MISSISSIPPI DEPARTMENT OF ENVIRONMENTAL QUALITY

DEEPWATER HORIZON OIL SPILL

Mississippi Trustee Implementation Group Draft Restoration Plan 4 and Environmental Assessment

Restoration of Wetlands, Coastal, and Nearshore Habitats; Nutrient Reduction (Nonpoint Source); and Provide and Enhance Recreational Opportunities

September 2023

EXECUTIVE SUMMARY

In the spring of 2010, the *Deepwater Horizon* (DWH) mobile drilling unit exploded resulting in loss of life and a massive release of oil and natural gas from the BP Exploration and Production, Inc. (BP) Macondo well. Extensive response actions, including cleanup activities and actions to prevent the oil from reaching sensitive resources, were undertaken; however, many of these response actions had collateral impacts on the environment and natural resource services. The oil and other substances released from the well, in combination with the extensive response actions, together make up the DWH oil spill.

Pursuant to the Oil Pollution Act (OPA), Title 33 United States Code § 2701 *et seq*., and the laws of individual affected states, federal and state agencies, Indian tribes, and foreign governments act as trustees on behalf of the public to assess injuries to natural resources and their services[1] that result from an oil spill incident, and to plan for restoration to compensate for those injuries. Under the authority of OPA, the DWH Trustees conducted a natural resource damage assessment (NRDA) to assess the impacts of the DWH oil spill on natural resources and their services and prepared the 2016 *Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan/Programmatic Environmental Impact Statement* (PDARP/PEIS),[2] which outlines the type of restoration needed to compensate the public for the diverse suite of injuries that occurred at both regional and local scales as well as the funding allocations to each Restoration Type.

In the PDARP/PEIS, the Trustees identified the need for a comprehensive restoration plan at a programmatic level to guide and direct an ecosystem-level restoration effort, based on four programmatic Restoration Goals: Restore and Conserve Habitat; Restore Water Quality; Replenish and Protect Living Coastal and Marine Resources; and Provide and Enhance Recreational Opportunities. In addition, a fifth Restoration Goal, Provide for Monitoring, Adaptive Management, and Administrative Oversight to Support Restoration Implementation, supports the Restoration Types under the Restoration Goals and informs overall decision-making (see Figure 5.4-1 in the PDARP/PEIS).

Draft Restoration Plan 4 and Environmental Assessment

The Mississippi Trustee Implementation Group (MS TIG) is responsible for restoring natural resources and their services within the Mississippi Restoration Area that were injured by the DWH oil spill. The MS TIG includes the following agencies: the Mississippi Department of Environmental Quality (MDEQ); the National Oceanic and Atmospheric Administration (NOAA), on behalf of the United States Department of Commerce (DOC); the United States Department of the Interior (DOI), represented by the United States Fish and Wildlife Service (USFWS), the National Park Service (NPS), and the Bureau of Land Management (BLM); the United States Department of Agriculture (USDA); and the United States Environmental Protection Agency (EPA).

[1] Services (or natural resource services) are defined as the functions performed by a natural resource for the benefit of another natural resource and/or the public (15 Code of Federal Regulations § 990.30).

[2] The PDARP/PEIS can be found at www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan/.

The MS TIG has prepared this *Mississippi Trustee Implementation Group Draft Restoration Plan 4 and Environmental Assessment: Restoration of Wetlands, Coastal, and Nearshore Habitats; Nutrient Reduction (Nonpoint Source); and Provide and Enhance Recreational Opportunities* (RP4/EA) to address, in part, injuries to natural resources in the Mississippi Restoration Area that occurred as a result of the DWH oil spill. The purpose of restoration, as discussed in this document and detailed in the PDARP/PEIS, is to make the environment and the public whole by implementing restoration actions that return injured natural resources and their services to baseline conditions and compensate for interim losses, in accordance with OPA and consistent with OPA NRDA regulations, 15 Code of Federal Regulations Part 990. This RP4/EA includes a description and evaluation of ten restoration projects, also called restoration alternatives, consistent with three of the Restoration Types from the PDARP/PEIS. The terms alternatives and projects are used interchangeably in this document. Pursuant to NEPA, a no action alternative is also considered for each Restoration Type.

Table ES-1 lists the reasonable range of alternatives, noting those that are preferred for funding at this time by the MS TIG in the RP4/EA.

Table ES-1 The reasonable range of restoration alternatives proposed in RP4/EA, by Restoration Type

Proposed Restoration Alternatives	Preferred Non-Preferred	Estimated Project Cost
Restoration Type: Wetlands, Coastal, and Nearshore Habitats (WCNH)		
WCNH1. Coastwide Habitat Acquisition	Preferred	$5,000,000
WCNH2. Living Shoreline Bulkhead Alternative	Preferred	$3,000,000
WCNH3. Hancock County Marsh Living Shoreline Phase 6 Breakwater	Preferred	$10,500,000
WCNH4. Sand Dune Restoration	Non-Preferred	$2,000,000
Restoration Type: Nutrient Reduction (Nonpoint Source) (NR)		
NR1. Back Bay – Davis Bayou Nutrient Reduction	Preferred	$2,500,000
NR2. Big Cedar Creek – Rocky Creek Nutrient Reduction	Preferred	$2,500,000
NR3. Big Cedar Creek – West Pascagoula River Nutrient Reduction	Non-Preferred	$2,500,000
Restoration Type: Provide and Enhance Recreational Opportunities (REC)		
REC1. Jourdan River Boardwalk	Preferred	$2,118,000
REC2. Shepard State Park Recreational Enhancements-1	Preferred	$735,000
REC3. Shepard State Park Recreational Enhancements-2	Non-Preferred	$3,045,000
Subtotal for Preferred Alternatives		**$26,353,000**

Public Participation in Draft Restoration Plan 4 and Environmental Assessment

The MS TIG prepared this Draft RP4/EA to (1) inform the public about DWH NRDA restoration planning efforts in the Mississippi Restoration Area, (2) present analyses on the potential restoration benefits and environmental consequences of the reasonable range of restoration alternatives, and (3) seek public comment.

The public is encouraged to review and comment on the Draft RP4/EA during the 30-day comment period following public notice. The deadline for submitting written comments is specified in the public notice published in the *Federal Register* and on this DWH Trustee website (see link below). Comments can be submitted during the comment period by one of the following methods:

- **Online**: www.gulfspillrestoration.noaa.gov/restoration-areas/mississippi
- **By mail**: Hard copy addressed to U.S Fish and Wildlife Service Gulf Restoration Office, 1875 Century Blvd., Atlanta, GA 30345. In order to be considered, mailed comments must be postmarked on or before the comment deadline.
- **During the public webinar**: See Section 1.7 for details on the webinar.

Please note that personal identifying information included in submitted comments (such as name, address, phone number, and email address) may be made publicly available. Personal information is not required to submit comment.

Table of Contents

1.0 INTRODUCTION, PURPOSE AND NEED, AND PUBLIC PARTICIPATION

1.1 Introduction

The Mississippi Trustee Implementation Group (MS TIG) has prepared this document, the *Mississippi Trustee Implementation Group Draft Restoration Plan 4 and Environmental Assessment: Restoration of Wetlands, Coastal, and Nearshore Habitats; Nutrient Reduction (Nonpoint Source); and Provide and Enhance Recreational Opportunities* (RP4/EA) to continue restoration of natural resources, and the services they provide, that were injured or lost as a result of the *Deepwater Horizon* (DWH) oil spill, inform the public about the DWH Natural Resource Damage Assessment (NRDA) restoration planning efforts, and seek public comment on the identified reasonable range of alternatives for restoration of injured resources. This Draft RP4/EA was prepared in accordance with the *DWH Oil Spill: Final Programmatic Damage Assessment and Restoration Plan/Programmatic Environmental Impact Statement* (PDARP/PEIS; DWH Trustees 2016a) and the Record of Decision (ROD), the Oil Pollution Act of 1990 (OPA) and associated NRDA regulations (15 CFR Part 990), and the National Environmental Policy Act of 1969 (NEPA) and its implementing regulations. The PDARP/PEIS and ROD can be found online at https://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan.

This RP4/EA evaluates a reasonable range of alternatives to restore injuries to wetlands, coastal, and nearshore habitats, reduce nutrient pollution (nonpoint source), and provide and enhance recreational opportunities to compensate for lost recreational use in the Mississippi Restoration Area. In the RP4/EA, the MS TIG identifies its preferred alternatives to partially compensate the public for injuries caused by the DWH oil spill in the Mississippi Restoration Area.

1.2 Deepwater Horizon Trustees, Trustee Council and Trustee Implementation Groups

As a result of the DWH oil spill, a council of federal and state DWH Trustees (the Trustees) was established on behalf of the public to assess natural resource injuries resulting from the incident and work to make the environment and public whole for those injuries. The MS TIG includes the following agencies: the Mississippi Department of Environmental Quality (MDEQ); National Oceanic and Atmospheric Administration (NOAA), on behalf of the United States Department of Commerce; the United States Department of the Interior (DOI), represented by the United States Fish and Wildlife Service (USFWS), the National Park Service (NPS), and the Bureau of Land Management (BLM); the United States Department of Agriculture (USDA); and the United States Environmental Protection Agency (EPA). The MS TIG makes all restoration decisions for the funding allocated to the Mississippi Restoration Area.

This RP4/EA was prepared by the federal and state natural resource trustees that comprise the MS TIG, which is responsible for restoring the natural resources and services in the Mississippi Restoration Area. Table 1-1 depicts the final settlement allocation for the Mississippi Restoration Area, funds previously allocated in other restoration plans, and funds proposed in this restoration plan, by Restoration Type.

Table 1-1: Allocation of DWH Settlement Funds for the Mississippi Restoration Area by Restoration Type

PDARP/PEIS Programmatic Restoration Goal	Restoration Type	Total MS TIG Settlement Funds	Funds Previously Allocated	Funds Proposed in RP4/EA
Restore and Conserve Habitat	Wetlands, Coastal, and Nearshore Habitats	$135,500,000	$107,137,500 [3]	$18,500,000
	Habitat Projects on Federally Managed Lands	$5,000,000	$3,000,000	--
Restore Water Quality	Nutrient Reduction	$27,500,000	$4,000,000	$5,000,000
	Water Quality	--	--	--
Replenish and Protect Living Coastal and Marine Resources	Sea Turtles	$5,000,000	$2,500,000	--
	Marine Mammals	$10,000,000	$5,440,000	--
	Birds	$25,000,000	$11,355,500	--
	Oysters	$33,600,000	$24,100,000	--
Provide and Enhance Recreational Opportunities	Provide and Enhance Recreational Opportunities	$23,957,000	$20,943,000	$2,853,000
	TOTAL	$265,557,000	$178,476,000	$26,353,000

1.3 OPA and NEPA Compliance

The DWH oil spill is subject to the provisions of OPA, 33 USC § 2701 *et seq*. A primary goal of OPA is to make the environment and public whole for injuries to natural resources and services resulting from an incident involving an oil discharge or substantial threat of an oil discharge. Federal trustees must also comply with NEPA, 42 USC § 4321 *et seq.*, its implementing regulations, 40 CFR § 1500 e*t seq.*, and agency-specific NEPA regulations when planning restoration projects.

USDA serves as the lead federal agency responsible for NEPA compliance for this RP4/EA, ensuring compliance with the Council on Environmental Quality (CEQ) NEPA implementing regulations and USDA NEPA implementing procedures. Three federal agencies (DOI, NOAA and EPA) and MDEQ act as cooperating agencies pursuant to NEPA (40 CFR § 1508.1(e)) and in accordance with Section 2.3.3 of the

[3] Includes funds allocated in MS TIG 2019 Final Supplemental Restoration Plan: Grand Bay Land Acquisition and Habitat Management; Mississippi Trustee Implementation Group 2019 Final Supplemental Restoration Plan: Grand Bay Land Acquisition and Habitat Management (noaa.gov).

Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the *Deepwater Horizon* (DWH) Oil Spill (TC SOPs). Each federal cooperating agency will review the Final RP4/EA for adequacy in meeting its own NEPA implementing procedures and decide whether to adopt the NEPA analysis. Adoption of the Final RP4/EA would be completed via signature on the relevant NEPA decision document.

1.4 Purpose and Need

The MS TIG has undertaken this restoration planning effort to restore natural resources and services injured in the Mississippi Restoration Area. This RP4/EA is consistent with and falls within the scope of the purpose and need identified in Section 5.3.2 of the PDARP/PEIS. The PDARP/PEIS defines five DWH Programmatic Trustee Goals that work independently and together to benefit injured resources and services. The proposed alternatives in this restoration plan would focus on the following three DWH programmatic restoration goals:

1) Restore and Conserve Habitat,
2) Restore Water Quality, and
3) Provide and Enhance Recreational Opportunities.

Consistent with the DWH Programmatic Trustee Goals for restoration, the Trustees also developed related Restoration Types, Restoration Approaches, and restoration techniques to guide restoration planning and project selection (See PDARP/PEIS Sections 5.5.2 for injuries to wetlands, coastal, and nearshore habitats, 5.5.4 for nutrient reduction (nonpoint source), and 5.5.14 for lost recreational use). The RP4/EA addresses three Restoration Types: Wetlands, Coastal, and Nearshore Habitats; Nutrient Reduction (Nonpoint Source); and Provide and Enhance Recreational Opportunities.

1.5 Proposed Action: Draft MS TIG RP4/EA

The MS TIG proposes to implement seven preferred alternatives, identified in Table 1-2. These seven preferred alternatives are included in a reasonable range of ten alternatives (Table 2-1).

To identify the reasonable range of alternatives, the MS TIG solicited public input for project ideas, screened project submittals against OPA NRDA evaluation standards found in 15 CFR § 990.54, and reviewed PDARP/PEIS Programmatic Trustee Goals for restoration to develop additional specific MS TIG RP4/EA Goals and Objectives. Further details on the screening process can be found in Section 2.4. Chapter 3 is a summary of the OPA analysis, resulting in the seven alternatives identified as preferred for implementation.

The proposed action for the plan is the selection of seven alternatives preferred for implementation to provide restoration towards meeting three of the programmatic Restoration Goals identified in the PDARP/PEIS. Table 1-2 is a summary of the proposed action (the preferred alternatives). Project locations for the preferred alternatives are depicted in Figure 1.1.

The TIG proposes to approve and fund the preferred alternatives in this RP4/EA with an estimated budget of $26,353,000. This would leave a balance of approximately $9,862,500 in the Wetlands, Coastal, and Nearshore Habitat (WCNH) Restoration Type; $18,500,000 in the Nutrient Reduction Restoration Type, and $161,000 in the Provide and Enhance Recreational Opportunities Restoration Type for future Mississippi TIG restoration plans. Detailed information on all alternatives can be found in Section 2.4 of this document.

1.5.1 Natural Recovery/No Action

Pursuant to NEPA, a no action alternative is also considered for each restoration type. Pursuant to OPA NRDA regulations and NEPA, the natural recovery/no action alternative was analyzed programmatically in the PDARP/PEIS, Section 5.3.2, and was found to not meet the purpose and need for implementing alternatives that address lost natural resources and their services. Based on this determination, tiering this RP4/EA from the PDARP/PEIS, and incorporating that analysis by reference, the MS TIG did not find natural recovery to be a viable alternative under OPA. Pursuant to NEPA, the no action alternative is analyzed in the RP4/EA by each Restoration Type as a "... benchmark, enabling decisionmakers to compare the magnitude of environmental effects of the action alternatives."

