can physiologically cope with this changing condition.

A few species are profiled based on their habitat location within the delta with their value as indicators of habitat requirements and public interest. The

importance of a balance between freshwater and salinity within the BTB delta is used as the habitat criteria for estuarine-dependent species. Salinity is measured in ppt with freshwater at < 1 ppt and Gulf ocean water at 32 to 34 ppt.

- Brown Shrimp: Brown shrimp spawn in the Gulf primarily in the fall on deep continental shelf waters with post-larvae immigrating into the BTES in great numbers through tidal passes of barrier islands in February-April and needing an ideal salinity of 10 ppt or greater to survive and grow to a size for commercial and recreational harvest. This is known as the "spring shrimp fishery" that usually opens in mid-May for about 60 days or until white shrimp larvae begin to show up in large numbers. The brown shrimp in May-June migrate in large numbers back to the Gulf to mature, mate, and spawn. Life span is one to two years. This is a fishery with the species contributing a new exploitable population annually. The species is not considered to be in decline.
- White Shrimp: White shrimp spawn in the Gulf of Mexico primarily in shallow continental shelf waters from March to November with post-larvae migrating to the estuaries in large numbers usually in June and in October-November. White shrimp migrate farther into the estuaries than brown shrimp and can do well at five ppt salinity. Cold fronts usually force mass migrations in the fall and early winter months. This is known as the "fall shrimp season." Life span is one to two years. This is a fishery with the species contributing a new exploitable population annually. The species is not considered to be in decline.

Note: Coastal wetland acreage (habitat) in estuaries is historically correlated to long-term carrying capacity for white and brown shrimp, and this

BTNEP supports conservation efforts that increase biodiversity. Image: BTNEP

hydrological connection between marsh and water is considered an important aspect of shrimp production.

- Eastern Oyster: This is an immobile species except as a larva for two to three weeks after fertilization, which requires a minimum salinity of 8 to 10 ppt for competent development and eventual setting onto a substrate where it will exist for the rest of its life. Once the larva has settled, it takes on the typical shape and appearance of an oyster and becomes physiologically tolerant to a wide range of salinity, depending on water temperature. From December to March, with relatively low water temperatures, the oyster can tolerate salinities a low as zero to one ppt for weeks, but in warm to hot waters by late spring/summer, the oyster will succumb to physiological stress and potential death in days if the salinity drops below five ppt. Oysters exhibit some low spawning throughout the year except in the coldest months of December-January with major spawns occurring typically in April-May and in September-October with a salinity minimum of 8 to 10 ppt need for adequate reproductive development. Oysters inhabit a narrow habitat zone within the estuaries because of their immobility and the prevalence of predators. Subtidal oysters are found in estuarine habitats that range from about 5 to 15 ppt, the low end of the salinity range because of physiological needs and the high end because of the abundance of predators. Intertidal oysters are in higher salinities out to the barrier islands because they are protected from major predation because of daily low-tide exposure. Life span is usually six to eight years. This species can mature and spawn within a few months after setting and contributes a new exploitable population within about 15 to 18 months. The species is not considered to be in decline.

- Blue Crab: This mobile species is one of the most salinity tolerant within the BTES and can be found in great numbers from freshwater to ocean habitats. However, two periods within its life cycle occur when salinity becomes extremely important. It is not known precisely what salinity is needed for mating pairs during March to May, but it is generally recognized that brackish water conditions are necessary. Mating occurs usually in the mid to lower regions of the BTES. Once mating has occurred, the female must migrate farther down the BTES to spawn from May-August in salinities of at least 20 ppt, ideally, for its larvae to hatch and develop properly. This is a species that matures within 10 to 12 months and essentially can contribute an annual crop for exploitation. Life span is usually two to three years. The species is presently considered to be in decline with no conclusive reasons why although commercial and recreational fishing pressure is significantly high.

- Speckled Trout: This highly popular recreational species is found along the coast from barrier islands to inland brackish ponds and lakes. Although substantial migration occurs up and down an estuary, the species does not move much between estuaries thereby creating estuary-specific populations. They are carnivores feeding on shrimp, crabs, and forage fish such as bay anchovy, Gulf menhaden, and even smaller juvenile spotted sea trout and red drum. Adults spawn primarily from May to August in a wide variety of habitats from sandy beaches to shallow vegetated ponds. This is often governed by water temperature and light, but the underlying habitat need is the proper salinity. The species can live and spawn in salinities from 10 to 40 ppt, but optimal spawning habitat is 17 to 35 ppt for best egg viability. Individuals mature and are capable of spawning by the beginning of their second year of life; males usually mature at a total length of 210 to 230 mm (8 to 9 in) and females at a total length of about 300 mm (12 in). Life span is usually five to nine years. This is a fishery with the species contributing a new exploitable population annually. The species is not considered to be in decline.

- Gulf Menhaden: By poundage, this is the

most abundant industrial species harvested in Louisiana and the northern Gulf of Mexico. The adults are harvested in great schools upon the shallow waters of the continental shelf off the barrier islands. This species can be found in a wide salinity range from ocean strength to as low as two to five ppt. Adults and juveniles are also found in large schools in all salinities of the estuaries. All life stages are most abundant in salinities ranging from 5 to 10 ppt. Menhaden mature and spawn offshore in their second year of life and have a protracted spawning period from September to April with a peak generally between December and February. This is a filter-feeding animal eating on microscopic animals and plants that constitute plankton.

Note: Menhaden is not only a commercial species but also a forage species providing a source of food as a prey animal for many important fish species. It provides a key ecological niche within the food web of the BTES. Other extremely important forage species include bay anchovies, killifish, mud crabs, and grass shrimp.

(4) Birds – All living creatures are directly tied to the habitats that sustain them. In general, birds need three things: places to nest, shelter from predators and inclement weather, and adequate food and water. Essentially, these needs are provided by different habitats.

The BTB is a patchwork of many different habitat types. Each of these different habitat types is used by different birds for different reasons. While much of this region consists of water, large expanses of wetland areas exist including saltwater marsh, freshwater marsh, and forested wetlands. These marsh and forested wetland habitats are lower in elevation than the surrounding natural ridges which cause them to remain wet throughout much of the year. Small remnants of upland forests still remain along the natural ridges of bayous and streams; however, many of these upland forests and some forested wetlands have been cleared for agriculture and residential/urban development.

- Barrier and Headland Beaches: Along the coast are the barrier islands and headland beaches, many of which are accessible only by boat. The beaches, mudflats, and adjacent gulf and bay waters form a ribbon of habitats that are extremely important to many species of birds that pass through on their long migratory journey, including shorebirds such as threatened piping plovers, Wilson's and snowy plovers, willets, sanderlings, and red knots. These areas are also important to colonial water birds including brown pelicans, laughing gulls, least and Foster's terns, and black skimmers. These habitats are not only used as staging and refueling areas for migrants, but they are also important for many species that breed in the BTB. Common birds that nest along barrier islands include the royal tern, Caspian terns, black-necked stilts, roseate spoonbills, great egrets, snowy egrets, and tricolored herons.

- Marshes: Many places in southeast Louisiana exist where vast freshwater, intermediate, brackish, and saltwater marshes stretch as far as one can see. These seemingly endless lush green fields with their intermittent ponds, lakes, and bays are important habitat for millions of birds. Freshwater marsh gives way to intermediate, brackish, and finally saltwater marsh, representing an increase in salinity and decrease in plant diversity as one progresses southward toward the Gulf of Mexico. Migratory songbirds that spend part of their journey in marsh habitats include northern waterthrush, yellow warblers, common yellow-throats, and indigo buntings. These birds can typically be found in the floating marsh habitats that support shrub species of plants. Resident marsh birds that nest and make their home here include mottled ducks, common moorhens, glossy and white-faced ibis, and marsh wrens. Common loons, horned grebes, lesser scaup, and red-breasted mergansers are usually found on the open lakes and bays that fringe many of these marsh habitats.

Distribution of many species of birds is influenced by salinity with species such as clapper rails and seaside sparrows restricted to salt marsh while least bitterns, king rails, and purple gallinules are found in fresher marshes. Some species tolerate a wide range of salinities and can be found throughout all marsh habitats including red-winged blackbirds, great blue herons, and white ibis.

