

# **Senate Resolution 172 Response**

January 2019

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# **SENATE RESOLUTION 172 RESPONSE**

January 2019

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# ACRONYMS AND ABBREVIATIONS

CDBG-DR	Community Development Block Grant – Disaster Recovery
Council	Council on Watershed Management
CPRA	Coastal Protection and Restoration Authority
CRS	Community Rating System
DNR	Department of Natural Resources
DOTD	Louisiana Department of Transportation and Development
FEMA	Federal Emergency Management Agency
FHBA	Flooding Hazard Based Alternative
FPC	Facilities Planning and Control
GOHSEP	Governor's Office of Homeland Security & Emergency Management
HU	hydrologic unit
HUC	hydrologic unit code
HUD	U.S. Department of Housing and Urban Development
IDNR	Illinois Department of Natural Resources
LCMP	Local Coastal Management Programs
LDEQ	Louisiana Department of Environmental Quality
LDH	Louisiana Department of Health and Hospitals
LDWF	Louisiana Department of Wildlife and Fisheries
LED	Louisiana Economic Development
LWI	Louisiana Watershed Initiative
LWRC	Louisiana Water Resources Commission
NFIP	National Flood Insurance Program
OCD	Office of Community Development
OTS	Office of Technology Services
Phase I Report	Phase I Investigation Report: Louisiana Statewide Comprehensive Watershed Based Floodplain Management Program Development
Response Repor	t SR 172 Response Report
RFP	request for proposals
RFQ	request for qualifications
SCR	Senate Concurrent Resolution
SOP	standard operating procedure

SR	Senate Resolution
TAG	Technical Advisory Group
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WBD	Watershed Boundary Dataset
WQC	water quality certification

# INTRODUCTION

Louisiana Senate Resolution (SR) 172 of the 2017 Regular Legislative Session, co-authored by Senators Mack A. "Bodi" White and Sharon W. Hewitt, directed the Louisiana Department of Transportation and Development (DOTD), in consultation with other state agencies, to "study construction or maintenance impacts, including channelization, dredging, and clearing and snagging activities, upon river basins and water transmission, and provide recommendations to establish, implement, and enforce floodplain management plans for each watershed in Louisiana."

DOTD, in consultation with the Federal Emergency Management Agency (FEMA), Louisiana Department of Environmental Quality (LDEQ), Louisiana Department of Wildlife and Fisheries (LDWF), Louisiana State University Center for River Studies, The Nature Conservancy, United States Fish and Wildlife Service (USFWS), United States Geological Survey (USGS), and the Water Institute of the Gulf, studied the potential effects of channelization, dredging, and clearing and snagging activities and reported back on its conclusions and recommendations.

The Council on Watershed Management (Council) composed of Office of Community Development (OCD), Coastal Protection and Restoration Authority (CPRA), Governor's Office of Homeland Security & Emergency Management (GOHSEP), and Louisiana Department of Wildlife and Fisheries (LDWF), and DOTD launched the Louisiana Watershed Initiative (LWI) as the coordinating body to plan and implement the transition toward a statewide watershed-based approach to floodplain management. The Council is charged with aligning existing programs, policies, and practices with the mission of the LWI and flood risk management best practices, as well as stewarding the state toward a watershed-based approach. In May 2018, the State released a *Phase I Investigation Report: Louisiana Statewide Comprehensive Watershed Based Floodplain Management Program Development* (Phase I Report) presenting initial findings and recommendations in response to SR 172. Since the release of the Phase I Report, the Council and LWI has worked with numerous stakeholders to address SR 172.

This Response Report presents the final findings and recommendations to the SR 172 directive. As such, this Response Report builds on, rather than supersedes, the Phase I Report and is organized into four parts:

- Part 1 documents the study of the impacts of channelization, dredging, and clearing and snagging activities upon river basins and water transmission.
- Part 2 provides an update on achievements since the release of the Phase I Report and progress on this Phase I Report implementation, related initiatives and programs, considerations and next steps related to roles and responsibilities at the watershed level, and geographic scale and boundaries for watershed-based planning.
- Part 3 provides recommendations and next steps.
- Part 4 outlines progress planned for 2019.

# PART 1. IMPACTS OF CHANNELIZATION, DREDGING, AND CLEARING AND SNAGGING ACTIVITIES UPON RIVER BASINS AND WATER TRANSMISSION

During the examination of the impacts of channelization, dredging, and clearing and snagging activities on river basins and water transmission in the state of Louisiana, applicable regulations were considered, available literature was researched, the Amite River basin dredging analysis was reviewed, and stakeholders were engaged and their input considered during the process. The results of these activities are summarized below.

# **1.1 REGULATORY CONSIDERATIONS**

Several federal and Louisiana state laws regulate dredging, channelization, and clearing and snagging activities in rivers, as summarized in Table 1.

Agency Regulation		Description	
USACE	Part 322 – Permits for structures or work in or affecting navigable waters of the United States	Requires a permit for work in or affecting navigable waters of the United States.	
USACE	Part 323 – Permits for discharges of dredged or fill material into waters of the United States	Authorizes the discharge of dredged or fill material into waters of the United States.	
FEMA	44 CFR 60.2 Minimum compliance with floodplain management criteria	At riverine sites, requires the notification of adjacent communities and the State Coordinating Office before any alteration or relocation of a watercourse.	
FEMA 44 CFR 60.3 Floodplain management criteria for flood-prone areas		Prohibits encroachments (including fill, new construction, substantial improvements, and other development) within the adopted regulatory floodway unless it has been demonstrated through hydrologic and hydraulic analysis that the proposed encroachment would not result in any increase in flood levels within the community during the occurrence of the base flood discharge.	
USACE (US Code) Title 33 Navigation and Navigable Waters Section 403. Obstruction of navigable waters generally; wharves; piers, etc.; excavations and filling in		Prohibits excavation or fill, or in any manner to alter or modify the course, location, condition, or capacity of the channel of any navigable water of the United States, unless the work has been recommended by the Chief of Engineers and authorized by the Secretary of the Army.	
USACE (US Code)	Title 33 Navigation and Navigable Waters Section 1344. Permits for dredged or fill materialRegulates the disposal of dredged material		
USACE (US Code)	Title 33 Navigation and Navigable Waters Section 1413. Dumping permit program for dredged material	Regulates the disposal of dredged material.	

Table 1. Current Statutes and Regulations Pertaining to Channelization, Dredging, and Clearing and Snagging

Agency	Regulation	Description	
Louisiana Department of Environmental Quality	Louisiana Administrative Code Title 33 Part 7 Chapter 3 Sect. 301	Dredged material which is contaminated will require permitting as if it were a solid waste.	
	Louisiana Administrative Code Title 33 Part 7 Chapter 3 Sect. 301	Solid waste permitting would be necessary if a new disposal area is required for material gathered by clearing and snagging.	
	Louisiana Administrative Code Title 33 Part 9 Chapter 11	The natural flow of state waters cannot be altered to the extent that the basic character of the water quality and ecosystems are adversely affected, except when needed to protect human life or property. All reasonable steps shall be taken to minimize and mitigate the adverse impacts.	
	Louisiana Administrative Code Title 33 Part 9, Chapter 15	An applicant for a federal license or permit may be required to obtain a water quality certification from the state which prohibits the violation of state water quality standards and certifies the project is in accordance with an approved water quality management plan.	
Louisiana Statewide Flood- Control Program	Senate Bill No. 71	Addresses negative and positive impacts on adjacent parishes both upstream and downstream of a project for Statewide Flood-Control Program funded projects.	
LDWF	Louisiana Scenic Rivers Act RS 56:1856 Part II. Natural and Scenic Rivers System	Applies to approximately 80 streams and regulates activities on river channels and in riparian corridors. Requires a permit for certain activities that may impact a designated river. RS 56:1856 §1842 prohibits the following activities: clear cutting within 100 feet, channelization, channel realignment, dredging, and clearing and snagging (defined in RS 56:1856 §1842 (7) as removal of most woody debris). Exceptions for certain streams exist within RS 56:1856 §1855.	

Acronyms & Abbreviations:

FEMA = Federal Emergency Management Agency

USACE = United States Army Corps of Engineers

# **1.2 STAKEHOLDER ENGAGEMENT**

The stakeholder group providing input included representatives from nine state and federal agencies (Table 2). The stakeholders were engaged as a group during a series of four conference calls, through correspondence with individuals via telephone or email, and follow-up review of meeting summaries and work products. They:

- 1. Provided input regarding impacts of channelization, dredging, and clearing and snagging on river basins and water transmission
- 2. Provided academic papers to include in a state of the practice summary
- 3. Reviewed and provided input for draft key findings, draft report, and final report

Organization	First Name	Last Name	Role within Agency
DOTD	Pat	Landry	Deputy Assistant Secretary, Office of Public Works
	Cindy	O'Neal	LA Floodplain Administrator
	Ed	Knight	State Dam Safety Program Manager
FEMA	Diane	Howe	Region VI Risk MAP Lead, Risk Analysis Branch
LDEQ	Chuck	Berger	Engineer (Water Quality Modeling/TMDLs)
	Amanda	Vincent	Water Permits Manager
LDWF	Matt	Weigel	Biologist Programs Manager
Louisiana State University Center for River Studies	Clint	Willson	Director, LSU Center for River Studies and Mike N. Dooley, PE Professor of Civil & Environmental Engineering
The Nature Conservancy	Bryan	Piazza	Director, Freshwater and Marine Science
USFWS	Yvonne	Allen	Spatial Ecologist, Science Applications
	Seth	Bordelon	Wildlife Biologist
	David	Walther	Supervisory Biologist
USGS	Todd	Baumann	Data Chief
The Water Institute of the Gulf and beginning November 1, 2018 Tulane University	Ehab	Meselhe	Former Vice President for Engineering at The Water Institute of the Gulf, Current Professor at Tulane

Table 2. SR 172 Response	Channelization, Dredgin	g, and Clearing and	<b>Snagging Research</b>	Stakeholders
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Four teleconference calls were held to obtain stakeholder input. The first kickoff call was held September 27, 2018; key findings were discussed October 31, 2018; draft report text was discussed December 19, 2018; and input on the final report text was collected on January 23, 2019. Attachment B.1 contains summaries of each teleconference call.

Channelization, dredging, and clearing and snagging can provide flood reduction benefits and increased navigation. Louisiana Scenic Rivers Act regulates those activities on river channels and in riparian corridors. Stakeholders expressed concerns about unintended consequences such as reduced water quality, decreased ecosystem biodiversity as a result of changing habitat, decreased stream baseflows, increase peak flows, erosion, channel bed aggradation or degradation, increased flood risk upstream or downstream of a project, change in channel size and shape causing bank failures and head-cutting, and impacts to adjacent wetland ecosystems due to a reduced frequency of overbank flows. Many of these impacts could translate to costly mitigation, damage to existing infrastructure, and impacts to fisheries, tourism, and economic growth. Stakeholder concerns are further detailed in the following section.

# 1.3 IMPACTS OF CHANNEL MAINTENANCE AND CONSTRUCTION PROJECTS

The stakeholder group researched available academic literature addressing impacts to river basins and water transmission from channelization, dredging, and clearing and snagging activities. The impacts of

these activities are discussed in the subsections below. Results of the lower Amite River basin dredging analysis are included in Section 1.4.

#### 1.3.1 Channelization

Channelization is defined in the Louisiana Scenic Rivers Act (RS 56:1856 §1842 (6)) as the practice of changing a natural stream, or a portion of a stream, into a man-made ditch or canal with a relatively uniform width and depth. Channelization typically requires the removal of trees and other woody vegetation adjacent to the stream. The following sections summarize flood control and other impacts of channelization. Specific case studies of actual channelization projects and the impacts observed are presented. Feedback obtained from the stakeholder group is also summarized.

#### FLOOD CONTROL IMPACTS

Channelization reduces flooding most effectively on the upper reaches of streams. Water, rather than spreading across the floodplain in the headwaters, is conveyed rapidly downstream by the channelized reach (Shankman 1996, Kroes and Hupp 2010, Landemaine et al. 2015).

Although channelization is effective in decreasing flooding in upper reaches, the rapidly moving water may increase flooding downstream (Hupp 1992). Water from the channelized portion of the watershed may converge downstream faster than the stream can handle, potentially resulting in increased flooding downstream. Although the frequency of downstream flooding increases, a channelized stream allows water to move rapidly out of the watershed, decreasing the average duration of flooding (Shankman 1996).

#### OTHER IMPACTS

Historically, channelization has been common practice for alleviating flooding and improving navigation. In recent years, channelization has become controversial due to a host of environmental impacts it can cause (Hupp 1992). Disconnecting the stream from its natural floodplain leads to a loss of natural function, ecological services, and values (Kroes and Hupp 2010). Channelization can lower the adjacent groundwater table and disrupt channel stability upstream and downstream of the channelized section as well as adjacent tributaries (Hupp 2009). Typically, upstream reaches experience erosion of the channel bottom and bank failures, leading to the transport of sediment downstream. For these downstream waterbodies, the increase in sediment leads to increased flood elevations and flood frequency. Over time, this can lead to debris jams, sediment plugs, destruction of aquatic habitat, and reduced water quality (Simon et al. 2002, Franklin et al. 2001, Landemaine et al. 2015, Hupp 1992). Living organisms are also adversely impacted by channelization, including both in-channel species and species that live in the floodplain and reducing nutrient flow (Hupp 2009). Other impacts for channelization and dredging can include reduction of base stream flows and the increase of peak flows. In other cases, these activities can lead to a reduction in the magnitude of the flooding, but the frequency may stay the same or decrease

#### CASE STUDIES

#### KISSIMMEE RIVER

Numerous flooding events in Florida, in the early half of the 20<sup>th</sup> century, prompted the Central and Southern Florida flood control project. As part of this project, canal C-38 was excavated along the entire length of the Kissimmee River floodplain. The canal was constructed to contain all channel and overbank flow of the Kissimmee River. The project was highly successful for flood control; however, there was a myriad of environmental consequences that were not considered during the design and construction phases of the project. These environmental impacts included the loss of nearly 8,000 hectares (19,768 acres) of wetlands; significant declines in bird, fish, and other animal populations that depended on the wetland habitats; and substantial reductions in water quality. These losses are being addressed by an environmental restoration effort that has a projected cost of nearly \$580 million and will take more than 15 years to complete. The environmental restoration effort includes construction activities along a substantial portion of C-38, re-excavation, and reconnecting of the original river channel. These efforts, when coupled with changes to system operations, will result in the restoration of flow to the original river channel and seasonal inundation to the floodplain (Bousquin et al. 2005).

#### OBION RIVER

The Obion River in western Tennessee was channelized by the USACE in the 1960s. The purpose of the project was to reduce flooding that inhibited agricultural productivity. The channelization involved enlarging and straightening of the channel to reduce flooding of the upper sections of the Obion River, which caused increased peak flows and increased flood frequency downstream. Following channelization, the number of floods on the lower Obion River increased 140% during the growing season. Although the channelization decreases the average length of flooding events, even brief periods of inundation can destroy crops. The higher flood frequency in the lower reaches essentially eliminated any flood reduction benefits channelization created in the upper reaches (Bousquin et al. 2005).

#### YALOBUSHA RIVER

The Yalobusha River and Topashaw Creek, located in north-central Mississippi, was channelized between the 1910s and 1940s to improve drainage. By the 1940s, the outlet was obstructed in many locations by sediment and debris and the flow capacity of the Yalobusha River was greatly reduced. As a result, the Yalobusha River was dredged, enlarged, and realigned, which caused headcutting and subsequently deepening of upstream reaches and mass failure of channel banks. As banks failed, woody vegetation was transported downstream, contributing to a large accumulation of sediment and debris at the downstream end of the channelization project. The debris caused increased flood stages and flood frequency, prompting a restoration project by the USACE (Simon 2000).

#### STAKEHOLDER FEEDBACK

The stakeholders provided feedback regarding the impacts of channelization projects on river basins and water transmission. Pertinent responses are summarized below and provided in Appendix B. Stakeholders indicated that channelization leads to:

• Reduction of base stream flows and the increase of peak flows can lead to reduction in the magnitude of the flooding, but the frequency may stay the same or decrease

- Increased erosion and vertical instability, which contributes to channel bed degradation
- Increased channel and bank instability as the channelized reach returns to a natural stable shape and configuration
- Extensive destruction of aquatic habitat
- Disconnection of the stream from its natural floodplain, equating to a loss of natural functions including floodwater storage, ecological services, and value
- Greatly reduced water quality, including lower dissolved oxygen, loss of nutrient processing, increased stream temperature, and increased turbidity
- Instability of tributaries, generally leading to their incision and other subsequent issues
- Reduced recreational opportunities due to loss of navigation, loss of deep water and swimming holes and loss of aesthetically pleasing natural settings
- Reduction in fish populations, including sport fish populations
- Waters that may no longer support ecologically designated uses
- Channelization requires regular maintenance impacting budgets.

#### 1.3.2 Dredging

Dredging removes sediment and other materials from the channel bottom. Potential impacts, dredging case studies and observed impacts, and feedback from the stakeholder group are summarized below.

#### FLOOD CONTROL IMPACTS

Dredging typically reduces flooding both upstream and in the immediate project area, however, the amount of flood reduction depends on the project's location within a watershed. Dredging does not always have the anticipated flood benefits, particularly in areas where the channel slope is effectively flat. Although dredging reduces flooding most effectively when performed on the upper stream reaches, the faster flow may increase downstream flooding.

#### OTHER IMPACTS

Dredging activities can result in negative near-term and long-term environmental impacts to aquatic habitat and water quality (Manap 2016). Dredging enlarges and deepens the channel, increasing the likelihood of bank failures and prompting channel incision and downcutting (SR 172 Stakeholder Group 2018). Similar to channelization, dredging impacts are observed both upstream and downstream of the project site and can migrate to adjacent tributaries. The long-term impacts from dredging result from the well-understood process of channel evolution, as the modified channel (left in a very unstable state) goes through decades (or centuries) of channel and floodplain re-development. Increased channel erosion causes downstream channels to fill with sediment and debris (Simon 2002). One of the most harmful effects of dredging is separating the river or bayou from its floodplain resulting in reduced floodwater storage, the delivery of more water delivered downstream at a much faster rate, and in degraded floodplain forests. The degraded state of the floodplain forest reduces protection from storm surges (Piazza 2013).

The environmental impacts of dredging can be observed immediately and long term. Table 3 summarizes the impacts of dredging. Depending on the properties of the dredged material and the dredging technique,

impacts to water quality can extend significant distances downstream of where the dredging takes place. Increases in sediment and the removal of bank vegetation make streams warmer and decrease dissolved oxygen levels. Dredging of streams can also release bacteria and toxic pollutants into the water (Wallace 1992). Dredging causes extensive destruction of aquatic habitat and negatively affects aquatic life. The direct removal of stream life and disturbance of surrounding areas when the dredged material has resettled can have lasting impacts on the number and types of plants and animals (Freedman 2013).

Table	3.	Impacts	of Dredging
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Activity	Impacts			
	Resuspends sediment and increases turbidity			
	Resuspends toxic materials			
	• Increases water temperatures			
<b>Excavation of Material</b>	• Decreases dissolved oxygen			
from the Channel Bottom	• Removes aquatic habitat, causing shift in number and type of species			
	• Decreases invertebrate drift			
	• Diverts populations to nongame species			
	• Injures, buries, and kills biota			
	Reduces bank stability			
	• Increases runoff, erosion, and pollution			
<b>Removal of Bank</b>	• Increases light intensity			
Vegetation during	Raises water temperature			
Dredging Project	Increases primary algal productivity			
	• Reduces riparian habitat and type and number of river-dependent species and encourages the			
	spread of invasive species			
	• Results in runoff and sloughing of sediments in river			
Placement of Dredged	• Increases sedimentation			
Material on Channel	• Increases turbidity			
<b>Banks or Floodplain</b>	Resuspends toxic materials			
	• Separates the river or bayou from it's floodplain wetlands			

#### CASE STUDIES

#### DREDGING PILOT STUDIES

The United Kingdom Environment Agency conducted a study to determine what extent waterway maintenance or dredging would reduce flooding. The study included six pilot sites where stream maintenance (weed control, blockage removal and de-silting) or dredging was conducted. Maintenance work at the pilot sites reduced local flooding but in some cases was not cost effective because too little flood benefit was achieved. One conclusion of the study was that decisions should be considered on a case-by-case basis to determine if the measures would be beneficial. (United Kingdom Environment Agency 2011).

#### ATCHAFALAYA RIVER BASIN

One of the most harmful effects of dredging is that the channel deepening separates the river or bayou from its floodplain wetlands. As a result, increasing flood levels are needed to move water out of the channel and into the floodplain. Although this is the desired effect from a flood control perspective, it is

damaging to the floodplain habitat and floodplain-dependent organisms, as experienced in the Atchafalaya River Basin. Dredging of the river and closure of many of the bayous that connected to the river were used to route flows into fewer channels for flood control. That channel routing caused deepening of remaining channels (in addition to dredging) for hydraulic equilibrium. As a result, the floodplain forests in the Atchafalaya River Basin are largely separated from overbank flow unless flood stages are very high. This separation is the cause of extensive degraded floodplain forest conditions, widespread oxygen deficiency, and periodic fish kills that occur in that system (Piazza 2013).

#### STAKEHOLDER FEEDBACK

Pertinent stakeholder responses regarding impacts of dredging on river basins and water transmission are summarized below and in Appendix B. According to stakeholders, dredging leads to:

- Increased shear stresses and other erosional forces, which contribute to channel bed degradation
- Increased lateral instability of channel banks as the resulting channel attempts to reach a stable shape and configuration
- Extensive destruction of aquatic habitat
- Degraded water quality, loss of bedform diversity, changes in substrate, and drastically altered channel flow regime
- Disconnection of the stream from its natural floodplain providing less floodwater storage, equating to a significant loss of natural functions, ecological services, and value
- Head-cutting and instability of channel tributaries, leading to incision and other issues
- Decreases in fish population, removal of recreational areas, waters that may no longer support designated use, and loss of aesthetically pleasing natural setting
- Requirement for ongoing maintenance as the channel will not maintain the original design over time
- Reduced groundwater recharges, providing less floodwater storage overall.

## 1.3.3 Clearing and Snagging

"Clearing and snagging" is defined in the Louisiana Scenic Rivers Act (RS 56:1856 §1842 (7)) as the practice of removing most obstructions, trees, snags, and other impediments that retard the natural stream flow. In Louisiana, clearing and snagging often involves the cutting of 10 to 20 feet of the top of bank to allow excavator access, with the excavator removing all debris within the channel. In some instances, instream work is conducted if the channel width and size of equipment used allows for it. This may involve multiple passes of large amphibious tracked equipment within a streambed. The following sections summarize flood control and other impacts of clearing and snagging activities. Clearing and snagging case studies were difficult to find in the published literature but currently several streams in Louisiana are undergoing clearing and snagging. LDEQ is collecting water quality data for "before" and "after" scenarios.

The Poudre River case study describes tools for rapid assessment and detailed analysis of the benefits and hazards of woody debris. Feedback from the stakeholder group is also summarized.

#### FLOOD CONTROL IMPACTS

Individual pieces of wood collected into jams can reduce flow velocity, which can increase the frequency, depth, and length of flooding (Wohl 2016, Chow 1959). Clearing and snagging projects involve the

removal of wood and other obstructions from streams to allow water to flow freely and reduce flooding (Wohl 2016). When flood control is the objective of the project, clearing and snagging is typically completed on small order streams (Marzolf 1978). Clearing and snagging can increase downstream flooding due to the inability of lower reaches to move water as rapidly as the cleared and snagged reaches.

#### OTHER IMPACTS

Clearing and snagging has been used for draining wetlands for agricultural use and improving navigation. In many cases, woody debris acts to stabilize the channel bottom and its removal influences channel erosion and deposition, leading to bank failures and increased sediment loadings onto downstream waterbodies. This increase in sediment causes channel filling and widening, destroying aquatic habitat and water quality (Heimann 2017, Wohl 2016, Kaller 2006).

Large woody debris can increase habitat diversity within channels and floodplains through numerous processes and impact groundwater-surface water interaction (Wohl 2016). Clearing and snagging can influence aquatic plants and animals through the removal of overhanging vegetation, increasing light intensity and resulting in warmer stream temperatures. These changes will encourage aquatic plant growth and result in greater dissolved oxygen level fluctuations over a 24-hour period. Additionally, organisms live in the sediments deposited around the wood that is removed by clearing and snagging (Heimann 2017, Wohl 2016, Marzolf 1978). These sediments erode after clearing and snagging, inevitably leading to the emigration of animals who live there and the larger species who feed on them. The loss of cover and shelter from clearing and snagging ultimately reduces the overall fish population in the vicinity of clearing and snagging projects (Marzolf 1978).

#### CASE STUDY

#### POUDRE RIVER CASE STUDY

Large woody debris deposits are widely credited for creating and maintaining habitat diversity that benefits aquatic ecosystems. A decision process for the management of large wood materials on streams was applied to the Poudre River system using tools for rapid assessment and detailed analysis of the benefits and hazards of woody debris. The study notes that the decision to retain, remove, or modify woody debris is highly dependent on the context. The process used in the study can be applied to a range of urban to natural river reaches so that opportunities for wood retention or enhancement are increased (Wohl 2016). A version of this decision process may be used in Louisiana.