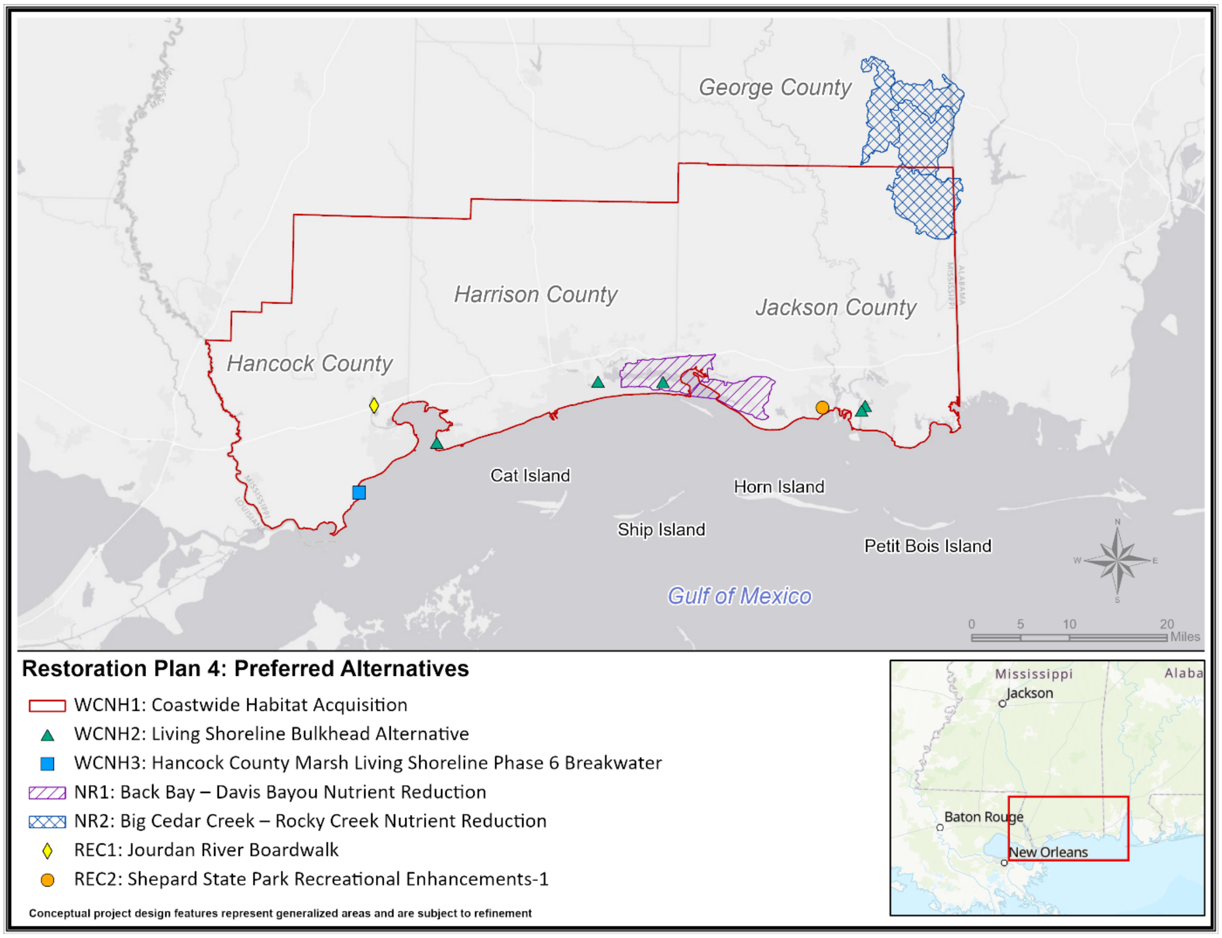

Figure 1.1 RP4/EA Proposed Action (Preferred Alternatives)

Table 1-2. Preferred Alternatives Comprising the Proposed Action in Draft RP4/EA

Proposed Action (Preferred-Alternatives)	PDARP/PEIS: Restoration Type	Proposed Funding
WCNH1 Coastwide Habitat Acquisition	Wetlands, Coastal, and Nearshore Habitats	$5,000,000
WCNH2 Living Shoreline Bulkhead Alternative	Wetlands, Coastal, and Nearshore Habitats	$3,000,000
WCNH3 Hancock County Marsh Living Shoreline Phase 6 Breakwater	Wetlands, Coastal, and Nearshore Habitats	$10,500,000
NR1 Back Bay – Davis Bayou Nutrient Reduction	Nutrient Reduction	$2,500,000
NR2 Big Cedar Creek – Rocky Creek Nutrient Reduction	Nutrient Reduction	$2,500,000
REC1Jourdan River Boardwalk	Provide and Enhance Recreational Opportunities	$2,118,000
REC2 Shepard State Park Recreational Enhancements -1	Provide and Enhance Recreational Opportunities	$735,000

1.6 Coordination with Other Gulf Restoration Programs

As discussed in Section 1.5.6 of the PDARP/PEIS, coordination with other Gulf restoration programs would promote successful implementation of restoration projects and optimize ecosystem recovery. The MS TIG is committed to coordinating with other DWH oil spill and Gulf restoration programs (e.g., the Resources and Ecosystems Sustainability, Tourist Opportunities, and Revived Economies of the Gulf Coast States [RESTORE] Act, the National Fish and Wildlife Foundation's Gulf Environmental Benefit Fund [NFWF-GEBF]) to avoid potential redundancies in project selection. NRDA, RESTORE, and NFWF-GEBF projects currently funded within Mississippi are described on the Mississippi Restoration, NFWF-GEBF, and RESTORE websites.

Examples of this coordination include the proposed Coastwide Habitat Acquisition WCNH alternative, which would coordinate with and leverage the ongoing land acquisition programs in Mississippi funded through the NRDA Grand Bay Land Acquisition and Habitat Management and Graveline Land Acquisition and Management projects, as well as RESTORE Strategic Land Acquisition and NFWF-GEBF Coastal Habitat Connectivity programs. Similarly, the proposed Hancock County Marsh Living Shoreline (HCMLS) Phase 6 Breakwater alternative would supplement RESTORE funds for the construction of an additional 1.7-mile segment of the NRDA Early Restoration HCMLS Project, which already successfully provides 5.9 miles of shoreline protection to the Hancock County Marsh Coastal Preserve.

1.7 Public Involvement

Public input is an integral part of NEPA, OPA, and the DWH oil spill restoration planning effort. The MS TIG published a notice on the DWH Trustee Council website calling for project ideas for this RP4/EA on February 7, 2022[4] (hereafter, February 7, 2022 Notice). The MS TIG requested project ideas focusing on three Restoration Types: Wetlands, Coastal, and Nearshore Habitats; Nutrient Reduction; and Provide

[4] https://www.gulfspillrestoration.noaa.gov/2022/02/mississippi-trustee-implementation-group-welcomes-publics-project-ideas

and Enhance Recreational Opportunities. The MS TIG encouraged the public to submit new ideas or make revisions to previously submitted project ideas by March 7, 2022, and considered any project ideas submitted or updated between January 1, 2018 and March 7, 2022. On October 11, 2022, the MS TIG published a Notice of Initiation of Restoration Planning in Mississippi.[5]

In developing this RP4/EA, the MS TIG considered projects previously submitted to the MDEQ Restoration Project Idea portal[6] and the Trustee Council Project Submission Portal[7] as well as those proposed in response to the February 7, 2022 Notice.[8]

The Draft RP4/EA is made available for public review and comment for thirty (30) days following its release, as specified in the public notice published in the Federal Register and noticed on the MDEQ Office of Restoration and the DWH Trustee Council web pages.

Comments on the Draft RP4/EA can be submitted during the comment period by one of the following methods:

Via the Web: https://www.gulfspillrestoration.noaa.gov/restoration-areas/mississippi
Via U.S. Mail:
U.S. Fish and Wildlife Service Gulf Restoration Office
1875 Century Blvd.,
Atlanta, Georgia 30345

Via the public webinar:

The MS TIG will post a pre-recorded public webinar no later than 15 days after publication of the Notice of Availability in the Federal Register to present an overview of the Draft RP4/EA. Webinar information is provided on the restore.ms website at https://www.mdeq.ms.gov/restoration/, and on the DWH Trustee Council website at https://www.gulfspillrestoration.noaa.gov/restoration-areas/mississippi. The recording will be posted for unlimited viewing during the public comment period. While public comment will not be taken as part of the pre-recorded webinar, the public may provide comment as noted above. Submissions must be postmarked no later than 30 days after the publication of the Notice of Availability for the Draft RP4/EA in the Federal Register.

After the close of the public comment period, the MS TIG will consider all comments received and revise the Draft RP4/EA, as needed. A summary of comments received and the MS TIG's responses will be included in the Final RP4/EA.

1.7.1 Decisions to be Made

This RP4/EA is intended to inform decision-makers and provide the public with information and analysis needed to enable meaningful review and comment on the alternatives presented in this document.

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[5] https://www.gulfspillrestoration.noaa.gov/2022/10/notice-initiation-restoration-planning-mississippi
[6] https://www.mdeq.ms.gov/restoration/project-ideas/
[7] http://www.gulfspillrestoration.noaa.gov/restoration/give-us-your-ideas/suggest-a-restoration-project/
[8] https://www.gulfspillrestoration.noaa.gov/2022/02/mississippi-trustee-implementation-group-welcomes-publics-project-ideas

Ultimately, the RP4/EA and the corresponding opportunity for the public to review and comment on this document are intended to guide the MS TIG's selection and implementation of one or more of the alternatives analyzed herein.

All alternatives are independent of each other and may be selected independently for implementation in this and/or future restoration plans by the MS TIG. Alternatives not implemented at this time may be considered for future restoration by the MS TIG or may be considered by other TIGs (e.g., Regionwide, Open Ocean). Section 3.3 provides a discussion of the preferred and non-preferred alternatives considered in this plan.

1.7.2 Administrative Record

Pursuant to 15 CFR § 990.45, the Trustees opened a publicly available Administrative Record for the DWH oil spill NRDA, including restoration planning activities, concurrently with the publication of the 2010 Notice of Intent to Conduct Restoration Planning (75 Fed. Reg. 60800). DOI is the lead federal Trustee for maintaining the Administrative Record, which can be found at http://www.doi.gov/deepwaterhorizon/adminrecord. Information about MS TIG restoration project implementation is being provided to the public through the MDEQ Website,[9] the Administrative Record, the Gulf Spill Restoration website,[10] NOAA's Data Integration Visualization and Exploration data warehouse (DIVER),[11] and other outreach efforts.

[9] https://www.mdeq.ms.gov/restoration/
[10] https://www.gulfspillrestoration.noaa.gov/2018/10/notice-initiation-restoration-planning-mississippi
[11] https://www.diver.orr.noaa.gov/web/guest/diver-explorer?siteid=9&sqid=643&subtitle=DWH%20Restoration%20Projects and https://www.gulfspillrestoration.noaa.gov/sites/default/files/wp-content/uploads/PDARP_ROD_Final-with-All-Signatures508.pdf

2.0 RESTORATION PLANNING PROCESS AND REASONABLE RANGE OF ALTERNATIVES

NRDA restoration, under OPA, is a process that includes evaluating injuries to natural resources and their services to determine the type and extent of restoration needed to address those injuries. Restoration activities produce benefits with a nexus (connection) to natural resources and their services impacted by an oil spill.[12] This chapter summarizes the restoration decisions stated in the PDARP/PEIS ROD,[13] the relationship of the PDARP/PEIS to this RP4/EA, injuries addressed, the screening process used by the MS TIG to identify the reasonable range of alternatives, and the projects considered in the reasonable range of alternatives. The reasonable range of alternatives is consistent with the PDARP/PEIS. The restoration planning process was conducted in accordance with OPA, the OPA NRDA regulations (15 CFR § 990.53-990.54), NEPA implementing regulations (40 CFR §§ 1500-1508), the Consent Decree, and the Trustee Council's Standard Operating Procedures (SOPs).

2.1 PDARP/PEIS and Record of Decision

Given the potential magnitude and breadth of restoration for DWH oil spill injuries, the Trustees prepared a PDARP/PEIS under OPA and NEPA. As a programmatic restoration plan, the PDARP/PEIS provides direction and guidance for identifying, evaluating, and selecting restoration projects to be implemented by the TIGs (Section 5.10.4 and Chapter 7 of the PDARP/PEIS). As the PDARP/PEIS analysis shows, the injuries caused by the DWH oil spill cannot be fully described at the level of a single species, habitat type, or region. Therefore, there is a need for comprehensive restoration planning on a landscape and ecosystem scale that recognizes and strengthens existing connectivity among habitats, resources, and their services in the Gulf of Mexico. The Trustees prepared a PEIS to analyze the environmental impacts of the reasonable range of programmatic alternatives, to consider the multiple related actions that could occur because of restoration planning efforts, and to allow for a better analysis of cumulative impacts of potential actions. The PDARP/PEIS was released on February 19, 2016 and detailed a programmatic plan to propose, select, fund, and implement restoration projects across the Gulf. Specifically, the PDARP/PEIS provides a description of the Trustees' framework for restoration which includes the programmatic Restoration Goals, Restoration Types (i.e., broad categories of restoration such as "sea turtles" or "birds") that fall under each programmatic goal, Restoration Approaches (i.e., options for conducting restoration such as create, restore, and enhance coastal wetlands or restore and conserve bird nesting and foraging habitat) under each Restoration Type, and restoration techniques (i.e., specific restoration methods) under each Restoration Approach.

On March 29, 2016, in accordance with OPA and NEPA, the Trustees published a Notice of Availability of a ROD for the PDARP/PEIS in the *Federal Register* (81 Fed. Reg. 17438). Based on the injury determination established in the PDARP/PEIS, the ROD set forth the basis for the Trustees' decision to select Alternative A: Comprehensive Integrated Ecosystem Alternative and its associated funding allocations. More information about Alternative A can be found in Sections 5.5 and 5.10 of the PDARP/PEIS. Summary information about the relationship between the PDARP/PEIS and this document can be found in Section 2.2 below.

[12] Includes exposure to the oil from the spill, dispersants, and response actions resulting from the incident.
[13] The PDARP/PEIS and ROD can be found at www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan

2.2 Summary of Injuries Addressed in RP4/EA

Chapter 4 of the PDARP/PEIS summarizes the injury assessment, which documented the nature, degree, and extent of injuries from the DWH oil spill to both natural resources and their services. The reasonable range of alternatives identified in RP4/EA is designed to address injuries in the Mississippi Restoration Area. This section summarizes the most relevant information from Chapter 4 of the PDARP/PEIS injury assessment, and references the section of the PDARP/PEIS that provides details for the Restoration Types which are included in this RP4/EA.

Wetlands, Coastal, and Nearshore Habitats: The DWH oil spill caused significant injuries to Mississippi's nearshore marine ecosystem, including interrelated and biologically diverse habitats such as estuarine coastal wetland complexes, beaches and dunes, barrier islands, submerged aquatic vegetation (SAV), oyster reefs, and shallow unvegetated areas (see PDARP/PEIS Section 4.6.1.1 Ecological Description). Injuries were detected over a range of species, communities, and habitats, affecting a wide variety of ecosystem components (PDARP/PEIS Section 4.6.9). The Trustees allocated the greatest amount of funding to the Restore and Conserve Habitat goal, because of the critical role that coastal and nearshore habitats play in the overall productivity of the Gulf of Mexico. Wetlands, coastal, and nearshore habitat injury in the Mississippi Restoration Area has been partially addressed through Early Restoration projects (Project IDs 38[14] and 60), MS TIG Restoration Plan 1/EA projects (Project IDs 112 and 113), and MS TIG Restoration Plan 2/EA projects (Project IDs 258 and 259).