- Forested Wetlands: Inland from the marshes are the seemingly impenetrable forested wetlands of the BTB that include both swamp and bottomland hardwoods. With their cathedral bald cypress, moss draped tupelo-gum, and tea-stained water, swamp forests are a hallmark of Louisiana. These majestic cypress/tupelo forests are important not only to migrants such as yellow-crowned night herons, Acadian flycatchers, northern parulas, and hooded, prothonotary, and yellow-throated warblers but are also equally important to resident great blue herons, wood ducks, red-shouldered hawks, barred owls, and pileated woodpeckers. In the winter, the swamps play host to yellow-bellied sapsuckers, Eastern phoebes, and hordes of yellow-rumped warblers.

Flanking many of these cypress/tupelo swamp forests are the bottomland hardwoods of the BTB. Here, plant diversity is at its greatest. Like the cypress/tupelo swamp, bottomland hardwoods are also very important for migratory songbirds, including yellow-billed cuckoos, summer tanagers, red-eyed vireos, and great-crested flycatchers. Resident birds such as eastern screech owls, northern cardinals, blue jays, and Carolina chickadees are common inhabitants of bottomland hardwood forests. In winter, forested wetlands shelter sharp-shinned hawks, American woodcock, hermit thrushes, ruby-crowned kinglets, blue-headed vireos, and white-throated sparrows.

- Upland Forests: Found along the natural ridges of relict distributaries (bayous) and on Cheniers (live oak forests) near the coast are the upland forests of the BTB. Historically, upland forests also dominated many of the barrier islands that still exist today. Much of these once vast forests were cleared for agricultural and urban development long ago as they represented the highest ground available. This "highest ground" was the last place to flood during periods of high rainfall and strong southerly winds.

Cheniers and upland forests on barrier islands are of particular importance to migratory songbirds just before or after their Gulf crossing including Swainson's thrushes; yellow-throated vireos; scarlet tanagers; painted buntings; rose-breasted grosbeaks; Baltimore orioles; Tennessee, Cerulean, Blackburnian, Kentucky, Wilson's, and black-throated green warblers; and many others. These upland plant communities produce seeds, fruit, and insects important to songbirds that spend part of their migratory journey in the BTE's habitats.

(5) Wildlife - A few species are profiled based on their location within the delta with their value serving as indicators of habitat requirements and public interest.

- American Bullfrog: The bullfrog is a very popular commercial and recreational species. A freshwater fishing license is all that is required for collection of individuals. It is the largest frog in North America reaching a length of 200 mm (8 in). Males are usually territorial, and when they mate, the female lays a film of 10,000 to 20,000 eggs on the surface of the water around vegetation. Mating occurs from early March to June. Bullfrogs occur in any freshwater habitat throughout the delta. A general decline in amphibian populations has occurred throughout the southern states. The status of the bullfrog in the BTB is not known; however, it is considered one of the hardiest amphibian species for survival.

- American Alligator: The alligator is managed effectively as a ranched (farmed) animal using wild-harvested eggs from nesting females collected from private lands with 12 percent of successful hatchlings returned to wild within

The blue crab is one of the most mobile species in the BTES. Image: Lane Lefort Photography

two years and with an adequate size for better survival. Additionally, the State allows wild harvest for skin and meat in September of each year. As of January 2015, 56 farmers were licensed in Louisiana with 32 having stock with an on-farm inventory totaling 799,047 alligators. During the 2014 tag year (January 2014 through December 2014), an estimated 341,888 farm-raised alligators were harvested with an estimated value of $81.7 million. Eight of the 32 farms with stock are located in the BTB.

During the 2014 wild season, a total of 36,277 alligators were harvested by 3,279 licensed alligator hunters. Alligators harvested averaged 7.6 feet in length with an estimated value of $13.8 million. Wild harvest for skin and meat is managed by the LDWF allowing one alligator per prescribed acreage. The importance of habitat acreage for alligator population management is exemplified in the State allowing Lafourche parish an alligator acreage ratio of 1:160 for cypress-tupelo swamp, 1:90 for freshwater marsh (< one ppt salinity), 1:55 for intermediate marsh (one to three ppt salinity), and 1:140 for brackish marsh (3 to 15 ppt salinity) in 2014. The acreage ratio varies from parish to parish, but the importance of freshwater and intermediate marsh is evident for nesting populations. The success of State management has removed the species from the threatened and endangered species list. The population is healthy but very dependent on adequate nesting habitat.

- Bottlenose Dolphin: An estuarine species might not exist that brings more delight to the public than the dolphin. Besides its fame, it has an integral position within the estuarine ecosystem as a top predator. Bottlenose dolphins inhabiting the bays, sounds, and other estuaries adjacent to

Bottlenose Dolphins live in the southern-most edge of the estuary. Image: USFWS

the Gulf of Mexico form discrete communities. Therefore, the Barataria population as well as the Terrebonne population are unique to their respective estuary. A 1995 NMFS study indicated a best estimate population of 209 dolphins in Barataria Bay and 100 in Terrebonne Bay. A dolphin can weigh 135 to 635 kg (300 to 1400 lbs.) and reach a length of two to four m (6.0 to 12.5 ft.). Their life span is 40 to 50 years, and sexual maturity varies by population and ranges from 5 to 13 years for females and 9 to 14 years for males. Calves are born after a 12-month gestation period and wean at 18 to 20 months. On average, calving occurs every three to six years.

Note: After nearly four years of monitoring after the Deepwater Horizon oil spill, NOAA found that only 86.8 percent of the Barataria Bay dolphins survived each year as compared to other populations where roughly 95 percent of the dolphins survived. The reduced reproductive potential, along with decreased survival, will have long-term consequences for the Barataria Bay dolphin population. Dolphins were noted with disease condition including lung disease and impaired stress response.

- American Black Bear: This species was recently removed from the threatened list in Louisiana. Home populations are known to exist in the coastal wetlands of the Atchafalaya Basin as well as the central and northern habitats of the BTB and in the northern region of the BTB in Point Coupee Parish near False River. Numerous sightings of black bears have occurred throughout the northern and central regions of the BTB.

(6) Threatened and Endangered Species - Threatened and endangered plant and animal species exist in all 16 parishes comprising the BTNE.

Louisiana has identified 20 rare natural communities in the BTES.

LEAD AGENCIES RESPONSIBLE FOR IMPLEMENTION

- **LDWF** - The lead state agency for fish and wildlife in the State is the LDWF. Major management divisions within the LDWF are Office of Fisheries, Office of Wildlife, Office of Management and Finance and Law Enforcement and Legal, all working together to assure conservation and stewardship of living resources.
    - LDWF factors in pollinators as a keystone species in large-scale land acquisition and restoration.
    - LDWF has developed Management Plans for alligators, shrimp, oysters, speckled trout, red drum, and many more species.
    - The LDWF 2015 Wildlife Action Plan will be effective for the next 10 years.
    - The Louisiana Natural Heritage Program within LDWF develops and maintains a database on rare, threatened, and endangered species of plants and animals and natural communities for Louisiana.
- Boards and commissions within LDWF (listed below) meet to discuss issues of importance specific to the management of a species.
    - Alligator Advisory Council
    - Fur Advisory Council
    - Hunting and Fishing Advisory Education Council
    - Artificial Reef Council
    - Oyster Task Force
    - Shrimp Task Force
    - Crab Task Force
    - Crawfish Task Force
- **LDNR** – LDNR is primarily a regulatory agency with coastal wetlands responsibilities housed within the Office of Coastal Management.
    - The Permits/Mitigation Division. An important activity within the division is the CUP process. The purpose of CUP is to document and regulate coastal zone activities that may increase the loss of wetlands and aquatic resources as well as to reduce conflicts between coastal resources users. A second activity within the office is Mitigation Banking. Mitigation must offset any activity that creates a net loss of wetlands.
    - Interagency Affairs & Field Services Division. This division is responsible for implementing the LCRP (1980 LRCP Final Environmental Impact Statement).
- **CPRA** – A principal function of CPRA is to develop and revise the Coastal Master Plan every five years. Reports have been published in 2007 and 2012, and the draft plan for 2017 was released in January 2017 for public comment. This document is the State's blueprint for coastal restoration and protection activities and has potential significant influence on living resources. Report development has public and agency inputs.
- **LDAF** – The Department has a pollinator education program, the Louisiana Pollinator Cooperative Conservation Program (LPCCP), in cooperation with the LSU Agriculture Center.
- **Federal Agencies**: USDA, NRCS, USFWS, USGS, and NOAA's NMFS.
    - USFWS's Wildlife & Sport Fish Restoration (WSFR) program, collaborating with the Association of Fish and Wildlife Agencies (AFWA), encourages states to address pollinator conservation in projects that use federal financial assistance funds.