#### STAKEHOLDER FEEDBACK

Pertinent stakeholder feedback on the impacts of clearing and snagging activities on river basins and water transmission is summarized below and in Appendix B. According to stakeholders, clearing and snagging results in:

- Increased shear stresses and other erosional forces, which contribute to channel bed degradation
- Increased lateral instability of channel banks as the resulting channel reaches a stable shape and configuration
- Extensive destruction of aquatic habitat

- Degraded water quality, loss of bedform diversity, changes in substrate, and drastically altered channel flow regime
- Increased stream erosion when the large woody debris that acts to stabilize channel systems is removed and where clearing activities remove excessive vegetation along the banks, inevitably leading to the emigration of organisms and animals who live there and the larger species who feed on them. Bank vegetation provides shade, stabilization, reduced downstream flooding, wildlife habitat, and a habitat and food source for aquatic organisms.
- Clearing and snagging results in the deposition of woody debris and shavings from the cutting into the stream channel. This will likely result in reduced oxygen concentrations in the water column. Additionally, this material will be carried downstream where it may be deposited into areas of low stream slope and velocity, leading to obstructions to flow.
- Clearing and snagging equipment must get into the stream bed, thus disrupting the sediment and altering the channel.

## **1.4 AMITE RIVER BASIN DREDGING ANALYSIS**

DOTD developed a limited detail numerical model to assess potential water elevation changes due to dredging in the lower Amite River. This model was built based on survey, land elevation, and historical stream gage data. Four models were created: an existing conditions base model referred to as *2017 Without Project Conditions* and three dredging scenarios referred to as *Alternative 1*, *Alternative 2*, and *Alternative 3*. The 2017 Without Project Conditions model was developed to compare the benefits of the alternatives. Six storms (August 2016 or greater than 500-year, 5-year, 10-year, 25-year, 50-year, and 100-year storms) were simulated to analyze potential flood risk reduction areas. Each design storm represents a one in X-year chance of occurring; for example, the 100-year storm has a one in 100-year probability of occurring, or a 1% chance of occurring in a given year. For the August 2016 profile, a fixed boundary condition elevation of 4.6 feet NAVD88 was applied to the downstream most cross section of each reach. This boundary condition is based on the observed conditions for the August 2016 flood event as recorded by the Coastal Reference Monitoring System gage CRMS0061-H01-RT converted to the NAVD88 was assumed for the downstream boundary.

#### 1.4.1 Dredging Scenarios

The three alternative models were based on the 2017 Without Project Conditions model, with the river bed elevation changed to simulate different dredging scenarios. Alternative 1 simulates dredging from the mouth of Lake Maurepas to approximately 10 miles upstream. The average dredging depth is 5 feet, with the maximum being 30 feet. This scenario would require 2 million cubic yards of material to be removed from the river. Alternative 2 requires an average of 10 feet of dredging, with a maximum depth of 20 feet and 3 million cubic yards of material removed between the Amite River diversion weir to approximately 12 miles downstream near the confluence with the Old River. Alternative 3 simulates the largest amount of material removed at approximately 8 million cubic yards. This material would be removed between the mouth of Lake Maurepas to 34 miles upstream at Port Vincent, with an average dredging depth of 7 feet and a maximum of 30 feet. A summary of the Alternative 1, 2, and 3 models is provided in Table 4.

Scenario	Location and Length of Dredging	Maximum Dredging Depth	Average Dredging Depth	Volume of Material Removed
Alternative 1	Mouth of Lake Maurepas to approximately 10 miles upstream	30 feet	5 feet	2 million cubic yards
Alternative 2	Amite River diversion weir to approximately 12 miles downstream near the confluence with the Old River	20 feet	10 feet	3 million cubic yards
Alternative 3	Mouth of Lake Maurepas to 34 miles upstream at Port Vincent	30 feet	7 feet	8 million cubic yards

#### Table 4. Summary of Dredging Alternatives 1, 2, and 3

#### 1.4.2 Analysis Results and Conclusions

The maximum decrease and increase in the surface water elevation of the Amite River based on each alternative is presented in Table 5. The maximum increase and decrease occur at different points along the river.

	Altern	ative 1	Altern	ative 2	Alterna	tive 3
Simulated Storm Flood	Maximum Decrease in Water Elevation (feet)	Maximum Increase in Water Elevation (feet)	Maximum Decrease in Water Elevation (feet)	Maximum Increase in Water Elevation (feet)	Maximum Decrease in Water Elevation (feet)	Maximum Increase in Water Elevation (feet)
August 2016	-0.05	0.00	-0.34	0.16	-0.39	0.12
5-year	-0.11	0.00	-0.48	0.24	-0.53	0.13
10-year	-0.16	0.00	-0.48	0.28	-0.52	0.14
25-year	-0.23	0.00	-0.44	0.32	-0.49	0.15
50-year	-0.29	0.00	-0.41	0.29	-0.45	0.10
100-year	-0.33	0.00	-0.40	0.29	-0.45	0.09
Estimated Cost <sup>1</sup>	\$20,00	00,000	\$30,00	00,000	\$80,00	0,000

 Table 5. Maximum Decrease and Increase in Water Surface Elevation Based on Alternatives 1, 2, and 3

Note:

<sup>1</sup>Estimated costs assume a reasonably close disposal distance. Increased disposal distance increases the cost.

From this table, the following conclusions can be made:

- Alternative 1 shows minimal reductions in surface water elevation as a result of the control that Lake Maurepas has on the river elevations. Dredging appears to have a larger impact on water surface elevations upstream of the confluence with the Old River.
- Alternative 2 shows a maximum flood reduction of -0.48 feet, with a minimum of -0.34 feet. The increase in water surface elevations for Alternative 2 are a result of less flow traveling over the Amite

River diversion weir and more flow traveling downstream in the Amite River. Surface water elevation increases downstream of the weir could be reduced with modifications to the Amite River diversion weir.

• Alternative 3 presents the greatest benefit in flood reduction but requires 34 miles of dredging. The maximum increase in surface water elevation in Alternative 3 is also reduced from Alternative 2.

The Investigation into the Potential Hydraulic Impacts of Dredging the Lower Amite River report is provided in Attachment B.2.

# **1.5 CONCLUSIONS**

Channelization, dredging, and clearing and snagging activities typically reduce flooding both upstream and in the immediate project area, however, the amount of flood reduction depends on the project's location within a watershed. For example, projects in the middle to upper stream reaches, with meaningful stream slopes, typically provide flood reduction but may exacerbate downstream flooding and tend to show the greatest local environmental impacts. Less benefit is realized with projects on stream segments in lower reaches with flatter slopes. Cost-benefit analysis is essential for any project and should include a determination of costs associated with environmental impacts. Stakeholders and their representatives will need to decide how much environmental impact is acceptable for the benefit received.

The Amite dredging analysis was conducted in the lower reach of the Amite River Basin. The results of the dredging analysis suggest that the cost of dredging versus the flood benefits are not economically viable in the lower part of the Amite Basin. Similar results are expected for clearing, snagging and channeling in the lower Amite. The dredging analysis supports the recommendation to use hydraulic models to evaluate the upstream and downstream changes from channelization, dredging, clearing and snagging on a watershed basis and that the analysis look at the effects in the middle and upper reaches where more benefit is anticipated.

In addition to the potential for increased downstream flooding, Channelization, dredging, and clearing and snagging can have other unintended consequences at a project site, such as:

- Reduced water quality
- Decreased ecosystem biodiversity as a result of a change in habitat
- Changes in channel size and shape that may cause bank failures and head-cutting
- Impacts to adjacent wetland ecosystems as a result of less frequent overbank flows.

Before implementing channelization, dredging, and clearing and snagging activities, these consequences should be considered.

Alternate approaches may be more effective in reducing long-term flood losses and have greater water quality, ecological, and economic benefits. Alternate approaches, such as careful land use planning and zoning, stormwater management, floodplain restoration and protection, structure floodproofing, removal of roadway embankments from the floodplain, and voluntary property buyouts, should be considered and compared to channelization, dredging, and clearing and snagging activities. Coordination of these approaches for application throughout the entire watershed may achieve even greater flood reduction benefits.

# PART 2. STATEWIDE, COMPREHENSIVE WATERSHED-BASED FLOODPLAIN MANAGEMENT

Throughout Louisiana the repetitive flooding of communities has led to widespread destruction, damage to homes and businesses, and economic consequences. While the state has many floodplain management tools in place, losses from flooding demonstrate that a different approach is needed to address the complex array of interconnected challenges that are leading to increasing flood risk—climate change, development patterns, subsidence, and more. A watershed approach to floodplain management is a tool the state can use to address these challenges. These challenges are not unique to Louisiana, but the State has an opportunity to be a leader in the field.

The Watershed Initiative's mission is critically important to ensure that funding opportunities are used to not just augment existing floodplain management strategies, but to fundamentally reshape the State's approach. Currently, the majority of floodplain management policy is set through the code of federal regulations (60.3) and are required to be followed for communities to be able to participate in the National Flood Insurance Program. The state acts as an intermediary to support compliance and provide technical support, and the policies are implemented through local flood damage prevention ordinances and other local policy. The state has the authority to increase standards through regulatory means but has historically not done so. Improving the effectiveness of existing floodplain management programs and policies across all jurisdictions and creating long-lasting and robust mechanisms to reduce flood risk at the watershed-scale is a significant effort. It will require leadership, hard decisions, and deep engagement of stakeholders from all levels of government and sectors. The Initiative's approach is to align state agency initiatives and programs and to improve local floodplain management capability and capacity. The potential benefits for the state are immense—not only in terms of reducing flood risks, but also in the creation of new expertise, infrastructure and management strategies that can generate a new economy and services that will be vital not just in Louisiana but nationally and even globally.

Initial findings and recommendations to establish, implement, and enforce floodplain management plans were presented in early 2018 in the Phase I Report (Louisiana Watershed Cooperating Agencies 2018). Since then, the LWI and stakeholders have made progress on key efforts and implementation of the initial recommendations. Part 2 documents progress since the Phase I Report, related initiatives and programs, and an update on answers to open questions necessary to establish, implement, and enforce watershedbased plans. The open questions discussed in Sections 2.2 and 2.3 include: 1. How are roles and responsibilities assigned to establish, implement and enforce watershed-based floodplain management plans across the state and 2. What geographic scale and boundary should be used for watershed-based planning in Louisiana? Part 3 of this report provides recommendations.

# 2.1 PROGRESS SINCE RELEASE OF THE PHASE I REPORT

Significant progress has occurred with implementing Phase I Report initial recommendations, which involved extensive stakeholder engagement throughout the process. Table 6 summarizes key efforts.

<b>Fable 6. Summary</b>	of	Progress	Since	Release	of	Phase	I	Report
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Key Effort	Description
Formed the Council on Watershed Management and LWI (Office of Gov. John Bel Edwards May 2018 and August 2018)	<ul> <li>The Council is composed of the heads of five state agencies, and its objective is to develop and implement the LWI, a watershed-based statewide floodplain management program.</li> <li>The goal of LWI is to assist federal, state, and local jurisdictions and communities in the implementation of regional, long-term solutions that follow watershed boundaries to most effectively reduce flood risk across Louisiana communities.</li> <li>LWI engages and includes the support of subject matter experts from federal, state, and local governments and the non-profit and private sector, who serve as advisors in building a foundation of data, projects, policies, standards, and guidance.</li> <li>Initial work includes efforts ranging from the background work necessary for the development of hydraulic and hydrologic models to the development of watershed coalitions in coordination with state, federal, and local government entities.</li> </ul>
Published "A Long-term Vision for Statewide Sustainability and Resilience" (Office of Gov. John Bel Edwards 2018)	• The governor's "A Long-term Vision for Statewide Sustainability and Resilience" modeled how the Council and technical advisory groups (TAGs) would align existing programs, policies, and practices, as well as identified key strategic statewide investments.
Created six TAGs	<ul> <li>TAGs were created in the following areas: Public Relations, Data, Projects, Policy, Engagement, and Planning. The Public Relations and Engagement TAGs have since been merged.</li> <li>Each TAG is responsible for recommendations and for seeking input from stakeholders across the state.</li> <li>Subject matter experts from educational institutions (e.g., LSU, ULL, Tulane, and more), researchers, private sector partners, federal agencies (e.g., FEMA, USGS, USFWS, USACE, and more), and other key stakeholders support these TAGs.</li> <li>Attachment C.1 provides additional detail on the initial form and function of the TAGs.</li> </ul>
Identified local support needed to address flood risk and conduct floodplain management activities	<ul> <li>LWI and CPRA partnered to pilot test a detailed capacity and capability assessment with 24 coastal (or near-coastal) parishes to understand their strengths, needs, and concerns associated with implementing flood risk-reduction projects and related policies and programs (CPRA 2018a and 2018b).</li> <li>Recommendations from the assessment are included in this Response Report as appropriate.</li> </ul>
Conducted a statewide listening tour	<ul> <li>Eight full-day workshops were conducted across the state to gather input from professional associations, regional commissions, elected officials, planning and floodplain officials, non-profit organizations, conservation districts, emergency managers, federal agency representatives, and private citizens on floodplain management issues in the state (Louisiana Watershed Initiative 2018), including those related to watershed-based planning and policy.</li> <li>Feedback from the tours is integrated into the recommendations presented in this Response Report.</li> </ul>
Established grant program to assist watershed-based entities	• Based on the findings of the capacity and capability assessment and the statewide listening tour, the Regional Watershed Initiative Capacity Building Grant Program will provide funding for staff time, coalition-building, education, training, workshops, peer-to-peer learning, watershed plan

Key Effort	Description
	<ul> <li>development, and land use and other policy-related improvements and program development.</li> <li>Eligible grant recipients include planning and development districts, metropolitan planning organizations, and other watershed-based entities, as defined by the program.</li> <li>Regional entities are encouraged to develop and adopt a watershed-based plan and implementation and enforcement strategy.</li> </ul>
Initiated the "everything flood related" website and data portal	<ul> <li>As part of the LWI, a website (https://www.watershed.la.gov) was launched to provide information about the LWI, ways to get involved, and resources and frequently asked questions (FAQs).</li> <li>A preliminary plan for further development of the website and data portal was presented before the Council at the November 2018 Council meeting and the catalyst and near-term actions of the plan are currently being implemented and integrated into https://www.watershed.la.gov (Attachment C.2).</li> </ul>
Drafted a data gap analysis and recommendations for data standards, quality, and framework for data delivery, as well as white paper publications for public consumption that provide briefings on the use, location, availability, and how to contribute to all datasets covered in the workshops	<ul> <li>The analysis describes high-priority datasets, the status of the data, existing data standards and quality assessment, potential issues/gaps, and anticipated future steps or needs.</li> <li>The outcomes of the analysis are used by the Data and Modeling TAG to fill gaps and resolve issues.</li> <li>For example, the Data and Modeling TAG is completing an implementation plan for the placement and maintenance of high-priority rain and flow gages statewide.</li> <li>The description of the gap analysis, white papers, data standards memo, data quality assessment, and framework for data delivery are provided in Attachment C.3. The final documents are expected to be delivered before the March meeting of the Council on Watershed Management.</li> </ul>
Started developing a modeling implementation plan	• The LWI contracted with Tulane and the University of Louisiana Lafayette, as well as engaged subject matter experts, including Council agencies, additional state agencies, federal agencies, universities, and nonprofit organizations to develop a modeling implementation plan to use once funding is available. This plan is slated for delivery at the March meeting of the Council on Watershed Management.
Completed cooperative endeavor agreements between Council agencies	• Council agencies have completed a Cooperative Endeavor Agreement, which required initial evaluation of capacity and identification of shortfalls and funding allocation to continue implementing Phase I Report recommendations and the needs of the LWI.

Acronyms & Abbreviations:

USACE = United States Army Corps of Engineers
USFWS = United States Fish and Wildlife Service
USGS = United States Geological Society

The Phase I Report identified specific actions and desired outcomes in an implementation roadmap across six strategic areas of focus. The status of each action is detailed in Attachment C.4.

# 2.2 RELATED COMMISSIONS, COMMITTEES, INITIATIVES, AND PROGRAMS

Multiple programs, separate from the LWI, inform floodplain management plan development and must be engaged by and coordinated with the LWI in order to appropriately leverage findings, resources, and outcomes.

#### 2.2.1 Louisiana Water Resources Commission

The Louisiana Water Resources Commission (LWRC) promotes and assists in the effective management of the state's ground water and surface water resources. This includes gathering and interpreting data, evaluating overall resource management, assessing current and future water demands, developing conservation programs, and researching incentives and new technologies (LWRC 2018). Active coordination with LWRC occurs through the LWI's Policy TAG.

#### 2.2.2 Louisiana State Law Institute Water Code Committee

The Water Code Committee, led by Tulane's Mark Davis, is researching United States and international water resource management laws to help Louisiana incorporate groundwater and surface water management best practices in the future (Louisiana State Legislature 2014). Researchers are communicating with the LWI's Policy TAG, as well as the LWI's program management team. Results of this research are expected to be presented to the Legislature during the 2020 session. Continued coordination is required to determine which legislative recommendations are applicable to the watershedbased floodplain management planning effort.

## 2.2.3 Louisiana Resilient Recovery Initiative

The Louisiana Resilient Recovery Initiative was developed to coordinate recovery efforts from the 2016 floods, and included data collection and sharing efforts. With participants from parish governments, OCD, GOHSEP, and FEMA, the Louisiana Resilient Recovery Initiative worked to facilitate the creation of watershed partnerships, or coalitions, for three pilot watersheds. Lessons learned from this effort are informing the Louisiana Watershed Initiative.

## 2.2.4 Existing State Agency Programs and Responsibilities

State agencies have the potential to impact flood risk by providing funding or other direct support for projects and activities, constructing or improving infrastructure, changing land uses, enforcing regulations and permits, and communicating and coordinating with the public or other entities. To maximize effective flood risk management, the LWI must coordinate with the state agencies and current programs listed in Table 7.

Agency	On Council?	Relevant Programs/Actions	Relevancy to the Initiative
OCD	Yes <sup>1</sup>	Community Development Block Grant Program, Local Government Assistance Program, Disaster Recovery Unit	OCD's multiple funding and planning programs have a direct impact on flood risk through project selection, funding, and guidance.
GOHSEP		Public Assistance, Hazard Mitigation Assistance Programs, Hazard mitigation Planning	State-level homeland security and emergency response, recovery, and mitigation planning and project funding administration. Oversight of local/multi-jurisdictional emergency and state and local/multi-jurisdictional hazard mitigation plan development.
CPRA		Coastal Master Plan, Flood Risk and Resilience Program	Hurricane protection, storm damage reduction, flood control, infrastructure, and coastal protection and restoration efforts.
DOTD		State NFIP coordination, including the Community Rating System, Statewide Flood Control Program, land use, and project implementation actions	DOTD significant impacts on land uses and infrastructure, and by extension, flood risk. DOTD's flood- related programs also affect flood risk through technical support, outreach and education, funding, and NFIP coordination, as well as encouraging CRS participation.
LDWF		Environmental Investigations, Louisiana Natural and Scenic Rivers Program, and other programs	LDWF manages and protects Louisiana's natural resources, including compiling data and assessing potential impacts of human activities on those resources. Reviews and recommends provides comments and mitigation recommendations on all permits sought from state and federal environmental regulatory agencies. LDWF also administers a permitting system for activities that have potential for significant ecological impact to designated Natural and Scenic Rivers, as well as a system of monitoring, surveillance, investigation and enforcement for the purpose of ensuring compliance with the act.
LDEQ	No	Watershed management, data collection and analysis, regulatory oversight / permitting, interagency project reviews, stormwater project funding, National Hydrography Dataset, Watershed Boundary Dataset	LDEQ's actions regularly affect flood risk through administering WQCs, drafting of Watershed Implementation Plans to address water quality issues, meeting with local jurisdictions, and gathering and maintaining a significant amount of data. LDEQ is not currently on the Council, but is represented on each TAG and has been critical in implementing the LWI to date.
Division of Administration – Other Offices	No	FPC	FPC administers the state's capital outlay budget, including preparation of a preliminary state construction plan for state and local public facilities and infrastructure. FPC administers funded projects from planning through construction. FPC has recently contributed to the Policy TAG and supports recommendations establishing uniform state-owned, operated, and funded facility and project standards.
		LED	LED administers various business incentives and financial assistance programs. LED administers the LED Certified Sites Program, which qualifies "business-ready" business/industrial sites based on zoning restrictions, environmental studies, etc. LED has recently contributed to the Policy TAG.

#### Table 7. State Agency Programs that Must Be Coordinated with the LWI to Maximize Effective Flood Risk Management

Agency	On Council?	Relevant Programs/Actions	Relevancy to the Initiative
		Office of Risk Management	The office manages all state insurance coverage covering property and liability exposure and is a relevant stakeholder in developing higher standards to reduce impacts to state facilities and projects.
		OTS	OTS provides IT support services for state executive cabinet agencies and is the sole authority for IT procurement. OTS will be important to the implementation of the data portal.
LDH	No	Office of Public Health Onsite Wastewater Program Operator Certification Program	LDH protects the health of Louisiana citizens by working to prevent sewage from entering the environment and is part of Louisiana's emergency preparedness network. LDH can play a critical role in protecting Louisiana's critical wastewater infrastructure against flood risks.
DNR	No	LCMP through the Office of Coastal Management	DNR regulates development activities and manages resources in the coastal zone through the issuance of coastal-use permits.
Department of Agriculture and Forestry	No	Office of Soil & Water Conservation	The department works to sustain and conserve water quality in Louisiana's wetlands and waterways. It works directly with landowners as well as with Soil & Water Conservation Districts in watershed management implementation.

Note:

<sup>1</sup> Additional detail on Council agency programs is provided in the Phase I Report.

Acronyms & Abbreviations:

DNR = Department of Natural Resources

FPC = Facilities Planning and Control

LCMP = Local Coastal Management Programs

LDH = Louisiana Department of Health and Hospitals

LED = Louisiana Economic Development

NFIP = National Flood Insurance Program

OTS = Office of Technology Services

WQCs = Water Quality Certifications

# 2.3 HOW ARE ROLES AND RESPONSIBILITIES ASSIGNED TO ESTABLISH, IMPLEMENT AND ENFORCE WATERSHED-BASED FLOODPLAIN MANAGEMENT PLANS ACROSS THE STATE?

As described in the Phase I Report, current development and project implementation practices in many areas lead to drastically increased runoff. Increased runoff can lead to increased flood risk, both in magnitude and extent of flooding, on adjacent properties and downstream of development. Areas considered to have low flood risk in prior years can experience frequent flooding due to changed land use and project practices outside of their jurisdiction. A comprehensive watershed-based approach to floodplain and flood risk management will allow Louisiana to manage floodplains consistently using best practices across the state and will significantly lower flood risk.

#### 2.3.1 Identification of Watershed-Based Roles

Building on the results of the Phase I investigation, the 24-parish capability and capacity assessment, the state-wide listening tour, the LWI has determined that watershed-based plans should be developed by coalitions formed at the watershed level and consisting of representatives and stakeholders from existing jurisdictions within each watershed. Stakeholder engagement and research indicated that such an approach is preferable in the near-term, at least, to other options (such as a new state agency, regional state entities, and/or new regional authorities). Also building on Phase I, these investigations and engagement actions have identified several roles that watershed-based coalitions could play over time. These roles, which are identified in Table 8, are not mutually exclusive.

Watershed-Based Coalition Role	Example Case Study
<u>Resource</u> : Coalitions communicate risk and provide education, funding, and technical assistance to local jurisdictions within the watershed.	In Quebec, watershed organizations are consultative groups set up by local stakeholders that include representatives of public and private users, non-governmental organizations, and water managers. The organizations primarily function to create dialogue among stakeholders and develop collective watershed plans, although the plans have no regulatory authority. The provincial government provides funding through annual grants and provides technical resources such as a plan development guides, data, and technical services (Baril, Maranda, & Baudrand 2015).
Guide/Vision:Members collaboratively create a sharedvision of resilience they all buy into.Members of the coalition meet regularlyto share knowledge and information,build relationships and connections,discuss proposed and upcomingresilience programs and projects, andprovide advocacy to state and federalagencies and stakeholders.Participation is not required but thereare incentives to engage.	In Colorado, the state created the Emergency Watershed Protection Program (funded by the Natural Resources Conservation Service (NRCS) and administered by the Colorado Watershed Conservation Board) following devastating flooding in 2013. The Colorado Watershed Conservation Board, a state entity, was allocated \$2.53 million to develop grants for local governments, watershed coalitions, non- profit organizations, and individual land and business owner pilot projects that illustrated a watershed-based approach to flood recovery. In 2015, additional Community Development Block Grant – Disaster Recovery (CDBG-DR) funding was made available to build the capacity of watershed coalitions through hiring dedicated coalition staff (Colorado Watershed Conservation Board 2018).

Table 8. Potential Watershed-based Coalition Roles and Example Case Studies

Watershed-Based Coalition Role	Example Case Study
Expert: Coalitions provide expert technical assistance as well as science and technology thought leadership and problem solving to assist local governments in communicating risk, drafting policies, understanding data, providing training and other floodplain management tasks. Resources are more robust than under previous options. Coalition resources are available to all members.	In Minnesota, the Watershed Act, M.S. Chapter 103D of 1955 (and updated in 1990) allows for the creation of watershed management districts through the petitioning of a majority of the counties and municipalities within a watershed region (Minnesota Water Law 1990). The districts develop regional watershed management plans at least every 10 years and construct projects for drainage, flood control, open space preservation in the floodplain, sanitation, etc. The member counties and municipalities must develop local surface water management plans, which are approved by watershed district. Land use and zoning powers are retained by counties and municipalities (Minnesota Association of Watershed Districts 2011).
<u>Leader</u> : The coalitions set and enforce standards that all local jurisdictions in the watershed adopt. The coalition has regulatory authority created through new legislation.	In Florida, the state's Department of Environmental Protection administrates water resources statewide but delegates some authority to five watershed management districts. The water management districts have the primary responsibility for floodplain management, which involves not only preventing damage from flooding, but also preserving and restoring the beneficial values of natural floodplains such as fish and wildlife habitat, nutrient absorption, and water storage. Some areas of the state are protected from flooding by district-operated control structures such as locks, spillways, pump stations, levees, and canals. In other areas, the flood storage capacity of natural floodplains is protected. The districts have permitting authority and coordinate with local floodplain managers.