Nutrient Reduction (Nonpoint Source): Excessive nutrient enrichment, or eutrophication, of Gulf Coast estuaries and their watersheds is a chronic threat that can lead to hypoxia (low oxygen levels), harmful algal blooms, habitat losses, and fish kills (PDARP/PEIS Section 5.5.4). Water quality improvements associated with nutrient reduction projects exhibit strong ecological linkages to Mississippi's estuarine and coastal habitats and communities. Reduction of rural and municipal nonpoint source pollution can be achieved by implementing and improving watershed best management practices (BMPs). Examples of restoration actions include reducing erosion and thus sedimentation into coastal streams and managing excess nutrient levels to coastal basins. A nutrient reduction project in the Mississippi Restoration Area is being implemented through MS TIG Restoration Plan 1/EA (Project ID 96).

Recreational Opportunities: The DWH oil spill resulted in losses to the public's use of natural resources for outdoor recreation. The Trustees estimated that more than 16 million boating, fishing, and other shoreline activity user-days were lost across the five affected Gulf states. Total recreational use injuries attributable to the DWH oil spill are estimated at $693.2 million (with an uncertainty range from $527.6 million to $858.9 million). The PDARP/PEIS indicates that recreational uses have recovered. The purpose of the recreational use alternatives in RP4/EA is to provide compensatory restoration for losses that occurred between May 2010 and November 2011, after which recreational use returned to baseline levels (Section 4.10 in the PDARP/PEIS). Recreational use injury in the Mississippi Restoration Area has been partially addressed through Early Restoration projects (Project IDs 44, 47, and 48) and MS TIG Restoration Plan 3/EA projects (Project IDs 258 and 259).

2.3 Screening for a Reasonable Range of Alternatives for RP4/EA

In developing a reasonable range of alternatives for RP4/EA, the MS TIG reviewed the Restoration Goals, Types, Approaches, and techniques described in the PDARP/PEIS. The MS TIG also considered other criteria identified

[14] These are project idea numbers referenced in the DWH Trustees' Gulf Spill Restoration Center website

in the PDARP/PEIS, including the six evaluation standards from the OPA NRDA regulations (15 CFR § 990.54), input from the public from the February 7, 2022 Notice, the current and future availability of funds under the DWH NRDA settlement payment schedule, as well as projects already funded or proposed to be funded by other TIGs (e.g., Regionwide TIG [RW TIG]) or other DWH funding sources (e.g., NFWF-GEBF, RESTORE). A summary of the OPA evaluation criteria is provided in Section 3.1. The MS TIG's screening process is described below in Sections 2.3.1 through 2.3.5.

2.3.1 Identification of Proposed Restoration Types and Approaches

On February 7, 2022, the MS TIG requested that the public submit project ideas related to the following Restoration Types: Wetlands, Coastal, and Nearshore Habitats; Nutrient Reduction (Nonpoint Source); and Provide and Enhance Recreational Opportunities.[15] The MS TIG screened projects that were submitted from February 7 through March 7, 2022, to either the Trustee Council Project Submission Portal[16] or the MDEQ Restoration Project Idea Portal.[17] Consistent with Section 9.4.1.4 of the Trustee Council's SOPs, the MS TIG also considered project ideas developed by MS TIG Trustees and project ideas from Gulf restoration reports, management plans, and/or related efforts. The MS TIG identified the below proposed Restoration Types and Approaches in the February 7, 2022 Notice. The MS TIG collaborated and decided on specific restoration techniques and project specific considerations as part of this screening process.

Wetlands, Coastal, and Nearshore Habitats: The MS TIG requested project ideas that specifically addressed the following restoration approaches from the PDARP/PEIS, and identified the following as specific techniques of interest for this RP4/EA:

- Approach: Create, Restore and Enhance Coastal Wetlands

  Techniques:
  - Create or enhance coastal wetlands through placement of dredge materials
  - Backfill canals
  - Restore hydrologic connections to enhance coastal habitats
  - Construct breakwaters

- Approach: Restore and Enhance Dunes and Beaches

  Techniques:
  - Plant vegetation on dunes
  - Protect dune systems through the use of access control
  - Construct breakwaters

- Approach: Protect and Conserve Marine, Coastal, Estuarine, and Riparian Habitats

  Techniques:
  - Acquire lands for conservation

[15] The invitation to submit project ideas can be found at https://www.gulfspillrestoration.noaa.gov/2022/02/mississippi-trustee-implementation-group-welcomes-publics-project-ideas

[16] Trustee Council Project Submission Portal: https://www.gulfspillrestoration.noaa.gov/restoration/give-us-your-ideas/suggest-a-restoration-project/

[17] MDEQ Restoration Project Idea Portal: https://www.mdeq.ms.gov/restoration/project-portal/

- Develop and implement management actions in conservation areas and/or restoration projects

The MS TIG also collaborated to develop these project specific considerations (included in Step 3 screening):

- To what extent does the project protect or restore a continuum of habitats (e.g., size and type of habitat; nearshore reef to salt marsh to coastal freshwater wetlands, riparian corridors, and adjacent upland buffers) within the coastal ecosystem mosaic and will it return injured resources and services to baseline conditions?
- Will the project contribute to habitat protection or restoration in the vicinity of other projects proposed for selection in this plan, thereby achieving a greater overall benefit to nearshore habitats?
- Is the project adjacent to land uses that would pose a threat to the success of the project?
- Is the project consistent with Mississippi Department of Marine Resources (MDMR) Coastal Preserves Program, the MDEQ Coastal Headwaters Program, existing management plans (e.g., Mississippi Gulf Coast Restoration Plan, National Wildlife Refuge Comprehensive Conservation Plans, National Estuarine Research Reserve Management Plans, State Wildlife Action Plan, species recovery plans) and/or other previous efforts completed by federal, state, local, NGO, or academic entities?

Nutrient Reduction (Nonpoint Source): The MS TIG requested projects that specifically addressed the following restoration approaches from the PDARP/PEIS, and collaborated on specific techniques of interest for this RP4/EA:

- Approach: Reduce Nutrient Loads to Coastal Watersheds
- Approach: Reduce Pollution and Hydrologic Degradation to Coastal Watersheds

The MS TIG also collaborated to develop the following initial project screening criteria (included in Step 2 screening) for RP4/EA:

- A project must occur in or provide benefits to an estuary or watershed that ultimately discharges into coastal MS waters. Geographic targets may include rivers, coastal streams, bays and/or estuaries that (1) have been identified in previous restoration/planning or regulatory documents, (2) have known sources of nutrient contributions from urban sources or agricultural/forestry settings, and/or (3) are co-located or have synergistic benefits with other DWH restoration initiatives. For RP4/EA, the MS TIG will focus on the following Mississippi coastal watersheds/areas:

  Back Bay and Biloxi Bay in Harrison and Jackson County and Hancock County
  East Hobolochitto (0318000408) Pearl River County
  West Hobolochitto Creek - West Hobolochitto Creek (0318000409) Pearl River County
  Big Cedar Creek - Pascagoula River (0317000601) George County
  Bushy Creek - Escatawpa River (0317000803) George County
  Rocky Creek - Escatawpa River (0317000804) George County and Jackson
  Stone County, MS

- A project is designed to make a direct contribution to reducing nutrients to coastal ecosystems injured by the DWH spill. Example related activities include:

  Agricultural conservation practices
  Forestry management practices
  Stormwater management practices
  Low-impact development (LID) practices
  Traditional stormwater control measures (SCM)
  Erosion and sediment control practices (ESC)

- Project ideas or components of projects that include the following restoration techniques will be screened out:

  Study/assessment/ data collection/monitoring (only)
  Sewer infrastructure
  Debris removal
  Dredging operations
  Heavy metal removal (water quality)

Provide and Enhance Recreational Opportunities: The MS TIG requested projects that specifically addressed the following Restoration approaches from the PDARP/PEIS, and identified the following as specific techniques of interest for RP4/EA (included in Step 2 screening):

- Approach: Enhance Public Access to Natural Resources for Recreational Use

  Technique: Enhance public access to natural resources for recreational use

- Approach: Enhance Recreational Experiences

  Technique: Enhance recreational fishing opportunities through aquaculture
  Technique: Reduce and remove land-based debris

- Approach: Promote Environmental Stewardship, Education, and Outreach

  Technique: Create or enhance natural resource-related education facilities
  Technique: Create or enhance natural resource-related education programs

In mid-2022, the MS TIG compiled all of the project ideas from the Trustee Council Project Submission Portal and the MDEQ Restoration Project Idea Portal for a total of 388 projects. The MS TIG used a series of key words to identify projects related to each Restoration Type from the call for project ideas and binned the projects into their appropriate Restoration Types, with many projects being binned under more than one Restoration Type. This resulted in a total of 388 projects being considered including: 370 Wetlands, Coastal, and Nearshore Habitats; 366 Nutrient Reduction (Non-Point Source); and 341 Provide and Enhance Recreational Opportunities projects (Figure 2-1). [18]

2.3.2 Eligibility Screening

The MS TIG completed Step 1, eligibility screening, of the 388 projects. The MS TIG screened out projects that were not consistent with the MS TIG Trustees' goals and objectives in returning the injured natural resources and services to baseline and/or compensating for interim losses in the Mississippi Restoration Area, projects that were already funded, and projects that were duplicative. This step resulted in a total of 208 projects remaining after screening criteria were applied (74 Wetlands, Coastal, and Nearshore Habitats; 82 Nutrient Reduction (Non-Point Source); and 52 Provide and Enhance Recreational Opportunities projects (Figure 2-1).

[18] Some projects indicated multiple resource benefits and were binned under multiple Restoration Types.

2.3.3 Initial Project Screening

The MS TIG completed Step 2, initial project screening, of the 208 projects. The MS TIG applied a number of screening criteria in Step 2 including:

- Project is a priority technique identified by the MS TIG for RP4/EA, as identified above in Section 2.3.1 according to Restoration Type;
- Project has a reasonable likelihood of success;
- Available information was sufficient or could be made sufficient in a reasonable amount of time to permit screening of the project;
- Project does not fund activities required by local, state, or federal law, order, or permit;
- Whether the project focused on active measures to meet the PDARP/PEIS goals as opposed to research, program management, planning, or monitoring activities.

This step resulted in a total of 98 projects (39 Wetlands, Coastal, and Nearshore Habitats; 42 Nutrient Reduction (Non-Point Source); and 17 Provide and Enhance Recreational Opportunities projects (Figure 2-1)).

2.3.4 Project Specific Screening

The MS TIG completed Step 3, project specific considerations, on the 98 projects remaining from Step 2. The following project screening criteria were applied:

- Is the project a priority consideration identified by the MS TIG for RP4/EA, as identified above in Section 2.3.1 according to Restoration Type?
- Can the project be implemented within the budget available for this restoration plan or is there a source of other funds that can be leveraged in conjunction with NRDA funds available to allow implementation?
- Is the restoration benefit commensurate with the cost of the project?
- Can the project be implemented in a reasonable time frame?
- Does the project have a significant potential to result in adverse environmental or human health impacts?
- Are there any other impediments to carrying the project forward as part of the reasonable range of alternatives designated for more detailed OPA and NEPA analysis (e.g., compliance issues)?
- For Wetlands, Coastal, and Nearshore Habitats projects:

    To what extent does the project protect or restore a continuum of habitats (e.g., size and type of habitat; nearshore reef to salt marsh to coastal freshwater wetlands, riparian corridors, and adjacent upland buffers) within the coastal ecosystem mosaic and will it return injured resources and services to baseline conditions?

    Will the project contribute to habitat protection or restoration in the vicinity of other projects proposed for selection in this plan, thereby achieving a greater overall benefit to nearshore habitats?

    Is the project adjacent to land uses that would pose a threat to the success of the project?

    Is the project consistent with MDMR Coastal Preserves Program, the MDEQ Coastal Headwaters Program, existing management plans (e.g., Mississippi Gulf Coast Restoration Plan, National Wildlife Refuge Comprehensive Conservation Plans, National Estuarine Research Reserve Management Plans, State Wildlife Action Plan, species recovery plans) and/or other previous efforts completed by federal, state, local, NGO, or academic entities?

- For Nutrient Reduction (Non-Point Source) projects:
    - Is the project consistent with existing management plans?

The MS TIG eliminated duplicate projects ideas, further developed projects of similar or overlapping scope, used components of submitted projects, utilized information in regional management plans, relied on resource expertise within the MS TIG, and consulted with relevant resource agencies in order to develop the reasonable range of alternatives. Ultimately, a total of ten projects are presented as the reasonable range of alternatives in the Draft RP4/EA (Figure 2-1).

This step resulted in a total of 10 projects: four Wetlands, Coastal, and Nearshore Habitats; three Nutrient Reduction (Non-Point Source); and three Provide and Enhance Recreational Opportunities projects (Figure 2-1).

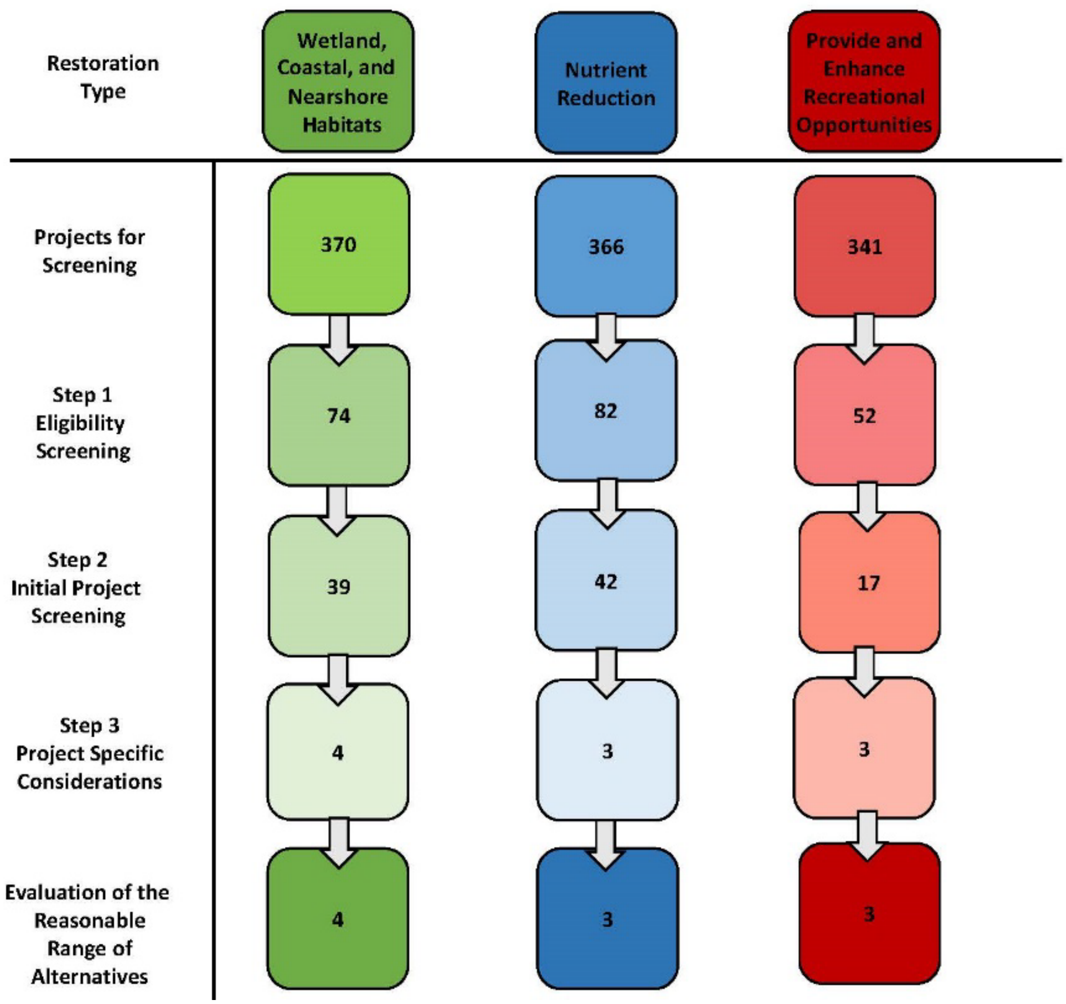

Figure 2-1 The MS TIG Screening Process to Develop the Reasonable Range of Alternatives Included in RP4/EA (numbers represent projects remaining after each screening step)

2.3.5 Alternatives not Considered for Further Evaluation in RP4/EA

The MS TIG made a decision to focus on projects that met some or all of the following criteria:

1) The project was at an appropriate stage of development;
2) The project could be completed for a cost appropriate for RP4/EA; and/or
3) Project proponents could provide some level of funding outside of DWH NRDA to supplement MS TIG-approved Recreational Opportunities Type funding.