- USFWS and NOAA administer the ESA.
- NRCS includes pollinator habitat as part of its EQIP. As of 2016, pollinator habitat projects do not occur in the BTNEP parishes.
- NOAA's NMFS administers the Marine Mammal Protection Act (MMPA), houses the Office of Sustainable Fisheries, and provides technical advice to government agencies and the public on proposed actions that could have a negative effect on living marine resources, including coastal wetlands.
- NOAA established the Coastal and Estuarine Land Conservation Program (CELCP) in 2002 to protect coastal and estuarine lands considered important for their ecological, conservation, recreational, historical, or aesthetic values.
- USGS administers the Amphibian Research and Monitoring Initiative (ARMI). The south-central region of AMRI includes the States of Texas, Oklahoma, Arkansas, Mississippi, and Louisiana.

Support implementers should include BTNEP, other state agencies including the LDCRT, the DODT, and others including NGOs. In particular, BTNEP has collaborated with a number of agencies and NGOs to advance aspects of the CCMP for 25 years. Over the past two decades, BTNEP has joined agencies including the LDWF, USFWS, and National Wildlife Research Center (NWRC) to collect data and synthesize information regarding colonial nesting birds. BTNEP, in collaboration with a number of other entities, has developed an extensive database regarding nesting shorebirds along the Louisiana coast. More recently, BTNEP, through partnerships with CPRA, LDWF, and USFWS, has developed an extensive dataset regarding wintering birds along the Caminada Headland including the threatened and endangered piping plover and red knot. Efforts to advance our knowledge regarding the life history requirements of these birds should continue through efforts similar to these. Furthermore, BTNEP has worked with a number of partners including the Greater Lafourche Port Commission (GLPC) to restore habitat for Neotropical migrants in the Port Fourchon area, with oil and gas companies to manage their properties for nesting shorebirds, and with CPRA to enhance habitat for birds in lower Plaquemines Parish. With the increased scope of this new Action Plan, BTNEP seems poised to work with many different partners to conduct similar work to support other wildlife and fish projects that benefit people and the natural habitats these species require.

TIMELINES AND MILESTONES

In part, as referenced here, the CCMP supports implementing the various plans developed by other agencies/entities. Each of those individual plans has their own specific timelines and milestones. Implementing actions through the BTNEP MC and financing through Section 320 funding are typically developed annually by various Action Plan teams. These actions typically involve partnerships/collaboration with various agencies/institutions; as such, many are considered opportunistic and do not follow specific timelines. Annual work plans developed through this process define timelines and milestones.

- **Pollinators** - The National Strategy to Promote the Health of Honey Bees and Other Pollinators outlines the following goals.
  * Reduce honeybee colony losses during winter (overwintering mortality) to no more than 15 percent by 2025
  * Increase the eastern population of the monarch butterfly to 225 million butterflies occupying an area of approximately 15 acres (6 hectares) in the overwintering grounds in Mexico through domestic/international actions and public-private partnerships by 2020
  * Restore or enhance seven million acres of

The American alligator needs healthy wetlands for nesting populations. Image: Lane Lefort Photography

land for pollinators by 2020 through federal actions and public/private partnerships

  * Pollinator habitat projects should be implemented within the BTES as suitable project sites and funding are identified

- **Threatened and Endangered Species** - For threatened and endangered species, federal recovery plans set timelines specific to each species varying from three to six years to completion after listing. Recovery plans will vary for each species and must include:

  * a description of "site-specific" management actions to make the plan as explicit as possible.

  * the "objective, measurable criteria" to serve as a baseline for judging when and how well a species is recovering.

  * an estimate of money and resources needed to achieve the goal of recovery and delisting.

POSSIBLE RANGE OF COSTS AND SOURCES OF FUNDING

As defined above, lead agencies/entities are legislatively mandated to manage issues related to EM-15. Furthermore, each agency/entity develops annual budgets and programmatic budgets internally to address those legislatively mandated requirements. These budgets and discussion thereof are not presented here.

BTNEP as a co-lead implementer works with other lead agencies/entities on an annual basis to define data gaps and develop partnerships with these organizations to address those data gaps. This includes an annual tiered process with first convening meetings of various Action Plan teams to

discuss needs for a particular Action Plan. Projects are defined during this phase along with appropriate costs/budgets. These costs vary according to the size and scope of the individual projects. As the process moves further, these project concepts and associated budgets are presented to the BTNEP MC where they are discussed and approved and included as part of individual BTNEP work plans. Funding sources vary, including CWA Section 320 funding. Other funding sources include but are not limited to the State Wildlife Grant Program administered through LDWF, Section 6 Grant Program administered through the USFWS, various funding sources through CPRA, and the RESTORE Act. Since the process of selecting projects to address data gaps is used annually, no reasonable expectation of costs can be presented beforehand.

PERFORMANCE MEASURES

Performance measures include:

- monitoring of Threatened and Endangered Species,
- abundance and distribution of select native species of conservation concern

Data Gathered:

For Plants, Pollinators, Fish and Shellfish, Birds, Wildlife, and Threatened and Endangered Species, lead agencies collect data as needed for the various species/habitats identified within this action plan. Certain data collection efforts are routine and extensive datasets exist for certain species/habitat types over time. Examples include LDWF fish

The American bald eagle uses wetlands to hunt and to feed its young. Image: Kim Comeaux

sampling and colonial nesting wading and seabird surveys. Other examples include CRMS vegetative surveys, agency lists of acres/square feet of pollinator habitat restored, and specific assessments for T&E species that could address presence/absence, reproductive success, breeding, survival, abundance, and density. BTNEP relies on these resource agencies' efforts to collect and supply data to inform project development and to use as certain indicators in the various BTNEP indicator reports. BTNEP has also collected data for certain species related to extensive habitat assessments and place-based surveys.

Monitoring:

Parties Responsible: Lead agencies conduct monitoring routinely for certain species and habitat types. See above. Other monitoring efforts are conducted as monetary resources become available. The State Wildlife Grants program administered annually through the LDWF State Wildlife Action Plan provides monetary resources for many of the projects conducted across the state. More specifically, the BTNEP Program collects data annually on nesting birds of the Caminada Headland and routinely across the coastal habitats of the State. Most of these efforts represent partnerships across several state and federal agencies and NGOs. The Endangered Species Act requires USFWS and NOAA to monitor species recovered and removed from the endangered species list "in cooperation with State…" and "for not less than five years."

Timetable for Gathering Data: See the LDWF Wildlife Action Plan at http://www.wlf.louisiana.gov/wildlife/wildlife-action-plan. Data gathering timelines vary significantly depending on species or habitat type while Threatened and Endangered Species are usually addressed in annual reports.

How Data is Shared: Much of the data collected is shared via agency web sites, technical reports, and through specific requests. Some data can be found in annual reports.

Possible Data Gaps: See the LDWF Wildlife Action Plan and species recovery plans developed by USFWS and NOAA.

Additional Funding Needed: Yes, additional funded is needed as available.

EM-16 Reduction of Impacts from Invasive Species

OBJECTIVE

- To prevent and reduce negative impacts caused by the proliferation of invasive exotic species in order to protect the native organisms and resources of the BTE

BACKGROUND/MAJOR ISSUES

Invasive exotic species can be plants or animals that have not historically been part of the natural community and that have the capacity to disrupt natural communities. When invasive exotic organisms move into an area, either through expansion of their range or importation, they leave their natural competitors and predators behind. Without these stressors, invasive exotic species can become established in natural areas and out-compete native species causing adverse ecological changes.

Invasive plants can form monocultures in previously diverse habitats, decrease forage value, and displace wildlife habitat. Noxious weeds are very difficult to eradicate, and millions of dollars are spent in the U.S. every year to control them. Noxious weeds occur on all types of land, public and private. In addition to species richness, noxious weeds affect farming, recreation, and navigation. Noxious weeds can be imported either accidentally, such as in agricultural crops brought into the U.S., or on purpose, such as the infamous water hyacinth give-away at the 1884 Cotton Exposition in New Orleans. To prevent new noxious weeds from establishing in the BTES, controls must be in place on both methods of entry.

Exotic plant species impact thousands of acres of wetlands and waterways in the BTES. Aquatic, exotic plants are a particular problem for the BTES with aquatic weeds invading previously unvegetated water and impeding water flow and navigation. Exotics can change submerged aquatic vegetation community structure and aquatic species composition by impacting food availability, photic zone, dissolved oxygen, and other physical qualities of water. Dozens of exotic plant species are established in the BTB. Among the most serious plant pests are: water hyacinth (*Echhornia crassipes*), water spangle (*Salvinia minima*), Eurasian watermilfoil (*Myriophyllum spicatum*), hydrilla (*Hydrilla verticillata*), alligatorweed (*Alternanthera philoxeroides*), giant salvinia (*Salvinia molesta*), Chinese privet (*Ligustrum sinense*), air potato (*Dioscorea bulbifera*), and Chinese tallow tree (*Sapium sebiferum*).