Effective floodplain management and flood risk management requires adoption of best practices in each of the following functional areas, building on the Phase I investigation:

- Flood analysis, mapping, and data
- Floodplain and construction codes and enforcement
- Land use planning and development review
- Management of flood control infrastructure
- Project funding, execution, monitoring, and evaluation
- Engagement and communication.

#### 2.3.2 Watershed-Based Roles by Functional Area

Within each functional area, a watershed-based entity could play the role of resource, guide, expert, or leader. Table 9 provides examples of the roles a watershed coalition may provide for each functional area of floodplain management. These pathways are not mutually exclusive and could build on one another or vary among functions. For instance, a watershed coalition could serve as a resource for the enforcement of floodplain construction codes by providing training for local staff, as well as a leader for flood analysis, mapping, and data by developing mandatory standards. The Planning and Policy TAG will continue to refine and develop these alternate roles and develop recommendations for the Council on Watershed Management.

			Possible Role of a Waters	hed-Based Coalition	
Function	Objectives	Resource	Guide	Leader	Expert
Flood analysis, mapping, and data	<ul> <li>Improve collection, management, and dissemination of data</li> <li>Communicate flood risk and the impacts of proposed projects across the watershed</li> </ul>	Support communicating current and future flood risk across the watershed	Follow and share recommended standards for data collection Contribute flood risk management data to data portal	Develop mandatory standards for data collection within the watershed	Update living hydrologic and hydraulic models
Floodplain and construction codes/enforcement	<ul> <li>Ensure consistent enforcement of codes across jurisdictions within the watershed</li> <li>Level the playing field for development across the watershed</li> <li>Establish watershed or statewide baseline standards that reduce risk for all communities</li> </ul>	Provide training for local floodplain administrators and other decision-makers Develop model local codes	Provide incentives for adopting higher standards	Develop codes and require local adoption (would require new legislation)	Provide on-call technical expertise
Land use planning and development review	<ul> <li>Fully communicate and minimize negative upstream or downstream impacts of development</li> <li>Target growth in areas with lower risk and existing infrastructure, and away from sensitive or high- consequence areas of the watershed</li> </ul>	Provide forum for idea sharing Fund capacity-building and training opportunities	Develop non-regulatory vision to guide local comprehensive plans and zoning Incentivize alignment of local comprehensive plans and zoning	Identify highly sensitive areas of the watershed Regulate development in highly sensitive areas of the watershed (would require new legislation)	Provide data and tools for project review to assess floodplain impacts
Management of flood control infrastructure	<ul> <li>Create stable revenue streams that can be used for ongoing operations and maintenance</li> <li>Share the responsibility of maintenance throughout the impacted watershed</li> </ul>			Generate revenue for O&M through tax assessment or fees	
Project funding, execution, monitoring, and evaluation	<ul> <li>Leverage and maximize positive impacts of existing and proposed projects</li> <li>Align multiple funding sources to most effectively and comprehensively reduce flood risk</li> </ul>	Maintain a map and database of existing and proposed projects	Develop common project evaluation criteria Ensure coordinated planning of state, federal, local, and regional projects	Determine which projects will be eligible for funding / implementation Create Hazard Mitigation Plan and pursue FEMA funding	Conduct monitoring and evaluation of projects Manage grants
Engagement and communication	<ul> <li>Ensure consistency of information and access to data</li> <li>Encourage joint decision-making about programs, policies, and projects</li> <li>Promote a shared understanding of risk and mitigation actions at multiple scales</li> <li>Foster a shared identity and develop relationships across the watershed and among decision-makers</li> </ul>	Provide training to local staff o Publish outreach and engagem Conduct outreach and engagen Conduct public engagement ca	n communication ent materials and resources nent activities mpaign		

#### Table 9. Potential Role of a Watershed-Based Coalition by Functional Area

#### 2.3.3 Next Steps and Recommendations

In the near-term, the LWI must support the development of watershed-based coalitions and develop and implement a statewide watershed-based flood risk management plan. Additionally, LWI must continue to strengthen and develop the Louisiana Watershed Initiative program through 2019 as described in Part 4.

Beginning in early 2019, LWI is working to support the development of **watershed-based coalitions** (and alignment with flood risk management best practices) in coordination with local governmental officials, economic development entities, regional entities, state and federal agencies, and other stakeholders. To that end, the LWI released an RFP in December 2018 for state-level consultant support and has been developing the Regional Capacity Building Grant to provide regional and local support. This support includes, but may not be limited to, the following:

- Providing logistical, planning, coordination, and engagement support related to the development of regional, watershed-based coalitions, including support in the development of regional and contextually appropriate goals and objectives for each of the regional coalitions, as well as governance, charters, and/or organization drafts and templates for regional coalitions to adopt
- Incorporating information and input from the program and associated coalition-building efforts; facilitating and developing contextually appropriate policies and procedures and criteria for regional coalitions to use in daily decision making and operations
- Developing template and sample codes, ordinances, and policies for local and regional coalitions.

The contents and specifications of an effective Floodplain Management Plan outlined in the Phase I Report are being evaluated in more detail by the Planning TAG and will be refined in coordination with stakeholders. Initial support identified above will aid in the development of a regional plan to include, but not be limited to:

- Summary of the identified region and the opportunities and challenges of the region, within the context of the LWI
- Summary of the history and steps associated with the development of the regional coalition
- Information, research, and recommendations from the various local and regional partners involved in the development of the regional coalition
- Detail of the goals and objectives of the regional coalition
- Identification of the regional coalition's minimum standards and processes for determining acceptable levels of flood risk and impact on watersheds to be considered when undertaking programs and projects
- Processes and criteria for project selection and approval
- Action items, benchmarks, and timelines for achieving the goals and objectives of the regional coalition.

As Louisiana pursues the formation of watershed-based coalitions and watershed-based planning, more intensive strategies should be progressively evaluated and phased in. Such an approach is anticipated to incentivize the increased participation and commitment of local jurisdictions to encourage stronger watershed coalitions and deeper plan alignment. For example, a "leader" style watershed coalition would

likely require legal authorization but could be phased in if the "guiding" or "expert" style is successful. In the longer-term, further investigation and piloting of the "leader" approach at the watershed level are recommended, involving increased regulatory, taxing authority, and technical resources on the part of the watershed-based coalitions. This would include the authority to ensure consistent development, implementation, and ensure compliance with the watershed plan. Under the "expert" approach, the focus would be on growing the technical resources of the coalition to provide science-based leadership and other technical expertise.

In the near-term, watershed-based coalition building should be a condition of any state or stateadministered flood risk related funding. Also in the near-term, the Water Code Committee should complete its study regarding the development of a model water code for the state of Louisiana, as charged under Senate Resolution No. 171 of the 2014 Regular Session; the LWI and the Water Code Committee should coordinate investigations into policy that could ultimately impact surface water, ground water, and a watershed-based approach to flood risk management.

As recommended in the Phase I Report, the state is also embarking on the development of a **state-wide Flood Risk Management Plan**, which will include, but not be limited to:

- Decisions made by the Council related to the LWI and state-wide plan, including support and context of the decision-making process
- Information, research, and recommendations from the various TAGs or similar type entities, state agencies, local and regional engagement efforts, and any other associated program efforts
- An updated and refined articulation of the goals and objectives of the program
- Details of conceptual and implementable statewide best practices that support the goals and objectives of the program
- Identification of the state's minimum flood risk and mitigation standards and processes for determining acceptable levels of flood risk and impact on watersheds to be considered when undertaking programs and projects
- Action items, benchmarks, and timelines for achieving the goals and objectives of the program.

# 2.4 WHAT GEOGRAPHIC SCALE AND BOUNDARIES SHOULD BE USED FOR WATERSHED-BASED PLANNING IN LOUISIANA?

In order to meet the state's objectives for managing future flood risk, the boundaries for watershed-based planning should be selected with the following in mind:

- Scientific and modeling considerations, including geographic and hydrologic features
- Watershed-based planning objectives
- Functional existing organizational boundaries
- Previous investigations and studies on the topic (see Figure 1).

Each of these considerations is described in more detail below.



Figure 1. Watershed Planning Configurations Should be based on Scientific and Modeling Considerations, Watershed-Based Planning Objectives, and Consideration of Existing Organizational Boundaries

## 2.4.1 Scientific and Modeling Considerations

USGS has delineated watersheds throughout the United States at varying scales in a multi-layer approach and has maintained these data in the Watershed Boundary Dataset (WBD) currently stewarded by the LDEQ for the state of Louisiana. The USGS refers to these watersheds as hydrologic units (HUs). The United States is split into 22 of the largest HUs, called regions. Each region is divided into subregions; each subregion is divided into basins; and each basin is divided into sub-basins, or watersheds. Each HU is represented by a unique hydrologic unit code (HUC).

Louisiana's previous basin boundaries were based on mapping from as far back as the 1950s. As such, Louisiana is moving toward the USGS' WBD system as the source of watershed boundaries, and the LWI's Data and Modeling TAG is in the early stages of exploring watershed modeling at the HUC8 scale. There are 59 HUC8 scale watersheds in the state of Louisiana. More detail on Louisiana's watershed delineations are available within the Phase I report (Louisiana Department of Transportation and Development, et al. 2014b).

#### 2.4.2 Watershed-Based Planning Objectives

The planning scale and physical planning boundaries should contribute to achieving watershed-based planning objectives. Land use and project decisions may impact smaller HUC8 watersheds or could impact whole basins or have cross-watershed impacts depending on the size of the project. The planning scale and physical planning boundaries should never be smaller than the scale and area upon which such actions will have an effect. Additionally, the planning scale should maximize ability to leverage capacity (i.e., staff and funding) and capability (i.e., skills and authority) to understand and address flood risk. The HUC8 watershed is roughly the size of a single parish. Coordinating and leveraging resources at this scale would be limited, and land use and project decisions made at this scale are likely to frequently impact other planning configurations. There are roughly 18 watersheds at the HUC6 scale and 12 at the HUC4 scale in Louisiana. Moving toward a HUC6 or HUC4 watershed size would facilitate multi-jurisdictional coordination to achieve watershed-based planning objectives, but may ignore existing infrastructure, population centers, and existing flood control structures.

## 2.4.3 Existing Organizational Boundaries

There are existing organizational boundaries that need to be considered when evaluating and recommending boundaries for watershed-based planning. These include parish boundaries, planning and development districts, levee boards, and more. Existing working relationships must also be considered. Some of these organizations already facilitate cross-jurisdictional coordination. As an example, Figure 2 and Figure 3 below provide a visualization of how watersheds interact with planning and development district and parish boundaries, respectively.



Figure 2. Planning and Development District Boundaries When Compared with HUC-4, 6, and 8 Watershed Boundaries



Figure 3. Parish Boundaries Comparison

#### 2.4.4 Previous Studies and Investigations

In addition, it is important to consider investigations into the Water Code and into flood control planning configurations that could ultimately affect or be affected by watershed-based planning geographic configurations. The selected geographic scale and boundaries should not preclude or complicate the state's ability to act in either of these related and parallel initiatives.

In 2014, CPRA and DOTD published a report in response to Senate Concurrent Resolution 39 (SCR 39) that investigated existing organizational bodies with flood control responsibilities (Louisiana State Legislature 2013). Under SCR 39, the analysis team gathered baseline data, reviewed relevant statutes, consulted with districts, analyzed existing alignments of all state-created governing entities for flood control, and developed several science-based scenarios for further study of the potential to re-align flood control governance statewide. According to the study (DOTD et al. 2014a):

There are more than 250 governmental entities with legal authority over surface water in Louisiana. Of these, roughly 75 were created in state law, including the state's 26 levee districts. Some entities are within one area of a parish, some align with parish boundaries, and others cross a number of parishes. In addition to levee districts, their missions are diverse in purpose and mission, ranging from reservoir commissions to soil and water conservation districts. These entities present potential challenges for the state as it works judiciously to manage and regulate the state's water resources and protect communities from hurricanes and floods. In addition, the state must be prudent to ensure financing is available to construct, operate, and maintain the appropriate infrastructure in order to meet these goals.

Three flood control governance alignments emerged as options for further analysis because they each considered a watershed-based approach while considering existing water management infrastructure and actions. These alignments also reflect major basins in the state where water management efforts are similar and focused and would enable the coordinated management of hydraulic structures and planned risk reduction actions. Accounting for existing infrastructure reduces fragmented planning around levee systems (DOTD et al. 2014b). The proposed flood control governance alignments could potentially accommodate regional ecosystem management as well, which would support the goals and objectives of the LWI.

# 2.4.5 Next Steps and Recommendations Regarding Geographic Scale and Boundaries for Watershed-Based Planning

Existing research is summarized in Table 10. The table has been adopted and modified from the SCR 39 report and evaluates different flood control governance geographic alignments. It is recommended that regional entities, including Planning and Development Districts, Parishes and municipalities, be provided an opportunity to review existing research and provide substantial and meaningful input into the geographic scale and boundaries decision-making process in early 2019.

Based on this preliminary evaluation, it would be appropriate for the LWI to review, test, and evolve the Flooding Hazard Based Alternative (likely Alternative 3 [FHBA3]) approaches demonstrated in the SCR 39 report in coordination with stakeholders. These alignments have nine to 14 districts that consider natural watershed boundaries, existing riverine and coastal water management infrastructure and population. FHBA3 would create 10 districts and meets the most criteria. See Figure 4 and Figure 5 for a visualization of FHBA3 compared to existing flood control infrastructure and population centers, respectively. The Data and Modeling TAG should complete further investigations of appropriate alignments along coastal transition zones. The FHBA3 alignment, which appears to be most favorable, performed second best in this area across all other alternatives evaluated. The FHBA approach would not preclude next steps in the SCR 39 investigation and could possibly provide a pilot and data points into its utility prior to any legislative action being taken related to SCR39 or the Water Code.



Figure 4. FHBA3 Compared to Existing Flood Infrastructure



Figure 5. FHBA3 Compared to Existing Population Centers

#### Table 10. Evaluation of Geographic Flood Control Alternatives Adapted from the SCR 39 Report

Crite	Criteria			Single USGS Districts						SCR 39				
(color or un	denotes favorable favorable criterion)	Definition	No Action	State Entity	DOTD Districts	HUC2	HUC4	HUC6	HUC8	HUC10	HUC12	FHBA	FHBA2	FHBA3
		Number of Entities	28-65	1	9	4	12	21	59	275	1273	9	14	10
1	Considers watershed	Watershed delineations (at any scale) are a factor				✓	~	~	$\checkmark$	$\checkmark$	~	$\checkmark$	~	~
2	Captures storm surge hazard	Storm surge propagates inland differently than rainfall flooding travels seaward through HUCs										~	~	√
3	Reduces fragmented infrastructure	Generally coterminous with existing infrastructure authorities		√		~	~	~				✓	~	~
4	Accounts for existing infrastructure	Generally conterminous with area affected by manmade features, such as dams, levees, elevated roadways, and pumps, which serve to realign watershed boundaries		~								~	~	~
5	Enables regional watershed approach	Appropriately sized to streamline overall number of management entities but at a manageable scale to enable coordination				~	~	~				~	~	~
6	Bisects urban areas	Separates urban areas into multiple management entities	$\checkmark$					~	~	~	~			
7	Difficulties generating revenue	Creates management entities with little population, businesses, or assets	$\checkmark$					~	$\checkmark$	$\checkmark$	~			
8	Incongruent geometry	Boundaries are overly complex without basis in political jurisdictions or natural features	~		~	~	~	~	~	~	~		~	

# PART 3. RECOMMENDATIONS

The SR 172 stakeholders developed recommendations for establishing, implementing, and enforcing floodplain management plans for each watershed in Louisiana through the following stakeholder engagement and research-related activities (described in more detail in Parts 1 and 2 of this Response Report):

- Phase I investigation process (fall and winter 2017)
- CPRA's Flood Risk and Resilience Program Capacity and Capability Assessment (spring and summer 2018)
- LWI Statewide Listening Tour (fall 2018)
- LWI Council and Technical Advisory Group meetings (fall and winter 2018)
- Stakeholder meetings and modeling to evaluate the benefits and impacts of channelization, dredging, clearing and snagging (fall 2018).

Table 11 lists each recommendation, provides the name of the responsible party, and indicates where additional funding or new legislation is anticipated to be needed. The list below does not duplicate the Phase I Report recommendations, except where additional emphasis is deemed beneficial.

Reco	ommendation	will help			Additional		
Establish	Implement	Ensure Compliance	Recommended Action	Responsible Party	Funding Needed?	Legislation Needed?	
Data- and I	Modeling-Rela	ted Recommendat	ions				
$\checkmark$			Continue development and implementation of the Everything Flood-related website and data portal.	LWI	✓1	✓2	
$\checkmark$	$\checkmark$		Continue to refine the river and rain gage placement plan and establish gages in priority locations to support watershed modeling.	LWI – Data and Modeling TAG	√1		
$\checkmark$	$\checkmark$		Develop a system and strategy to store and maintain watershed hydrologic and hydraulic models.	LWI – Data and Modeling TAG	√1		
$\checkmark$	$\checkmark$		Prioritize HUC8 watersheds for hydraulic model development based on repetitive losses, data availability, and population density.	LWI – Data and Modeling TAG			
			Adopt the recommendations of the Data Gap Analysis, Data Quality Assessment, Data Standards Memorandum, and Data Delivery Framework (see Attachment C.3).	LWI, with possible legislative support		$\checkmark$	
$\checkmark$			Expand the Amite River Basin analysis to model clearing and snagging in upper reaches.	DOTD, with support from LWI	$\checkmark$		
~			Identify proposed dredging or clearing and snagging projects and study flooding and other impacts through field data collection and watershed modeling.	LWI – Projects and Data and Modeling TAG	$\checkmark$		
$\checkmark$	$\checkmark$		Develop standardized tools to evaluate the flood risk to and from proposed infrastructure and development plans prior to implementation.	LWI – Projects TAG			
Standards-	and Policy-Re	elated Recommend	ations				
	~	~	Adopt more stringent uniform siting and design standards for all state or federally funded (in partial or in full), owned, or operated facilities or projects, and require that state agencies meet the more stringent of local standards or the statewide uniform standards.	LWI – Policy TAG with legislative support		$\checkmark$	
$\checkmark$	$\checkmark$	$\checkmark$	Adopt a standard method for determining future flood risk and considering risk in project planning and design.	LWI with legislative support		$\checkmark$	
	$\checkmark$	$\checkmark$	Develop guidelines for reviewing all channelization, dredging, and clearing and snagging projects for environmental and ecological impacts.	LWI – Projects TAG			
	~		Provide funding and other incentives for state and local higher flood risk reduction standards and proof of community investment in flood risk reduction.	Council agencies and LWI	$\checkmark$	$\checkmark$	
$\checkmark$	$\checkmark$		Set metrics for flood risk reduction and stormwater management for watershed-scale implementation.	LWI			

#### Table 11. Recommended Actions for Establishing, Implementing, and Enforcing Floodplain Management Plans for Each Watershed in Louisiana
Recommendation will help		will help			Additional	
Establish	Implement	Ensure Compliance	Recommended Action	Responsible Party	Funding Needed?	Legislation Needed?
	~	~	<ul> <li>Increase resilience of building stock by updating building standards for high risk structures in the floodplain and continuing to provide resources for local implementation and enforcement of LSUCC standards:</li> <li>Create a state-wide standard process for building code enforcement</li> <li>Update building code standards to promote flood damage reduction by adopting ASCE-24-14 into the 2015 IRC</li> <li>Prevent the weakening of the code and rescind deletion of the statewide freeboard requirement</li> <li>Consider automatically adopting future updates of ASCE 24</li> <li>Maintain minimum disaster related provisions of the adopted model code and adopt higher regulatory standards such as a foot of freeboard above minimum ASCE-24 standards, additional levels of protection for structures behind levees, or cumulative substantial damage tracking requirements.</li> </ul>	Louisiana Legislature, with possible incentives by LWI		~
√		$\checkmark$	Adopt a state modification to the 44 CFR 60.3 federal requirement, (d)(3), that requires the community to: "Prohibit encroachments, including fill, new construction, substantial improvements, and other development within the adopted regulatory floodway unless it has been demonstrated through hydrologic and hydraulic analysis that the proposed encroachment would not result in any increase in flood levels <i>upstream or downstream within the watershed</i> (as defined by the Louisiana Watershed Initiative), during the occurrence of the base flood discharge" (modification in italics).	Louisiana Legislature		~
~			Require that all flood models be developed in accordance with minimum standards established by LWI (for example, models should include historical floods, and typical design storms [1-year through 500-year return interval], channelization, dredging, and clearing and snagging analysis for each HUC8 modeled).	Louisiana Legislature		~
Engagemen	t-Related Rec	ommendations				
$\checkmark$	✓	$\checkmark$	Engage key industries such as finance and banking, property assessment and appraisal, development, and construction, as well as the code council to communicate risk and build awareness and support for flood risk management best practice programs, policies, and projects.	LWI – Outreach and Engagement TAG		
$\checkmark$			Facilitate workshops (within parishes, between parishes, and regionally, for example) to increase coordination, with a focus on watershed-scale coordination, as well as alignment of planning and implementation actions with flood risk management best practices.	LWI – Outreach and Engagement TAG, Planning TAG, non- profits, and universities		
	~		Support the expansion of CRS user groups into additional geographies so that every portion of the state can access this support network.	DOTD, with support of LWI		

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Recommendation will help		will help			Additional	
Establish	Implement	Ensure Compliance	Recommended Action	Responsible Party	Funding Needed?	Legislation Needed?
	~		Publish customizable outreach materials for local use, including benefits and costs of flood risk reduction-related policies and project types.	Council agencies, LWI – Outreach and Engagement TAG		
~	~	$\checkmark$	Review and publish materials that clearly communicate risk and support the implementation of flood risk management best practices related to planning, policies, programs, and projects.	LWI – Outreach and Engagement TAG		
	$\checkmark$		Make widespread use of social media to share flood risk-related communications.	LWI – Outreach and Engagement TAG		
	~		Promote the purchase of flood insurance to mitigate loss	LWI		
	✓		Create a public engagement campaign with a focus on establishing a watershed-scale identity.	LWI – Outreach and Engagement TAG		
Funding-R	elated Recomm	nendations				
	~		Pilot test a funding source to assist substantially damaged properties to achieve compliance in communities that adopt higher standards, such as 2 feet of freeboard with fill restrictions.	LWI	$\checkmark$	√3
	~		Develop an annual state-funded grant program that can be used for flood risk reduction-related costs, such as staffing, planning, project execution, training, engagement and outreach, review of local policies and regulatory regimes with incentives for adoption of recommendations, cost-share reward for local governments with higher standards, low-interest loans or micro-loan programs for site-specific improvements, sliding scale for homeowner match support, funding to bring non-conforming or pre-FIRM properties to higher standards.	Legislature, with recommendations from LWI	~	~
	✓		Consider developing a consolidated funding application for all state or federally funded flood-mitigation related projects in the state	All State agencies		$\checkmark$
$\checkmark$	$\checkmark$	$\checkmark$	Require watershed-based coalition building as a condition of funding for any flood risk related projects or activities	All State agencies		
		$\checkmark$	Incentivize local investment in flood hazard mitigation and floodplain management best practices through project scoring criteria.	All State agencies		
	$\checkmark$		Engage federal agencies and elected officials to advocate for more flexible use of funding to fill flood risk reduction need gaps	LWI – Outreach and Engagement TAG		
Capacity an	nd Capability	Improvement-Rela	ated Recommendations			
	$\checkmark$		Publish standard template/model for RFPs and RFQs related to common flood risk management needs, such as funding application development,	LWI		

Recommendation will help		will help			Additional	
Establish	Implement	Ensure Compliance	Recommended Action	Responsible Party	Funding Needed?	Legislation Needed?
			grant management, program management, project implementation (such as elevation and acquisition), training, and outreach support.			
~	✓	$\checkmark$	Leverage emergency response and programs to enhance capacity for hazard mitigation and flood risk reduction such as Emergency Management Assistance Compacts, National Association of Voluntary Organizations, Emergency Management Accreditation Programs, and Community Emergency Response Teams.	GOHSEP, LWI, LFMA-DRT team		
	~		Include standard template language that requires evaluation of the upstream and downstream changes to specific, defined characteristics on a watershed basis to evaluate channelization, dredging, clearing, and snagging, for any RFP that includes the use of hydrologic and hydraulic models.	LWI – Data and Modeling TAG		
	$\checkmark$	$\checkmark$	Consider developing a consolidated permitting portal for environmental review and permitting of all flood mitigation-related projects.	LWI	~	$\checkmark$
	~	~	<ul> <li>Publish materials that support capability building around flood resilience, such as:</li> <li>Policy value propositions and development guidance</li> <li>SOPs and templates (RFPs, forms, training presentations)</li> <li>Best practices "library" from other parishes and states, including processes parishes or municipalities have undertaken to engage in dialogues with other parishes or municipalities</li> <li>"Handbooks" for grant managers/general homeowners/ public with consistent and accessible language pertaining to flood risk</li> <li>Model regulatory language for high-priority standards.</li> </ul>	LWI – Policy TAG		
~	~		Pilot a university apprenticeship program to specifically support parishes and municipalities in their flood risk reduction-related activities (projects and programs) and give them access to needed expertise and a pipeline of future employees. Relevant programs include policy, planning, engineering, modeling, and other technical studies.	State universities	~	
$\checkmark$	$\checkmark$	$\checkmark$	Increase the availability of flood risk reduction-related technical support at the state level.	Agencies participating in the LWI		
~	~	$\checkmark$	Implement the planned Regional Capacity Building Grant. Develop metrics to track the success of the grant and develop a report with lessons learned and indicating whether this should be a long-term program.	LWI, OCD		
~	~	$\checkmark$	Develop and implement recommendations to incentivize the private market to make flood-resilient decisions through tax-credits or certification programs.	LWI, with possible implementation from the Legislature		~