Decisions of the MS TIG to move projects from Step 3 to the reasonable range of alternatives were based on a balancing of the considerations outlined above and in the context of the full suite of restoration alternatives being advanced for analysis in RP4/EA. As a result, a project considered in Step 3 could receive a generally favorable review yet be excluded by the MS TIG from the reasonable range of alternatives for this plan. While these projects have restoration potential and may be evaluated and potentially selected in a future restoration plan, they are not considered for further evaluation in this RP4/EA.

2.4 Reasonable Range of Alternatives

Based on the screening process described in Section 2.3, the MS TIG identified a reasonable range of alternatives for further evaluation in this RP4/EA (Table 2-1). The alternatives considered in this RP4/EA are consistent with three of the PDARP/PEIS Restoration Types.

Table 2-1 The reasonable range of restoration alternatives for this RP4/EA by Restoration Type

Proposed Restoration Alternatives		Estimated Project Cost
Restoration Type: Wetlands, Coastal, and Nearshore Habitats (WCNH)		
WCNH1. Coastwide Habitat Acquisition	Preferred	$5,000,000
WCNH2. Living Shoreline Bulkhead Alternative	Preferred	$3,000,000
WCNH3. Hancock County Marsh Living Shoreline Phase 6 Breakwater	Preferred	$10,500,000
WCNH4. Sand Dune Restoration	Non-Preferred	$2,000,000
Restoration Type: Nutrient Reduction (Nonpoint Source) (NR)		
NR1. Back Bay – Davis Bayou Nutrient Reduction	Preferred	$2,500,000
NR2. Big Cedar Creek – Rocky Creek Nutrient Reduction	Preferred	$2,500,000
NR3. Big Cedar Creek –West Pascagoula River Nutrient Reduction	Non-Preferred	$2,500,000
Restoration Type: Provide and Enhance Recreational Opportunities (REC)		
REC1. Jourdan River Boardwalk	Preferred	$2,118,000
REC2. Shepard State Park Recreational Enhancements-1	Preferred	$735,000
REC3. Shepard State Park Recreational Enhancements-2	Non-Preferred	$3,045,000
Subtotal for Preferred Alternatives		**$26,353,000**

2.4.1 Project Descriptions: Wetlands, Coastal, and Nearshore Habitats

This RP4/EA identifies four restoration alternatives consistent with the Restore and Conserve Habitat Restoration Goal (PDARP/PEIS Section 5.3.1) and underlying Wetlands, Coastal, and Nearshore Habitats Restoration Type (PDARP/PEIS Section 5.5.2).

WCNH1 Coastwide Habitat Acquisition

WCNH1: Coastwide Habitat Acquisition
Restoration Approach
Protect and Conserve Marine, Coastal, Estuarine, and Riparian Habitats
Restoration techniques
Acquire Land for Conservation
Project location
Various locations in Hancock, Harrison and Jackson counties, MS (see Figure 2-1 below)
Project background and summary
Consistent with the PDARP/PEIS Restoration Type goals, the project would restore for injuries to habitats in the geographic areas where the injuries occurred, while considering approaches that provide resiliency and sustainability. The project would 1) acquire land in coastal areas for conservation that have high ecological value and/or 2) where wetlands, coastal, and nearshore habitat creation, restoration, and preservation projects could be implemented in future restoration actions (for example, lands adjacent to coastal bays and estuaries). Conserving and protecting land parcels via acquisition can protect wetlands and other significant coastal, estuarine, riverine and riparian habitats; create connections between protected areas and remove direct threats of development. Once acquired, parcels would be conserved, complementing and advancing the goals of coastal management, habitat conservation, and other applicable plans. In addition, parcels may be sites for future restoration activities not currently a part of this project budget (e.g., habitat management, installation of living shorelines, intertidal and subtidal oyster reef restoration, hydrologic connectivity projects, and/or expansion/enhancement of marsh habitat using beneficial use materials).
Project implementation methodology and timing
The Implementing Trustee for this proposed project would be MDEQ. The project goal would be the acquisition of privately owned coastal lands in all three coastal counties. The properties would be purchased at the Yellow Book appraised value. This project would not be used to acquire parcels within the Grand Bay Land Acquisition and Habitat Management Project or the Graveline Bay Land Acquisition and Management Project boundaries unless the project funds allocated for acquisition with those projects have been exhausted. Acquisition and conservation (as well as future restoration) could serve to decrease habitat fragmentation and increase habitat connectivity to other large conservation parcels in the area. Target habitats include estuarine marsh, dune/shoreline (beach), islands, and other coastal riparian habitats. The project would restore injuries to wetlands, coastal, and nearshore habitats in Mississippi through multiple targeted/strategic land acquisitions that would help maximize ecological functions. The project could help facilitate future habitat restoration potential (e.g., habitat enhancement/management, beneficial use, living shorelines), on or adjacent to acquired lands. Acquisitions would be implemented with available funding for up to 10 years. A preliminary project implementation schedule is provided here: Years 1-10 (2024-2034) • Land acquisition • Monitoring
Adaptive Management
All acquired properties would be owned by the State of Mississippi and/or project partners, and potential subsequent management would be conducted by project partners.
Monitoring summary
A draft Monitoring and Adaptive Management Plan can be found in Appendix C. Monitoring metrics would include number of acres of land acquired.
Costs
The total estimated cost of this project is $5,000,000.

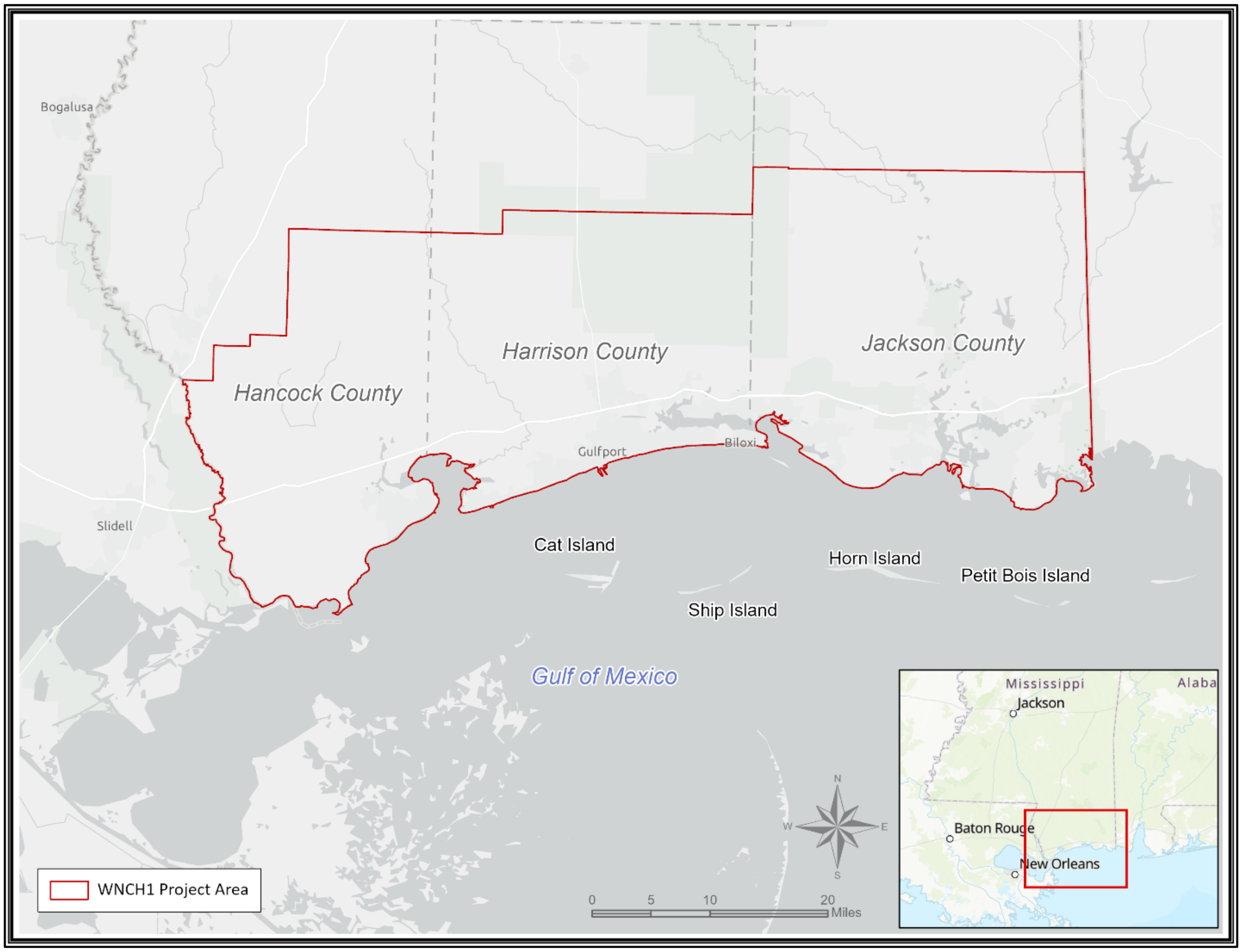

Figure 2-1 Project area WCNH1 Coastwide Habitats Acquisition

WCNH2 Living Shoreline Bulkhead Alternative

WCNH2: Living Shoreline Bulkhead Alternative
Restoration approach
Create, Restore, and Enhance Coastal Wetlands
Restoration techniques
Construct Breakwaters
Project location
Various locations in Hancock, Harrison and Jackson counties, MS (see Figure 2-2)
Project background and summary
The project would construct small-scale living shorelines that would reduce shoreline erosion and incorporate vegetation or other living, natural “soft” elements alone or in combination with some type of harder shoreline protection structure (e.g., oyster or mussel reefs or rock sills) for added habitat, protection, and stability. The living shorelines would maintain the natural continuity of the land-water interface and retain or enhance shoreline ecological processes. Projects would be located adjacent to properties with public shoreline access to view as demonstration projects. The project would protect coastal wetland habitat through the construction of nearshore breakwaters parallel to the shoreline for the purpose of reducing shoreline erosion.

WCNH2: Living Shoreline Bulkhead Alternative
Project implementation methodology and timing

The Implementing Trustee for this proposed project would be MDEQ. Parameters for planning, design, and construction would adhere to living shorelines/alternative bulkhead designs under Mississippi General Permit MSGP-01 – Shoreline Stabilization, or any subsequent revisions to or replacements for the same. Design criteria include but are not limited to the following:

- Alternative bulkhead designs (ABD) structures and fill areas should be constructed the minimum distance necessary to protect shoreline and facilitate construction, but may not extend into the waterbody more than 35 feet from the mean high water (MHW) line or ordinary high water (OHW) line, or more than 25% of the distance across the waterbody as measured from the MHW line or OHW line, or from the waterward limits of emergent vegetation;
- The structure is no more than 500 feet in length;
- Living shorelines must have a substantial biological component including use of native vegetation or plantings and/or native materials (i.e., mussel, clam, and oyster shell);
- Structures must be of minimal size to provide adequate protection required in higher energy environments, properly secured/anchored, and not create a navigational hazard; and
- All plantings and materials (coir logs, coir mats, root wads, etc.) utilized with the structure should be composed of native vegetation.

Potential project locations under consideration are provided in Table 1, other locations could be identified later, at which time, additional NEPA analysis would be conducted by the MS TIG, as appropriate.

Table 1. Living Shoreline Bulkhead Alternatives Details

Project Locations	Project Details
Land Trust Parcel, Pass Christian, Harrison, County, MS (Figure 2-2, #1)	The site is on the eastern shore of St. Louis Bay and is owned by the Land Trust for the Mississippi Coastal Plain. The living shoreline would be a maximum of 500 feet linear feet.
James Hill Park, Gulfport, MS Harrison County, MS (Figure 2-2, #2)	The site is adjacent to Bayou Bernard and is owned by the City of Gulfport. Living shoreline length would be a maximum of 500 linear feet. The project would be visible to pedestrians utilizing the park and to boaters.
River Park Site, Pascagoula, Jackson County, MS (Figure 2-2, #3)	The site is located on the shore of the western fork of the Pascagoula River. The park is owned by the Mississippi Secretary of State. The living shoreline length would be a maximum of 500 linear feet.

Proper siting is a critical consideration when planning the construction of the living shorelines. If improperly sited, breakwaters can alter wave and current energies in ways that can cause scouring of benthic habitats and erosion of adjacent shorelines. The project design would be consistent with local and regional sediment management plans and programs and include a complete understanding of the sediments and physical processes within the area where each breakwater is sited. The living shorelines would be designed, constructed, and maintained so that there are no more than minimal adverse effects on water movement between the waterbody and the shore and the movement of aquatic organisms between the waterbody and the shore.

A preliminary project implementation schedule is provided here:

Years 1-3 (2024-2026)

- Engineering and design (E&D) and permitting
- Construction

Years 4-7 (2027-2030)

- Monitoring

Adaptive management

MDEQ would be responsible for adaptive management in accordance with the MAM plan, for example the periodic repair of breakwaters or reefs or replacing components after severe storms or erosion events and replanting of vegetation.

WCNH2: Living Shoreline Bulkhead Alternative
Monitoring summary
A draft MAM plan is attached in Appendix C. Monitoring metrics would include as-builts surveys and shoreline edge position.
Costs
The total estimated cost of this project is $3,000,000.