Invasive animals normally move into an area through importation and eventual release into the wild. Releases can be either accidental or planned. Examples of accidental releases in Louisiana include the escape of nutria (*Myocaster coypus*) imported for the fur industry. Escape was caused by natural disaster. In other areas of Louisiana, people intent on improving hunting opportunities have moved wild hogs (*Sus scrofa*) from one area to another. The aquarium industry has been a source of invasive species for many areas because aquarium owners release fish such as Rio Grande cichlids (*Herichthys cyanoguttatus*) or snails such as apple snails (*Pomacea maculata*) when they grow tired of maintaining an aquarium. Finally, increases in ambient and water temperatures are allowing some cold intolerant invasive species to expand their ranges. Invasive animals can out-compete native animals for food, consume commercially important plant species, and cause major disruptions of the food web.

Nutria are the best known invasive exotic animal in the BTES. However, many other animal species representing numerous taxa are known to have established and growing populations in, or adjacent to, the BTES. These include apple snails, wild hogs, Rio Grande cichlids, brown anoles (*Anolis sagrei*), spotted jellyfish (*Phyllorhiza punctata*), lionfish (*Pterois volitans*), Asian tiger shrimp (*Panaeus monodon*), red imported fire ants (*Solenopsis invicta*), house sparrows (*Passer domesticus*), and four species of Asian carp (*Hypophthalmichthys nobilis*, *Hypophthalmichthys molitrix*, *Mylopharyngodon piceus*, and *Ctenopharyngodon idella*).

Controlling exotic species is an ongoing battle. Several steps can be taken to help battle the problem. Once a species becomes established, it is very difficult, if not impossible, to eradicate it. Therefore, education and prevention should be considered as a first step in invasive species management. Once populations become established, management and control generally become the only feasible alternative to prevent adverse impacts on the environment. Control efforts will require regional cooperation and planning to prevent new exotic species from becoming established and to control existing species. Continued monitoring and repeat control efforts are necessary for sustainable natural resource management.

DESCRIPTION

Four key strategies are necessary to address the invasive species problem in Louisiana. These strategies are: (1) education, (2) prevention, (3) control, and (4) data collection and dissemination. While overlap exists in action items that could be taken to address the invasive species problem, the following identify the general and/or specific steps under each strategy that BTNEP could take to prevent or control invasive species.

Education

- Educate the public on the impact of invasive species in the BTES and in adjacent areas. A special effort should be made to identify invasive species that have the potential to establish, or have established, populations in coastal Louisiana. Sources of such information include other states'

invasive species reports as well as exotic species country and region import lists.

- Provide guides to identify invasive species that will include how they may be differentiated from similar native species. Included in those guides should be appropriate contact information to report observations of species of special concern.
- Release (or encourage/assist the creation of) public service announcements on the impacts of invasive species on the human environment and recommend actions people can take to prevent the spread of invasive species.
- Post, or encourage the posting of, educational signage at major boat ramps recommending efforts be undertaken to ensure exotic plants on boats and trailers be removed prior to placing potentially infested boats or trailers into the water.
- Use a grant program to encourage education efforts specific to controlling, preventing, collecting data on, and monitoring invasive species.

Prevention

- BTNEP will encourage legislative efforts to prevent the import of species identified as potentially invasive to southern Louisiana habitats.
- Post, or encourage the posting of, educational signage at major boat ramps recommending efforts be undertaken to ensure exotic plants on boats and trailers be removed prior to placing potentially infested boats or trailers into the water.

Control

- Help develop laws and regulations aimed at controlling the spread of invasive species, especially those reported to be of most concern or of future threat. Activities include coordinating with federal and state law makers as well as federal and state agencies charged with enforcing the regulations.
- Develop projects to encourage the harvest of invasive species using bounties or developing markets for those species.
- Develop or encourage developing projects to involve scientists, educators, and the public in controlling, managing, and eradicating various life stages of invasive species.

Data Collection and Dissemination

- Compile an annual review of information concerning invasive species in the BTES including a list of documented invasive species that highlights species of most concern, species that are currently being targeted by research, and species that are most likely to be invasive in the future.
- Summarize this information in the BTNEP Indicator Report published every five years.
- Sponsor and/or encourage original research efforts on invasive species through projects headed by internal and external research teams.
- Use a grant program to assist in the development of data collection protocols specific to invasive species.

This action will concentrate on locations throughout the BTES, but in order to prevent and control invasive species within the BTES, the program may address areas adjacent to the designated boundaries of the BTES.

LEAD AGENCY RESPONSIBLE FOR IMPLEMENTATION

BTNEP will be responsible for compiling primary data, species lists, results on control projects, and Summary Reports on efforts within the BTES. However, as a component of that activity, it will also include results from other sources including numerous federal, state, and local agencies;

academics; and intergovernmental organizations doing projects involving invasive species. These include the following:

- The USDA has a nation-wide Noxious Weed List. Species on that list cannot be imported into the U.S. except for some limited scientific research exemptions. They do not, however, regulate plant imports into Louisiana from other states.
- The Animal and Plant Health Inspection Service (APHIS) of the USDA operates a Biological Control Program that studies, develops, and deploys biocontrol agents to protect agriculture and natural areas.
- The USGS maintains reporting and monitoring data and publishes factsheets and reports on its Nonindigenous Aquatic Species website.
- The USGS Wetland and Aquatic Research Center in Lafayette, Louisiana, maintains an active effort in studying and controlling invasive species.
- The Bureau of Land Management (BLM), National Biological Service (NBS), U.S. National Park Service (USNPS), USDA Agricultural Research Service, USDA Forest Service, NRCS, and USFWS have entered into a MOU for Federal Native Plant Conservation. The understanding sets up a committee to work with state and non-federal cooperators on native plant conservation on federal lands, including exotic species management.
- USACE has been the leader in research and control of aquatic exotic plants. Continuing the program, especially biological control research, is critical to long term management of exotic plants in the BTES. The USACE Aquatic Growth Control Unit works on biological, mechanical, and chemical control of aquatic weeds in navigable waterways. In the past, USACE has participated in a 50/50 cost share program with the state to manage aquatic weeds in other water bodies. USACE has worked on selection and release of biocontrol agents in the region including the alligatorweed flea beetle, the water hyacinth weevil, and the hydrilla fly.

  USFWS and NOAA oversee an invasive species program funded under the authority of the National Invasive Species Act. This Act created the Aquatic Nuisance Species Task Force to oversee developing and funding individual state invasive species programs. LDWF has created an invasive species program, the Louisiana Aquatic Invasive Species Council and Task Force, using funding derived under this statute. This organization developed a state-approved Statewide Management Plan for Invasive Species in 2005, which is currently under implementation.
- USFWS is also responsible for oversight of importing invasive species under the authority of the Lacey Act. This act identifies a number of species as being injurious and regulates the import of such species.
- LDAF enforces seed certification laws. It lists noxious weeds for different crops that cannot be present or can be present in only small amounts when the seeds are shipped.
- LDWF maintains a noxious aquatic plant list. Plants on the list cannot be imported into Louisiana. The list is in the fishing regulations pamphlet that is distributed to fishing license applicants. LDWF has developed brochures to educate citizens about the impacts of exotic plants and to encourage the use of native species when possible.
- The LSU Cooperative Extension Service has weed scientists who are available to help land owners with noxious weed problems.
- CWPPRA, while not developed to address the problem of invasive species, provides funds for the Coastwide Nutria Control Program, a project to control nutria populations in coastal

Nutria continue to cause devastation in Louisiana marshes. Image: LDWF

Louisiana through incentive payments to hunters and trappers. Under this program, approximately 400,000 nutria have been eradicated annually in Louisiana's coastal zone.

TIMELINES AND MILESTONES

In part, as referenced here, the CCMP supports implementing the various plans developed by other agencies/entities. Each of those individual plans has their own special Section 320 list of timelines and milestones. Implementing actions through the BTNEP MC and financing through Section 320 funding are typically developed annually by various action plan teams. These actions typically involve partnerships/ collaboration with various agencies/institutions; as such, many are considered opportunistic and do not follow specific timelines. Annual work plans developed through this process define timelines and milestones. Examples of possible plans and potential responsible parties follow.