Recommendation will help		will help			Additional	
Establish	Implement	Ensure Compliance	Recommended Action	Responsible Party	Funding Needed?	Legislation Needed?
Integrated 1	Planning-Rela	ted Recommendat	ions			
$\checkmark$	$\checkmark$	~	Facilitate alignment of parish policies and actions toward state, regional, and local flood risk-reduction objectives.	LWI – Planning and Policy TAGs		
~	~	$\checkmark$	Support integration and coordination of local hazard mitigation plans, comprehensive plans, capital improvement plans, and others to better align these plans with flood risk-reduction goals. All plans should reduce repetitive losses. Consider funding or providing staff support for parish studies of plan integration using the DHS Plan Integration for Resilience Scorecard (or something similar) to encourage consistency of parish plans and overlaying of policy districts with hazard zones (with projections of future conditions), leveraging findings into state initiatives, funding opportunities, and technical assistance.	LWI – Policy, Planning, and Projects TAGs to evaluate local plans for both spatial and policy alignment, Regional Capacity Building Grant		
~	$\checkmark$	$\checkmark$	Strengthen and improve quality of local hazard mitigation plans to assist with planning for future flood risk-reduction efforts and require or incentivize inclusion of land use planning element.	GOHSEP, LWI – Planning TAG		
~	~	$\checkmark$	Require that watershed-based floodplain management plans meet, at minimum, the 510 requirements outlined by CRS to ensure that proper credit is achieved toward the reduction of flood insurance premiums	Louisiana legislature		~
		$\checkmark$	Focus funding on projects developed through watershed-based coordination.	LWI and associated agencies		
		$\checkmark$	Provide a mechanism for local review of state and quasi-state projects.	LWI, Facilities Planning and Control		$\checkmark$
$\checkmark$			Review and refine the minimum content and standards for watershed-based plans explored in the Phase I Report.	LWI - Planning TAG		
$\checkmark$	$\checkmark$	$\checkmark$	In the near-term, incentivize the development of watershed-based multi- jurisdictional planning coalitions.	LWI – Projects TAG		
$\checkmark$	$\checkmark$	$\checkmark$	Build on the research completed for the SCR 39 Report by vetting and refining the geographic boundaries developed in the SCR 39 Report with stakeholders within each of the proposed regions.	LWI – Data and Modeling TAG and Planning TAG		
$\checkmark$	$\checkmark$	$\checkmark$	Pursue development of watershed-scale planning entities within refined and vetted geographic boundaries.	LWI		
~	~	$\checkmark$	Investigate the extent, cost, prevalence, and policies related to urban flooding in Louisiana. Identify resources and technologies that may lead to mitigation of the impact of urban flooding, in a similar manner that Illinois undertook with its Urban Flood Awareness Act Report (IDNR 2015). The exercise should directly inform or contain recommendations to be carried	LWI	~	~

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Recommendation will help		vill help			Additional	
Establish	Implement	Ensure Compliance	Recommended Action	Responsible Party	Funding Needed?	Legislation Needed?
			forward in other efforts, such as amending state building codes or land use ordinances.			
~	~		<ul> <li>Amend the Louisiana Revised Statutes to require parishes and municipalities to develop a comprehensive plan whether or not they have adopted a planning commission.</li> <li>Amend the Louisiana Revised Statutes to require that a comprehensive plan include elements that address land loss, flood risk, post-disaster recovery, and/or natural hazards. Statutory language should more closely reflect the APA's recommendations that a comprehensive plan include: <ul> <li>Land Use</li> <li>Transportation</li> <li>Critical Infrastructure and Community Facilities</li> <li>Housing</li> <li>Economic Development</li> <li>Natural Hazards and Disaster Recovery <ul> <li>Flood risk and floodplain management should be addressed explicitly</li> </ul> </li> <li>Environmental and Water Management</li> <li>Coastal Management and Conservation</li> </ul> </li> </ul>	Louisiana legislature, with possible incentives by LWI		~
			Program Implementation			

Notes:

<sup>1</sup> Initial or development funding planned or allocated. Funding for long-term maintenance needed.

 $^{2}$  Legislation may be needed to require that all state-gathered data related to flooding in Louisiana is linked to or referenced within this website and includes metadata related to the quality, date gathered, and maintenance plan.

<sup>3</sup> Possible future need for legislation to provide recurrent funding source, depending on success of the pilot test.

Acronyms & Abbreviations:	
CRS = Community Rating System	RFPs = requests for proposals
DHS = Department of Homeland Security	RFQs = requests for qualifications
FIRM = Flood Insurance Rate Map	SCR = Senate Concurrent Resolution
IDNR = Illinois Department of Natural Resources	SOPs = standard operating procedures
LFMA-DRT = Louisiana Floodplain Management Association Disaster Recovery	TAG = Technical Advisory Group
Team	

LWI = Louisiana Watershed Initiative

### PART 4. PROGRESS PLANNED FOR 2019

Most immediately, the governor and Council's near-term focus is how to direct the \$1.21 billion in HUD funding announced in April 2018. The State is awaiting a Federal Register Notice, which will identify regulations and guidance for how the funding can be used. Following this notice, the State will prepare an Action Plan for the use of the funds, though a draft is in progress. Once this plan in approved by the U.S. Department of Housing and Urban Development, this funding can be directed to support the work of the Council.

The LWI neither began nor will end with the expenditure of these funds. Council agencies need to leverage efforts and funds in the near and long term to maximize effective flood risk management, and long-term sustainable funding is needed to maintain several important elements of the initiative at the state, regional, and local level. Table 12 summarizes additional actions planned for early 2019 and the rest of the year. Note that these activities continue to evolve and are subject to change based on the needs of the Initiative and Louisiana stakeholders.

Timeframe	Category	Description
	Outreach and Engagement	• Implement state-wide outreach and engagement plan informed by statewide listening tour.
	Regional Watershed Capacity Building Program	• Continue with ongoing development of the LWI's Regional Watershed Capacity Building Program, which includes providing staff and technical support to local jurisdictions on a watershed basis.
January 2019	"Everything Flood Related" Website and Data Portal	• Develop and launch new website features, including public comment capabilities for forthcoming LWI plans, reports, or documents, along with additional technical resources.
	Project Funding	• Finalize evaluation criteria and preliminary application materials for Round 1 funding of low risk, high rewards projects (more information below).
February 2019	Interstate Summits	• Coordinate dialogue between state agency staff and other states or large regional areas considered to be "best practices" for watershed-based floodplain management for potential incorporation into state-level planning and local or regional engagement.
	Program Publications and Technical Resources	• Continue with developing additional program publications and technical resources
	Regional Watershed Capacity Building Program	• Implement the Regional Watershed Capacity Building Program, including open application periods for regions to submit requests for program grants to address capacity needs involving watershed-based floodplain management.
March 2019	State's Implementation Plan for Advancing Statewide Hydraulic and Hydrologic Modeling Efforts	• Facilitate the initial public review and comment on the state's implementation plan for advancing statewide hydraulic and hydrologic modeling efforts
	Program Publications and Technical Resources	• Release program-related publications such as research involving flood risk-reduction policy measures and related value propositions for local communities, funding guidance, best practices, and other items.

#### Table 12. Planned Activities for 2019

Timeframe	Category	Description
April 2019	Interstate Summits	• Coordinate a Louisiana-based summit of neighboring states to discuss interstate watershed-based floodplain management approaches and how best to collaborate across watersheds that cross state lines, as well as to fully understand how actions taken in one state may impact another located downstream.
	Watershed-Based Coalition Building	• Build watershed-based coalition and conduct state flood risk management planning, as described within Part 3 above.
	Technical Support	• Through the LWI, Council and participating agencies are developing a process by which state agencies can provide increased technical support for communities
	Watershed-Based Modeling	• Upon funding availability, initiate watershed-based modeling in accordance with the LWI's modeling implementation plan.
	LWI Project Evaluation Tool	• Initial public review and comment on the LWI project evaluation tool, which will guide how early flood risk reduction and mitigation projects are scored and prioritized in coordination with available funds.
Additional Example Work Planned for 2019	Project Funding	<ul> <li>Complete Round 1 funding applications, pending release of HUD's federal register notice for Louisiana's \$1.2 billion allocation.</li> <li>Round 1 funding is expected to amount to \$100 million for No Regrets projects, those that are deemed high-benefit, low-impact activities that can be completed in the near term to reduce immediate risk.</li> <li>The LWI has developed preliminary application materials and evaluation criteria to take advantage of these funds as soon as they are made available.</li> </ul>
	Program Alignment	• During 2019, the Policy TAG expects to initiate program alignment audits of Council agencies to identify opportunities for improvements that can be made to more effectively accomplish flood risk reduction and related outcome metrics identified through the LWI.
	Program Publications and Technical Resources	• Prepare technical support publications, such as best practices for use in decision-making and establishing incentives, model policies that include higher than minimum standards, and procurement templates.



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### **APPENDIX A**

Annotated Bibliography

### ANNOTATED BIBLIOGRAPHY

## Alexander, Jason Scott, Richard C. Wilson, and W. Reed Green. A brief history and summary of the effects of river engineering and dams on the Mississippi River system and delta. US Department of the Interior, US Geological Survey, 2012.

The Mississippi River Basin is controlled and regulated through a series of dams and river engineering structures. Numerous river engineering techniques have been employed on the Mississippi River and its delta, including clearing of snags and obstructions, channel straightening and cutoffs, revetments, dikes, levees and floodways, and dams and reservoirs. These modifications have resulted in the realization of multiple benefits, including navigation, flood control, hydropower, bank stabilization, and recreation. This report provides a full synopsis of existing literature and other agency reports and provides detailed summaries that are critical to understanding how river engineering has impacted the Mississippi River and its delta.

### Ali, Ammar, et al. "Evaluation of dredging operations for Tigris river within Baghdad, Iraq." *Journal of Water Resource and Protection* 6.4 (2014): 202-213.

The author describes how the capacity of the Tigris River has been reduced due to the growing number of islands and bars within the Baghdad area. To alleviate flooding issues and provide additional aesthetic benefit, the Iraqi Ministry of Water Resources proposed a series of dredging operations at numerous locations along the Tigris River. This study aims to examine the dredging plan as well as provide information for additional dredging activities. The authors demonstrate, through use of numerical models—in this case HEC-RAS—that dredging can provide significant flood mitigation. The authors note that water-intake structures could be adversely impacted due to expected drop in water levels associated with dredging operations.

### Allison, Mead A., and Ehab A. Meselhe. "The use of large water and sediment diversions in the lower Mississippi River (Louisiana) for coastal restoration." *Journal of Hydrology* 387 (2010): 346-360.

This article provides a review, analysis, and synthesis of existing research on the use of large sediment and water diversions in the lower Mississippi River for coastal restoration purposes, outlining critical research gaps that need to be addressed before any additional construction begins on future diversions. They ground their review in extensive studies of the causes of wetland loss in south Louisiana which have determined that anthropogenic mechanisms, including artificial channel cutting and reduction in sediment supply, have played a significant role in wetland degradation. The authors conclude that there are critical knowledge gaps which must be filled in order to inform the selection of final sites for large sediment and water diversions, their size, operation strategy, and the post-emplacement monitoring of their effect, including an understanding of the longer-term ecological impact of the diversion(s) on the basin.

## Bączyk, Anna, et al. "Influence of technical maintenance measures on ecological status of agricultural lowland rivers–Systematic review and implications for river management." *Science of The Total Environment* 627 (2018): 189-199.

The authors compile and analyze a database of scientific articles addressing impacts of dredging, including macrophyte removal, effects to fish populations and macroinvertebrates, as well as ecological status of lowland agricultural rivers. The authors inform that 96% of the analyzed papers indicate a unilateral, negative response of

aquatic ecosystems, particularly macroinvertebrates, to maintenance measures. The analyzed studies report an overall decline in the abundance of macrophytes and benthic macroinvertebrates as well as a statistically significant decline of fish abundance in rivers undergoing maintenance.

## Baril, P., Maranda Y., and Baudrand, J. . "Integrated watershed management in Québec: a participatory approach centred on local solidarity." Province of Quebec, Canada. Quebec Ministry of Sustainable Development, Environment and Parks. 2005.

This paper provides an overview of the history and structure of watershed management in Quebec, including it legal basis and goals.

### Bousquin, Stephen G., et al. "Establishing a baseline: pre-restoration studies of the channelized Kissimmee River." South Florida Water Management District, West Palm Beach, Florida, USA (2005).

This publication investigates the C-38 project, which provided flood control along the entire length of the Kissimmee River floodplain. The project entailed the excavation of a canal large enough to contain all channel and overbank flow of the Kissimmee. The authors determine that the project was highly successful regarding the intent of the design (flood protection), but that it had a myriad of environmental consequences that were not considered during the design and construction phases of the project. The project resulted in the loss of nearly 8000 hectares of wetlands, drastic decline in biodiversity, and a substantial reduction in water quality. This spurned an environmental restoration effort that has a projected cost of \$578,000,000 and will also take 15 years to complete. The South Florida Water Management district provides several baseline studies to evaluate changes resulting from the restoration and provide a measurement of success for the restoration project.

## Chizewer, D. M. and A. D. Tarlock. "New Challenges for Urban Areas Facing Flood Risks." 40 Fordham Urb. L.J. 1739 (2013). Available online at: <u>https://ir.lawnet.fordham.edu/ulj/vol40/iss5/2</u>. Retrieved December 21, 2018.

This article surveys the flood risks that local governments confront during "normal" flood events as well as from climate change and traces the evolution of United States flood control policy from local responsibility to the federal government and back to local governments in partnership with state and federal governments. This shift reflects the growing recognition that effective flood control requires partnerships among multiple levels of government that can each contribute distinct expertise and resources.

### Clark, Ryan F., Harris C. Bienn, and Clinton S. Willson. *Assessing the Cost of Coastal Land Creation Using Dredged Material*. The Water Institute of the Gulf, 2015.

This report studies the factors that influence the cost of marsh creation using dredged material, in support of implementation of the Coastal Protection and Restoration Authority's (CPRA's) 2012 Coastal Master Plan, to identify potential cost saving strategies. The report recommends a sustained dredging program to achieve the goals of the Master Plan Marsh Creation projects in close collaboration with the dredging industry, as opposed to ad hoc, on-off projects, through which CPRA may have the opportunity to influence the process under which it currently uses dredging services and to lower dredging costs. Detailed overviews of marsh creation project planning, design, and construction as well as of dredging technology, power sources, and industry make this report a useful resource for understanding how dredging plays a role in large-scale ecosystem restoration in coastal Louisiana.

### Coastal Protection and Restoration Authority. "Parish Flood Risk and Resilience Capability and Capacity Assessment." 2018a. Available at <a href="http://coastal.la.gov/wp-">http://coastal.la.gov/wp-</a>

<u>content/uploads/2017/02/ParishCapabilityCapacityAssessment-9.14.18.pdf</u>. Retrieved December 28, 2018. With input from several other state agencies, including the Governor's Office of Homeland Security and Emergency Preparedness, the Office of Community Development, the Department of Transportation and Development, and the Department of Wildlife and Fisheries, CPRA and its consultants conducted a capability and capacity assessment with 24 parishes during the spring and summer of 2018, and the results, recommendations, and potential opportunities for improvement therefrom are presented in this document.

### Coastal Protection and Restoration Authority. "Parish Flood Risk and Resilience Capability and Capacity Assessment – Executive Summary." 2018b. Available at http://coastal.la.gov/wp-

<u>content/uploads/2017/02/ParishCapabilityCapacityAssessment-ExecutiveSummary\_9.25.18.pdf</u>. Retrieved December 28, 2018.

This executive summary describes the capability and capacity assessment conducted by CPRA in 2018 to identify resource gaps that exist on the local level in Louisiana that impede the success of resiliency programs and projects, particularly non-structural programs like property acquisitions and elevations.

### Colorado Water Conservation Board, Colorado Department of Local Affairs. "Colorado Watershed Flood Recovery 2013-2018." Denver, CO. 2018.

This document is an overview and "progress report," on the Colorado Watershed Flood Recovery program implemented following the 2013 floods in the Front Range region of the state.

### Daigneault, A., P. Brown, and D. Gawith. "Dredging versus hedging: Comparing hard infrastructure to ecosystem-based adaptation to flooding." *Ecological Economics* 122 (2016): 25-35.

The authors of this study conduct a comparative cost-benefit analysis of a range of hard infrastructure and ecosystem-based adaptation options to mitigate flooding under various climate change scenarios using data from two catchments in Fiji. Ecosystem-based adaptation (EbA) options to mitigate flooding include strategies such as replanting of headwaters and riparian zones, serving as lower-cost alternatives to engineered solutions and consisting of many co-benefits. The study's findings indicate that EbA options are generally more cost-effective than hard infrastructure options, such as dredging. Planting riparian buffers is found to be the most cost-effective option and upland afforestation is found to provide the greatest benefits overall. Among hard infrastructure approaches, river dredging is found to provide the greatest overall benefits, but the costs are found to be high relative to benefits, and the benefits are unevenly distributed toward downstream communities.

### Federal Emergency Management Agency. Floodplain Management. 2018a. Available online https://www.fema.gov/floodplain-management. Retrieved December 21, 2018.

FEMA floodplain management tools and resources to help communities navigate National Flood Insurance Program (NFIP) requirements and implement higher standards of floodplain management.

Federal Emergency Management Agency. National Flood Insurance Program Community Rating System. 2018b. Available online at: <u>https://www.fema.gov/national-flood-insurance-program-community-rating-system</u>. Retrieved December 21, 2018.

Reservoir of fact sheets, contact information, a national map of participating communities, details about how community discounts are calculated, and other information about the NFIP's Community Rating System (CRS).

## Federal Emergency Management Agency. 44 C.F.R. § 60.2: Minimum compliance with flood plain management criteria. 2018c. Available online at: <u>https://www.govinfo.gov/content/pkg/CFR-2018-title44-vol1/pdf/CFR-2018-title44-vol1-sec60-2.pdf</u>. Retrieved January 16, 2019.

Requires notification of, in riverine situations, adjacent communities and the State Coordinating Office prior to any alteration or relocation of a watercourse.

### Federal Emergency Management Agency. 44 C.F.R. § 60.3: Flood plain management criteria for floodprone areas. 2018d. Available online at: <u>https://www.govinfo.gov/content/pkg/CFR-2018-title44-</u>

#### vol1/pdf/CFR-2018-title44-vol1-sec60-3.pdf. Retrieved January 16, 2019.

Prohibits encroachments, including fill, new construction, substantial improvements, and other development within the adopted regulatory floodway unless it has been demonstrated through hydrologic and hydraulic that the proposed encroachment would not result in any increase in flood levels within the community during the occurrence of the base flood discharge.

### Franklin, S. B., et al. "Channelization effects on floodplain functions in western Tennessee." *WIT Transactions on Ecology and the Environment* 50 (2001).

The authors give some insight into how channel alteration can affect floodplain hydrology and nutrient pools through a field investigation of six river reaches in Western Tennessee. They show that channelized streams have higher mean water tables and lower soil redox potentials than non-channelized or channelized and leveed streams. Soils in levee systems generally have more oxidized conditions compared to upland regions.

### Freedman, Jonathan A., Robert F. Carline, and Jay R. Stauffer Jr. "Gravel dredging alters diversity and structure of riverine fish assemblages." *Freshwater Biology* 58 (2013): 261-274.

The authors of this article combine ecological metrics, such as species richness and diversity, with stable isotope analysis to study the differences in fish assemblages between dredged and undredged sites sampled by benthic trawls in Allegheny River, Pennsylvania. Their findings indicate that gravel dredging can cause anthropogenic habitat loss, decreasing benthic fish abundance and diversity, which manifests in part by altering resource use and nutrient pathways within food webs. They find that dredging puts substratum-specific reproductive guilds at particular risk.

### Grimes, Jay D. "Bacteriological Water Quality Effects of Hydraulically Dredging Contaminated Upper Mississippi River Bottom Sediment." *Applied and Environmental Microbiology* **39**(4) (1980): 782-789.

This paper investigates the bacteriological effects of hydraulically dredging polluted bottom sediment in the navigation channel of the Upper Mississippi River. The results of the study indicate that water quality was substantially lower in dredged sites, with the bottom sediment in those sites containing four times the density of total and fecal coliform bacteria than upstream sites and 50 times the density of fecal streptococcus bacteria than upstream sites, all correlated with higher turbidity. The study finds that turbidity and indicator bacteria levels returned to pre-dredging levels within less than 2 km below the dredge spoil discharge area.

### Grygoruk, Mateusz, Magdalena Frąk, and Aron Chmielewski. "Agricultural Rivers at Risk: Dredging Results in a Loss of Macroinvertebrates. Preliminary Observations from the Narew Catchment, Poland." *Water* 7 (2015): 4511-4522.

The authors report on a study comparing the abundance and taxonomic structure of benthic macroinvertebrates in dredged and non-dredged stretches of small lowland agricultural rivers and tributaries of the Narew River in Poland. Their findings indicate that river dredging causes ecological deterioration, including homogenization of habitats and a loss of biodiversity, posing a significant threat to riverine ecosystems. They emphasize that mechanical dredging of the river bed degrades the structure and composition of riverbanks and river bottoms and has a strongly negative impact on macroinvertebrate communities and species diversity.

## Guida, Ross J., Jonathan W.F. Remo, and Silvia Secchi. "Tradeoffs of strategically reconnecting rivers to their floodplains: The case of the Lower Illinois River (USA)." *Science of the Total Environment* 572 (2016): 43-55.

Drawing on a wealth of research which has shown how long-term flood risk is exacerbated in situations in which rivers are disconnected from their floodplains through continued increases in levee heights, the authors assess the tradeoffs of reconnecting the Illinois River to its floodplain in order to decrease flood risk, improve floodplain habitats, and limit the costs of reconstruction. They demonstrate through tested scenarios that lower-cost scenarios fall short of achieving a sufficient set of benefits and argue that higher costs—such as building-associated losses, lost agricultural profits, and levee removal and construction costs—are the tradeoff for reducing flood risk and improving habitats. The article stresses the importance of maintaining connectivity between rivers and their floodplains for healthy habitats and flood risk reduction.

### Havekes, H. et. al. "Water Governance, The Dutch Water Authority Model." The Hague, The Netherlands: Opmeer BV, 2017.

This text provides an overview of the Dutch Water Authority model for watershed governance. It describes the legal basis for water authorities in the Netherlands, including relevant legislation; the democratic nature of the authorities' governing boards and their composition; and the financial independence of the Authorities as a result of being able to levy their own taxes.

### Heimann, David C. Assessment of an in-channel redistribution technique for large woody debris management in Locust Creek, Linn County, Missouri. No. 2017-5120. US Geological Survey, 2017.

This report provides an assessment of a mechanical redistribution technique for the management of large woody debris (LWD) jams for a portion of the Locust Creek in Missouri. Treatments of extensive LWD were completed from 1996 to 2009, using a low-impact technique, that mechanically redistributed LWD to the inside meander of the of the channel. The scope of the study includes a comparison of channel characteristics between treated and untreated reaches of the Locust Fork Creek. There are no significant differences found in the overall distributions of cross-sectional area, channel width, or streamflow capacity in treated and untreated reaches; however, the overall median width-depth ratio in treated reaches is found to be significantly greater than untreated reaches. The report shows that channel metrics are more closely correlated to longitudinal distances, indicating that channel geometry is under basin-scale control rather than LWD treatment control.

### Hupp, Cliff R. "Riparian vegetation recovery patterns following stream channelization: a geomorphic perspective." *Ecology* 73.4 (1992): 1209-1226.

This article presents the eco-geomorphic analyses and interpretation of a large multidisciplinary study, with reference to the interrelated hydrogeomorphic aspects of channel recovery. The author accomplishes this through the statistical analyses of 150 sites along 15 streams, in the Obion Forked Deer, Hatchie, and Wolf River Basins in West Tennessee. The implications of the study suggest that fluvial geomorphic recovery can be described through a six-stage model of bank evolution, which describes landscape development over time. Additionally, the study shows that vegetation establishes in three distinct suites of species, separated in time and corresponding to the middle and late stages of the bank-evolution model. The first suite of species establishes in the middle of bank evolution, the second suite of species establishing late in bank-recovery, and the third suite of species establishing after completed bank recovery.

## Hupp, Cliff R., Aaron R. Pierce, and Gregory B. Noe. "Floodplain geomorphic processes and environmental impacts of human alteration along coastal plain rivers, USA." Wetlands 29.2 (2009): 413-429.

This paper looks at three case studies (in North Carolina, Tennessee, and Louisiana) to investigate the impacts of human hydrogeomorphic alterations along stream channels and within catchments on sediment deposition as well as the natural ecology of floodplains. The human alterations the authors investigate include flow regulation through dams, stream channelization, and canal and artificial levee construction, respectively. They find that these alterations result in negative impacts to ecosystem functions through reductions in suitable habitats, biodiversity, and nutrient cycling as well as shifting affected streams away from the natural dynamic equilibria of their fluvial geomorphic systems, affecting their ability to entrain, transport, and store the sediment provided by the associated catchment in a balanced fashion. Human alterations also are found to impact natural hydraulic connectivity, critical to a floodplain's ecosystem services, which, in worst-case scenarios, can lead to hypoxia if severely reduced or unsustainably high rates of deposition if severely increased.

### Kaller, Michael D. and William E. Kelso. "Effects of a Small-Scale Clearing on Habitat and Macroinvertebrates of a Coastal Bottomland Stream in Louisiana." *The Southwestern Naturalist* 51(2) (2006): 143-151.