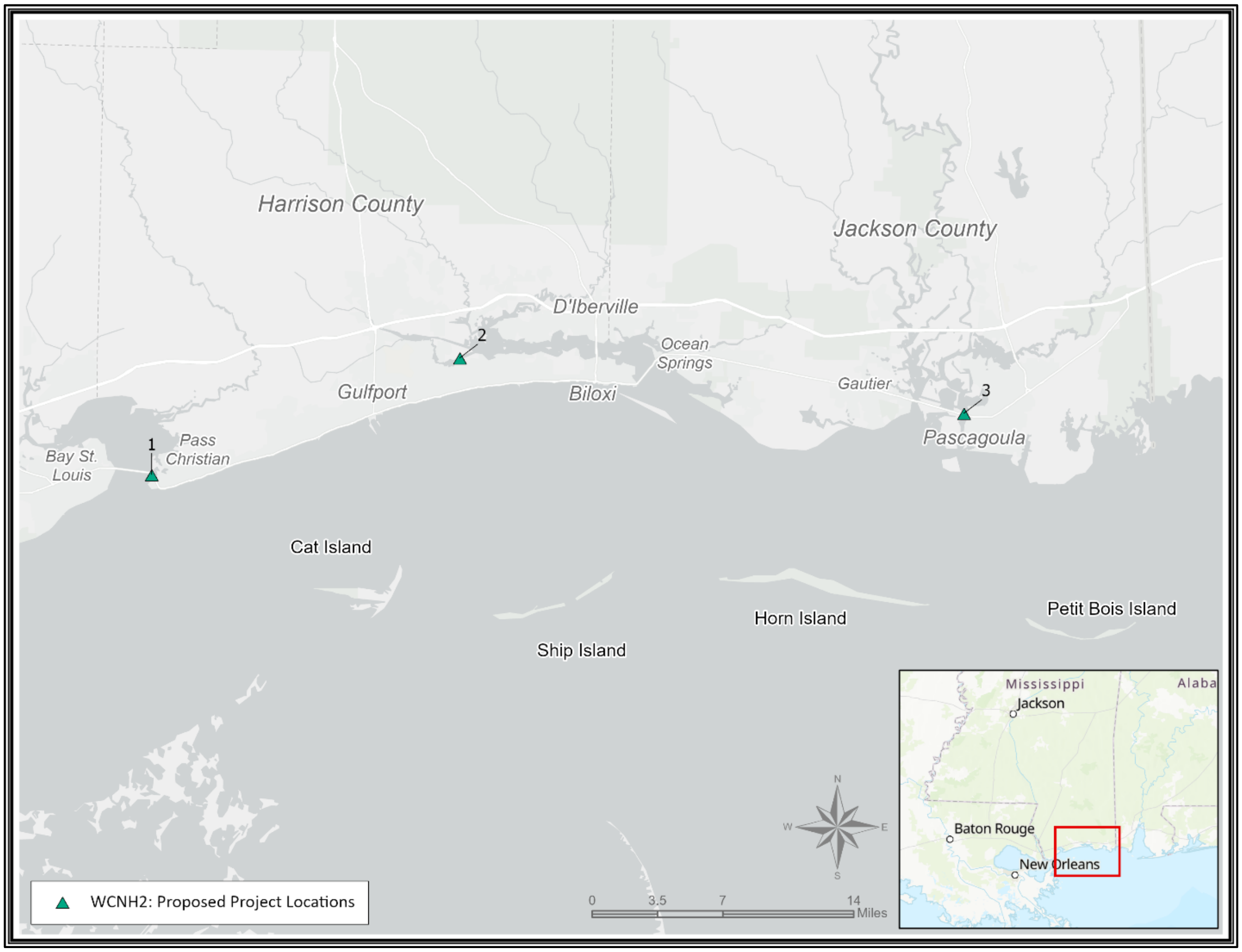

Figure 2-2 Project area for WCNH2 Living Shoreline Bulkhead Alternative

WCNH3 Hancock County Marsh Living Shoreline Phase 6 Breakwater

WCNH3: Hancock County Marsh Living Shoreline Phase 6 Breakwater
Restoration approach
Create, Restore, and Enhance Coastal Wetlands
Restoration techniques
Construct Breakwaters
Project location
Hancock County, MS (see Figure 2-3)
Project background and summary
The proposed project would construct an approximately 1.7-mile-long segmented riprap breakwater in the Mississippi Sound between Bayou Bolan and Bayou Caddy. It would be Phase 6 of the existing Hancock County Marsh Living Shoreline Project (HCMLS), an ongoing Early Restoration DWH NRDA Project which includes 5.9 miles of breakwater (construction complete,

WCNH3: Hancock County Marsh Living Shoreline Phase 6 Breakwater
monitoring ongoing), a 46-acre subtidal reef (construction complete, monitoring ongoing) and a 46-acre created marsh (under construction). Historic erosion rates from 1850 to 2001 along Hancock County Marsh from Pearl River to Bayou Bolan range from 6 to 10 feet per year (Schmid 2002) and shoreline position monitoring data have shown the existing breakwaters' success in decreasing shoreline erosion. The purpose of the project is to protect the Hancock County Marsh Preserve shoreline and salt marsh habitat from erosion and to create habitat for secondary benthic productivity. The project would extend the shoreline protection and enhanced benthic secondary productivity benefits already provided by the Hancock County Marsh Living Shoreline breakwaters (which originate at the Louisiana/Mississippi state line and extend northward to Bayou Bolan).
Project implementation methodology and timing
The Implementing Trustees for this project would be MDEQ and NOAA. The project would be funded using a combination of RESTORE Act funding (which has already been used for engineering and design and permitting and would be used for a portion of the construction and construction management) and NRDA funding (which would be used for the balance of construction and for monitoring). Engineering and design and permitting is complete. A preliminary project implementation schedule is provided here: Year 1 (2024) • Construction Years 2-6 (2025-2029) • Monitoring
Adaptive management
Adaptive management would be the responsibility of MDEQ.
Monitoring summary
A draft MAM plan is attached in Appendix C. Monitoring metrics would include breakwater elevation, breakwater area, infaunal and epifaunal invertebrate biomass, shoreline profile/slope, and shoreline edge position.
Costs
The total estimated cost of this project is $10,500,000.

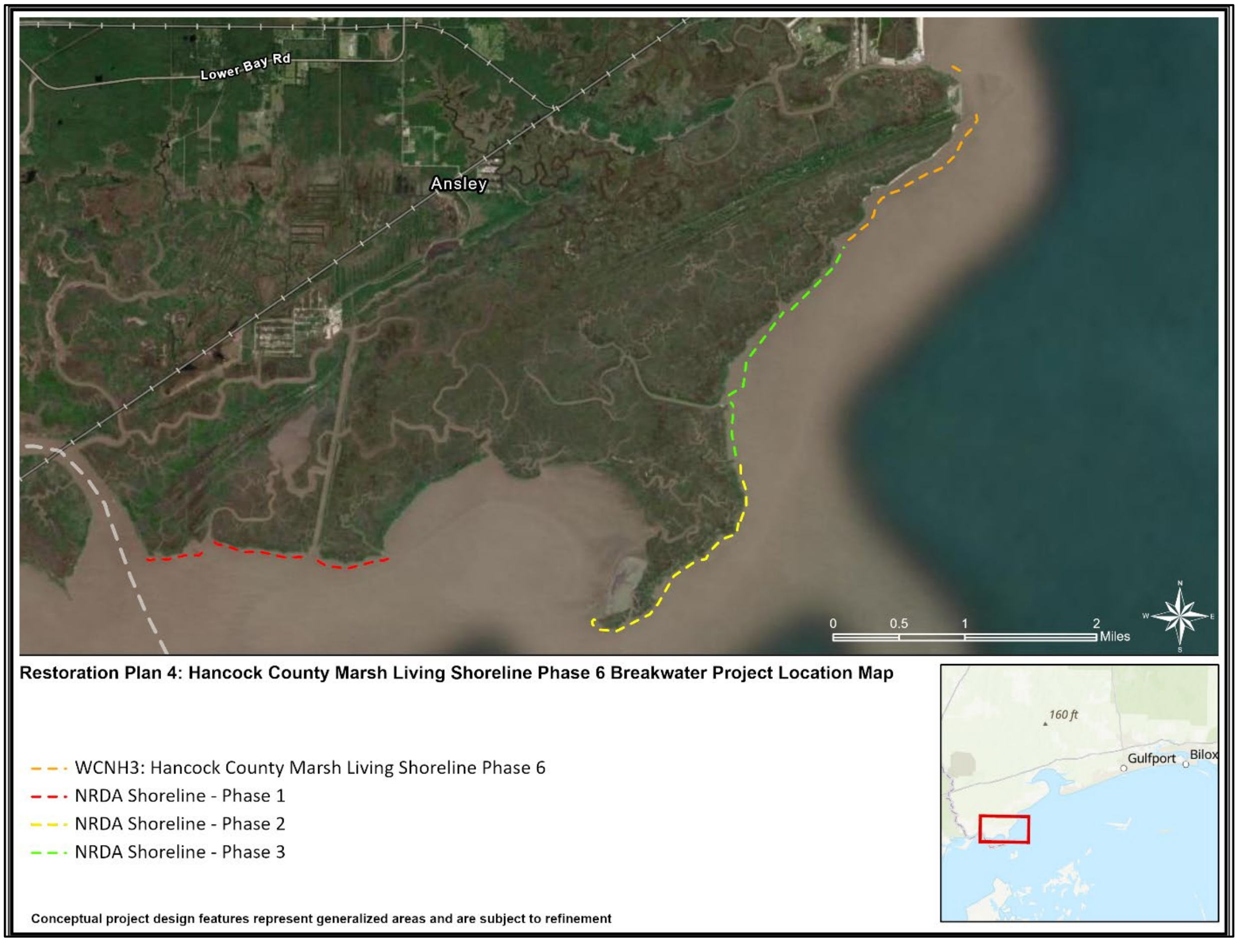

Figure 2-3 Project area for WCNH3 Hancock County Marsh Living Shoreline

WCNH4 Sand Dune Restoration

WCNH4: Sand Dune Restoration
Restoration approach
Restore and Enhance Dunes and Beaches
Restoration techniques
Restore dune and beach systems through use of passive techniques to trap sand Plant vegetation on dunes
Project location
Various locations in Hancock, Harrison and Jackson counties, MS (see Figure 2-4)
Project background and summary
The purpose of the coastwide Sand Dune Restoration Project is to support the restoration and enhancement of coastal and nearshore habitat by creating and planting sand dunes in various coastal locations across Mississippi, up to 900 acres. Mississippi coastal beaches are predominantly man-made and county-maintained and are subject to sand migration onto U.S. Highway 90 and other adjacent roads. This project would provide habitat by mitigating beach erosion and would promote the health and integrity of the beach ecosystem by utilizing methods that accelerate and maximize dune formation, such as planting native plants and installing sand fencing.
Project implementation methodology and timing
Mississippi Gulf Coast beaches are a unique coastal environment providing critical habitat functions. The project would create and enhance coastal and nearshore habitats using dune fencing and plantings. The project would be administered by the MDEQ. Components of the project may be implemented by MDEQ and/or eligible sub-recipients (e.g., counties/sand beach

WCNH4: Sand Dune Restoration
authorities). Specific project locations would be selected based on needs identified through coordination with county authorities. Specific activities and preliminary project implementation schedule are provided here: Years 1-2 (2024-2025) • Identification of sites and scopes of work • E&D and permitting Years 3-8 (2026-2031) • Planting of native plants (e.g., sea oats) on existing beaches or dunes • Installation, maintenance, and repair of sand fencing • Replanting of storm or otherwise damaged areas. Marsh elder and wax myrtle shrubs that are native to the dunes would be spaced periodically to establish the dunes and help hold when impacted by tropical weather occurrences • Monitoring
Adaptive management
Dune fence repair and re-planting of previously planted areas would be coordinated and completed as needed.
Monitoring summary
This project has not been identified at this time as a preferred alternative by the MS TIG, therefore, a project MAM plan has not been developed.
Costs
The total estimated cost of this project is $2,000,000.

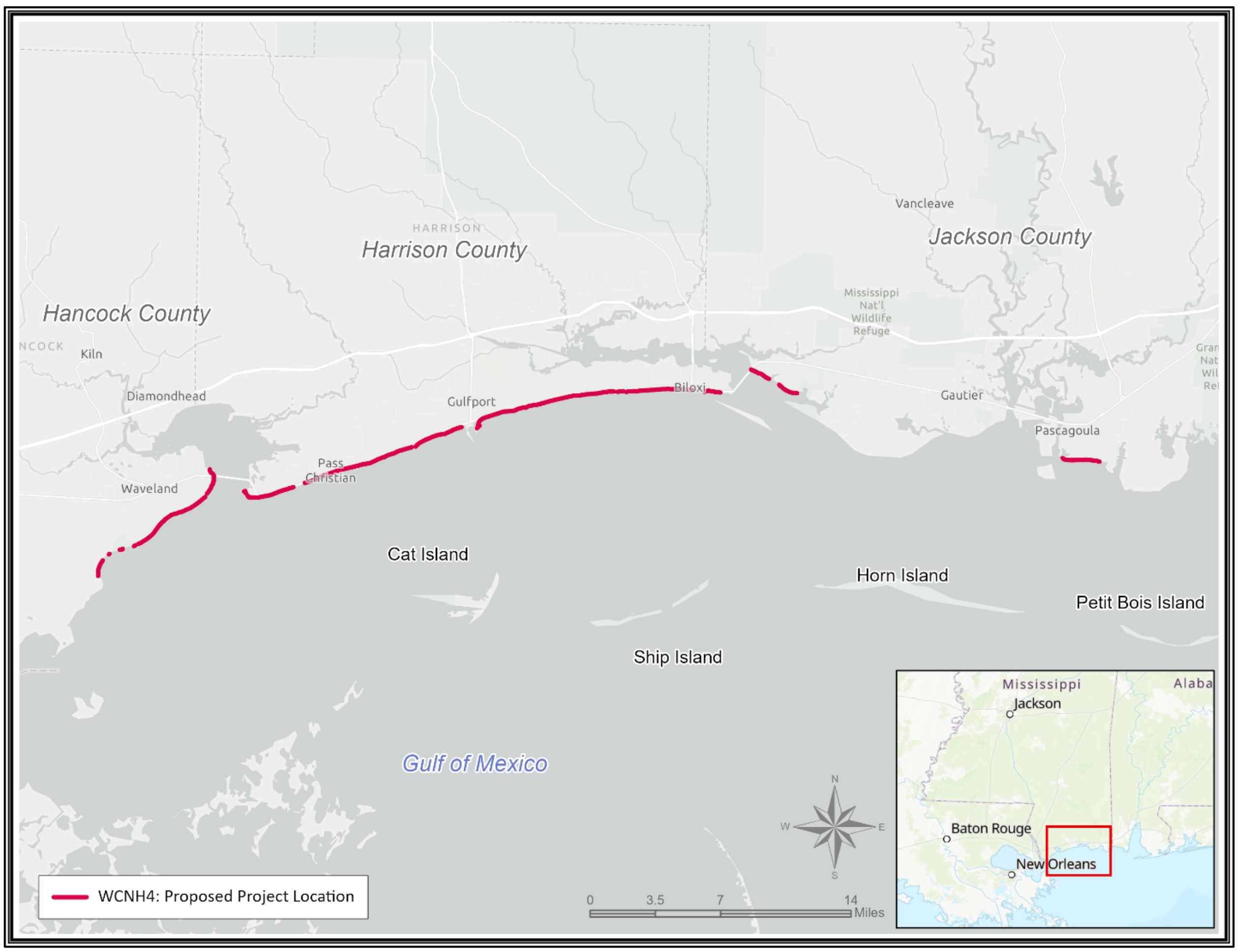

Figure 2-4 Project area for WCNH4 Sand Dune Restoration

2.4.2 Project Descriptions: Nutrient Reduction

This RP4/EA identifies three restoration alternatives consistent with the Restore Water Quality Goal (PDARP/PEIS Section 5.3.1) and underlying Nutrient Reduction (Nonpoint Source) Restoration Type, abbreviated as "NR" in the tables below (PDARP/PEIS Section 5.5.4).

NR1 Back Bay – Davis Bayou Nutrient Reduction

NR1 Back Bay – Davis Bayou Nutrient Reduction
Restoration approach
Reduce Pollution and Hydrologic Degradation to Coastal Watersheds
Restoration techniques
Implement low-impact development (LID) practices Implement traditional stormwater control measures (SCM) Implement erosion and sediment control (ESC) practices
Project location
Back Bay of Biloxi and Davis Bayou - Biloxi Bay, Harrison and Jackson counties, MS (see Figure 2-5)
Project background and summary
The project would improve water quality by implementing conservation practices to reduce nutrients and sediment runoff in coastal watersheds. The MDEQ Non-Point Source Program identified two priority hydrologic unit code (HUC) 12 watersheds for this project: Back Bay of Biloxi (031700090605) and Davis Bayou - Biloxi Bay (0317000906060). MDEQ and its watershed stakeholders would develop conservation plans to identify conservation practices that reduce nutrient runoff and sediment and then implement those practices. Practices could include stormwater runoff control, heavy use protection area, streambank and shoreline protection, stream habitat improvement and management, constructed wetland, wetland enhancement, brush management, herbaceous weed treatment, restoration of rare or declining natural communities, construction of dike and levees, water and sediment control basin, and other conservation practices. A list of potential nutrient reduction practices is located in Appendix A.
Project implementation methodology and timing
The Implementing Trustee for this proposed project would be MDEQ. In an initial round of stakeholder engagement, MDEQ identified conservation practices that could be implemented depending on feasibility, project cost, and funding available for the project. MDEQ would work with stakeholders to identify candidate projects/conservation practices. The project proposes to implement clusters of conservation practices within the smallest watershed practicable with the goal of making a discernable difference in water quality at the watershed level. Two potential project areas have been identified to implement appropriate conservation practices adjacent to waterways that discharge into Back Bay: D'Iberville Lamey Street Bank Stabilization: Includes conservation practices to reduce sediment and nutrient contribution on publicly owned lands adjacent to a waterway that discharges into Biglin Bayou. Hiller Park and Keesler AFB Drainage Area 9 Nutrient and Stormwater Control Project: Includes conservation practices to reduce sediment and nutrient contribution on publicly owned lands adjacent to a waterway that drains into Bayou Laporte. Other projects or conservation practices could be identified during stakeholder outreach. Table 1 provides a comparison of Back Bay-Davis Bayou project activities with USDA Conservation Practices that are parallel in scope.