Education

E.1 Produce a brochure for home/land owners explaining impacts from exotic species; provide a list of alternative native species for use in landscaping, aquariums, and ponds. Emphasize the impacts from non-native species and the benefits of natives, such as opportunities to view more bird and butterfly species (LSU Cooperative Extension Service and USDA).

E.2 Develop an outreach program that identifies species of concern in the BTES. Identify cost-effective means to eradicate species based on geographic scope of removal area.

E.3 Support the establishment and funding educational programs that highlight and encourage the control of a specific exotic species.

E.4 Develop species specific information sheets for the public that explain plant biology and least toxic management (LSU Cooperative Extension Service, USDA).

E.5 Inform the public, school, and scout groups about impacts from exotic species by promoting that USFWS, USNPS, and state parks implement the exotic species programs including tree removal and replanting with native species

(USFWS, USNPS).

Prevention and/or Control

P.1 Identify legislation that regulates introduction of exotic species and urge the appropriate agencies to fully enforce those regulations. For example, recommend banning the sale of Chinese tallow trees in Louisiana.

P.2 Identify problematic species of concern to Louisiana where introduction of such species are not regulated. Recommend State legislation which would disallow the introduction and sale of those species in Louisiana.

P.3 Develop a noxious weeds law for Louisiana that includes a noxious weed list making interstate import or transplant of invasive exotic species illegal within the state (LDWF responsible for compiling list; LDAF lead agency for listing terrestrial species).

P.4 Study the noxious plant and exotic animal control program in Florida. Contact Exotic Pest Plant Councils in Florida, California, and the Pacific Northwest to see if similar activities could work in Louisiana (USFWS, LDWF, and USNPS).

P.5 Study the hydrilla biocontrol program in Florida to determine if it will work in Louisiana (USACE, LDWF).

P.6 Support projects that eradicate or control exotic species. For example, BTNEP could encourage the continued funding of the nutria control program by CWPPRA or new funding by CWPPRA of the salvinia weevil propagation program. BTNEP could promote projects to eradicate Chinese tallow trees at designated areas within the BTES.

P.7 Keep the Louisiana noxious plant list updated (LDWF, USDA, and LDAF).

P.8 Require all aquatic plants for sale to be native species; provide information about the impacts of aquatic exotic plants at pond and aquarium shops (LDAF, LDWF, and LSU Cooperative Extension Service).

P.9 Develop biocontrol for other invasive exotic species (USACE, USDA, LDWF, and LDAF).

Data Collection and Dissemination

D.1. Identify a suite of recommended monitoring protocols, by species, for use in quantifying density of exotic species in various habitats within the BTES.

D.2 Set up a contact point where users can report infestations of new exotic weeds and new management techniques (LDWF and USDA).

D.3 Encourage the creation of a database to monitor and report effectiveness of eradication efforts within the BTES.

D.4 Designate areas of exotic infestation to use for demonstrating successful exotic species removal and native species replanting projects (USFWS, NRCS, USNPS, USACE, LDWF, and LDAF).

D.5 Research a second biocontrol organism for water hyacinth (USACE and LDWF).

D.6 Study biocontrol for Chinese tallow trees (USDA and LDAF).

POSSIBLE RANGE OF COSTS AND SOURCES OF FUNDING

As defined above, lead agencies/entities are legislatively mandated to manage issues related to EM-16. Furthermore, each agency/entity develops annual budgets and programmatic budgets internally to address those legislatively mandated requirements. These budgets and discussion thereof are not presented here.

BTNEP as a co-lead implementer works with other lead agencies/entities on an annual basis to define projects, programs, and data gaps and develop

Water hyacinth choke local waterways. Image: BTNEP

partnerships with these organizations to address these. This includes an annual tiered process, first convening meetings of the BTNEP Invasive Species Action Plan Team (ISAPT) to discuss needs for a particular action plan project or program. Scopes of work are defined during this phase along with appropriate costs/budgets. These costs vary according to the size and scope of the individual projects. As the process moves further, these project concepts and associated budgets are presented to the BTNEP MC where they are discussed, approved, and included as part of individual BTNEP work plans. Funding sources vary, including CWA Section 320 funding. Other funding sources include but are not limited to the LDWF and various other state and federal programs dealing with invasive species. Because the process of selecting projects to address invasive species issues is used annually, no reasonable expectation of costs can be presented beforehand.

PERFORMANCE MEASURES

Performance measures include:

- location, number, and abundance of invasive species
- minimize number of new introductions of invasive species

Data Gathered:

State and federal resource agencies routinely conduct surveys to identify animal and plant species under various scopes of work that can be used to identify invasive species presence/absence. Examples include LDWF fish sampling, CRMS vegetative surveys, bird surveys, etc. BTNEP relies on these resource agencies' efforts to supply data to inform project development. BTNEP also conducts its own surveys for tracking the presence/absence of various species

Invasive species removal is often accompanied by chemical control. Image: Woodlands Conservancy

as well as contracting original scientific research specific to project goals.

Monitoring:

Parties Responsible: See **TIMELINES AND MILESTONES.**

Timetable for Gathering Data: annual and special reports from state and federal agencies

How Data is Shared:

- quarterly report activity at BTNEP MC meetings
- document meetings and activities of the ISAPT
- regularly report to EPA

Possible Data Gaps: none identified

Additional Funding Needed: yes, as available

EM-17 Improvement of Water Quality through the Reduction of Inshore and Marine Debris

OBJECTIVE

To improve water quality by significantly reducing the amount of trash entering the BTB's water bodies and the ocean through education and awareness activities targeted at students (K-12), parish governments, business communities, and individual citizens.

BACKGROUND/MAJOR ISSUES

Despite Louisiana having the highest fine for littering in the country, Louisiana waterways are still full of trash and debris. Marine debris results in animal fatality through ingestion, entanglement, and habitat damage. It also results in engine damage through a tangled propeller or clogged intake, a loss of tourism revenue because of unsightly shorelines, and a decrease in water quality from toxic pollutants. The breakdown of plastics creates toxic pollutants that are dangerous to sea life that see the microplastics as a food source. Research on the effects of this plastic ingested by sea life as food is ongoing.

Current/past programs of BTNEP include:

- Bayou Lafourche Cleanup
- Marine Debris Education and Prevention Program
- Lake Field's Cleanup
- DEQ's Trash Free Water participant
- Canvas Bag Distribution
- School Sustainability Programs (recycling)
- Derelict Crab Trap Removal Program

DESCRIPTION

This Action Plan will support education and awareness of the issues surrounding marine debris through hands-on projects to promote removing and preventing marine debris in the BTES. We will strive to create common understandings concerning the severity of aquatic trash in Louisiana communities and educate citizens through workshops and volunteer opportunities.

The primary goal of this Action Plan is to reduce inshore and marine debris in the BTES. It will serve to educate and engage stakeholders. These stakeholders will be informed and concerned and create a responsible citizenry within the BTES. The population will become more literate in issues surrounding marine debris such as animal fatality, engine and propeller damage, tourism reduction, and impacts to water quality.

LEAD AGENCY RESPONSIBLE FOR IMPLEMENTATION

The BTPO staff will be the co-lead implementer with the BTNEP MC, EPA, GOMP, Louisiana Sea Grant, LDWF, LDEQ, NOAA, Keep Louisiana Beautiful (KLB), Keep America Beautiful (KAB), LSU, and BTEF.

TIMELINES AND MILESTONES

Timelines

- Bayou cleanups sponsored by BTNEP will be held as funds are available.
- The Marine Debris Education and Prevention Program are held as funds are available.
- Involvement in EPA's Trash Free Waters Initiative is ongoing.
- Education/outreach events are ongoing.

Milestones

The team will:

- create common understandings concerning the severity of aquatic trash in Louisiana communities and watersheds.
- understand applicable anti-littering State laws.
- attend and host seminars and presentations pertaining to existing prevention and education programs especially those near waterbodies.
- partner with appropriate marine debris removal initiatives located inside the BTES.
- promote healthy watershed education and outreach.
- review and incorporate ongoing research.