The authors of this paper use sampling in three locations along a third-order stream in southwestern Louisiana to investigate the effects of a small-scale clearing associated with a pipeline crossing. The locations for the study include one area within the clearing, one upstream location, and one downstream location. The authors sample habitat, water chemistry, stream microbes, and benthic and wood-dwelling macroinvertebrates. Compared to upstream and downstream locations, their study finds, the clearing area had significantly higher temperature and fecal coliform bacteria counts as well as significantly lower dissolved oxygen, debris and detritus, and heterotrophic plate counts. The study concludes that the small-scale clearing did not have any substantial effect on the composition or density of the macroinvertebrate community, although multiple similar such small-scale disturbances could compound and negatively impact species diversity. While maintaining that large-scale or repetitive small-scale disturbances could increase fragmentation in the watershed and negatively affect stream macroinvertebrates, the paper suggest that stream macroinvertebrates in western Louisiana are resilient to limited small-scale disturbances.

### Kennedy, Thomas L., and Thomas F. Turner. "River channelization reduces nutrient flow and macroinvertebrate diversity at the aquatic terrestrial transition zone." *Ecosphere* 2(3) (2011): Article 35.

In this article, the authors evaluate the effects of channelization on the linkages between aquatic and terrestrial macroinvertebrate assemblages in Rio Grande, New Mexico using stable isotope analysis, emphasizing the importance of connectivity for the unique communities within the transition zone. Their findings indicate that channelization can reduce taxonomic richness as well as macroinvertebrate densities in the transition zone by severing lateral connectivity between aquatic and riparian communities and reducing nutrient flows. Predatory macroinvertebrate species are found to be particularly affected. The article highlights the importance of the transition zone as a critical habitat to be considered and the negative impacts of human activities in waterways, such as channelization, on surrounding terrestrial ecosystems.

#### King County Ordinance 15728 of 2007.

This local ordinance dissolved all existing flood control districts in King County, Washington (the City of Seattle is the county seat) and created a single flood control district covering all the watersheds in the county. The ordinance also covers the governance structure, management positions and to a small extent the financing of the new district.

### King County Flood Control District. Dunn, R. "Be Flood Ready: Your Guide to Flood Preparedness In King County." 2018.

This brochure provides an overview of King County Flood Control District's flood preparedness resources, structure, and approach.

## Kroes, Daniel E., and Cliff R. Hupp. "The Effect of Channelization on Floodplain Sediment Deposition and Subsidence Along the Pocomoke River, Maryland." *Journal of the American Water Resources Association* 46.4 (2010): 686-699.

The authors investigate the effect of channelization on floodplain sediment deposition and subsidence through field efforts on six sites along the Pocomoke River in Maryland. The Pocomoke River was significantly channelized by the mid-1900s, and experienced channel incision, head-cut erosion, and spoil bank perforation. The channelization resulted in the separation of the main channel and the original floodplain, impacting floodplain sediment dynamics and eliminating any sediment storage functions of the upper Pocomoke River. The authors find high rates of deposition along unchannelized reaches, with some sites experiencing complete channel abandonment. Additionally, the authors suggest that the improved drainage of floodplains have resulted in the oxidation of stored organic sediments, resulting in subsidence, with nutrient by-products of this subsidence contributing to eutrophication of downstream waterbodies.

### Landemaine, Valentin, et al. "Morphological evolution of a rural headwater stream after channelization." *Geomorphology* 230 (2015): 125-137.

In this article, the authors investigate the sedimentary response to channelization of the Ligoire River in France. The Ligoire river is described as a main channel of a small rural headwater stream, of which 21 kilometers has been channelized. A comparison of cross sections before and after the channelization are analyzed, revealing that the stream channel morphology has been completely altered. The study shows that the main channel length has reduced by 10% overall, with the bankfull width being increased on average by 63%. Additionally, the streambed has incised up to 0.41 meters on average. Moreover, this erosion has generally occurred in high-energy stresses of the channel, with the thickness and grain size measurements of the sediments indicating that a general widening of the channel has caused deposition of fine-grained sediments in low-energy sections.

### Lohrer, Andrew M. and Jennifer Jarrell Wetz. "Dredging-induced nutrient release from sediments to the water column in a southeastern saltmarsh tidal creek." *Marine Pollution Bulletin* 46 (2003): 1156-1163.

The authors of this study investigate the impact of a small-scale dredging operation on water chemistry in shallow estuarine waterways—here a salt marsh in South Carolina—by comparing nutrient levels (which may cause eutrophication) and total suspended solid concentrations before and during dredging. The results of their study reveal substantial variation in changes in nutrient levels, depending on the season, amount of natural variability in the estuary's water chemistry, and other factors. Additionally, the study reveals short-term increases in turbidity due to small-scale dredging. They find that several factors minimized the impact of the dredging activities examined by their study, including the relatively small scale of the dredging permit, the fall-winter season, the coarse-grained nature of the sediments dredged, and the natural variability in water chemistry.

## Louisiana Department of Transportation and Development, et al. "SCR 39 Phase I Study – Exploring the Reorganization of Levee Districts and Other State-Created Entities with Flood Control Responsibilities." 2014a.

In 2014, CPRA and DOTD published a report in response to SCR 39 that investigated existing organizational bodies with flood control responsibilities. Under SCR 39, the analysis team gathered baseline data, reviewed relevant statutes, consulted with districts, analyzed existing alignments of all state-created governing entities for flood control, and developed several science-based scenarios for further study of the potential to re-align flood control governance statewide.

# Louisiana Department of Transportation and Development, et al. "Senate Concurrent Resolution 39 of the 2013 Regular Legislative Session – Phase I Study Report Summary PowerPoint." 2014b. Available at <a href="http://coastal.la.gov/wp-content/uploads/2013/12/Brett-Mccan.-SCR-39-Summary-Presentation-03-28-14.pptx">http://coastal.la.gov/wp-content/uploads/2013/12/Brett-Mccan.-SCR-39-Summary-Presentation-03-28-14.pptx</a>. Retrieved December 28, 2018.

Provides a summary of the SCR 39 report, including key findings and recommendations

### Louisiana Department of Wildlife and Fisheries. LA Rev Stat § 56:1856: Part II. Natural and Scenic Rivers System. 2009. Available online at:

#### http://www.wlf.louisiana.gov/sites/default/files/pdf/document/36295-scenic-rivers-

#### act/scenicriversact2009.pdf. Retrieved January 16, 2019.

Scenic Rivers Act (1970) applies to around 80 streams and regulates activities on river channels and in riparian corridors. Prohibited activities include: Clear cutting within 100 feet, channelization, channel realignment, dredging and clearing and snagging (no removal of woody debris). Some exceptions have been granted with clearing and snagging, such as after tornados.

### Louisiana Department of Wildlife and Fisheries. Scenic Rivers: Permit Process. 2018. Available online at: <a href="http://www.wlf.louisiana.gov/permit-process">http://www.wlf.louisiana.gov/permit-process</a>. Retrieved January 16, 2019.

Detailed resource for LDWF's Scenic Rivers permitting process, including link to the Scenic Rivers permit application.

## Louisiana State Legislature. Senate Concurrent Resolution 39, 2013 Regular Session. By Senator Morrish. 2013. Available online at <u>https://www.legis.la.gov/legis/ViewDocument.aspx?d=849462</u>. Retrieved December 28, 2018.

Louisiana Senate Concurrent Resolution (SCR) 39 of the 2013 Regular Session requests a comprehensive study of government entities with legal authority over surface water in Louisiana, including levee districts and water boards.

Louisiana State Legislature. Senate Resolution No. 171, 2014 Regular Session. By Senator Claitor. 2014. Available online at: <u>http://www.legis.la.gov/legis/ViewDocument.aspx?d=909337</u>. Retrieved December 28, 2018.

Louisiana Senate Resolution No. 171 of the 2014 Regular Session requests the Louisiana State Law Institute to create a Water Code Committee to develop a model water code for the state of Louisiana.

## Louisiana State Legislature. Senate Resolution No. 172, 2017 Regular Session. By Senators White and Hewitt. 2017. Available online at: <u>http://www.legis.la.gov/legis/ViewDocument.aspx?d=1048006</u>. Retrieved December 21, 2018.

Louisiana Senate Resolution (SR) 172 of the 2017 Regular Legislative Session, co-authored by Senators Mack A. "Bodi" White and Sharon W. Hewitt, which directs the Louisiana Department of Transportation and Development (DOTD), in consultation with other state agencies, to "study construction or maintenance impacts, including channelization, dredging, and clearing and snagging activities, upon river basins and water transmission, and provide recommendations to establish, implement, and enforce floodplain management plans for each watershed in Louisiana."

Louisiana Watershed Cooperating Agencies. "Phase 1 Investigation; Louisiana Statewide Comprehensive Watershed Based Floodplain Management Program Development." 2018. Available online at <a href="https://watershed.la.gov/assets/docs/Phase-1-Full-Report-with-Appendices\_compressed.pdf">https://watershed.la.gov/assets/docs/Phase-1-Full-Report-with-Appendices\_compressed.pdf</a>. Retrieved December 28, 2018.

The State of Louisiana is in the process of developing a statewide, comprehensive Watershed-based Floodplain Management Program, and the Phase I Investigation report identifies existing floodplain management conditions in the state, best practices from other states and abroad, and current needs. It identifies six strategic areas of improvement and concrete steps to address them moving forward.

#### Louisiana Water Resources Commission. "Report on Activities." 2018. Available online at

http://www.dnr.louisiana.gov/assets/OC/env\_div/gw\_res/WRCReportonActivities/WaterResourcesCommis sion-ReportonActivities-April2018-FINALFORRELEASE-April17-2018.pdf. Retrieved December 21, 2018.

The Louisiana Water Resources Commission (LWRC) promotes and assists in the effective management of the state's ground and water resources. This includes gathering and interpreting data, evaluating overall resource management, assessing current and future water demands, developing conservation programs, and researching incentives and new technologies. This report provides an overview of the Commission's activities for the calendar year 2017.

### Manap, Norpadzlihatun and Nikolaos Voulvoulis. "Data analysis for environmental impact of dredging." *Journal of Cleaner Production* 137 (2016): 394-404.

The authors conduct data analysis using historical dredging data from dredging projects in Malaysia to investigate the environmental impact of dredging on water and sediment quality and seek to identify the main factors determining that impact. The results indicate that dredging results in increased levels of dissolved oxygen and metal concentrations and that the main factors associated with these impacts are both the contamination level of sediment and the contamination level of water in the neighboring area. The authors emphasize the importance of conducting analyses on these factors via sediment quality analyses and water quality monitoring prior to dredging, particularly when dealing with sensitive and contaminated areas.

### Marzolf, G. Richard. "The potential effects of clearing and snagging on stream ecosystems." No. 78/14. US Fish and Wildlife Service, 1978.

This publication reviews potential ecological impacts caused by the method of clearing and snagging for increasing channel capacity. The author shows that the hydraulics impacts of clearing and snagging include the altering of channel roughness, impacting velocity, and influencing the pattern of erosion and deposition. The author stresses that clearing and snagging can have many potential effects on in-stream biological processes, including the removing of canopy cover, alteration of plankton production, alteration of substrate type, and alteration of habitat type for rooted macrophytes. Additionally, the paper proves that there can be negative impacts on benthic macroinvertebrates as well as adverse impacts on fish populations.

#### Minnesota Association of Watershed Districts. "Watershed District Handbook." Saint Paul, MN, 2011.

This text is a resource for managers of watershed districts in Minnesota. It covers the history of watershed districts in the state including the enabling legislation, and covers management structure, meetings and committees, watershed planning and rulemaking, financing and fiscal management.

## Office of Gov. John Bel Edwards. "A Long-term Vision for Statewide Sustainability and Resilience." 2018a. Available online at <u>https://watershed.la.gov/assets/docs/TWI-Vision-White-Paper\_9-5-18.pdf</u>. Retrieved December 28, 2018.

The document models how the Council and Technical Advisory Groups (TAGs) would align existing programs, policies, and practices, as well as identified key strategic statewide investments.

Office of Gov. John Bel Edwards. "Gov. Edwards Issues Executive Order to Manage Future Flood Risks Statewide." 2018b. Available at: <u>https://watershed.la.gov/news/press-releases/gov-edwards-issues-</u> <u>executive-order-to-manage-future-flood-risks-statewide</u>. Retrieved December 28, 2018. Press release announcing Executive Order JBE18-16 creating the Council on Watershed Management.

### Office of Gov. John Bel Edwards. "Gov. Edwards Announces Launch of Louisiana Watershed Initiative, Sets Long-Term Vision for Statewide Sustainability and Resilience." 2018c. Available at: <u>https://watershed.la.gov/news/press-releases/gov-edwards-announces-launch-of-louisiana-watershed-</u> initiative-2. Retrieved December 28, 2018.

Press release announcing the launch of the Louisiana Watershed Initiative and a long-range vision for the state's multi-pronged approach to mitigating future flood risk focusing on natural boundaries, not political ones. The Louisiana Watershed Initiative was officially launched as a continuation of the planning, coordination, and

collaboration across various federal, state, and local agencies in direct response to the historic flooding events of March and August 2016.

#### Peckinpaugh, C. "How does a revolving fund work?" FCW. 1999.

This journal article provides a general overview of revolving funds, from a government accounting perspective.

### Piazza, Bryan P. *The Atchafalaya River Basin: History and Ecology of an American Wetland*. Texas A&M University Press, 2013.

A comprehensive scientific resource of Louisiana's Atchafalaya River Basin, one of the largest drainage basins in the world. The book documents the ecological state of the basin and details its hydrology and how it has been managed over time.

### Roberts, David A. "Causes and ecological effects of resuspended contaminated sediments (RCP) in marine environments." *Environment International* 40 (2012): 230-243.

Through an extensive literature review, including of laboratory-based, field-based, and monitoring studies, the author compiles existing research and identifies research gaps on the ecological effects of resuspended contaminated sediments (RCP) in marine environments. RCPs are described as particulate sediments bound to anthropogenic contaminants which are remobilized into the water column through a range of natural and anthropogenic processes, causing pulsed disturbances (i.e., toxicity, bioaccumulation) in marine habitats. The author highlights studied linkages between various anthropogenic disturbances of contaminated sediments— including dredged material disposal—and long-term and widespread community level effects, reproductive effects in marine fish, and sublethal responses in invertebrates. The author also identifies a need for further research into how marine communities respond to temporally variable exposures to RCS and the relative importance of various disturbances.

## Roberts, James H., Gregory B. Anderson, and Paul L. Angermeier. "A Long-Term Study of Ecological Impacts of River Channelization on the Population of an Endangered Fish: Lessons Learned for Assessment and Restoration." *Water* 8 (2016): 240.

The authors of this paper worked with two federal agencies to monitor habitat availability for and population density of an endangered fish species in the Roanoke River, VA, from 1997 to 2015, in order to study the potential impacts of river channelization on the species population. The paper extracts key lessons learned for and challenges of future long-term monitoring of ecological effects of environmental impacts or river restoration on endangered populations. The authors find that large-scale spatiotemporal dynamics of endangered populations and the attendant use of flexible conceptual models and sampling designs are critical components of measuring demographic responses of a threatened biota in dynamic river environments. For future studies, they recommend planning ahead, developing adaptable conceptual and analytical models early, recognizing limits to the scope of study, and carefully choosing analytical frameworks and tools.

### Scorpio, Vittoria, et al. "Channelization of a large Alpine river: what is left of its original morphodynamics?" *Earth Surface Processes and Landforms* 43 (2018): 1044-1062.

The authors use several available historical maps of the large Adige River of the Eastern Alps, in addition to geomorphological analysis and bar and channel prediction models, to undertake a unique case study of the extent to which channelization during the 19<sup>th</sup> century has changed the morphology of the river. Their findings indicate

an almost complete loss of exposed sediment bars following channelization. Using a proposed conceptual model for other similarly large rivers and similar massive channelization, they demonstrate that a relatively small difference in the engineered channel width may have a strong impact on river dynamics, specifically on bar formation.

### Shankman, David. "Stream channelization and changing vegetation patterns in the U.S. Coastal Plain." *Geographical Review* 86(2) (1996): 216-232.

Drawing on existing literature, this paper provides an overview of the effects on stream channelization on plantcommunity patterns in the alluvial wetlands of the southeastern U.S. Coastal Plan, where stream channelization is one of the most common flood-control methods. The author highlights how changes in hydrology and geomorphology caused by channelization result in dramatic alterations of the magnitude and duration of flooding and sedimentation, disruption of critical river-floodplain interactions, and lower peak discharges in the upper sections of watersheds (promoting deforestation and land-use conversion to agriculture), all of which affect the composition of plant communities. Channel enlargement increases flood discharges downstream and straightened alignment can result in increased water velocity, resulting in higher peak flows and flood frequencies downstream. The correlated significant decrease in flooding upstream is likely to affect the distribution of species on lower bottomland sites within the floodplain. The author also hypothesizes that increased flooding downstream could limit regeneration of plant communities. The paper concludes that, although the responses of plant communities to hydrologic changes following channelization are partially speculative, channelization causes loss of habitat and plant-community heterogeneity in adjacent floodplains.

### Siham, Kamali, et al. "Marine dredged sediments as new materials resource for road construction." *Waste Management* 28.5 (2008): 919-928.

The authors inform of the potential reuse of non-contaminated dredged materials as aggregate for road construction, particularly for road foundation and base layers, which require competent mechanical properties. The authors evaluate the use of sediments dredged from Dunkirk harbor in France for road building. They determine the mineralogical composition of dredged sediment through x-ray diffraction, with geotechnical criteria being checked as given by French standards. Mechanical testing considers compaction, bearing capacity, compression, and tensile testing. Results show the feasibility of using the dredged sands and sediments as new material for construction of foundation and base layers for roadways. The authors note that additional research is necessary to prove the resistance of the material to environmental impacts.

## Simon, Andrew, and Robert E. Thomas. "Processes and forms of an unstable alluvial system with resistant, cohesive streambeds." Earth Surface Processes and Landforms: *The Journal of the British Geomorphological Research Group* 27.7 (2002): 699-718.

The authors report a case study of the Yalobusha River, which has experienced deposition and flood problems in downstream reaches and erosion through headward-progressing knickpoints and bank failures in upper reaches. These problems have stemmed from the channelization of the entire stream network, a straightened and enlarged main stem which terminated into an unmodified sinuous reach, and a plug of sediment and debris completely blocking lower ends of channelized reaches. The authors determine that through a channel evolution model, the downstream reaches have reached equilibrium, with upstream reaches actively degrading. Strategies to reduce downstream flooding involve the removal of sediment plugs to allow for better downstream drainage. The authors

suggest adequate time for drainage of groundwater from channel banks be allowed so as not to induce bank failure.

### Smith, Douglas R., et al. "Dredging of Drainage Ditches Increases Short-Term Transport of Soluble Phosphorus." *Journal of Environmental Quality* 35 (2006): 611-616.

This article documents the findings of a laboratory study undertaken to study the impact of drainage ditch dredging on soluble phosphorus transport. Dredging is a common, and often necessary, practice in the management of drainage ditches to curb sediment buildup. The experiment revealed that phosphorus concentrations were lower in the pre-dredged sediments and that transport of soluble phosphorus after dredging is likely to increase in drainage ditches.

#### State of Louisiana. Louisiana Watershed Initiative. "One-Pager." 2018a. Available online at:

https://watershed.la.gov/assets/docs/Louisiana-Watershed-Initiative-One-Pager-10-12-18.pdf. Retrieved December 28, 2018.

This one-pager gives an overview of the Louisiana Watershed Initiative; its mission, history, structure and membership, ongoing efforts and contact information for the general public.

## State of Louisiana. Louisiana Watershed Initiative. Statewide Listening Tour Resources. 2018b. Available at: <u>https://www.watershed.la.gov/resources/statewide-listening-tour-resources</u>. Retrieved December 28, 2018.

Contains the contents, videos, resources, and outcomes of the Louisiana Watershed Initiative Statewide Listening Tour.

#### State of Minnesota. Water Law of 1990. Chapter 103D. Water Planning and Project Implementation.

Chapter 103 is the authorizing statute of the Minnesota watershed organizations and districts, and codifies their formation, structure, powers and purpose.

### Suedel, Burton C., et al. "A risk-informed decision framework for setting environmental windows for dredging projects." *Science of the Total Environment* 403 (2008): 1-11.

This article summarizes recent developments in the fields of risk assessment for non-chemical stressors and riskinformed decision-making tools for sediment management in relation to setting environmental windows (EWs) for dredging, which is presented as a complex socio-political issue. EWs are detailed as a management practice used to alleviate stresses dredging activities may put on aquatic biotic by placing seasonal restrictions on those activities. The authors ultimately propose a framework based on risk assessment and multi-criteria decision analysis (MCDA) as an approach for deciding on dredging possibility and selecting appropriate methods when dredging must be done outside of EWs, in order to minimize disturbances while incorporating stakeholder values. A hypothetical application of the framework for the protection of Pacific herring against dredging impacts is demonstrated.

The Advocate. Louisiana flooding will cost U.S. economy more than \$10 billion. 2016. Available online at: <u>https://www.theadvocate.com/louisiana\_flood\_2016/article\_378487b6-768e-11e6-832f-df9408322f2c.html</u>. Retrieved December 21, 2018.

News article following the historic August 2016 Louisiana floods reporting that estimated economic losses from the event would cost the U.S. between \$10 billion to \$15 billion, and that as many as 110,000 homes and more than 100,000 vehicles were damaged by the floods.

#### United Kingdom Environment Agency. Dredging pilot studies report. 2011. Available at:

https://webarchive.nationalarchives.gov.uk/20130903121531/http://www.environment-

agency.gov.uk/research/policy/31740.aspx . Retrieved January 30, 2019.

The United Kingdom Environment Agency conducted a study to determine what extent waterway maintenance or dredging would reduce flooding. The study included six pilot sites where stream maintenance (weed control, blockage removal and de-silting) or dredging was conducted. Maintenance work at the pilot sites reduced local flooding but in some cases was not cost effective because too little flood benefit was achieved. One conclusion of the study was that decisions should be considered on a case-by-case basis to determine if the measures would be beneficial.

### United States Army Corps of Engineers. 33 U.S.C. § 403: Obstruction of navigable waters generally; wharves; piers, etc.; excavations and filling in. 2017a. Available online at:

https://www.govinfo.gov/content/pkg/USCODE-2017-title33/pdf/USCODE-2017-title33-chap9-subchapIsec403.pdf. Retrieved January 16, 2019.

Prohibits excavation or fill, or in any manner to alter or modify the course, location, condition, or capacity of the channel of any navigable water of the United States, unless the work has been recommended by the Chief of Engineers and authorized by the Secretary of the Army.

United States Army Corps of Engineers. 33 U.S.C. § 1344: Permits for dredged or fill material. 2017b. Available online at: <u>https://www.govinfo.gov/content/pkg/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2018-title33/pdf/USCODE-2018-title33/pdf/USCODE-2018-title33/pdf/USCODE-2018-title33/pdf/USCODE-2018-title33/pdf/USCODE-2018-ti</u>

United States Army Corps of Engineers. 33 U.S.C. § 1413: Dumping permit program for dredged material. 2017c. Available online at: <u>https://www.govinfo.gov/content/pkg/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-2017-title33/pdf/USCODE-</u>

### United States Army Corps of Engineers. 33 C.F.R. § 322: Permits for structures or work in or affecting navigable waters of the United States. 2018a. Available online at:

https://www.govinfo.gov/content/pkg/CFR-2018-title33-vol3/pdf/CFR-2018-title33-vol3-part322.pdf.

Retrieved January 16, 2019.

Requires a permit for work in or affecting navigable waters of the United States.

United States Army Corps of Engineers. 33 C.F.R. § 323: Permits for discharges of dredged or fill material into waters of the United States. 2018b. Available online at: <u>https://www.govinfo.gov/content/pkg/CFR-2018-title33-vol3/pdf/CFR-2018-title33-vol3-part323.pdf</u>. Retrieved January 16, 2019.

Authorizes discharge of dredged or fill material into waters of the United States.

### University of Maryland, Center for Disaster Resilience, and Texas A&M University, Galveston Campus, Center for Texas Beaches and Shores. "The Growing Threat of Urban Flooding: A National Challenge." 2018. College Park: A. James Clark School of Engineering. Available online at

### https://cdr.umd.edu/sites/cdr.umd.edu/files/urban-flooding-report-online.pdf. Retrieved December 21, 2018.

This study investigates the extent and consequences of urban flooding in the U.S. and explores what actions might be taken to mitigate this flooding in the future. The study finds that, while primary responsibility for mitigation of urban flooding rests with local governments, division of responsibilities across multiple levels of government are not clearly defined and are too diffuse, lacking the collaboration and coordination necessary to address the magnitude of challenges faced.

### Wallace, David L. "Short- and Long-Term Water Quality Impacts from Riverine Dredging." In *Water Quality '92: Proceedings of the 9<sup>th</sup> Seminar*, U.S. Army Corps of Engineers. (1992): 172-177.

This paper presents an evaluation and quantification undertaken by the U.S. Army Corps of Engineers Water Quality Section of water quality impacts due to riverine dragline and hydraulic dredging channelization in the Upper Yazoo River Basin (UYRB), for the purposes of a series of Environmental Impact Statements on three separate channelization projects in the UYRB. Amongst its list of likely impacts to water quality as a result of riverine channel dredging are resuspension of sediments, removal of aquatic habitats, and injury and death of biota. The paper notes that the major short-term impact to water quality caused by dredging is the resuspension of bottom sediments, which results in increased turbidity, decreased dissolved oxygen, increased temperatures, and potential release of contaminants. Turbidity levels appear to return to ambient conditions within one-half mile downstream of dredging activity. In the long-term, the impacts are less clear and seasonally varied. The paper concludes that the most significant impacts to water quality due to hydraulic and dragline riverine dredging are likely to be loss of aquatic habitats and increases in turbidity and suspended solids, but that the latter is likely to be temporary and localized in effect and highest during actual construction.