NR1 Back Bay – Davis Bayou Nutrient Reduction

Table 1. Back Bay-Davis Bayou project activities and corresponding USDA Conservation Practices

Back Bay-Davis Bayou Project Activities18F[19]	USDA Conservation Practice
Streambank Stabilization	Streambank and Shoreline Protection (580)
Removal of Invasive/Non-Native Plants	Brush Management (314)
	Herbaceous Weed Treatment (315)
Establishment of Check Dams	Dike and Levee (356)
Detention Pond Enhancement	Sediment Basin (350)
Planting of Native Vegetation	Critical Area Planting (342)
Low-Impact Development Practices	Stormwater Runoff Control (570)
Stormwater Control Measures and Stormwater Management	
Stream Restoration	Stream Habitat Improvement and Management (395)
Wetlands Creation and Enhancement	Wetland Enhancement (659)
	Wetland Creation (658)

Please see the following link for a comprehensive list of all USDA Conservation Practice Standards: [Conservation Practice Standards | Natural Resources Conservation Service (usda.gov)]

The project would be implemented over a 5-year period with the first year consisting primarily of stakeholder outreach and planning. Implementation of the conservation plans would begin in year three and continue through year five. Specific activities and project implementation schedule are provided here:

Years 1-2 (2024-2025)

- Conservation planning (including stakeholder outreach)
- Environmental evaluation
- E&D

Years 3-5 (2026-2028)

- Implementation
- Monitoring and adaptive management

Adaptive management

Adaptive management would be the responsibility of MDEQ and would be conducted in accordance with the MAM plan.

[19] The MS TIG evaluated the Back Bay-Davis Bayou project activities for their potential impacts to the affected environment (Back Bay-Davis Bayou watershed). The Back Bay-Davis Bayou project activities are similar in scope to USDA-NRCS conservation practices that address water quality and soil erosion concerns. The purpose, condition, and criteria for applying the specific conservation practices to reduce nutrient and sediment runoff in an urban landscape are considered. Information on the practices considered can be found here (https://www.nrcs.usda.gov/getting-assistance/conservation-practices#standard). For the purposes of this RP4/EA, environmental consequences are based on the USDA Conservation Practice descriptions, as well as anticipated construction and maintenance activities that could be implemented for the Back Bay-Davis Bayou Nutrient Reduction Alternative.

NR1 Back Bay – Davis Bayou Nutrient Reduction
Monitoring summary
A draft MAM plan is attached in Appendix C. Monitoring metrics would include number of local units of government agreements, installed conservation practices, and measurement of appropriate water quality parameters.
Costs
The total estimated cost of this project is $2,500,000.

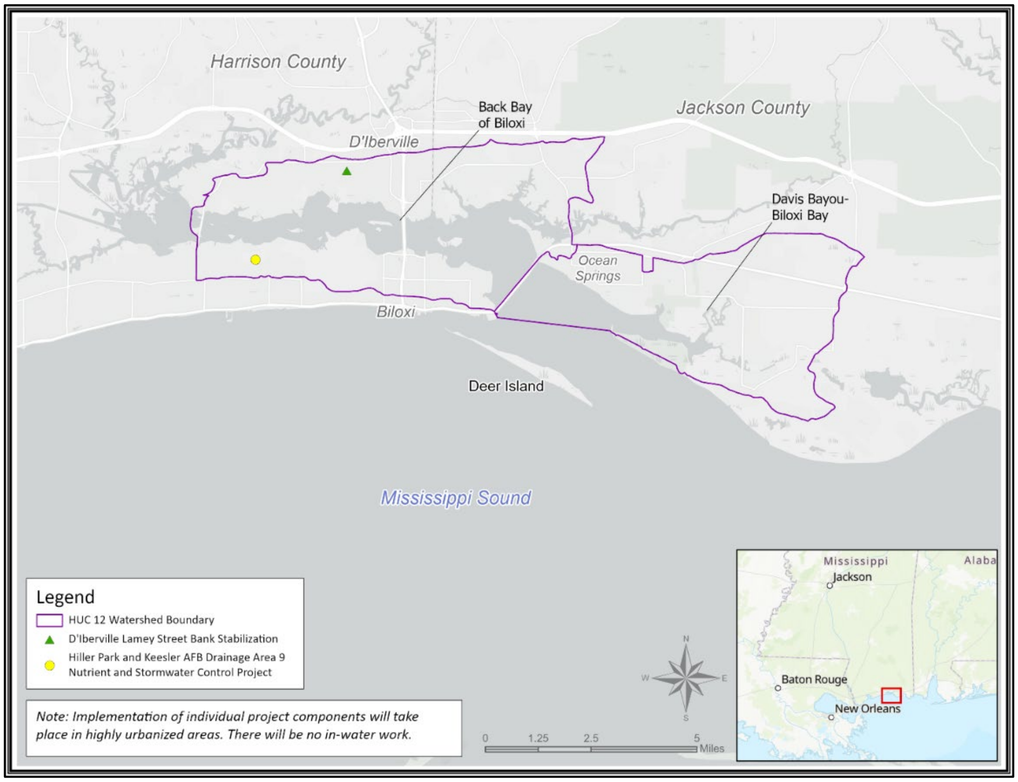

Figure 2-5 Project area for NR1 Back Bay – Davis Bayou Nutrient Reduction

NR2 Big Cedar Creek – Rocky Creek Nutrient Reduction

NR2 Big Cedar Creek – Rocky Creek Nutrient Reduction
Restoration approach
Reduce nutrient loads to coastal watersheds Reduce pollution and hydrologic degradation to coastal watersheds
Restoration techniques
Agricultural conservation practices Forestry conservation practices
Project location
12-Digit HUC — George and Jackson counties, Mississippi (see Figure 2-6): 1) 031700080402 – Red Creek-Escatawpa River 2) 031700080403 – Juniper Bay-Escatawpa River 3) 031700080405 – Spring Creek-Escatawpa River 4) 031700060106 – Little Cedar Creek

NR2 Big Cedar Creek – Rocky Creek Nutrient Reduction
Project background and summary
The project would be implemented by USDA in the Big Cedar Creek and Rocky Creek watersheds to improve water quality by implementing conservation practices to reduce nutrient and sediment runoff. USDA and its conservation partners would help private landowners on a voluntary basis to adopt management strategies to address nutrient and sediment transport from their farming operations. The project would focus on the enrollment of targeted tracts of agricultural and associated forested lands within the boundaries of four 12-digit HUC watersheds to reduce sediment and nutrient loading at the watershed level. Practices are included in Appendix A.
Project implementation methodology and timing
The project would be implemented over a 5-year period with the first year consisting mainly of landowner outreach and planning. Implementation of the conservation plans would begin in year two and continue through year four. The project would consist of: 1) conservation planning (including landowner outreach) and environmental evaluation; 2) engineering and design; 3) implementation, and 4) monitoring. All the project phases may be initiated simultaneously, depending on the level of outreach efforts needed to engage landowners. The Implementing Trustee for this proposed project would be USDA, with EPA and MDEQ as MS TIG Trustees assisting in the project. This proposed project would improve water quality by reducing nutrient loads to coastal watersheds. Conservation plans would be developed and implemented on agricultural and forested landscapes to address nutrient and sediment runoff. The primary goal of this nutrient reduction project is to improve water quality by reducing nutrient and sediment loading. The health of the Gulf of Mexico depends upon the health of its estuaries, and the health of those coastal waters is influenced by land uses in the watersheds of its tributaries. In the five Gulf States, over 80 percent of the acreage is in private ownership (USDA-NRCS 2014) and is used for forestry and agriculture. This watershed-scale project would restore water quality impacted by the DWH oil spill by reducing nutrients and the sediments carrying them into coastal waters. Runoff from cropland, grassland, forest, and urban sources contributes nutrients and sediments to coastal Gulf waters that adversely affect their health. While agricultural and forested lands are not the sole contributors (and in many instances, not the leading contributors) of nutrients to coastal waters, there are opportunities to address this resource concern at these sources within the Big Cedar Creek and Rocky Creek watersheds. The USDA would provide outreach and technical assistance to voluntary participants (private landowners), especially on acres within the watersheds where conservation measures would have the greatest potential to improve water quality, to develop conservation plans and implement nutrient reduction-related conservation practices. The project proposes to implement clusters of conservation practices within the smallest watershed practicable with the goal of making a discernable difference in water quality at the watershed level. While the targeted approach described here is expected to reduce pollution and hydrologic degradation, the project's proponents understand that implementation of conservation practices depends on landowner participation and would therefore make outreach a key component of the overall effort. The proposed conservation practices would reduce nutrient and sediment losses from the landscape, reduce nutrient and sediment loads to streams and downstream receiving waters, and reduce water quality degradation in watersheds that could provide benefits to coastal watersheds and marine resources. Activities to be Funded: • Program Oversight and Management • Conservation Planning/Environmental Compliance/Engineering and Design • Implementation (non-construction) • Implementation (construction) • Short-term Operations and Maintenance • Project Performance Monitoring
Adaptive management
Operations and maintenance of restoration activities, BMPs, and conservation practices would be included in this project and coordinated with the stakeholders during the planning/implementation phases of the project.

NR2 Big Cedar Creek – Rocky Creek Nutrient Reduction
Monitoring summary
A draft MAM plan is attached in Appendix C. Monitoring metrics would include number of landowner contracts, installed conservation practices, and measurement of appropriate water quality parameters. Outcomes models that project nutrient and sediment reductions would be consulted to acquire output data to document the impact of the conservation practices applied.
Costs
The total estimated cost of this project is $2,500,000.

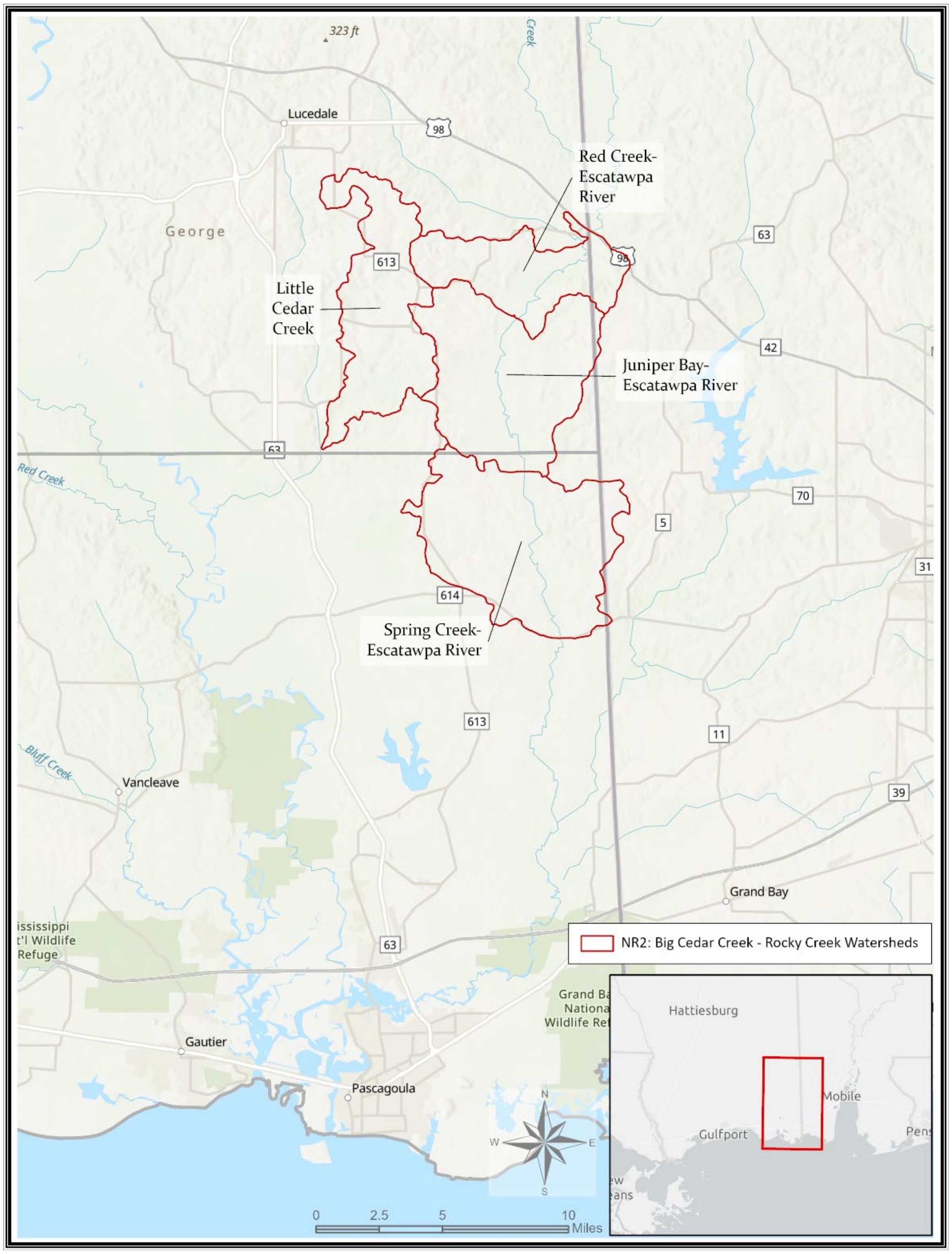

Figure 2-6 Project area for NR2 Big Cedar Creek – Rocky Creek Nutrient Reduction

NR3 Big Cedar Creek – West Pascagoula River Nutrient Reduction

NR3 Big Cedar Creek – West Pascagoula River Nutrient Reduction
Restoration approach
Reduce nutrient loads to coastal watersheds Reduce pollution and hydrologic degradation to coastal watersheds
Restoration techniques
Agricultural conservation practices Forestry conservation practices
Project location
12-Digit HUC — George and Jackson counties, Mississippi (see Figure 2.7): 1) 031700060104 – Plum Bluff Cutoff-White Creek 2) 031700060107 – Lyons Creek-Big Cedar Creek 3) 031700060108 – Indian Creek-Pascagoula River 4) 031700060301 – Black Creek-Pascagoula River
Project background and summary
The project would be implemented by USDA in the Big Cedar Creek and West Pascagoula River watersheds to improve water quality by implementing conservation practices to reduce nutrient and sediment runoff. USDA and its conservation partners would help landowners on a voluntary basis to adopt management strategies to manage nutrients and sediments from their farming operations. The project would focus on the enrollment of targeted tracts of agricultural and associated forested lands within the boundaries of four 12-digit HUC watersheds to reduce sediment and nutrient loading at the watershed level. Exemplar practices are included here: Nutrient Reduction Exemplar Practices.pdf.
Project implementation methodology and timing
The project would be implemented over a 5-year period with the first year consisting mainly of landowner outreach and planning. Implementation of the conservation plans would begin in year two and continue through year four. The project would consist of: 1) conservation planning (including landowner outreach) and environmental evaluation; 2) engineering and design; 3) implementation, and 4) monitoring. All the project phases may be initiated simultaneously, depending on the level of outreach efforts needed to engage landowners. The Implementing Trustees for this proposed project would be USDA, EPA and MDEQ. This proposed project would improve water quality by reducing nutrient loads to coastal watersheds. Conservation plans would be developed and implemented on agricultural and forested lands to address nutrient and sediment runoff. The primary goal for this nutrient reduction project is to improve water quality by reducing nutrient and sediment loading. The health of the Gulf of Mexico depends upon the health of its estuaries, and the health of those coastal waters is influenced by land uses in the watersheds of its tributaries. In the five Gulf States, over 80 percent of the acreage is in private ownership (USDA-NRCS 2014) and is used for forestry and agriculture. This watershed-scale project would restore water quality impacted by the DWH oil spill by reducing nutrients and the sediments carrying them into coastal waters. Runoff from cropland, grassland, forest, and urban sources, contributes nutrients and sediments to coastal Gulf waters that adversely affect their health. Agricultural and forested lands are not the sole contributors (and in many instances, not the leading contributors) of nutrients to coastal waters. However, agricultural and forested lands within the Big Cedar Creek and Rocky Creek watersheds were identified as nutrient sources that, if addressed, could improve the health of coastal waters. The USDA would provide outreach and technical assistance to voluntary participants (private landowners, especially on acres within the watersheds where conservation measures would have the greatest potential to improve water quality, to develop conservation plans and implement nutrient reduction-related conservation practices. The project proposes to implement clusters of conservation practices within the smallest watershed practicable with the goal of making a discernable difference in water quality at the watershed level. While the targeted approach described here is expected to reduce pollution and hydrologic degradation, the project's proponents understand that implementation of conservation practices depends on landowner participation and would therefore make outreach a key component of the overall effort. The proposed conservation practices would reduce nutrient and sediment losses from the