Students identify common household items that can easily become marine debris. Image: Alma Robichaux Jackson, BTNEP

POSSIBLE RANGE OF COSTS AND SOURCES OF FUNDING

Range of cost:

Total Funding Necessary (Annually): $50,000 to $100,000

Sources of funding:

- local, state, federal, industry, institutional, non-governmental organizations, and private
- BTEF and its partners
- marine debris grants (i.e. NOAA, GOMA, KLB, and KAB)

PERFORMANCE MEASURES

Performance measures include:

- amount of material removed from water bodies, shorelines, and riparian and coastal areas
- educational activities related to marine debris prevention reported on BTNEP MC agendas

Possible Data Gathered:

- document marine debris collected
- document meetings and activities of the BTNEP staff
- report regularly to BTNEP MC and appropriate partners

Monitoring:

Parties Responsible: BTNEP staff and its partners

Timetables for Gathering Data: as required by funding source entities

How Data is Shared: All data and projects are available on the BTNEP website and/or partner websites. Data is collected and shared with GOMA, NOAA and Ocean Conservancy.

Additional Funding Needed: Additional funding is always needed.

EM-18 Protection of Drinking Water Sources

OBJECTIVES

- To have a clear delineation of all drinking water sources
- To identify possible problems and potential sources of contamination including but not limited to toxics, sewage, microplastics, pharmaceuticals, and other emerging contaminates
- To use BMPs to diminish or eliminate problems
- To engage citizens in active protection of their drinking water
- To educate about appropriate actions to protect drinking water in the event of an emergency
- To support improvement in appropriate training and pay to develop an experienced workforce related to drinking water
- To participate in the education of public officials about the long term commitment that is needed to properly train certified water operators and related jobs
- To support appropriate improvements to the water resources infrastructure
- To support emerging technologies related to protecting drinking water sources
- To support and recommend sweeps of the water systems

Background/Major Issues

The quality of a drinking water source depends largely on what happens on the land surface above it (in the case of groundwater) or around it (in the case of surface water).

In 1996, the Safe Drinking Water Act Amendments required all states to submit a source water assessment plan to the EPA by February 1999 and complete a Source Water Assessment Program (SWAP) by May 6, 2003. The State of Louisiana was one of only ten states to complete all assessments by the statutory deadline.

The purpose of the SWAP was to assess the potential susceptibility to contamination of each drinking water source. Through the SWAP, LDEQ delineated source water protection areas around water supply wells and intakes and mapped the locations of all public supply wells, surface water intakes, and significant potential sources of contamination (SPSOC) within the 3,500 public water supply wells, 85 surface water supply intakes, and 18,058 SPSOC were identified in the State. SPSOC may include gas stations, dry cleaners, or other facilities that sell, store, use, or dispose of chemicals or fuels. Chemicals and fuels, if not handled properly, have the potential to contaminate our surface water and ground water. For ground water systems, the delineated protection area is a 1609.3 meter (one mile) radius circle around wells less than 304.8 meters (1000 feet) deep. For wells greater than 304.8 meters (1000 feet) deep, the area is reduced to a 804.7 meters (0.5 mile) radius for wells drilled before the Louisiana Department of Transportation and Development Water Well Construction Standards were adopted in November 1985; for wells deeper than 304.8 meters (1000 feet) drilled after November 1985, the radius is further reduced to 304.8 meters (1000 feet). For surface water systems, the delineated area is the upstream portion of the watershed within 8046.7 meters (five miles) of the intake. This is

known as the "critical area," and SPSOC in this area were located by GPS. In addition, the "non-critical area" is the entire watershed upstream of the intake up to the boundary of the state border. SPSOC in the non-critical area were identified by a database search.

Due to the unique hydrologic setting and SPSOC associated with the Mississippi River, the assessment approach differed from that of other surface water sources. SPSOC were identified by GPS within the navigable waterway of the river from the St. Francisville Ferry Landing to the lowest drinking water supply intake at Boothville, Louisiana. This is considered the critical area for the Mississippi River and is bordered by levees. Vulnerability risk rankings were based on a four-hour time of travel, or 53,108.4 meters (33 river miles). Rankings are highest if a SPSOC is within 53,108.4 meters (33 river miles) of the intake and decrease with each 53,108.4 meter (33 mile) segment.

Other factors that could affect the susceptibility of a drinking water source to contamination were also considered. For ground water systems, the age and depth of the well, the average groundwater velocity in the aquifer, and the aquifer recharge potential were considered. For surface water systems, the age of the intake, average annual rainfall, vegetative cover, slope of the land, and the number of feeder streams to the water source were considered. LDEQ issued a final report to each system assessed through the SWAP. The report ranked each system's susceptibility to contamination. The susceptibility to contamination rankings are used as a priority-setting approach to implement the Drinking Water Protection Program and to assist local communities in implementing drinking water protection measures. Parishes with numerous systems having high susceptibility rankings are targeted first, especially in higher population centers, and protection activities are driven by the most prevalent and most threatening SPSOC identified by the assessment. The most threatening SPSOC are defined as the high-risk SPSOC found within 304.8 meters (1000 feet) of public supply wells or intakes in the parish. High risk SPSOC include above and underground storage tanks, auto body shops, abandoned water wells, dry cleaners, chemical plants, animal feedlots, military facilities, petroleum plants, and truck terminals. The most prevalent SPSOC are the most common SPSOC found for all protection areas in the parish.

"Drinking Water Protection Area" signs are placed on major highways at the boundary of the drinking water protection areas for drinking water wells and surface water intakes to remind citizens that the actions they take in these sensitive areas may have an impact on the quality of their drinking water. LDEQ gives educational presentations to schools and other organizations and speaks to local citizens, officials, and water system operators about the importance of drinking water protection. Businesses and industries within the drinking water protection area that store or handle chemicals have a greater chance of inadvertently contaminating the drinking water source because of their location. Therefore, LDEQ also visits, or recruits volunteers to visit, businesses and other establishments within the drinking water protection area to educate them on BMPs or measures taken to prevent or reduce the possibility of contamination.

Local water system managers and operators also have a distinctive interest in protecting the quality of the water they provide to their customers. LDEQ visits the operators and/or managers of each community water system in a parish selected for a drinking water protection program. The LDEQ staff review the SWAP reports with the water system personnel, answering any questions and pointing out possible risks to drinking water source contamination. The staff discusses with the water system personnel possible prevention tools and BMPs, such as contingency planning, to prevent contamination of drinking water. They also assist the operator or manager in developing a contingency plan for their water system.

Ordinances are also an important means of protecting drinking water. An ordinance is a statute enacted

Clean, safe drinking water contributes to public health as well as a healthy environment. Image: BTNEP

by the city or parish government. A drinking water protection ordinance is designed to protect the community's drinking water sources. Zoning and ordinances can provide a high level of drinking water protection by specifying and regulating the type of activity surrounding drinking water sources. The Louisiana State Sanitary Code (12:008-3) promulgated in 1988 requires a minimum setback distance from a potable water well of 15.2 meters (50 feet) from septic tanks, storm or sanitary sewers, and drainage canals, ditches, or streams. In addition, the minimum setback distance from a cesspool, oxidation pond, subsurface absorption field, mechanical sewage treatment plant, sanitary landfill, animal feed lot, manure pile, or solid waste dump is 30.5 meters (100 feet). Also, potable water wells must be spaced at least 7.6 meters (25 feet) apart. Aside from the few setback distances required by the Sanitary Code, no state regulations specifically protect drinking water wells from potential sources of contamination. A local ordinance affords that protection.

LDEQ recommends that communities adopt a drinking water protection ordinance and consider the location of public water supplies in planning and zoning activities. LDEQ can provide maps in electronic or hard copy format to planning and zoning boards that show where wells and drinking water intakes are located and the extent of the drinking water protection area around each well or intake.

A model drinking water protection ordinance is provided to local officials to assist them in preparing their own ordinance. The model ordinance defines the area covered by the ordinance or the "critical area" as a 304.8 meter (1000 feet) radius around a public water supply well. It also lists the types of facilities that are prohibited in the critical area. These are SPSOC that were identified by the SWAP. The list and the critical area can be modified if the community chooses to do so. The model ordinance also contains a grandfather

clause for existing facilities. If the facility already exists, it can remain there when the ordinance is adopted.

Community involvement is a very effective and inexpensive means of protecting drinking water resources. An informed public is often a more responsible public. With education and guidance, local stakeholders can take actions to reduce or eliminate threats to the drinking water supply thereby benefiting their health, the economy, and the environment.

DESCRIPTION

This Action Plan is designed to preserve and work to protect drinking water for all of the residents of the BTES. This Action Plan will also provide for building support from local residents for clean drinking water and the use of BMPs to diminish or eliminate problems. Additionally, the Action Plan will serve as a way to engage citizens in active protection of their drinking water and to educate about appropriate actions to protect drinking water in the event of an emergency.

Each of the objectives is addressed in the description below. The first step in the Action Plan is to be sure that all public drinking water sources and source water protection areas are properly identified.