### Wohl, Ellen, et al. "Management of large wood in streams: an overview and proposed framework for hazard evaluation." *Journal of the American Water Resources Association* 52.2 (2016): 315-335.

Large woods are widely recognized for their capacity to create habitat diversity and channel changes that benefit aquatic ecosystems. However, the removal of large woods to facilitate navigation and control floods early in the 17<sup>th</sup> century resulted in the misconception that large woods are not a natural component of the river ecosystem and habitat. Understanding this, the authors provide a decision process for the management of large woods on streams. A series of tools that allow for both rapid assessment and detailed analysis of benefits and hazards are presented along with a sample application of its use. The authors note that the decision to retain, remove, or modify woody debris is highly dependent on the context, but the process can be applied in a range of urban to natural river reaches so that opportunities for wood retention or enhancement are increased.



Senate Resolution 172 Response

### **APPENDIX B**

**Part 2 Attachments** 

Senate Resolution 172 Response



Attachment B.1 Stakeholder Input Teleconference Call Summaries



### STAKEHOLDER INPUT TELECONFERENCE CALL SUMMARY SEPTEMBER 27, 2018, 10:00 A.M. TO 11:00 A.M. CENTRAL

### Attendees

Pat Landry, DOTD	Cindy O'Neal, DOTD
Ehab Meselhe, The Water Institute	Todd Baumann, USGS
Matthew Weigel, LDWF	Billy Williamson, DOTD
Clint Willson, LSU	Natalie Postel, Arcadis
Ed Knight, DOTD	James Jones, Arcadis

#### **Action Items**

Individual(s)	Item	Due Date
Natalie Postel	Send call summary to call participants	October 4, 2018
Natalie Postel	Contact Amanda Vincent and/or Chuck Berger with DEQ to participate in stakeholder input calls	October 4, 2018
James Jones	Review literature references and regulations discussed and add to annotated bibliography	October 4, 2018
All Attendees	Provide feedback on draft outline, annotated bibliography, etc.	October 4, 2018
Natalie Postel	Prepare key findings	October 31, 2018

### Agenda Items

#### Item #1 Introductions

• Attendees gave brief introductions as part of the roll call.

### Item #2 Task Introduction

- The SR 172 response will incorporate stakeholder feedback and summarize relevant activities included in the Louisiana Watershed Initiative.
- Key findings from research and modeling studies will be prepared and submitted to stakeholders for review. Comments will be included in the draft response.

#### Item #3 Milestones and Schedule for Stakeholder Input

- The suggested schedule for stakeholder input was discussed and agreed upon.
- Proposed Schedule:

- Kickoff Call-Thursday, September 27 10:00-11:00 a.m. Central
- Review and Discuss Key findings-Wednesday, October 31 10:00-11:00 a.m. Central
- Feedback on Draft-Wednesday, December 12 10:00-11:00 a.m. Central
- Feedback on Final draft and final slide deck-Wednesday, January 16, 10:00-11:00 a.m. Central.

### Item #4: Senate Resolution No. 172: Stakeholder's Input on Clearing & Snagging, Dredging, and Channel Manipulation

Ehab Meselhe, Water Institute of the Gulf, Vice President for Engineering:

- The results of clearing and snagging vary on a reach-by-reach basis, with potential negative impacts caused by increased downstream peak flows.
- Studies have indicated that clearing and snagging is not as effective in close proximity to the coast, as velocities become controlled by slope rather than channel roughness.

#### Matt Weigel, Louisiana Department of Wildlife and Fisheries, Program Manager:

- Clearing and snagging may cause incision and a lowering of the water table, there could be habitat loss, decrease in bedform diversity, reduced oxygenation, and removal of channel substrate.
- Additional impacts will include change in flow regime, flashing, and downstream flooding.

#### Cindy O'Neal, Louisiana DOTD, State NFIP Coordinator:

- If clearing and snagging of a reach causes a rise in the downstream floodway, then there would be a violation of 44 CFR 60.3D.
- Channelization and clearing and snagging are prohibited on Scenic rivers through the Louisiana Scenic Rivers Act (RS 56:1856).
- There should be preventative measures installed on road crossings to discourage the dumping of debris that obstruct drainageways and induce flooding.

#### Matt Weigel, Louisiana Department of Wildlife and Fisheries, Program Manager:

- The LDWF have jurisdiction over scenic rivers, while the USACE has jurisdiction on waters of the U.S., under Section 10 and 404 permits.
- The clearing and snagging permitting process will vary by district. The Vicksburg district generally requires clearing and snagging projects to minimize impacts and provide mitigation where they claim jurisdiction, whereas the New Orleans district may not require a permit and currently do not require mitigation for stream impacts. The coastal zone may be potentially under the jurisdiction of the DNR below the 5-foot contour.
- Endangered species will fall under the USFWS and LDWF and will have an economic impact on the state with future projects if new species are listed.
- If LDWF had to choose between the two, in regard to ecological impacts, etc. then, clearing and snagging is preferred over dredging.

#### Todd Bauman, USGS, Hydrologist:

- There have been USGS studies on the effects of clearing and snagging and should be incorporated into the response.
- Blocking access to streams and rivers at roadway crossings may cause difficulty in obtaining stream measurements.

- Impacts in flow by clearing and snagging would be recorded by the existing stream gage network.
- No new permanent gages are planned on being installed.
- If there is an area proposed for modeling, there could be rapid deployment of stream gages to get measurements before and after clearing and snagging to capture changes.
- There are reports under the statewide flood protection program on clearing and snagging costs and benefits compared to pumping.

#### Ed Knight, DOTD, State Dam Safety Engineer:

- The Amite River Basin model will be completed near the end of December.
- Preliminary results show that dredging does not provide significant benefit in low-lying areas. The modeling study analyzed dredging from the diversion to the mouth. It was noted that the Amite River is 50-feet deep in some areas, whereas the mouth is only 12-feet deep.
- There will be analysis of different rain events to determine benefits of higher probability events as well as the influence of a strong northern wind.
- It is suggested that prior to any implementation of a dredging or clearing and snagging program, that a numerical simulation be completed.

#### Clint Willson, LSU Center for River Studies, Director:

- The evaluation of impacts will be necessary and will require numerical modeling.
- Clearing and snagging will change the sediment transport regime and will influence stream channel morphology.
- It is noted that biology will follow geomorphology which must also be considered.

#### Item #4: General Questions and Comments

Cindy O' Neal: How do the sand and gravel pits affect the Amite River?

- Ed Knight: Sand and gravel pits become flooded and transport sediment into the Amite River, changing bathymetry over time.
- Ehab Meselhe: The Water Institute has done some work in collecting sediment samples in the Amite River to determine how the river system responds to flooding. Results of the study prove that the Amite River is one of the more dynamic rivers in the state.
- Matt Weigel: The banks of the Amite have been replaced with sand tailings in many places. The banks are especially erosive in these areas (poor BEHI). We also see a good bit of pit capture on the Amite and other S&G streams. There are no regulations over Sand and Gravel mining. In our opinion they are needed.

Natalie Postel: Will there be any modeling results available to include in the SR172 response?

• Ed Knight: The Amite modeling will be completed between January and February. Preliminary results are available for some dredging options. Preliminary results could potentially be included as part of the response based on model review.

Ed Knight: There needs to be some investigation of cumulative impacts downstream of clearing and snagging projects.

### Item #5 Response Approach and Draft Outline

<u>Pat Landry:</u> The report needs to be readable, and not have extensive technical detail. Any conclusions derived from research and modeling studies need to be kept concise. Prepare three pages at most to summarize the response.

- Ed Knight: There should be no duplication of effort, as a truncated version of the Louisiana Watershed Initiative can provide a major portion of the response.
- Cindy O' Neal: Legislators are looking for a cliff notes version of the report.

<u>Pat Landry:</u> The DEQ should be included on future calls to provide information on the impact that dredging and clearing and snagging activities have upon water quality and TMDLs. Potential contacts: Amanda Vincent and/or Chuck Berger.

#### Item #6 Feedback Process

- The feedback process will include verbal feedback as recorded in meeting minutes.
- Written feedback can be sent directly to <u>Natalie.Postel@arcadis.com</u>.

### **Future Meeting Dates**

Date Group / Topic

10/31/2018 Review and Discuss Key Findings



## STAKEHOLDER INPUT TELECONFERENCE CALL SUMMARY OCTOBER 4, 2018, 3:00 P.M. TO 4:00 P.M. CENTRAL

### Attendees

Chuck Berger, Louisiana Department of Environmental Quality (DEQ) Amanda Vincent, Louisiana DEQ Natalie Postel, Arcadis James Jones, Arcadis

### **Action Items**

Individual(s)	Item	Due Date
Natalie Postel	Send call summary to call participants	October 16, 2018
All Attendees	Provide feedback on draft outline, annotated	October 31, 2018
	bibliography, etc.	
Natalie Postel	Prepare key findings	October 31, 2018

### Agenda Items

### Item #1 Introduction and Task Introduction

- Attendees gave brief introductions as part of the roll call.
  - Amanda Vincent: Involved on the Louisiana Watershed Initiative Project Technical Advisory Group (TAG).
  - Chuck Berger: Involved on the Data and Modeling TAGs.
- The schedule for stakeholder input was discussed:
  - Review and Discuss Key findings Wednesday, October 31 10:00-11:00 a.m. Central
  - Feedback on Draft Wednesday, December 12 10:00-11:00 a.m. Central
  - Feedback on Final draft and final slide deck Wednesday, January 16, 10:00-11:00 a.m. Central.
- It was discussed that the SR 172 response is separated into two distinct objectives.
  - Objective 1: The study of construction or maintenance impacts, including channelization, dredging, clearing and snagging, upon river basins and water transmission.
  - Objective 2: Recommendations for the establishment, implementation, and enforcement of a statewide floodplain management program for each watershed in Louisiana.
- It was noted that Objective 2 is being addressed by the Louisiana Watershed Initiative TAGs.
- Key findings from the Objective 1 literature review will be prepared and provided to stakeholders for review. Stakeholder comments will be included in the draft response.

#### Item #2 General Questions and Comments

Amanda Vincent: Is the DEQ responsible for writing a portion of the Objective 1 response?

• Natalie Postel: Arcadis will write most of the response, with the Department of Transportation and Development (DOTD) providing any portions related to the Amite River Basin Study.

#### Item #3 Proposed Report Outline and Annotated Bibliography

- The proposed report outline, and annotated bibliography were introduced.
  - In separate e-mails following the call, Amanda Vincent and Chuck Berger provided additional references to be considered for review and inclusion into the report and annotated bibliography, including the "Draft EPA-USGS Technical Report: Protecting Aquatic Life from Effects of Hydrologic Alteration".
- Stakeholder comments, about Objective 1, from the September 27th meeting was briefly discussed. Amanda Vincent and Chuck Berger were in concurrence with the input provided.

### Item #4 Senate Resolution No. 172: Stakeholder's Input on Clearing & Snagging, Dredging, and Channel Manipulation

#### Chuck Berger:

- The channelization, dredging, and clearing and snagging of streams will have a profound impact on the geomorphology of streams and rivers.
- Dredging of streams can reduce baseflows and water surface elevations, affecting aquatic habitat and lifecycle. There are a number of species whose life-cycles, including spawning, are dependent upon the level of the water surface as signals. These species will be adversely impacted. These activities can also adversely impact the stream's connection to groundwater aquifers, altering the ability to replenish those aquifers and thus reducing baseflows.
- The disconnecting of the stream and floodplain will have unintended consequences, including the altering of sediment loads, disturbance of aquatic habitat and instream species, loss of riparian vegetation, and increase of stream energy.
- The EPA and DEQ provides criteria for each stream the designated uses assigned to each stream. The use of these practices may limit the streams ability to meet these criteria and support the designated uses.
  - Example: A stream with a criterion of 5 mg/L of dissolved oxygen is channelized or altered changing the streams ability to reaerate and meet the dissolved oxygen criterion.
  - This could cause additional low dissolved oxygen impairments, requiring the development of additional TMDLs. It could also contribute to existing impairments or adversely affect the ability of the stream to meet the requirements of existing TMDLs. Either scenario would likely make it harder to obtain water discharge permits and possibly limit economic growth in many areas.
- Channelization causes a dramatic change in channel slope, which will result in a stream aggrading or degrading, depending on the situation. This would lead to erosion and increased sediment loads and the gradual meandering of the channel as it ultimately tries to achieve equilibrium. This requires additional expenditures for maintenance and mitigation.
  - Amite River Diversion Canal Example: The original intent of the diversion canal was to divert 20% of the water, but due to subsidence of the weir, approximately 80% of the water is diverted

down the canal. This altered the base flow of the original channel system and has impacted downstream dissolved oxygen concentrations, wetlands and groundwater recharge zones.

#### Amanda Vincent:

- The designated uses of streams and rivers cannot be changed. It can take between 3-4 years total time to develop to define water quality criteria that must be met in order to meet designated use.
- The development of water quality criteria is costly and requires the collection of data over an extended time period.

#### Item #5 General Questions & Comments

<u>Natalie Postel</u>: Previous stakeholder input has mentioned the regulation of debris. What are your thoughts?

• Chuck Berger: Debris tends to be regulated by existing laws and ordinances. Some municipal separate stormwater sewer systems (MS4s) are required to control debris and trash from entering waterways. There could be definite benefit to the removal of debris. The build-up of debris and trash at bridge piers can impede flow and introduce pollutants into waterbodies.

James Jones: Do you have any thoughts on the impacts of sand and mining regulations on streams and rivers?

• Amanda Vincent: Not much personal experience in this area, although there are certain BMPS which should be put in place to minimize impacts on streams and rivers. There are personnel within DEQ who specialize in this area that can be reached out to.

<u>Chuck Berger:</u> Recommend reaching out to Dave Rosgen from Wildlands Hydrology for additional input on stream channel morphology.

#### Item #6 Feedback Process

- The feedback process will include verbal feedback as recorded in meeting minutes.
- Written feedback can be sent directly to <u>Natalie.Postel@arcadis.com</u>.

### **Future Meeting Dates**

#### Date Group / Topic

10/31/2018 Review and Discuss Key Findings



### STAKEHOLDER INPUT TELECONFERENCE CALL SUMMARY OCTOBER 17, 2018, 11:00 A.M. TO 12:00 P.M. CENTRAL

### Attendees

Yvonne Allen, USFWS Natalie Postel, Arcadis James Jones, Arcadis

### **Action Items**

Individual(s)	Item	Due Date
Natalie Postel	Send call summary to call participants	October 29, 2018

#### **Agenda Items**

#### Item #1 Introduction and Task Introduction

- Attendees gave brief introductions
  - Yvonne Allen: Performs GIS and remote sensing work with an aquatic biology and ecology emphasis
  - Natalie Postel: Leading SR 172 response with Pat Landry at DOTD
  - Jimmy Jones: Assisting with SR 172 response
- The schedule for stakeholder input was discussed:
  - Review and Discuss Key findings Wednesday, October 31 10:00-11:00 a.m. Central
    - Yvonne was provided with a copy of the call summary.
  - Feedback on Draft Wednesday, December 12 10:00-11:00 a.m. Central
  - Feedback on Final draft and final slide deck Wednesday, January 16, 10:00-11:00 a.m. Central
- It was discussed that the SR 172 response is separated into two distinct objectives.
  - Objective 1: The study of construction or maintenance impacts, including channelization, dredging, clearing and snagging, upon river basins and water transmission.
  - Objective 2: Recommendations for the establishment, implementation, and enforcement of a statewide floodplain management program for each watershed in Louisiana.
- It was noted that Objective 2 is being addressed by the Louisiana Watershed Initiative TAGs.
- Key findings from the Objective 1 literature review will be prepared and provided to stakeholders for review. Stakeholder comments will be included in the draft response.

### Item #2 Senate Resolution No. 172: Stakeholder's Input on Clearing & Snagging, Dredging, and Channel Manipulation

• Yvonne generally agrees with the viewpoints expressed in the kickoff call summary. Item #4 of the kickoff call seemed to focus more on clearing and snagging and less on channelization.

- Many studies show that presence of woody debris is absolutely associated with fish habitat and ecosystem health and impact sedimentation and changes in geomorphology.
- Clearing and snagging also leads to concerns of bank stabilization and increased erosion.
- Yvonne recognizes that there are also benefits to increased accessibility and flow conveyance concerns and that a balance between these benefits and ecosystem protection is needed.
- Yvonne also has concerns about the potential for channel incision causing disconnection of the stream with the floodplain. She has seen dredging impacts on head cuts in the Pearl River happening overtime. The channel was dredged for navigation and materials were used as a source for levee construction. The stream experienced many changes to geomorphology with accelerated head cutting upstream and downstream sedimentation.
- Yvonne stated that a log jam on the Pearl River has caused access issues and impeding boat traffic upstream and downstream The log jam was removed to improve access.
- Disconnection from the floodplain results in less overbank flows, local channel sedimentation can lead to decreased floodplain connectivity. Lack of overbank water can lead to a decline in forest health in disconnected backwater areas.
- Yvonne's work looked at satellite imagery of where water goes during all conditions and has informed understanding of how the floodplain functions.
- Yvonne has seen from imagery that there has been a huge increase over time or sand and gravel pits along river reaches.
- Forked Deer River in western TN an example of channelization on a floodplain river. Compare with the Hatchie River to the south which is unchannelized.

#### Item #3 Feedback Process

- The feedback process will include verbal feedback as recorded in meeting minutes.
- Written feedback can be sent directly to <u>Natalie.Postel@arcadis.com</u>.

### **Future Meeting Dates**

#### Date Group / Topic

10/31/2018 Review and Discuss Key Findings



## STAKEHOLDER INPUT TELECONFERENCE CALL SUMMARY OCTOBER 31, 2018, 10:00 A.M. TO 11:00 A.M. CENTRAL

### Attendees

Diane Howe, FEMA	Cindy O'Neal, DOTD	Natalie Postel, Arcadis
Matthew Weigel, LDWF	Bryan Piazza, TNC	James Jones, Arcadis
Clint Willson, LSU	Todd Bauman, USGS	
Ehab Meselhe, The Water Institute	Chuck Berger, DEQ	
Ed Knight, DOTD	Yvonne Allen, USFWS	

### **Action Items**

Individual(s)	Item	Due Date
Natalie Postel	Send call summary to call participants	November 7, 2018
All Attendees	Provide feedback on key findings handout	November 7, 2018
James Jones/	Revise key findings, prepare draft report of	December 12, 2018
Natalie Postel	SR-172 Objective 1 Response	

### Agenda Items

### **Item #1 Introductions**

• Attendees gave brief introductions as part of the roll call.

#### Item #2 Review Draft Report Outline

Natalie Postel reviewed the proposed draft report outline that was initially distributed prior to the September 27, 2018 kickoff call. The key findings of the literature search will make up much of the State of Practice section in the response report. Arcadis distributed the draft key findings handout (Key Findings draft 2018-10-25.pdf) to call invitees prior to the call. The "For Stakeholder Consideration" section of the handout will be the focus of the discussion.

### Item #3 Questions & Comments on Key Findings Handout

Call attendees noted that many impacts were missing from the key findings handout. Arcadis will revise the summaries to include all impacts in the draft report.

#### Chuck Berger, DEQ:

- All three options presented (channelization, dredging, clearing & snagging) have the potential to impact water quality. These practices can limit the re-aeration of streams, resulting in lowered dissolved oxygen levels.
- <u>Matt Weigel, LDWF:</u> In concurrence with Chuck Berger's statement.

#### Yvonne Allen, USFWS:

• It would be beneficial to show weighted costs and benefits as part of the literature review. A case study presented in the key finding's handout inform that 96% of studies have shown negative impacts of technical maintenance.

#### Ed Knight, DOTD:

- The Amite River Basin numerical model will be predominately done in December and will look at some of the practices under review, specifically dredging and clearing and snagging.
- The model is showing that dredging of the lower Amite River does not greatly reduce flood elevations.
- Channelization at higher elevations can provide flood control benefit.
- These measures will typically cause damage to the wetland habitat in lower reaches.
   Requires development of numerical model.

#### Natalie Postel, Arcadis:

Could the Amite River Basin Model provide a decision tree for selection of projects?
 <u>Ed Knight:</u> It may be able to provide a generic example.

#### Chuck Berger, DEQ:

- A weir and diversion canal were constructed on the on the Lower Amite River near French Settlement, LA. The design was intended to divert 20% of the flow down the Amite River Diversion Canal and 80% down the Lower Amite River under normal flow conditions. Over the years, the weir has subsided, resulting in approximately 80% of the flow going down the Amite River Diversion Canal and 20% of the flow going down the Lower Amite River. This decrease in flow led to lower stream velocities, which have been a significant contributor to lower dissolved oxygen levels in the Lower Amite River, which triggered the development of TMDLs.
- Dredging can also reduce baseflows by reducing the frequency of water surface elevations that typically reach overbank areas.

#### Ed Knight, DOTD:

- The regulatory considerations should be a precursor to the watershed initiative.
   The Policy TAG can engage legislators for clarification.
- There needs to be more thought about the process of project implementation.
   Example: Decision is made and results in the change of expectation of stream.
- The audience of the report will be legislators and should be reflected in the report.
#### Chuck Berger, DEQ:

- The designated use of streams cannot change.
- The water quality criteria will not change under natural conditions.
- There needs to be some investigation on the impact of hydraulic fracturing and the impact it has on base flows.
  - Arkansas has computed baseflow calculations for all of its streams.

#### Bryan Piazza, TNC:

- There are base flow estimates for most, if not all, streams in Louisiana.
  - 35-year record.
  - Some effort towards the assessment of baseflow needs for streams, allowing for rapid assessment of fish communities.

#### Yvonne Allen:

- Suggested grouping impacts into direct and indirect impacts.
  - Direct Impacts include flow dynamics and flow volume, physical structure of the river bottom and banks and water quality concerns.
  - Indirect impacts include impacts to structures, people, etc.

#### Chuck Berger:

- Reduced water levels will lead to upstream impacts.
  - Reduced water levels at power plant cool water intakes.
  - Impacts to fish communities
  - Reduced channel aesthetics
- Planning projects should consider long-term maintenance of implemented projects. Approaches considering stream geomorphology may present a better long-term investment.

Natalie Postel: If we were to plan a clearing and snagging project what would we consider?

- <u>Ed Knight</u>: There can be some benefits, but it can change the hydrograph downstream. Overall it depends on where the project is implemented.
  - Clearing and snagging projects involve:
    - The cutting of 10-20 feet of the top of bank to allow excavator access.
    - Excavator within the channel, removing all the debris and putting it on the banks.
    - There should be additional consideration of the placement of debris in order to not disturb overland flow hydraulics.
- <u>Chuck Berger:</u> In concurrence with Ed Knight.

#### Bryan Piazza, TNC:

- It can take thousands of years for a stream to reach geomorphic equilibrium.
- Identifying the ecological functionality of streams can be a starting point for project consideration. Then design the landscape to meet the stream where it is functioning ecologically. Using this information, tradeoffs of management objectives can be estimated by experts using good modeling with estimates of the uncertainty.

#### Yvonne Allen, USFWS:

- Could there be a static product that provides highly functioning streams?
- <u>Bryan Piazza, TNC:</u> There could be a high-level product which displays "No-Regret" project locations. This would be followed by good governance where projects can then be assessed by experts through a general management framework.

#### Natalie Postel:

- Could there be impacts to tourism from these practices?
- <u>Chuck Berger:</u> It depends on the type of tourism. It will affect aesthetics for recreational activities. Additionally, the increasing or decreasing of flows could affect kayaking, tubing, and fishing activities.

#### Natalie Postel:

- Is there any way to predict fish populations on a project-by-project basis?
- <u>Bryan Piazza, TNC:</u> It is possible to estimate impacts to fish populations using expected changes in flow characteristics to estimate which fish species would see population decline and which populations may increase.

#### Ed Knight, DOTD:

• It cannot be stressed enough that numerical modeling must occur prior to project implementation. Modeling will inform every part of the equation for determining if a project should be undertaken and will be able to support legislations.

#### Item #3 Next Call Date

- The remaining schedule for the Objective 1 response was discussed and agreed upon.
- Proposed Schedule:
  - Feedback on Draft-Wednesday, December 12, 10:00-11:00 a.m. Central
  - Feedback on Final Draft and Final Slide Deck-Wednesday, January 16 10:00-11:00 a.m. Central

#### Item #4: Feedback Process

- The feedback process will include verbal feedback as recorded in meeting minutes.
- Written feedback can be sent directly to <u>Natalie.Postel@arcadis.com</u>.

#### **Future Meeting Dates**

#### Date Group / Topic

12/12/2018 Feedback on draft response report text



# STAKEHOLDER INPUT TELECONFERENCE CALL SUMMARY DECEMBER 19, 2018, 10:00 A.M. TO 11:00 A.M. CENTRAL

#### Attendees

Matt Weigel, LDWF	Todd Baumann, USGS	Billy Williamson, DOTD
Clint Willson, LSU	Chuck Berger, LDEQ	Natalie Postel, Arcadis
Ed Knight, DOTD	Amanda Vincent, LDEQ	James Jones, Arcadis
Cindy O'Neal, DOTD	Yvonne Allen, USFWS	
Bryan Piazza, TNC	David Walther, USFWS	

#### **Action Items**

Individual(s)	Item	Due Date
Natalie Postel	Send call summary to call participants	January 3, 2019
All Attendees	Provide feedback on draft report of SR-172	January 3, 2019
All Attendees	Discuss and provide feedback on combined	January 16, 2019
	SR-172 draft	

#### **Agenda Items**

#### Item #1 Roll Call

Attendance was taken to document who was on the call.