NR3 Big Cedar Creek – West Pascagoula River Nutrient Reduction
landscape, reduce nutrient and sediment loads to streams and downstream receiving waters, and reduce water quality degradation in watersheds that could provide benefits to coastal watersheds and marine resources. Activities to be Funded: • Program Oversight and Management • Conservation Planning/Environmental Compliance/Engineering and Design • Implementation (non-construction) • Implementation (construction) • Short-term Operations and Maintenance • Project Performance Monitoring
Operations and maintenance
Operations and maintenance of restoration activities, BMPs and conservation practices would be included in this project and coordinated with the stakeholders during the planning/implementation phases of the project.
Monitoring summary
This project has not been identified at this time as a preferred alternative by the MS TIG, therefore, a project MAM plan has not been developed.
Costs
The total estimated cost of this project is $2,500,000.

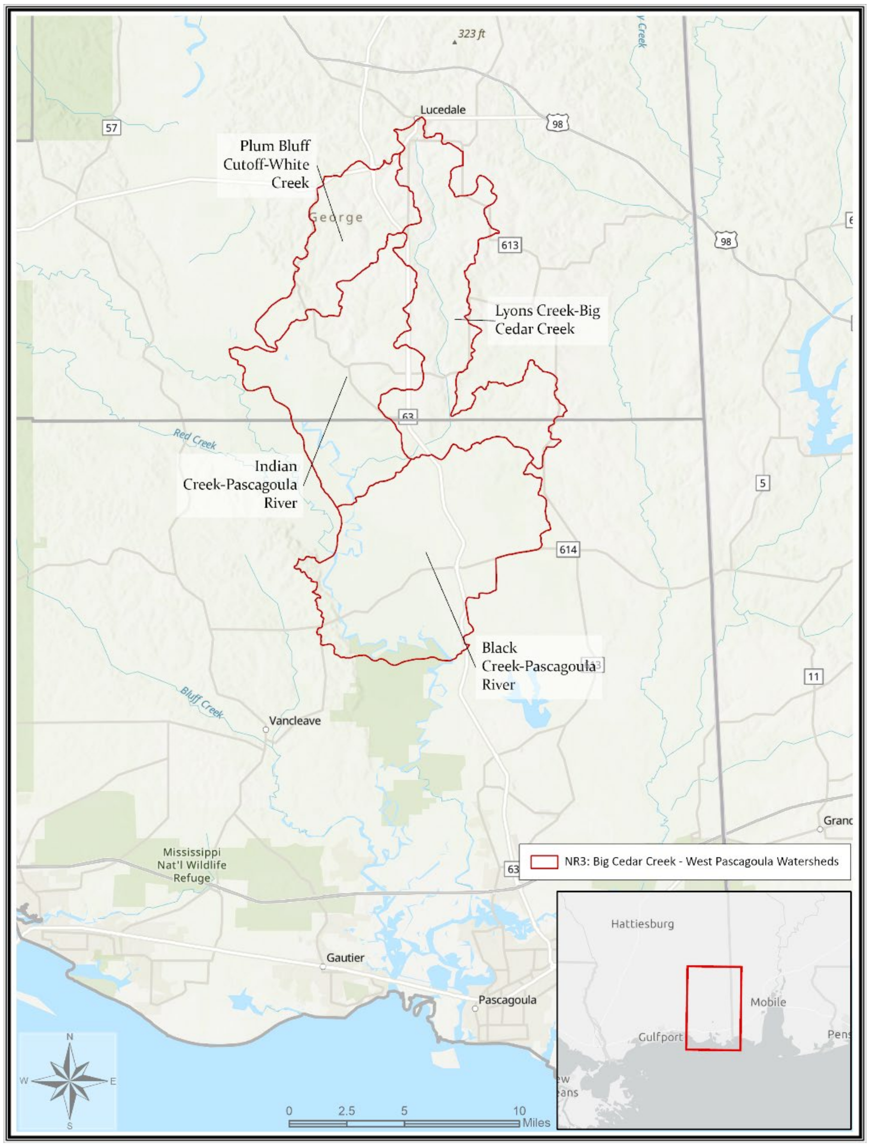

Figure 2-7 Project area for NR3 Big Cedar Creek – West Pascagoula River Nutrient Reduction

2.4.3 Project Descriptions: Provide and Enhance Recreational Opportunities

This RP4/EA identifies three restoration alternatives consistent with the Provide and Enhance Recreational Opportunities Goal (PDARP/PEIS Section 5.3.1) and the Provide and Enhance Recreational Opportunities Restoration Type, abbreviated as “REC” in the tables below (PDARP/PEIS Section 5.5.14).

REC1 Jourdan River Boardwalk

REC1 Jourdan River Boardwalk
Restoration approach
Enhance Public Access to Natural Resources for Recreational Use Promote Environmental Stewardship, Education, and Outreach
Restoration techniques
Enhance Public Access to Natural Resources for Recreational Use Create or Enhance Natural Resource-related Educational Facilities

REC1 Jourdan River Boardwalk

Project location

Diamondhead, Mississippi (see Figure 2-8)

Project background and summary

This project would construct a public boardwalk along the Jourdan River to provide access to and information about this tidal estuarine ecosystem in coastal Mississippi. The project would include a boardwalk, nature observatory, seating areas, and educational signage about the wetlands, coastal, and nearshore habitats including the tidal Jourdan River, adjacent estuarine marsh, and living resources (e.g., birds) that use these habitats.

Project implementation methodology and timing

The Implementing Trustee for this proposed project would be MDEQ. The City of Diamondhead would be a project partner. The Jourdan River Boardwalk project is one component (Phase 2) of the City of Diamondhead's proposed Noma Drive Public Access Improvements Project.

Jourdan River Boardwalk (Noma Drive Public Access Improvements Phase 2)

The Jourdan River Boardwalk would extend from Phase 1 of the Noma Drive Public Access Improvements Project (see details below) westward to the Jourdan River. The boardwalk and associated amenities would then parallel the Jourdan River and would terminate at the northern end of the MDOT ROW. Public access to the boardwalk would be provided by the City through agreements with adjacent landowners. The in-water project includes the installation of approximately 1,250 linear feet of 8-foot wide timber pile supported pier and walkway, one-20'x20' elevated nature observatory (with upper level deck), three-20'x20' seating areas, associated low level lighting and safety railing. The decking is anticipated to be timber with an alternate bid item to include fiberglass reinforced plastic grating for better weather resiliency. Educational signs and displays would be placed along the boardwalk.

The Phase 1 Noma Drive Public Access Improvements project (not part of this proposed NRDA project) would be implemented by the City of Diamondhead, using other funding which has already been secured. Phase 1 recreational/educational amenities include a 150-foot long, 12-foot wide public boardwalk, adjacent boat ramp, free public parking lot (178' x 292' with twelve car and twenty-four car/trailer parking spots), and wildlife-proof trash receptacles.

The preliminary implementation schedule is provided here:

Years 1-2 (2024-2025)

- E&D and Permitting
- Construction

Years 3-5 (2026-2028)

- Boardwalk open to the public
- Monitoring of visitor use

Adaptive management

Adaptive management would be the responsibility of MDEQ and would be conducted in accordance with the MAM plan.

Monitoring summary

A draft MAM Plan is attached in Appendix C. Monitoring metrics would include documentation of as-built construction and annual visitor use estimates of the boardwalk.

Costs

The total estimated cost of this project is $2,118,000.

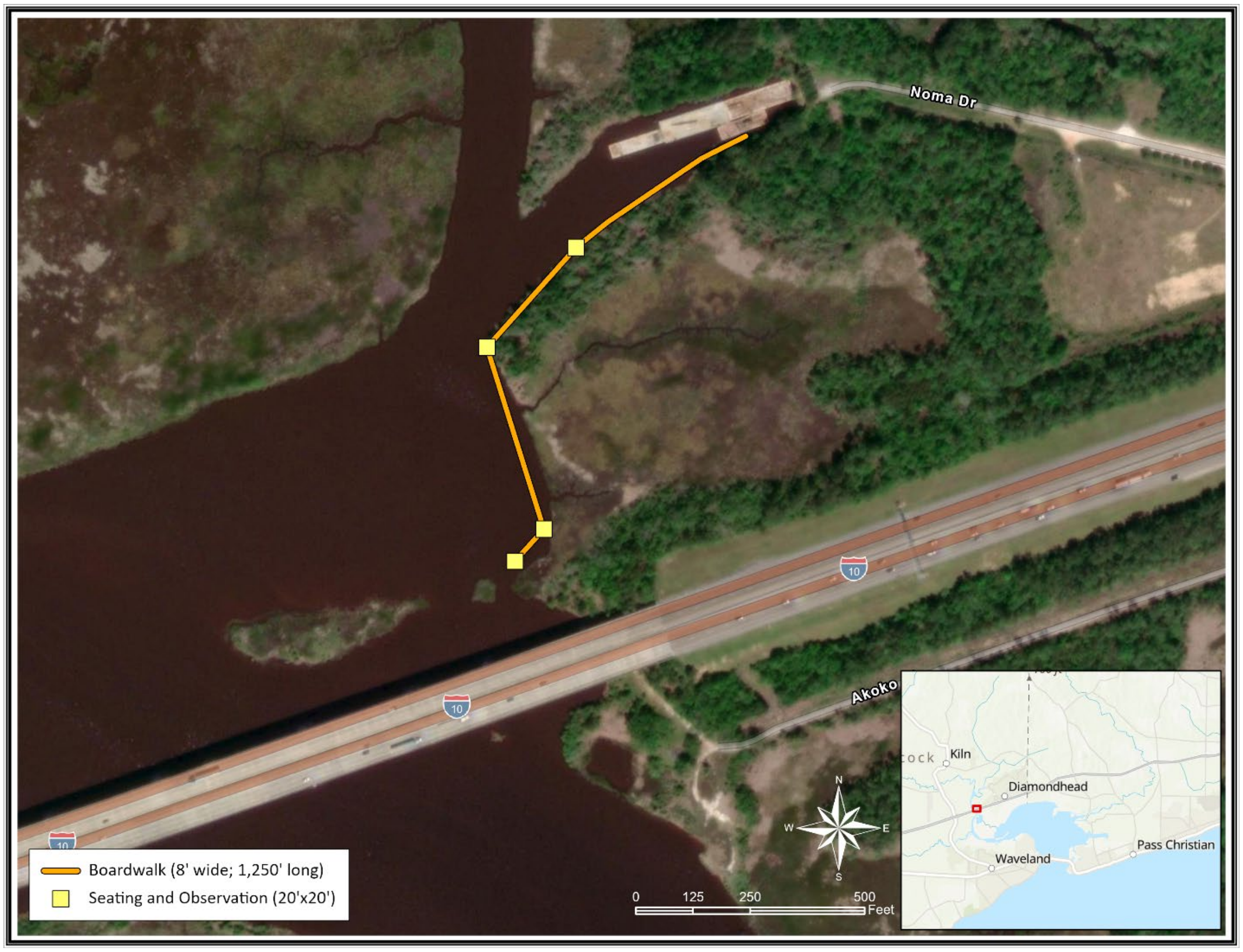

Figure 2-8 Project area for REC1 Jourdan River Boardwalk

REC2 Shepard State Park Recreational Enhancements-1

REC2 Shepard State Park Recreational Enhancements-1
Restoration approach
Enhance Public Access to Natural Resources for Recreational Use Promote Environmental Stewardship, Education, and Outreach
Restoration techniques
Enhance Public Access to Natural Resources for Recreational Use Create or Enhance Natural Resource-Related Education Programs Create or Enhance Natural Resource-Related Facilities
Project location
Shepard State Park in Gautier, MS, Jackson County (see Figure 2-9)
Project background and summary
The purpose of the Shepard State Park Enhancements-1 is to provide additional visitor use experience and enhance access to natural resources by improvements to existing facilities, improvement and maintenance of existing trails, and providing enhanced natural resources related education programs for park visitors including students.

REC2 Shepard State Park Recreational Enhancements-1
Project implementation methodology and timing
Shepard State Park is a 400-acre park located south of U.S. Highway 90 on Graveline Road in Gautier, MS. The City of Gautier assumed the daily operations and management of Shepard State Park in January of 2013. The park is open year-round and currently has a mix of developed campsites and primitive camping sites. The park offers approximately eight miles of trails over five distinct locations and traverses coastal habitats including maritime forests, bottomland hardwoods, pine savanna and estuarine marsh. Other recreational opportunities include an RV park, a disc golf course, a marsh walk, and other recreational opportunities. The park also is part of the National Audubon Society's Mississippi Coastal Birding Trail. The following recreational enhancements are proposed: Environmental Education Center/Gray House Renovation: The "Gray House" is adjacent to the log cabin at the park entrance and was used previously as a park ranger house. Funds would be for interior renovations (e.g., sheetrock, flooring, paint, interior walls) to convert the building to an interactive Environmental Education Center where schoolchildren can come for field trips. The center would also be used for hosting nature-based classes and events. There would be interactive components to help children/visitors to learn about natural resources at Shepard State Park. The center would be used to host events such as the annual Earth Day event. There would be no charge for visitors and students to attend events at the Environmental Education Center. This project would provide recreational and educational opportunities to schools. The City of Gautier would build upon their current relationship with the Pascagoula-Gautier School District to bring students to Shepard State Park for field trips and would provide an enhanced learning experience. The park entrance fees for the school would be waived and school field trips and students would be allowed to use all of the different amenities throughout the park. Educational Signage and/or Educational Programs: Educational signage and/or educational programs would highlight habitats and resources that were injured by the spill and/or are being restored by the Trustees (e.g., Wetlands, Coastal, and Nearshore Habitats; Birds). The City has partnered with a local ecologist in the past for educational projects at Shepard State Park. Trail Enhancement and Maintenance: Funding would be used to complete an assessment to determine a plan for maintenance and enhancements as identified by the assessment. A contractor may be hired to enhance and/or maintain trails periodically as budget allows. The Implementing Trustee for this proposed project would be MDEQ. The preliminary implementation schedule is provided here: Years 1-3 (2024-2026) • E&D, Permitting, and Trail Assessment Plan • Construction and Trail Maintenance Years 4-6 (2027-2029) • Amenities open to the public and educational programs in place • Trail Maintenance
Adaptive management
Adaptive management would be the responsibility of MDEQ and would be conducted in accordance with the MAM plan.
Monitoring summary
A draft MAM Plan is attached in Appendix C. Monitoring would be conducted for 3 years. Monitoring metrics would include documenting as-built(s) for various facility improvements and collecting visitor use data in the park including attendees at various educational programs.
Costs
The total estimated cost of this project is $735,000.