1. The State has a clear delineation of all drinking water sources and source water protection areas.

Parish drinking water source data is maintained by LDH. LDH Drinking Water Branch maintains a database of information for drinking water sources and is engaged in recording the annual operating periods, populations served, service connections, sources of water, service areas, and water purchases.

Information about the data base can currently be found on the web at LDH - http://sdw.oph.dhh.la.gov/DWW/Maps/Map_Template.jsp

Water System Type

Water systems are classified according to rules developed by the EPA and each state. Water Systems fall into two broad categories: public and non-public. A public water system can be further classified as one of the following:

It is important to support appropriate improvements to water resource infrastructure. Image: Lane Lefort Photography

Drinking Water Acronyms *The following acronyms, terms, and descriptions are used to describe drinking water information.*	
C - Community	Serves at least 15 service connections used by year-round or regularly serves 25 year-round residents.
GU - Groundwater Under the Direct Influence (UDI) Surface Water	System has a source that provides water UDI of surface water (e.g., unprotected well or springs) and no surface water sources.
GUP - Purchased Groundwater UDI Surface Water	System purchases water that originates from source that provides water UDI of surface water (e.g., unprotected well or springs) and no surface water sources.
GW - Groundwater	System has a groundwater source that is not UDI of surface water (e.g., protected wells) and no surface water or groundwater under the influence of surface water sources.
GWP - Purchased Groundwater	System purchases water that originates from groundwater source that is not UDI of surface water (e.g., protected wells) and no surface water or groundwater under the influence of surface water sources.
NC - Transient Non-Community	Regularly serves at least 25 non-residential individuals (transient) during 60 or more days per year.
NTNC - Non-Transient Non-Community	Serves at least the same 25 non-residential individuals during six months of the year.
SW - Surface Water	System has a surface source (e.g., river, reservoir, intake).
SWP - Purchased Surface Water	System purchases water that originates from a surface source (e.g., river, reservoir, intake).

Primary Source Water Type categorizes the primary source water used by a water system. Permitted entries include the following: ***Primary Source*** categorizes the primary water source for the public water system. The source of water determines treatment requirements or other standards. For example, the presence of any surface water sources in a public water systems inventory forces a Surface Water (SW) classification, even though more groundwater may be supplied than surface water. Any groundwater under the influence of surface water sources in a water system inventory necessitates a Ground Water Under the Influence of Surface Water (GUISW) classification. These higher classifications dictate higher monitoring requirements for the water system and greater public health protection.

Additionally, LDEQ maintains information and a GIS database of all intake wells and protected drinking water areas in a five-mile radius of drainage areas. This information is available to the public on an as needed basis. In compliance with security protocols,

a list of all people requesting information is kept by appropriate agencies.

2. Identify possible problems and potential sources of contamination including but not limited to toxics, sewage, microplastics and pharmaceuticals.

LDEQ is monitoring or is prepared to monitor carcinogenic compounds in high organic drinking water, estrogen mimics in drinking water (phthalates), pharmaceuticals in the drinking water, possible pesticide and herbicide inputs, too much fluoride in the drinking water, and microplastics in drinking water supply.

LDEQ keeps abreast of trend in research of additional sources of contamination that are showing up in all surface water body and receiving stream and keeps stakeholders apprised of the changes.

LDEQ also keeps a database of ambient water quality data active on their website at http://deq.louisiana.gov/page/ambient-water-quality-monitoring-data.

LDEQ collects ambient surface water data at approximately 125 sites across the state each month. This data is used for establishing water quality criteria or standards, assessment of conditions, and development of TMDLs. TMDLs are one means of establishing water quality discharge permit limits and NPS Pollution reduction recommendations for the protection and improvement of surface water quality in Louisiana.

Over 600 monitoring sites have been established by LDEQ since 1958, but not all sites are currently in use. Data has been collected at some of these sites since the inception of the program; however, most sites were established more recently. In 1998, LDEQ established a rotating basins monitoring program in order to expand the coverage of monitoring efforts. Under this plan, approximately 100 sites are selected each year for monitoring once a month. In addition, 21 sites on 16 water bodies are monitored every month of every year as long-term trend sites.

3. Use BMPs to diminish or eliminate problems.

LDEQ maintains a website and information on BMPs that should be used for protecting Louisiana's water. LDNR also provides the public with information on BMPs to improve water quality in watersheds. LDAF and USDA NRCS share information and implementation assistance for farming, agricultural, and forest management BMPs with the public as well. LSU Ag Center also works with farmers on environmental BMPs that improve water quality. Local industry associations are also instrumental in sharing information with their members. A suite of BMPs is available for residents of the estuary, and as new scientific information becomes available, the information is shared.

BMPs may also be assigned through ordinances for public water wells and wastewater treatment. These ordinances keep new sources of chemical contamination from coming within dangerously close proximity to wells and treatment facilities. Ordinances also ensure that wastewater should have properly functioning Onsite Sewage Disposal System (OSDS).

4. Engage citizens in active protection of their drinking water.

BTNEP's efforts to improve water sources are also identified in the following CCMP Ecological Management Action Plans: EM-8 Pollutant Identification and Assessment, EM-9 Oil and Produced Water Spill Prevention and Early Dedication, EM-10 Improvement of Water Quality through Reduction of Sewage Pollution, EM-11 Improvement of Water Quality through the Reduction of Agricultural Pollution, EM-12 Improvement of Water Quality through Stormwater Management, EM-14 Assessment of Harmful Algal Blooms, EM-17 Improvement of Water Quality through Reduction of Inshore and Marine Debris.

BTNEP also has a long history of engaging citizens in active protection of their drinking water sources. Activities and education related to activities that

The active parish water systems in the estuary are listed alphabetically by parishes. By clicking on the links for each water system, additional data such as populations served can be identified.

Parish	Water System Name	Status	Primary Water Source	Water System Number
Ascension	PARISH UTILITIES OF ASCENSION	A	SW	1005035
Assumption	ASSUMPTION PAR WW DIST 1	A	SW	1007001
Iberville	A. WILBERT & SONS TRAILER PARK	A	GW	1047021
Iberville	AIR LIQUIDE AMERICA INCORPORATED	A	GW	2047009
Iberville	ANNADALE PLANTATION	A	GW	1047011
Iberville	CHOCTAW MOBILE HOME PARK NORTH	A	GW	1047025
Iberville	CHOCTAW TRAILER PARK SOUTH	A	GW	1047020
Iberville	CITY OF PLAQUEMINE	A	GW	1047005
Iberville	G.W. LONG HANSENS DISEASE CENTER	A	GW	1047008
Iberville	GEORGIA GULF CORPORATION	A	GW	2047004
Iberville	IBERVILLE WATER DISTRICT #4	A	GW	1047024
Iberville	IBERVILLE WATER WORKS DISTRICT #3	A	GW	1047002
Iberville	SHINTECH LOUISIANA	A	GW	2047043
Iberville	STONESTHROW SUBDIVISION	A	GW	1047017
Iberville	SYGENTA	A	GW	2047001
Iberville	TIMBERLANE SUBDIVISION	A	GW	1047014
Iberville	TOWN OF WHITE CASTLE	A	GW	1047009
Iberville	VILLAGE OF MARINGOUIN	A	GW	1047003
Iberville	VILLAGE OF ROSEDALE	A	GW	1047006

Parish	Water System Name	Status	Primary Water Source	Water System Number
Lafourche	LAFOURCHE WATER DISTRICT #1	A	SW	1057001
Lafourche	THIBODAUX WATERWORKS	A	SW	1057003
Pointe Coupee	ALMA PLANTATION	A	GW	1077048
Pointe Coupee	BIG CAJUN II POWER PLANT	A	GW	2077010
Pointe Coupee	BIG CAJUN POWER PLANT	A	GW	2077009
Pointe Coupee	BIG RIVER INDUSTRIES	A	GW	2077011
Pointe Coupee	CITY OF NEW ROADS	A	GW	1077026
Pointe Coupee	FALSE RIVER WATERWORKS	A	GW	1077041
Pointe Coupee	JUDGE DIGBY AMOCO	A	GW	2077049
Pointe Coupee	LABARRE ELEMENTARY SCHOOL	A	GW	2077022
Pointe Coupee	POINT COUPEE CENTRAL HIGH SCHOOL	A	GW	2077048
Pointe Coupee	POINTE COUPEE DETENTION CENTER	A	GW	1077046
Pointe Coupee	POINTE COUPEE WATER DISTRICT #1	A	GW	1077043
Pointe Coupee	POINTE COUPEE WATER DISTRICT #2 HIGHWAY 10	A	GW	1077047
Pointe Coupee	SUGARLAND PLANTATION	A	GW	2077005
Pointe Coupee	TORBERT - FRISCO SERVICE	A	GW	1077037
Pointe Coupee	VILLAGE OF FORDOCHE	A	GW	1077009
Pointe Coupee	VILLAGE OF LIVONIA	A	GW	1077022
Pointe Coupee	VILLAGE OF MORGANZA	A	GW	1077025
Pointe Coupee	WATERLOO WATER SERVICE	A	GW	1077039
St. Mary	MORGAN CITY WATER SYSTEM	A	SW	1101005
St. Mary	ST. MARY PARISH WATER SEWERAGE COMMISSION NO 1	A	SW	1101009
Terrebonne	HOUMA WATER TP SERVICE AREA	A	SW	1109001
Terrebonne	SCHRIEVER WTP SERVICE AREA	A	SW	1109002
West Baton Rouge	CARGO CARRIERS	A	GW	2121001