#### Item #2 Review of Draft Report

Natalie Postel introduced the SR-172 draft report that was distributed prior to the call. It was discussed that although the SR-172 response will include two distinct objectives, the purpose of the call was to discuss the draft report for objective one. Text providing recommendations to establish, implement, and enforce floodplain management plans for each watershed in Louisiana will be completed over the next several weeks, with Carly Foster of Arcadis leading that effort.

#### Item #3 SR-172 Report Discussion

The format of the call was to obtain feedback from each agency represented, with some general feedback and discussion throughout. Arcadis will incorporate feedback into a revised draft report.

#### Clint Willson, LSU:

• Will there be a glossary to define technical terms used within the SR-172 Response?

• <u>Natalie Postel:</u> There is potential for a glossary to be included, with a simplified executive summary being provided to state legislators.

#### Amanda Vincent, DEQ:

• Portions of the report are very technical, and some minor generalities may be beneficial in the report. The presented case studies are good but lacks quantitative information.

#### Chuck Berger, DEQ:

- There needs to be more quantifiable information about economic impacts.
- There could be a recommendation that presented case studies be followed up on, specifically in Louisiana.
- <u>Ed Knight:</u> There is a need for further analysis. That should be a recommendation in the response. Currently, there are not many studies looking at the effect of these projects on small ephemeral streams, but rather on large navigable waterways.
- There may be some data in the future for clearing and snagging projects, related to flood control, through DEQ.
- The document should be cleaned up and reviewed by a technical editor.

#### David Walther, USFWS:

- There needs to be an executive summary at the very beginning of the report. The USFWS may have additional references which look at environmental impacts of these projects.
- There needs to discussion of alternate solutions in the report, such as removing embankments within the floodplain.

#### Yvonne Allen, USFWS:

- Alternate solutions need to be included.
- It could be worthwhile to go to parishes and identify where these projects have taken place and where data is being collected. This data should be used for future studies.
- The case study of the Poudre River should be reviewed and potentially eliminated for being out of context.

#### Todd Baumann, USGS:

- There should be a figure mapping out various statutes and regulations, showing which watersheds are impacted by each respective regulation.
- Will there be any recommendations concerning improved baseline collections of parameters not generally considered, such as sediment and water quality?

#### Clint Willson, LSU:

• The SR-172 Response is well put together, consistent with the level of technical knowledge and reads well at this point in time. There needs to be some thought in changing the document headings to better align with presented content.

#### Bryan Piazza, TNC:

• Have not yet reviewed the document, comments to be provided at a later date.

#### Cindy O' Neal, DOTD:

- There could be more information on the policy, not just on clearing and snagging and channelization, but other alternate solutions. These solutions could be building restrictions and decrease in runoff through regulation.
- Additional comments can be addressed through the Policy TAG.

#### Ed Knight, DOTD:

- There is not a definite solution on approving or rejecting the use of these projects.
- There will need to be modeling studies to determine when to implement projects.
- <u>Natalie Postel, Arcadis:</u> Generally, flood reduction should be quantified in some way because you may not achieve the level of reduction that is anticipated. Legislators should have informed decision making when considering these projects.

#### Chuck Berger, LDEQ:

• One of the recommendations should include studying case studies in Louisiana.

#### Item #3 Next Call Date

- The remaining schedule for the Objective 1 response was discussed and agreed upon.
- Proposed Schedule:
  - Feedback on Final Draft and Final Slide Deck-Wednesday, January 16 10:00-11:00 a.m. Central

#### Item #4: Feedback Process

- The feedback process will include verbal feedback as recorded in meeting minutes.
- Written feedback can be sent directly to <u>Natalie.Postel@arcadis.com</u>.

#### **Future Meeting Dates**

#### Date Group / Topic

01/16/2019 SR 172 Obj 1 and Obj 2 combined report Stakeholder Call



# STAKEHOLDER INPUT TELECONFERENCE CALL SUMMARY JANUARY 23, 2019, 2:30 P.M. TO 3:30 P.M. CENTRAL

#### Attendees

Matt Weigel, LDWF	Cindy O'Neal, DOTD
Clint Willson, LSU	Chuck Berger, LDEQ
Ed Knight, DOTD	Natalie Postel, Arcadis

#### **Action Items**

Individual(s)	Item	Due Date
Natalie Postel	Send call summary to call participants	January 25, 2019
Natalie Postel / Ed	Incorporate feedback on draft #2 report of SR-	February 1, 2019
Knight / Cindy	172	
O'Neal		

#### **Agenda Items**

#### Item #1 Review of Draft #2 Report

Natalie Postel introduced the SR-172 draft #2 report that was distributed by email prior to the call. As of the date of this call, written comments were received via email from Matt Weigel and Chuck Berger. Jeffrey Giering and Sam Martin submitted written comments as part of the working group's review.

#### Item #2 SR-172 Report Discussion

The format of the call was discussing the feedback that was provided in written format. Group expressed desire to have better dredging case studies. Arcadis requested that additional studies be sent if attendees are aware of their existence. Matt Weigel recommended that the tailwater conditions for each dredging analysis be included in the final report. Arcadis will make that change. Matt Weigel also wanted the Allegheny case study removed as it was not the type of dredging that would occur in Louisiana. Arcadis will also make that change.

Senate Resolution 172 Response



Attachment B.2 Investigation into the Potential Hydraulic Impacts of Dredging the Lower Amite River







# Investigation into the Potential Hydraulic Impacts of Dredging the Lower Amite River

Final: January 24, 2019

#### SUBMITTED BY:

**Dewberry Engineers Inc.** 1615 Poydras Street, Suite 650 New Orleans, LA 70112 504.872.3769

#### SUBMITTED TO:

Louisiana Department of Transportation and Development (LA DOTD) 1201 Capital Access Road Baton Rouge, LA 70802 225.379.1232

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# INVESTIGATION INTO THE POTENTIAL HYDRAULIC IMPACTS OF DREDGING THE LOWER AMITE RIVER

#### PURPOSE

The purpose of this investigation is to assess the potential hydraulic impacts of dredging sections of the lower Amite River with the goal of reducing flood elevations. Several dredging alternatives have been modeled. While some of the alternatives studied in this report may reflect excessively large projects, they aim to demonstrate the sensitivity of dredging to guide the development of a more focused feasibility study if desired that refines the magnitude and extent of dredging.

#### **APPROACH**

A limited detail, steady state HEC-RAS hydraulic model was developed leveraging intermediate modeling data from the ongoing Amite River Numerical Model being developed by Dewberry on behalf of LA DOTD. This limited detail model begins at the Highway 42 Bridge in Port Vincent and extends downstream to Lake Maurepas. It includes the Amite River Diversion weir and a portion of the Amite Diversion Canal as illustrated in Figure 1. Simulations include a baseline model geometry referred to as *2017 Without Project Conditions* in addition to three concept dredge alternative *2* and *Alternative 3*. All dredging alternatives were confined to the lateral limits of the existing river banks.

The Without Project Conditions and each alternative simulation was developed utilizing a steady state discharge applied to the upstream most cross section adjacent to USGS Gage 07380120 Amite River at Port Vincent, LA. Six flood profiles were developed representing the August 2016 observed discharge at Port Vincent adjusted for lateral flow losses in addition to the 5-, 10-, 25-, 50- and 100-year probabilistic flood discharges derived from historical annual peak discharges at USGS Gage 07380120. For the August 2016 profile, a fixed boundary condition

elevation of 4.6 feet NAVD88 was applied to the downstream most cross section of each reach. This boundary condition is based on the observed conditions for the August 2016 flood event as recorded by the Coastal Reference Monitoring System (CRMS) gage CRMS0061-H01-RT converted to the NAVD88 vertical datum. For the probabilistic profiles, a Mean Higher High Water (MHHW) elevation of 1.5 feet NAVD 88 was assumed for the downstream boundary. In order to determine the magnitude of the MHHW, a search of tide gauges was conducted online using the NOAA Tides and Currents website. While there are no active tide stations in Lake Maurepas, a deactivated tide station was located on the west end of Pass Manchac at US Highway 51 which was active between November 1982 and January 1991 and was used to estimate the MHHW.





#### 2017 Without Project Conditions Model Development

The 2017 Without Project Conditions model geometry was developed as a baseline to represent existing on the ground conditions. A baseline comparison to the project alternatives allows the potential impacts of the dredging to be determined.

Lateral flow losses from the Amite River were modeled in the vicinity of the western, upstream most confluence with the Old River (hereinafter referred to as Confluence with the Old River) using lateral structures. Additional flow losses were modeled towards the lower river where flows from preliminary two-dimensional models can be observed to spill into the right over bank and travel south to Lake Maurepas. Geometric data sources used to develop the model included:

- 2017 USACE bathymetric survey
- 2017-2018 bridge survey and Amite Diversion Weir survey performed by Forte & Tablada
- NOAA Nautical chart 11369, Edition 48 (for the mouth of Lake Maurepas)
- 2007 Statewide LiDAR data from https://atlas.ga.lsu.edu/

A limited calibration was performed on the 2017 Without Project Conditions model using observed flows and known high-water marks from the August 2016 flood event. The model was demonstrated to generally match within 6 inches of the observed high water marks for both the main river channel and diversion canal. For this updated study, the geometry for the Amite Diversion Weir was coded using 2017 survey of the weir collected by Forte & Tablada as a subcontractor to Dewberry. The survey included the full weir crest and sections through the weir openings including the boat passage. A weir coefficient of 1.0 (U.S. Customary Units) was assumed. This number would seem very low compared to the HEC-RAS default value of 2.6 for a broad crested weir, however, this was considered to be more appropriate given the submerged conditions experienced at the weir. Table 1 provides a summary of the modeled flow split at the Amite Diversion Canal. Currently there is no observed discharge data available to validate this assumption. Ongoing coordination between LA DOTD and the USGS may result in future gauged discharge measurements of the weir which will provide further data to validate and update model assumptions and parameters if refinements are needed.

Table 1 - Estimated Flow Split at the Amite Diversion Canal

Flood Profile	Flow Remaining in the Amite River	Flow Diverting into Canal
August 2016	54%	46%
5-YR	47%	53%
10-YR	48%	52%
25-YR	49%	51%
50-YR	51%	49%
100-YR	52%	48%

Figure 2 illustrates the profile of the Amite River within the study area for the 2017 Without Project Conditions simulation of the August 2016 flood. Key observations from the profile include:

- The river bed generally exhibits a negative slope from Port Vincent to Lake Maurepas with channel inverts reaching as low as -49 feet NAVD88 about midway between Lake Maurepas and Port Vincent while invert elevations at the mouth of the river at Lake Maurepas are approximately -4.4 feet NAVD88.
- The river bed appears to rise approximately 10-12 feet immediately downstream of the Amite River Diversion weir. This rise appears to continue for approximately 12 miles in the downstream direction.
- A very flat hydraulic slope of 0.00001 is observed from Lake Maurepas upstream to the confluence with the Old River. In the vicinity of this confluences, a distinct hydraulic grade inflection is observed. Upstream of the Old River confluence, the hydraulic grade is approximately 4 times steeper.

#### **Dredge Alternative 1 Model Development**

The Alternative 1 model geometry was developed to simulate dredging of the Amite River from the mouth of Lake Maurepas to a point approximately 10 miles upstream. At the mouth of Lake Maurepas, it was assumed that the existing river bed would be dredged to an elevation of -35 feet NAVD88 to support a positive bed slope for the lower section of river. The maximum dredge depth would be approximately 30 feet at the mouth and the average dredge depth would be approximately 5 feet. Approximately 2 million cubic yards of dredged material would need to be removed from the Lower Amite River.

While this represented an excessively deep dredge resulting in invert elevations lower than in Lake Maurepas, it provides an insight into the potential impacts of the shallow mouth to Lake Maurepas and serves as a demonstration of whether the underlying concept of dredging the mouth of the Amite River would have beneficial impacts on flood elevations.

Figure 3 illustrates this concept utilizing the modeled August 2016 flood profile.

#### **Dredge Alternative 2 Model Development**

The Alternative 2 model geometry was developed to simulate removal of the elevated river bed found immediately downstream of the Amite River Diversion weir. The dredging would begin adjacent to the diversion weir and extend to a point approximately 12 miles downstream near the confluence with the Old River. The maximum dredge depth would be approximately 20 feet and the average dredge depth would be approximately 10 feet. Approximately 3 million cubic yards of dredged material would need to be removed from the Amite River.

Figure 4 illustrates this concept utilizing the modeled August 2016 flood profile.

#### **Dredge Alternative 3 Model Development**

The Alternative 3 model geometry was developed to simulate a larger dredging of the Amite River from the mouth of Lake Maurepas, upstream to Port Vincent (approximately 34 miles). The maximum dredge depth would be approximately 30 feet at the mouth and the average dredge depth would be approximately 7 feet. Approximately 8 million cubic yards of dredged material would need to be removed from the Amite River.

Figure 5 illustrates this concept utilizing the modeled August 2016 flood profile.

#### NATIONAL WEATHER SERVICE FLOOD STAGES

The National Weather Service (NWS) flood stages at USGS gage 07380200, Amite River near French Settlement, LA, located at the Highway 16 bridge provide an insight into critical flood stages that result in flooding. The NWS defines four stages at this stream gage with the following elevations (converted to NAVD88) and definitions:

Major Flood Stage (7.1 feet NAVD 88)

• Extensive inundation of structures and roads. Significant evacuations of people and/or transfer of property to higher elevations.

Moderate Flood Stage (5.1 feet NAVD 88)

 Some inundation of structures and roads near streams. Some evacuations of people and/or transfer of property to higher elevations.

Minor Flood Stage (3.1 feet NAVD 88)

• Minimal or no property damage, but possibly some public threat or inconvenience.

Action Stage (2.1 feet NAVD 88)

• The stage which, when reached by a rising stream, represents the level where the NWS or a partner/user needs to take some type of mitigation action in preparation for possible significant hydrologic activity.

#### **ALTERNATIVE RESULTS**

The 3 project alternatives would result in the following approximate dredge volumes:

- Alternative 1 2 million cubic yards
- Alternative 2 3 million cubic yards
- Alternative 3 8 million cubic yards

Tables 2 provides a summary of the maximum and minimum range of impacts for each modeled flood profile for the three project Alternatives. Tables 3 through 8 summarize the results of this study for individual flood profiles at reference points along the Amite River.

#### CONCLUSIONS

- Dredging of the Amite River near and at the mouth of Lake Maurepas as demonstrated by Alternative 1 appears to result in negligible reductions in the water surface elevations for the August 2016 flood profile. This is because the lower river flood elevations are largely controlled by Lake Maurepas which is predominantly influenced by lunar driven tides and wind setups.
- Modeled probabilistic floods for Alternative 1 which utilized a MHHW boundary condition (approximately 3 feet lower than the August 2016 boundary condition) result in reductions in flood elevation in the lower river as great as -0.33 foot, however these benefits are generally only experienced below minor flood stages and therefore would result in only negligible flood reduction benefits.
- Review of the flood profiles suggest that the Amite River flood elevations become less controlled by Lake Maurepas in the general vicinity of the confluence of the Old River. From this point upstream, as demonstrated by Alternative 2, dredging appears to have greater benefits and generally reduces water surface elevations by up to -0.48 foot for most flood profiles.

- Reductions in water surface elevation in the vicinity of the Amite River Diversion weir reduce the flow over the weir, increasing flow along the Amite River downstream of the weir and potentially causing minor increases in water surface elevation.
- If modifications were performed to the Amite River Diversion weir in conjunction with dredging of the Amite River in the vicinity of the weir, increases in downstream water surface elevations could potentially be eliminated as a result of flows going over the Amite River Diversion Weir being restored to pre-project conditions. This will also have the potential benefit of further reducing flood elevations slightly along the Amite River as a result of restored (reduced) flows downstream of the weir during flood stages like those experienced in 2016.
- Alternative 3 results in slightly greater but more extensive benefits upstream of the Old River when compared to Alternative 1, however it would require a significantly larger dredge effort.

#### RECOMMENDATIONS

- It is recommended that any further dredging study of the Lower Amite River focus on the sections of river demonstrated by this report to respond more positively to dredging. This is generally considered to be the river close to and upstream of the confluence with the Old River as demonstrated by Alternative 2.
- Due to the relatively low elevations associated with minor and moderate flood stages in the lower Amite River, reductions in elevations as little as 0.5 as demonstrated by Alternative 2 will potentially result in significant flood reduction benefits. It is recommended that these benefits be quantified.

- It is recommended that any further detailed dredging investigation be performed concurrently with the investigation of the potential rehabilitation of the Amite River Diversion weir.
- If there is an interest in implementing dredging of the Amite River, a formal feasibility study should be conducted developing a broad array of project alternatives which optimize the dredge extent and depths using a system wide approach to modeling for the Lower Amite River. The feasibility study should include (but not be limited to):
  - Utilization of the Amite River Numerical Model HEC-HMS and HEC-RAS components which are currently under development to assess water surface elevations and further investigate and refine dredge configurations for a variety of flood events and boundary conditions.
  - Modeling and investigating reconfiguration of the weir to offset any increased water surface elevations during flood conditions.
  - Assessing and quantifying the potential residual benefits of dredging which results in cleaner channels and consequential reductions in hydraulic roughness which may further reduce flood elevations and improve recreational navigation.
  - Utilization of the Amite River Numerical Model HEC-FIA component to quantify project benefits and compare to estimated project implementation costs.
  - An assessment of other factors including but not limited to water quality, environmental, cultural resources, geotechnical, navigation,

dredge methods, dredge material disposal and potential reuse.

- Performance of an assessment of long term operations and maintenance needs and costs.
- Assessment of all potential permits.
- Identification and engagement of potential stakeholders.



Figure 2 – Bed profile of the Amite River from Lake Maurepas to Port Vincent for the August 2016 Without Project Conditions simulation with known high water marks annotated



Figure 3 - Bed profile of the Amite River Dredge Alternative 1 using the August 2016 discharges

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Figure 4 - Bed profile of the Amite River Dredge Alternative 2 using the August 2016 discharges



Figure 5 - Bed profile of the Amite River Dredge Alternative 3 using the August 2016 discharge

#### Table 2 - Summary of Impacts for Project Alternative 1 - 3

	Alternative 1		Alterna	ative 2	Alternative 3		
Hydrologic Event	Minimum Impact	Maximum Impact	Minimum Impact	Maximum Impact	Minimum Impact	Maximum Impact	
August 2016 Flood*	-0.05	0.00	-0.34	0.16	-0.39	0.12	
5-Year Flood**	-0.11	0.00	-0.48	0.24	-0.53	0.13	
10-Year Flood**	-0.16	0.00	-0.48	0.28	-0.52	0.14	
25-Year Flood**	-0.23	0.00	-0.44	0.32	-0.49	0.15	
50-Year Flood**	-0.29	0.00	-0.41	0.29	-0.45	0.10	
100-Year Flood**	-0.33	0.00	-0.40	0.29	-0.45	0.09	

\* With observed elevation downstream boundary condition \*\* With MHHW downstream boundary condition

Reference Point	Without Project Conditions	Alternative 1	Alternative 2	Alternative 3	Alternative 1 Impacts	Alternative 2 Impacts	Alternative 3 Impacts
Highway 42 at Port Vincent	15.91	15.90	15.79	15.66	-0.01	-0.12	-0.25
Approximately 2 miles downstream of Highway 42	13.76	13.76	13.57	13.49	0.00	-0.19	-0.27
Adjacent to the Amite River Diversion Weir	11.83	11.82	11.49	11.44	-0.01	-0.34	-0.39
Just downstream of Highway 16	8.69	8.68	8.42	8.45	-0.01	-0.27	-0.24
Confluence with the Old River	5.96	5.95	6.08	6.06	-0.01	0.12	0.10
Approximately 2 miles downstream of the Confluence with the Old River	5.75	5.74	5.91	5.87	-0.01	0.16	0.12
Approximately 6 miles upstream of Highway 22	5.29	5.24	5.45	5.39	-0.05	0.16	0.10
Approximately 3 miles upstream of Highway 22	5.03	4.99	5.14	5.11	-0.04	0.11	0.08
Just upstream of Highway 22	4.84	4.82	4.91	4.90	-0.02	0.07	0.06
Approximately 3 miles upstream from Lake Maurepas	4.64	4.63	4.66	4.65	-0.01	0.02	0.01
Amite River at the Mouth of Lake Maurepas	4.60	4.60	4.60	4.60	0.00	0.00	0.00
				Maximum Increase	0.00	0.16	0.12
				Maximum Decrease	-0.05	-0.34	-0.39

#### Table 3 - Water surface elevations (Feet NAVD88) and comparison for the August 2016 flood profiles

Reference Point	Without Project Conditions	Alternative 1	Alternative 2	Alternative 3	Alternative 1 Impacts	Alternative 2 Impacts	Alternative 3 Impacts
Highway 42 at Port Vincent	7.55	7.55	7.34	7.13	0.00	-0.21	-0.42
Approximately 2 miles downstream of Highway 42	6.55	6.55	6.23	6.13	0.00	-0.32	-0.42
Adjacent to the Amite River Diversion Weir	5.59	5.59	5.11	5.06	0.00	-0.48	-0.53
Just downstream of Highway 16	3.97	3.96	3.74	3.74	-0.01	-0.23	-0.23
Confluence with the Old River	2.55	2.52	2.71	2.67	-0.03	0.16	0.12
Approximately 2 miles downstream of the Confluence with the Old River	2.40	2.35	2.60	2.53	-0.05	0.20	0.13
Approximately 6 miles upstream of Highway 22	1.99	1.88	2.23	2.11	-0.11	0.24	0.12
Approximately 3 miles upstream of Highway 22	1.83	1.73	2.00	1.91	-0.10	0.17	0.08
Just upstream of Highway 22	1.73	1.65	1.85	1.77	-0.08	0.12	0.04
Approximately 3 miles upstream from Lake Maurepas	1.64	1.57	1.72	1.63	-0.07	0.08	-0.01
Amite River at the Mouth of Lake Maurepas	1.50	1.50	1.50	1.50	0.00	0.00	0.00
				Maximum Increase	0.00	0.24	0.13
				Maximum Decrease	-0.11	-0.48	-0.53

#### Table 4 - Water surface elevations (Feet NVD88) and comparison for the 5-year flood profiles

Reference Point	Without Project Conditions	Alternative 1	Alternative 2	Alternative 3	Alternative 1 Impacts	Alternative 2 Impacts	Alternative 3 Impacts
Highway 42 at Port Vincent	9.03	9.03	8.83	8.65	0.00	-0.20	-0.38
Approximately 2 miles downstream of Highway 42	7.86	7.86	7.55	7.47	0.00	-0.31	-0.39
Adjacent to the Amite River Diversion Weir	6.77	6.77	6.29	6.25	0.00	-0.48	-0.52
Just downstream of Highway 16	4.78	4.78	4.53	4.55	0.00	-0.25	-0.23
Confluence with the Old River	3.02	2.98	3.17	3.14	-0.04	0.15	0.12
Approximately 2 miles downstream of the Confluence with the Old River	2.83	2.77	3.04	2.97	-0.06	0.21	0.14
Approximately 6 miles upstream of Highway 22	2.28	2.12	2.56	2.41	-0.16	0.28	0.13
Approximately 3 miles upstream of Highway 22	2.05	1.89	2.25	2.13	-0.16	0.20	0.08
Just upstream of Highway 22	1.88	1.75	2.03	1.92	-0.13	0.15	0.04
Approximately 3 miles upstream from Lake Maurepas	1.74	1.63	1.83	1.71	-0.11	0.09	-0.03
Amite River at the Mouth of Lake Maurepas	1.50	1.50	1.50	1.50	0.00	0.00	0.00
				Maximum Increase	0.00	0.28	0.14
				Maximum Decrease	-0.16	-0.48	-0.52

#### Table 5 - Water surface elevations (Feet NVD88) and comparison for the 10-year flood profiles

#### Table 6 - Water surface elevations (Feet NVD88) and comparison for the 25-year flood profiles

Reference Point	Without Project Conditions	Alternative 1	Alternative 2	Alternative 3	Alternative 1 Impacts	Alternative 2 Impacts	Alternative 3 Impacts
Highway 42 at Port Vincent	10.90	10.90	10.72	10.56	0.00	-0.18	-0.34
Approximately 2 miles downstream of Highway 42	9.54	9.54	9.26	9.18	0.00	-0.28	-0.36
Adjacent to the Amite River Diversion Weir	8.31	8.31	7.87	7.82	0.00	-0.44	-0.49
Just downstream of Highway 16	5.86	5.85	5.60	5.62	-0.01	-0.26	-0.24
Confluence with the Old River	3.71	3.69	3.88	3.83	-0.02	0.17	0.12
Approximately 2 miles downstream of the Confluence with the Old River	3.48	3.43	3.72	3.63	-0.05	0.24	0.15
Approximately 6 miles upstream of Highway 22	2.79	2.59	3.11	2.92	-0.20	0.32	0.13
Approximately 3 miles upstream of Highway 22	2.43	2.20	2.68	2.51	-0.23	0.25	0.08
Just upstream of Highway 22	2.17	1.97	2.36	2.20	-0.20	0.19	0.03
Approximately 3 miles upstream from Lake Maurepas	1.92	1.74	2.04	1.85	-0.18	0.12	-0.07
Amite River at the Mouth of Lake Maurepas	1.50	1.50	1.50	1.50	0.00	0.00	0.00
				Maximum Increase	0.00	0.32	0.15
				Maximum Decrease	-0.23	-0.44	-0.49