Parish	Water System Name	Status	Primary Water Source	Water System Number
West Baton Rouge	SID RICHARDSON CARBON PLANT	A	GW	2121008
West Baton Rouge	WEST BATON ROUGE DISTRICT #4	A	GW	1121027
West Baton Rouge	WEST BATON ROUGE DISTRICT 4, A. R. BROTH	A	GW	1121026
West Baton Rouge	WEST BATON ROUGE DISTRICT 4, HOLIDAY INN	A	GW	1121024
West Baton Rouge	WEST BATON ROUGE PUBLIC UTILITIES	A	GW	1121008
West Baton Rouge	WEST BATON ROUGE WATER DISTRICT #1	A	GW	1121017
West Baton Rouge	WEST BATON ROUGE WATER DISTRICT #2	A	GW	1121018
West Baton Rouge	CITY OF PORT ALLEN	A	GW	1121014
West Baton Rouge	PORT OF GREATER BATON ROUGE WELL 3	A	GW	

protect drinking water can be found in Action Plans related to Sustained Recognition and Citizen Involvement SR-2 Civic Engagement.

5. Educate about appropriate actions to protect drinking water in the event of an emergency.

The LDH has prepared a Lower Mississippi River Waterworks Warning Network Plan that was created in cooperation with the USCG, Louisiana Law Enforcement, First Responders, LDQ, LA Emergency Management Officials, and many industries along the Mississippi River.

Past experiences of almost complete deterioration of Mississippi River water quality from the health, safety, taste and odor standpoint due to accidental discharges by industry or shipping vessels indicated a need for the development of a warning system so that all water treatment plants could take any necessary precautions to assure the production of the best quality water possible in the event of such accidental discharge. A warning system involving the participation of the waterworks facilities, LDH, LDEQ, and industry was developed to provide a reasonable safeguard to maintain the quality of the drinking water going to consumers.

The 2017 Waterworks Warning Network Plan and Directory was updated with no significant changes to the original plan as it has operated satisfactorily to date.

The purpose of the Waterworks Warning Network Plan is to set up the specific procedures to be followed and to provide a listing of the responsible persons to be contacted in the event of a reported discharge. These procedures were outlined in the September 2017 plan.

These procedures are as follows:

- If a water plant operator becomes aware of a deterioration in the quality of raw water, either

by personal observation or by reports from consumers using the finished water, or learns of discharges which may affect supply or others, the operator will immediately notify the nearest downstream plant with a water intake as well as one of the LDH officials.

- The LDH official, upon receiving the report, will proceed to advise all those downstream plants with a water intake which might conceivably be affected by the discharge, in a descending order from the point of discharge.
- As a practical matter, the USCG is the first to be notified of the majority of spills or other incidents affecting river water quality, and, therefore, routinely notifies LDH personnel of such incidents. For this reason, a water plant operator, upon becoming aware of a spill, should also immediately notify the USCG.
- Sheriff's offices and State Police in the area parishes may be of great assistance in notifications of waterworks personnel.
- Additionally, it should be noted that reporting of certain abnormalities detected in permitted discharges is also required by DEQ regulations. In those instances, where such reportable permit violations occur, the permittee should, in addition to the standard notifications to be made in accordance with this plan, notify LDEQ.
- In emergency situations, the Bayou Lafourche Fresh Water District will, upon notification of a spill, in turn, notify those plants with intakes in Bayou Lafourche.
- Local governments will, in turn, make the public aware of the emergency.

The remaining objectives were created to provide guidance to the BTNEP MC and staff to provide support for:

6. improvement in appropriate training and pay to develop an experienced workforce related to drinking water.

7. the education of public officials about the long term commitment that is needed to properly train certified water operators and related jobs.

8. appropriate improvements to the water resources infrastructure.

9. emerging technologies related to protecting drinking water sources.

10. the BTNEP MC to recommend sweeps of the water systems.

The true value of clean drinking water is not always respected. Humans must be taught again to recognize the economic value of water. According to EPA, "Much of the public trusts that safe drinking water will come out of their taps every day. However, many do not understand the service that water utilities provide in delivering safe water to their communities."

Clean drinking water keeps our communities healthy and our economies growing. The people who work in the industry and the water infrastructure are largely out of the public eye but necessary for our very existence. Few people realize what it takes to treat and deliver drinking water every day or how wastewater is cleaned so that it can be safely reused or returned to the environment. Investments in water professionals and in water infrastructure puts people to work and builds a reliable water resource. The costs to individuals, government, and businesses for water service disruption is vastly underestimated. By providing support for the aforementioned objectives, the BTNEP MC and staff help to insure the safety of our drinking water.

PERFORMANCE MEASURES

Performance measures include:

- drinking water quality as reported by local water districts
- drinking water quality as measured at the tap

Data Gathered

LDEQ:

- locations of wells
- locations and sources of drinking water as a database
- delineation of water protection areas
- SPSOC locations including information that is associated with possible concerns
- ambient groundwater monitoring program data (Aquifer Sampling and Assessment Program ASSET)
- sewage survey data and associated GIS layers on maps
- ambient water monitoring data
- aquifer water monitoring data

LDH:

- water intakes
- groundwater wells, LDNR layer
- infrastructure for the water system as GIS layers
- drinking water watch data
- (CCR) from individual water works
- pump station data
- treatment plant reports
- the results from Lower Mississippi River Waterworks Warning Network

Local Water Districts:

- drinking water reports,
- CCRs
- local water district commission reports

USDA/LDAF:

- mixing station reports
- Farm/Nutrient and Management Plans
- current BMPs

Business and Industry Leaders:

State and local agencies work together to provide quality drinking water for residents. Image: Lane Lefort Photography

Lead Agencies Responsible for Implementation	
LDH	enforce EPA and state regulations of drinking water; from intake through treatment and delivery of polished water
LDEQ	maintain the environmental quality of the waters of the state - both surface and groundwater; source water protection, NPS protection, and permitted discharge, prohibit discharge without a permit, enforcement of permits
LDNR	permit water well drilling for private and commercial wells, plugging of wells, registration information SONRIS, unconventional reservoirs, permits for injection wells
USDA, NRCS, & LDAF	share technical expertise, planning, information and costs for implementation of BMPs with local farmers and foresters
Local Water Districts and Water Providers	
BTNEP MC	host volunteer and educational events
Local Citizens	participation on volunteer activities to improve drinking water quality
Water Advisories	water system calls LDH; voluntarily done by the local waterworks – precautionary until samples come from LDH and a boil order comes from LDH based on the evidence, boil orders come from the state

- share current BMPs

BTNEP Staff and MC Members:

- opportunities to provide support to improvements of clean drinking water, water professionals, and water infrastructure

BTNEP staff and BTNEP MC members report to BTNEP MC about opportunities to provide support to improvements of clean drinking water, water professionals, and water infrastructure.

Monitoring:

Parties Responsible:

LDEQ, LDH, local water districts, USDA NRCS, LDAF, BTNEP staff and BTNEP MC

Timetable for Gathering Data:

A timeline for reporting data gather is developed by the funding agency and the implementer and will provide the basis for the monitor to assess plan implementation.

How is the Data Shared:

The primary way to share data is online at the various agencies. Additionally, some print materials are distributed to the public.

Possible Data Gaps:

It should be noted that data provide a snapshot of time with regards to drinking water. Additional surveys are needed to update the source water assessment for potential source survey.

Is additional funding needed: yes

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LAWARN system – cooperative agreements between water systems.

Lower Mississippi River Waterworks Warning Network Plan.

Educators learn the value of good water quality. Image: BTNEP