Reference Point	Without Project Conditions	Alternative 1	Alternative 2	Alternative 3	Alternative 1 Impacts	Alternative 2 Impacts	Alternative 3 Impacts
Highway 42 at Port Vincent	12.30	12.30	12.13	11.97	0.00	-0.17	-0.33
Approximately 2 miles downstream of Highway 42	10.78	10.78	10.52	10.44	0.00	-0.26	-0.34
Adjacent to the Amite River Diversion Weir	9.43	9.43	9.02	8.98	0.00	-0.41	-0.45
Just downstream of Highway 16	6.75	6.74	6.48	6.50	-0.01	-0.27	-0.25
Confluence with the Old River	4.35	4.31	4.48	4.43	-0.04	0.13	0.08
Approximately 2 miles downstream of the Confluence with the Old River	4.10	4.04	4.29	4.20	-0.06	0.19	0.10
Approximately 6 miles upstream of Highway 22	3.32	3.08	3.61	3.40	-0.24	0.29	0.08
Approximately 3 miles upstream of Highway 22	2.86	2.57	3.10	2.89	-0.29	0.24	0.03
Just upstream of Highway 22	2.50	2.23	2.68	2.49	-0.27	0.18	-0.01
Approximately 3 miles upstream from Lake Maurepas	2.14	1.88	2.25	2.00	-0.26	0.11	-0.14
Amite River at the Mouth of Lake Maurepas	1.50	1.50	1.50	1.50	0.00	0.00	0.00
				Maximum Increase	0.00	0.29	0.10
				Maximum Decrease	-0.29	-0.41	-0.45

#### Table 7 - Water surface elevations (Feet NVD88) and comparison for the 50-year flood profiles

Reference Point	Without Project Conditions	Alternative 1	Alternative 2	Alternative 3	Alternative 1 Impacts	Alternative 2 Impacts	Alternative 3 Impacts
Highway 42 at Port Vincent	13.71	13.71	13.56	13.43	0.00	-0.15	-0.28
Approximately 2 miles downstream of Highway 42	12.04	12.04	11.80	11.72	0.00	-0.24	-0.32
Adjacent to the Amite River Diversion Weir	10.60	10.60	10.20	10.15	0.00	-0.40	-0.45
Just downstream of Highway 16	7.66	7.65	7.40	7.42	-0.01	-0.26	-0.24
Confluence with the Old River	5.02	4.99	5.16	5.10	-0.03	0.14	0.08
Approximately 2 miles downstream of the Confluence with the Old River	4.75	4.69	4.95	4.84	-0.06	0.20	0.09
Approximately 6 miles upstream of Highway 22	3.90	3.65	4.19	3.97	-0.25	0.29	0.07
Approximately 3 miles upstream of Highway 22	3.35	3.03	3.61	3.37	-0.32	0.26	0.02
Just upstream of Highway 22	2.89	2.58	3.10	2.87	-0.31	0.21	-0.02
Approximately 3 miles upstream from Lake Maurepas	2.39	2.06	2.52	2.21	-0.33	0.13	-0.18
Amite River at the Mouth of Lake Maurepas	1.50	1.50	1.50	1.50	0.00	0.00	0.00
				Maximum Increase	0.00	0.29	0.09
				Maximum Decrease	-0.33	-0.40	-0.45

#### Table 8 - Water surface elevations (Feet NVD88) and comparison for the 100-year flood profiles



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# **APPENDIX C**

**Part 3 Attachments** 

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Attachment C.1 Technical Advisory Group Council Briefing

# TECHNICAL ADVISORY GROUPS

# Roles

#### **ROLE IN THE INITIATIVE**

- Make sure the Council has the best information to make decisions
- Provide transparency into the decision making process

### RESPONSIBILITIES

- Identify key stakeholders, and help ensure these perspectives are represented
- Identify any additional relevant issues and pertinent questions around data and information collection, management, and processing
- Identify any additional research, resources or support that will be needed to respond to the questions
- Identify, analyze and evaluate a multitude of possible strategies to address the issues and questions at hand and how those strategies might interact with program development, implementation and execution
- Present initial recommendations to the Council and develop final recommendations to be included in the Program Framework and Implementation Plan)



## TAGs ARE EMPOWERED TO:

- Define the process needed to answer the questions
- Form committees as needed
- Reach out to outside entities, groups, people, as needed (keeping the TAC chair and Program Manager informed)
- Identify the need for / ask for additional resources and contract support
- Identify additional stakeholders as needed

#### TAG DEVELOPMENT PROCESS

- Step 1. Convene state agency experts to:
  - Ensure we're asking the right questions
  - Identify stakeholders that could inform, support, benefit from, or be affected by the outcome / recommendations of the TAC
  - Recommend initial TAC members, process, and key milestones
  - Present proposed TAC membership and work plan for Council approval
- Step 2. Convene initial TAC members to confirm we have the right people, process, questions
- Step 3. Conduct engagement and coordination process to ensure TAC objectives are met



#### LOUISIANA WATERSHED INITIATIVE

### WORKING TOGETHER FOR SUSTAINABILITY AND RESILIENCE

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Attachment C.2 Initial Plan for Build Out of the "Everything Flood Related Website and Data Portal"



# "EVERYTHING FLOOD RELATED"

# WEBSITE INITIAL PLAN DRAFT

#### Last updated November 19, 2018

This scope represents the goals and possible content for the website based on stakeholder engagement through Phase I (November to February 2018), CPRA's Flood Risk and Resilience Program Capacity and Capability Assessment (April to August 2018), and the Statewide Listening Tour (October to November 2018).

# WHAT IS THE GOAL OF THE SITE?

- To provide Louisiana flood-related stakeholders a single portal that can be used to submit and access all flood-related information relevant to the state, including, but not limited, to data, information, and applications
- To serve a public relations and communications role and connect audiences with important information from the Initiative

USER GROUP	FEATURES REQUESTED DURING ENGAGEMENT				
Public	General information about the initiative, education about key concepts and value				
	propositions (what is a watershed? Project and policy specific case studies), self-help and				
	empowerment content and publications (how-to guides, mapping tool)				
	Links to related websites and resources				
	Projects tracker				
	• Geospatial viewing capability to see location of projects that are proposed, those selected, and status of those being implemented				
	Collaborative tool to allow public to contribute to flood risk-related reporting and to				
	make information on historical flood timing and extent available for viewing				
Technical users	Data aggregation from multiple sources				
(modelers,	• Measured data (historic/current)				
engineers, technical	Model output (predicted)				
specialists)	Data upload and repository				
	Data access and download				
	Model information (version, domain, code, inputs, etc.)				
	Mapping tool				
	• To explore: Possibility of being able to pull information from a variety of sources				
	into a single mapping tool				
	Confirmation of quality, coverage, dates of submittal for data on the site				
	Standard data maintenance policy				

# WHO WILL BE THE TARGET AUDIENCE/USERS?



USER GROUP	FEATURES REQUESTED DURING ENGAGEMENT			
	Mechanism for QA/QC for user-submitted data			
	Best practice library			
	Training materials and curricula			
	Links to related websites and resources			
Funding applicants	Place to link to all related funding sources and information about funding sources			
	Joint application portal for multiple state funding programs			
	• Project proposal submission function - tool for users to submit their project			
	proposals and projects to be evaluated, and for the public to see what projects			
	have already been submitted			
	Tracking of review			
	Grants and project management portal			
	Submittal of progress reports, documentation			
	Project tracking			
	Links to related websites and resources			
Local governments	Tracking system for information submitted by local governments that all state agencies			
	can access (to avoid redundant submittals)			
	Flood risk engagement and communication materials			
	Training materials and curricula for local staff			
	Online decision tools for land use and project decisions			
	Best practice and case study library (local funding generation, policy, projects, planning,			
	engagement, etc.)			
	Model ordinances, engagement templates, RFP templates, standard operating procedures,			
	etc.			
	Links to related websites and resources			

# WHAT OTHER GENERAL FEATURES HAVE BEEN REQUESTED?

- Option to enter feedback
  - About the site and its content / ease of use
  - o Generally and specifically
  - o On public documents prior to adoption by Council
- Interactive blog and FAQs
- User specific notification options
- Streamlined information on specific topics from multiple sources
- Standards, data, etc. able to be updated as needed
- Mechanism to allow parties to submit websites for consideration to be linked into the port
- Calendar of events
- Contacts
- Track user activities on the website (such as through Google Analytics) to guide future website improvements



• Access to staff available to answer questions and provide support for use of the site

### WHAT DON'T WE WANT THE WEBSITE TO DO?

- Supplant or duplicate other existing resources (avoid version-control issues and duplication)
- Be a static site

# WHEN DO WE WANT TO BE ABLE TO USE THE SITE?

Site is up in basic fashion as of September 25, 2018. Goal is to continue to build out catalyst and short-term features through December 2018 and begin working on longer-term features in early / spring of 2019.

# WHAT FEATURES CAN BE CONSIDERED CATALYST (IMMEDIATE), SHORT-TERM, AND LONG-TERM? WHAT FEATURES REQUIRE FURTHER COORDINATION BEFORE THEY CAN BE CONFIRMED FOR IMPLEMENTATION?

CATALYST FEATURES	SHORT-TERM FEATURES	LONG-TERM FEATURES	MORE COORDINATION NEEDED
<ul> <li>Information about the Initiative and how to get involved</li> <li>Feedback portal and speaker requests</li> <li>Calendar</li> <li>FAQs</li> <li>News</li> <li>Links to connect to live meetings</li> <li>Repository for meeting content</li> <li>Links to relevant agencies, websites, resources</li> <li>Public review and comment feature</li> <li>Program publications, as developed</li> </ul>	<ul> <li>Links to flood risk reduction resources, clear policy and project value propositions, etc.</li> <li>Coordinated and organized links to data</li> <li>Outcomes of data gap analysis and explanation of status of existing data in the state</li> <li>Metrics and loss avoidance reports posting</li> <li>Landing pages by audience type</li> <li>Flood risk engagement materials and risk communication</li> <li>Guidance on requirements/inspec tions/scope</li> </ul>	<ul> <li>Standards and policies related to data</li> <li>Metadata, rating of data to clarify QA/QC, maintenance, and standards compliance</li> <li>Data portal (or links to regional portals) and library (hold all local, state, and federal datasets regarding surface water, flood risk, training, etc.)</li> <li>Online decision making tools</li> <li>Mapping tools (to enable application and use of the data by locals,</li> </ul>	<ul> <li>Grant management portal</li> <li>Joint funding application portal and funding clearing house (long- term)</li> <li>A tracking system to unify information needed by and sent to multiple agencies</li> <li>Permitting support tools</li> <li>Project tracking tools</li> </ul>



CATALYST FEATURES	SHORT-TERM FEATURES	LONG-TERM FEATURES	MORE COORDINATION NEEDED
• Announce availability of new information	<ul> <li>alignment to keep parishes aligned</li> <li>Library for best practices and standards</li> <li>Funding information and best practices, including links to sources</li> <li>Findings from Standards Substantiation and Economic Benefits study (performed by the State)</li> <li>Project awards/candidate projects by parish</li> <li>Example best practice ordinances for parishes/cities/tow ns</li> <li>Resident-level information (how residents can positively contribute to flood risk mitigation in their own communities – support more responsible development practices, importance of detention/retention ponds, low impact development techniques, runoff impacts, etc.)</li> </ul>	specialists, & general public)	



# WHO ARE THE STAKEHOLDERS TO ENGAGE AS WE PROCEED WITH IMPLEMENTATION?

KEY USERS	IT NEEDS AND SOLUTIONS	FUNCTIONAL NEEDS AND SOLUTIONS (PRACTICAL)	PUBLIC FACING NEEDS AND SOLUTIONS
Regions / parishes	• OTS	• Data TAG	• PR TAG
/cities /towns	• CPRA	<ul> <li>Projects TAG</li> </ul>	<ul> <li>Engagement</li> </ul>
<ul> <li>Subject matter</li> </ul>	<ul> <li>Similar websites</li> </ul>	Policy TAG	TAG
experts	(see below)	• Key users	• Key users
• Academia			
Other agencies			
• Statewide			
associations			
/industry			
stakeholders			
General public			
• Business,			
construction, and			
development			
community			
• Finance and			
insurance industry			

## WHAT ARE ADDITIONAL OUTSTANDING QUESTIONS?

- How will data be displayed?
- Who will have permissions, and at what level?
- Who will liaison with other data sites to work out details of interlinking?

# SAMPLE SITES USED BY OTHER STATES OR GROUPS

- Consortium of Universities for the Advancement of Hydrologic Science Inc. (CUAHSI) https://www.cuahsi.org/ http://data.cuahsi.org/ https://www.hydroshare.org/
- North Carolina Flood Risk Information System <u>https://fris.nc.gov/fris/Home.aspx?ST=NC</u>
- Harris County Flood Control District <u>https://www.hcfcd.org/</u>
- Colorado Water Conservation Board <u>http://cwcb.state.co.us/Pages/CWCBHome.aspx</u>
- Illinois Watershed Plans (shows an example of each of the approved plans on one page as .pdf files) <u>https://www2.illinois.gov/epa/topics/water-quality/watershed-management/watershed-based-planning/Pages/default.aspx</u>

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Attachment C.3 Description of Data Reports Under Development

# Description of Data Reports Under Development

The following documents are in draft form and expected to be finalized by the March meeting of the Council on Watershed Management:

- A **data gap analysis** for the highest priority datasets for flood risk modeling and project identification. The analysis describes the dataset, the status of the data, potential issues/gaps, and anticipated future steps or needs related to the dataset for all priority datasets. Priority data sets covered include high quality elevation data, hydrography, river flow and stage, rainfall, conveyance structures and hydraulic structures, water quality, ecological and biological responses, assessor and built asset inventory, aerial photographs and imagery, historical flood data). The paper also includes a description of the availability, quality, and potential next steps for impervious surface, land cover, buildings / structures, soils, wetlands, bathymetry, and wave heights. As an example of the outcome of this investigation, the Data TAG is completing an implementation plan for the placement and maintenance of high priority gages statewide
- White papers that provide briefings on the use, location, availability, and how to contribute to all datasets covered in the workshops. Includes:
  - o NHD/WBD/LIDAR White Paper
  - o Historical Flood Data White Paper
  - River and Rain gages white paper
  - Water Quality white paper
  - o Ecological/ Biological White Paper
  - o Hydraulic Structures/Bridges and Roads White paper
- A data standards memorandum that provides a summary of existing state and federal data standards for each dataset identified in the preliminary data list, comparisons of standards when more than one set exists, and recommendations on standards for use by the Louisiana Watershed Initiative
- A data quality assessment provides a description of the framework/process for QA/QC of newly collected data that should be performed before it adopted/accepted into any overall database maintained by the Initiative or other data stewards. The document includes examples of other organizations and their QA/QC procedures as potential examples to be followed by the Initiative. The document describes what data may reasonably be collected through the Initiative and minimum quality control measures that may be considered. Where applicable, the describes acceptable data formats, references to standards recommended in the data standards memo
- A conceptual framework for data delivery based on case studies, such as North Carolina, Harris County, and the Consortium of Universities for the Advancement of Hydrologic Science, Inc. The document provides pros and cons for each possible framework along with a description of Louisiana Watershed Initiative needs and recommendations




Attachment C.4 Implementation Roadmap Progress by Strategic Area of Focus



# PHASE I IMPLEMENTATION ROADMAP PROGRESS BY STRATEGIC AREA OF FOCUS

From the Phase I investigation, the Council identified long-term outcomes for six areas to focus the development of floodplain management plans for each watershed in Louisiana. Table 1 lists the strategic areas and desired outcomes.

Strategic Area	Desired Outcome
Data	H&H models and data for each watershed that are used for land use,
	policy decision-making, and project evaluation.
Engagement	Stakeholders from all sectors and corners of the state have contributed and
	bought into the program and its outcomes.
Standards	Jurisdictions across Louisiana lead in understanding and developing
	standards that align with state objectives, while the State of Louisiana
	adopts these standards and adheres to them before asking watersheds,
	parishes or municipalities to do so.
Funding	Sustainable funding sources for each watershed to meet near and long-
	term project and maintenance needs, with support and leadership from the
	State.
Capability and Capacity	Watersheds, jurisdictions, and the State have the resources, staff, skills,
	and tools necessary to effectively reduce existing flood risk and limit
	future risk through future development, redevelopment and project
	implementation.
Integrated Planning	Each watershed has a floodplain management plan developed by its
	member parishes and aligned with the state floodplain management plan.
	The state plan is supported by existing programs and state agencies.

Table 1 Six Strategic Areas for Floodplain Management Plan Development

The statuses of meeting the desired outcomes for each strategic area are described below by action identified in the Phase I implementation roadmap. More detail on each strategic area is available within the Phase I report (Louisiana Watershed Coordinating Agencies 2018).



# STRATEGIC AREA 1: COLLECTING, DEVELOPING, MANAGING, PROCESSING, AND SHARING DATA

**Phase I Premise**: Information and data is the foundation for all analysis, decision making, and management of the floodplain and associated watersheds. This information and data must be as complete as possible, relevant, current, of appropriate quality, and as consistent as possible to ensure wise decision making and appropriate action. This information and data must be processed using impartial methods and industry best practices and tools to ensure that it is put to sound use.

Actions <sup>1</sup>	Status	Details
1.1 Ensure that data presently collected are available to those who need it, with clear metadata defining source and status	IN PROGRESS	Initial website complete with short and long term content plan developed. The Initiative developed white papers on priority data sets to inform users of where data is available, how it can be used, and how users can contribute to the data set. Initiative data gap analysis, data quality assessment, and data delivery recommendations complete. Mapping tool planned for 2019.
1.2 Identify and fill critical data and data collection process gaps	IN PROGRESS	Initial data gap analysis with recommendations complete.
1.3 Define a quality control and maintenance process for future data collection	IN PROGRESS	Initial data quality assessment complete.
1.4 Develop and enforce minimum standards for dynamic watershed models	IN PROGRESS	Minimum standards identified for priority data list.
1.5 Ensure that models adhering to specific minimum standards are developed for every watershed	IN PROGRESS	Modeling implementation plan in progress. Outreach and policy investigations related
1.6 Ensure that dynamic watershed models are used in decision making	IN PROGRESS	to this topic planned for 2019.

<sup>&</sup>lt;sup>1</sup> The Phase I report referred to these actions as "Initiatives," and the steps to achieve the desired outcome of the Initiative as "actions." Nevertheless, to avoid confusion with the Louisiana Watershed Initiative, which was developed as a result of the Phase I investigation and is the whole of each of these initiatives, this SR 172 response has changed the terminology



## STRATEGIC AREA 2: EXPANDING AND REFINING ENGAGEMENT AND TRUST BUILDING

**Phase I premise:** Engagement must be thorough and widespread to understand and address floodplain, flood risk, and watershed management related needs.

Actions	Status	Details
2.1a Ensure that the right stakeholders are	IN PROGRESS	During Phase I, stakeholders were
involved to build consensus around program		interviewed to support the plan for the
planning and implementation		Initiative and guide future engagement. A
2.1b Work to build trust across and between	IN PROGRESS	capacity and capability assessment with 24
all levels of government required for		parishes was performed in the summary of
floodplain management		2018 to develop a better understanding of
		needs in those parishes. Statewide
		Listening Tour events completed fall of
		2018. The Council has developed various
		mechanisms to share information including
		a website, Initiative email, and Facebook
		and Twitter accounts to reach social media
		users. The Regional Capacity Building
		Grant is in progress. The 2019 engagement
		strategy is under development.
2.2 Ensure that information needed to make	IN PROGRESS	The Council assembled Technical Advisory
program and floodplain management		Groups to engage stakeholders and gather
decisions is properly and effectively		information needed to make key decisions.
communicated at all levels		
2.3 Continue and regularly coordinate	IN PROGRESS	Council on Watershed Management
between agencies to support floodplain		Working Group and State multi-agency
management planning, program		advisory groups. Each TAG includes an
effectiveness, and leverage resources		order of business related to aligning
		existing programs and actions with the
		mission of the Initiative
2.4 Provide a mechanism for direct one-on-	IN PROGRESS	The Initiative has developed a website
one feedback on program success and areas		feedback tool (located at
for improvement.		watershed@la.gov), has been initiating
		direct contact with officials, and has
		engaged in other outreach mechanisms
		described above.
2.5 Coordinate planning at a regional	IN PROGRESS	Recommendations for proceeding with a
(watershed) level.		statewide approach to coordinate planning
		at the regional level are being evaluated and
		implemented by the Initiative. Actions to be
		incentivized and encouraged through
		Round 1 HUD funding criteria and
		Regional Capacity Building Grant



#### **STRATEGIC AREA 3: STANDARDS**

**Phase I premise**: Leadership and support at the state level will ensure consistent and effective floodplain management.

Actions	Status	Details
3.1 Publish best practices for use in	NOT STARTED.	Planned for 2019
decision-making and establishing incentives		
3.2 Publish model policies that include	NOT STARTED.	There are existing policies published
higher than minimum standards		through DOTD's State Floodplain
		Management Office.
		Examples from other states include
		Harris County TX, Maryland, and
		Florida
3.3 Establish appropriate mandatory flood	NOT STARTED	Phase I (early 2018), Statewide
damage prevention standards at the state		Listening Tour (fall 2018), and pilot
level		capacity and capability assessment
		(summer 2018) provide initial input

#### **STRATEGIC AREA 4: FUNDING**

**Phase I premise**: Both availability and effective use of funding should be maximized toward best floodplain management and flood risk reduction practices.

Actions	Status	Details
4.1 Fund Phases II and III of the program	COMPLETE	Funding provided through Office of
development process		Community Development and existing
		State agency programs
4.2 Ensure that existing available funding	ONGOING.	Ongoing order of business for the
sources are maximized, leveraged, and		Projects Technical Advisory Group and
aligned		Policy Technical Advisory Group,
4.3 Maximize the effectiveness and reach of	IN PROGRESS	comprised of project and program
state-administered funding sources such as		managers from LDWF, DOTD, DEQ,
Flood Risk and Resilience Program cost-		GOHSEP, OCD, CPRA.
share reduction incentives by integrating		
transparent standard-based and regional-		First application of this will be Round 1
planning incentives		Funding of 2016 CDBG-DR allocation
4.4 Increase provision equity by integrating	IN PROGRESS	and the Regional Capacity Building
capacity building mechanisms into state-		Grant.
administered funding sources		
4.5a Facilitate local funding generation for	NOT STARTED	Phase I (early 2018), Statewide
project implementation and long-term		Listening Tour (fall 2018), and pilot
project maintenance		capacity and capability assessment
		(summer 2018) provide initial input



Actions	Status	Details
4.5b Support the development of funding	IN PROGRESS	First application of this will be the
mechanisms that allow beneficiaries of		Regional Capacity Building Grant in
projects across jurisdictional boundaries to		spring of 2019.
contribute to the funding and		
implementation of floodplain management-		
related actions		
4.6 Be prepared to maximize the	IN PROGRESS	First application of this will be Round 1
effectiveness of congressional		Funding of 2016 CDBG-DR allocation
appropriations and funding from		and the Regional Capacity Building
presidential disaster declarations by having		Grant.
prioritized and consensus-based state-level		
initiatives and "shovel-ready" projects, and		
by promoting the same at the watershed and		
local levels		
4.7 Expand the reach of funding by	NOT STARTED	
disincentivizing development policies that		
will require corrective action to mitigate		
flood damage, water quality degradation, or		
habitat loss at a later date		

## STRATEGIC AREA 5: CAPABILITY AND CAPACITY

**Phase I premise**: Sufficient capacity, in the form of human and financial resources, and adequate capability, in the form of appropriate tools and skillsets, must be in alignment at the state, local, and watershed level to ensure program effectiveness.

Actions	Status	Details
5.1 Initially and then periodically assess	IN PROGRESS.	Phase I (early 2018), Statewide
local capacity and capability needs to		Listening Tour (fall 2018), and pilot
effectively target and develop state		capacity and capability assessment
technical support initiatives		(summer 2018) provide initial input
5.2 Initially and then periodically assess	NOT STARTED	As part of Phase II, cooperating
state program capacity and capability needs		agencies completed a Cooperative
to effectively plan resource requirements		Endeavor Agreement, which required
and initiatives		initial evaluation of capacity and
		identification of shortfalls.



#### **STRATEGIC AREA 6: INTEGRATED PLANNING**

**Phase I premise**: Immediate, near-term, and long-term planning and coordinating actions should be in alignment toward a long-term mission.

Actions	Status	Details
6.1 Develop and maintain a multi-agency	ONGOING	Ongoing through the Louisiana
program operating framework that shows		Watershed Initiative and Council on
the authorities, responsibilities, and		Watershed Management
interrelationships of the cooperating		
program management agencies		
6.2 Provide interim recommendations for	IN PROGRESS	Round 1 CDBG-DR funding criteria
high-benefit, low-impact activities that can		and application materials drafted by the
be completed in the near term to reduce		Projects TAG
immediate risk		
6.3 Use interstate summits as an important	IN PROGRESS	The first round of interstate summits in
partnership development and planning		early 2019. Multiple states interviewed
support mechanism		and contacted through Phase I and
		Phase II.
6.4 Develop a State Floodplain	IN PROGRESS	Current order of business for the
Management Plan		Planning TAG. Initial options expected
		early 2019
6.5 Develop a flood risk-reducing master	NOT STARTED	Expected to begin 2019
plan for each watershed consistent with the		
Coastal Master Plan in relevant areas		
6.6 Include a mechanism to expand and	NOT STARTED	
regularly publish studies that substantiate		
the value of Louisiana's Watershed-based		
Floodplain Management Program and		
practices		
6.7 Continue to engage and periodically	ONGOING	Converted to the Council on Watershed
evaluate the form and function of a Steering		Management.
Committee to support program development		
and management		
6.8 Engage a Technical Advisory	ONGOING	Technical Advisory Groups established
Committee for program development and		
periodic evaluation		