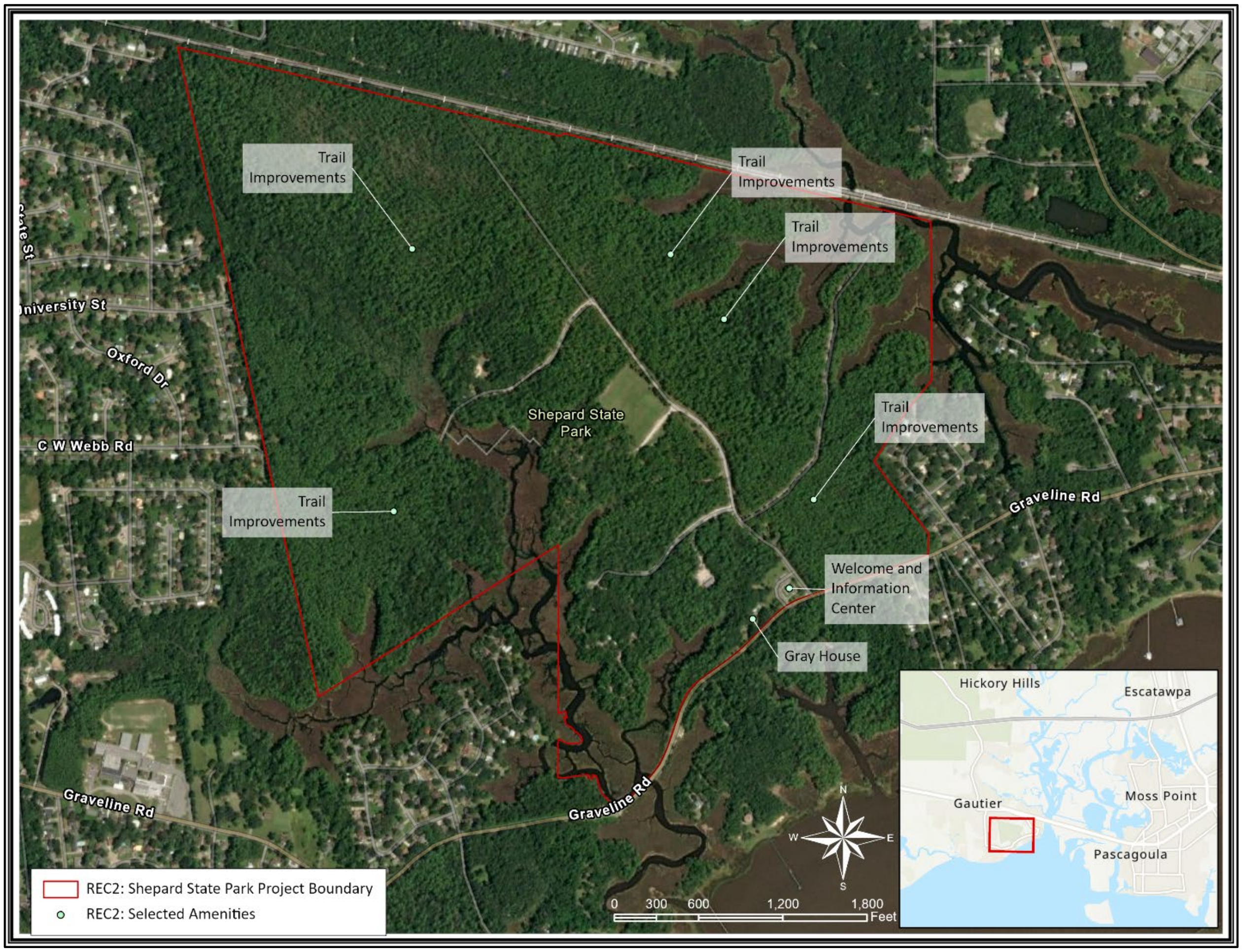

Figure 2-9 Project area for REC2 Shepard State Park Recreational Enhancements-1

REC3 Shepard State Park Recreational Enhancements-2

REC3 Shepard State Park Recreational Enhancements-2
Restoration approach
Enhance Public Access to Natural Resources for Recreational Use Promote Environmental Stewardship, Education, and Outreach
Restoration techniques
Enhance Public Access to Natural Resources for Recreational Use Create or Enhance Natural Resource-Related Education Programs
Project location
Shepard State Park in Gautier, MS, Jackson County (see Figure 2-10)
Project background and summary
The purpose of the Shepard State Park Enhancements-2 is to provide additional visitor use experience and enhance access to natural resources by the creation of new facilities, improvements to existing facilities and to provide enhanced natural resources related education programs for park visitors including students.
Project implementation methodology and timing
Shepard State Park is a 400-acre park located south of U.S. Highway 90 on Graveline Road in Gautier, MS. The City of Gautier assumed the daily operations and management of Shepard State Park in January of 2013. The park is open year-

REC3 Shepard State Park Recreational Enhancements-2
round and currently has a mix of developed campsites and primitive camping sites. The park offers approximately eight miles of trails over five distinct locations and traverses coastal habitats including maritime forests, bottomland hardwoods, pine savanna, and estuarine marsh. Other recreational opportunities include an RV park, a disc golf course, a marsh walk, and other recreational opportunities. The park also is part of the National Audubon Society's Mississippi Coastal Birding Trail. The following recreational enhancements are proposed: <u>Environmental Education Center/Gray House Renovation</u>: The "Gray House" is adjacent to the log cabin at the park entrance and was used previously as a park ranger house. Funds would be used to renovate the house for use as an interactive Environmental Education Center where schoolchildren can come for field trips. The center would also be used for hosting nature-based classes and events. There would be interactive components to help children/visitors to learn about natural resources at Shepard State Park. The center would be used to host events such as the annual Earth Day event. There would be no charge for visitors and students to attend events at the Environmental Education Center. This project would provide recreational and educational opportunities to schools. The City of Gautier would build upon their current relationship with the Pascagoula-Gautier School District to bring students to Shepard State Park for field trips and would provide an enhanced learning experience. The park entrance fees for the school would be waived and school field trips and students would be allowed to use the marsh walk and different amenities throughout the park. <u>Educational Signage and/or Educational Programs</u>: Educational signage and/or educational programs would highlight habitats and resources that were injured by the spill and/or are being restored by the Trustees (e.g., Wetlands, Coastal, and Nearshore Habitats, Birds). The City has partnered with a local ecologist in the past for educational projects at Shepard State Park. <u>Outdoor Stage</u>: This component includes replacing the existing wooden stage at the festival area. This would facilitate live performances in the festival area. <u>Playground Enhancements</u>: Playground enhancements would include upgrading the existing playground and adding a splash pad to the playground area. <u>Pavilion</u>: This component includes construction of a second pavilion in the festival area. <u>Glamping Sites</u>: Up to ten (10) glamping sites would be constructed to attract a group of visitors that are currently not using the current camping facilities (e.g., RV sites; primitive camping). Based on inquiries, there is a high demand for these sites and the City of Gautier expects high occupancy. Visitors would be provided with glamping sites that are nestled into surrounding maritime forests and walking distance to the existing marsh walk. <u>Existing Dog Park Enhancements</u>: Dog Park Enhancements would include replacing fencing, and upgrades to dog exercise/play structures. This would enhance the visitor experience and could increase use of the park by pet owners. <u>Trail Enhancement and Maintenance</u>: Funding would be used to complete trail maintenance and/or hiring a contractor to clear trails once every two years for a four-year period. <u>Playing Field Enhancements</u>: Playing field enhancement would include lighting rehabilitation in the playing field/green space area. <u>Disc Golf Improvements</u>: Disc Golf Course Improvements would be funded for the 16-hole Disc Golf course in cooperation with local golfers who are active in maintaining the course. The preliminary implementation schedule is provided here: Years 1-3 (2024-2026) • E&D, Permitting, and Trail Assessment Plan • Construction and Trail Maintenance Years 4-8 (2027-2029) • Amenities open to the public • Educational programs in place • Trail Maintenance • Monitoring
Adaptive Management
Adaptive management would be the responsibility of MDEQ and would be conducted in accordance with the MAM plan.

REC3 Shepard State Park Recreational Enhancements-2
Monitoring summary
This project has not been identified at this time as a preferred alternative by the MS TIG, therefore, a project MAM plan has not been developed.
Costs
The estimated cost of this project is $3,045,000.

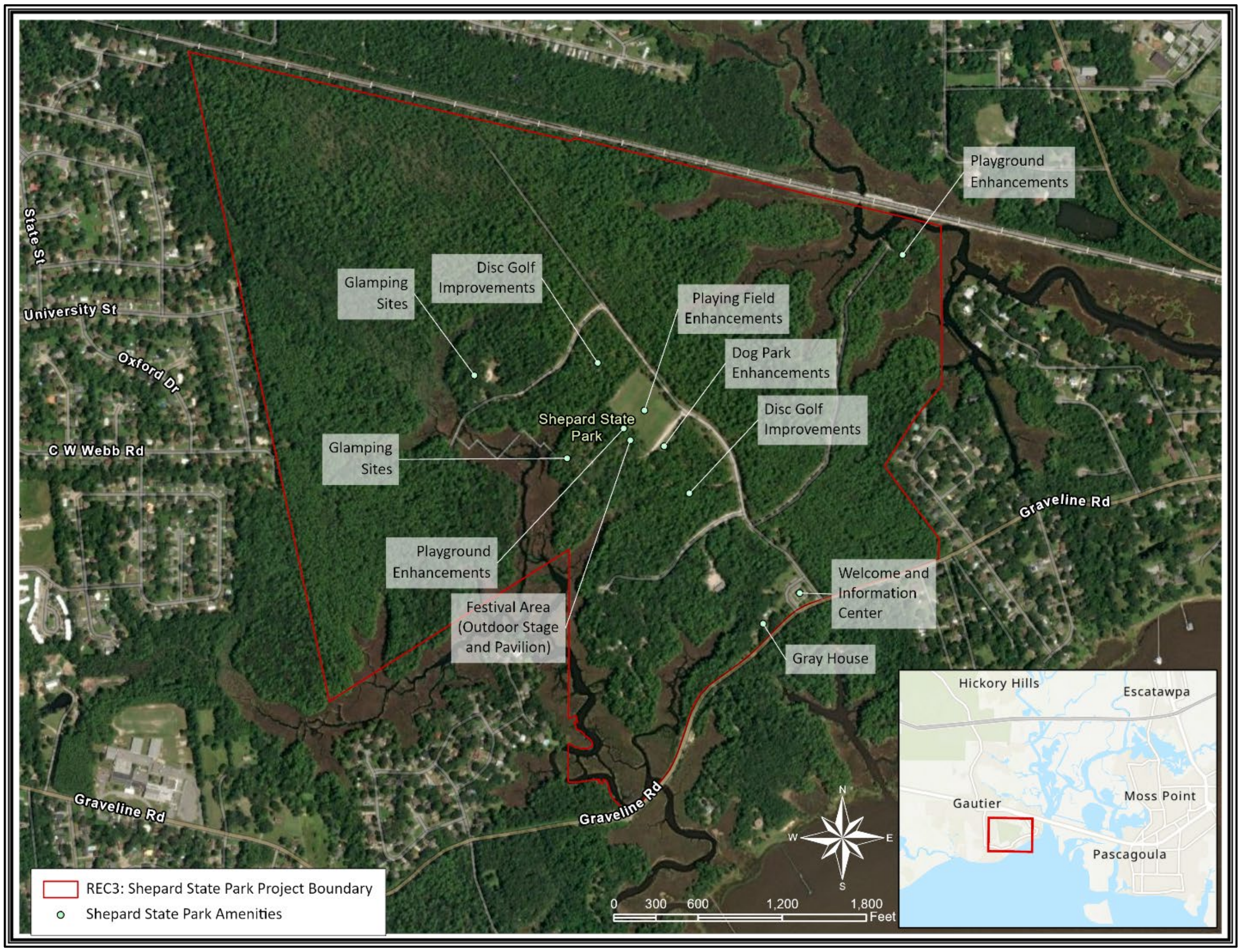

Figure 2-10 Project area for REC3 Shepard State Park Recreational Enhancements-2

3.0 OPA EVALUATION OF REASONABLE RANGE OF ALTERNATIVES

This chapter provides an OPA analysis of each restoration project in this RP4/EA based on the OPA NRDA standards. OPA NRDA evaluations for each project by Restoration Type are found in the following sections of this chapter:

- Wetlands, Coastal, and Nearshore Habitats: four alternatives (Section 3.2);
- Nutrient Reduction (Nonpoint Source): three alternatives (Section 3.3); and
- Provide and Enhance Recreational Opportunities: three alternatives (Section 3.4).

Based on the OPA evaluation in this Chapter, the MS TIG identified preferred restoration alternative(s) which are the Proposed Action for this RP4/EA.

3.1 Overview of OPA Evaluation of Restoration Alternatives

Consistent with the OPA NRDA regulations, the MS TIG considered a reasonable range of alternatives (15 CFR § 990.53(a)(2)) to be evaluated based on the OPA NRDA evaluation standards (15 CFR § 990.54(a)). The MS TIG identifies its preferred restoration alternatives in this RP4/EA. This chapter includes the MS TIG's evaluation of the proposed restoration alternatives based on these OPA evaluation standards:

- **The cost to carry out the alternative.** This criterion considers whether the cost to carry out the alternative is reasonable, appropriate, and comparable to other similar restoration alternatives. The MS TIG considered the estimated cost of the alternative, including, if appropriate, the costs for design, planning, permitting, construction, oversight and management, and monitoring and maintenance. If two or more alternatives are equally preferable based on these factors, the Trustees select the most cost-effective alternative.
- **Trustees' goals and objectives.** This criterion considers the extent to which each alternative is expected to meet the Trustees' goals and objectives in returning the DWH-injured natural resources and services to baseline and/or compensating for interim losses. This encompasses the PDARP/PEIS programmatic Restoration Goals and Types (Section 5.3.1 of the PDARP/PEIS).
- **Likelihood of success.** This criterion includes consideration of each project's likelihood of success such as whether the alternative proposes approaches or techniques that have been executed successfully in the past; whether the approach or technique is routinely employed; and whether there are significant impediments to successful implementation and/or realization of the project benefits (e.g., local support for a project, potential regulatory compliance issues).
- **Prevents future injury and avoids collateral injury**. This criterion evaluates the extent to which an alternative would prevent future injury as a result of the incident, and/or avoid collateral injury as a result of implementing the alternative. None of the alternatives considered in this RP4/EA prevent future injuries from the incident. Instead, for this OPA evaluation, the MS TIG focused on whether the restoration alternative has the potential to cause collateral environmental injuries. For projects proposing more than E&D and acquisition activities, these considerations are covered in more detail in the environmental consequences sections of Chapter 4.
- **Benefits multiple natural resources/services.** This criterion evaluates the extent to which an alternative would provide benefits to more than one natural resource. This includes whether the project benefits would make the alternative more valuable (e.g., by providing both recreational and ecological benefits).

- **Effects on public health and safety.** This criterion evaluates whether any aspect of the alternative could affect public health and/or safety. This evaluation includes consideration of both positive and negative impacts that cannot be mitigated.

3.2 OPA Evaluation: Wetlands, Coastal, and Nearshore Habitats Alternatives

The MS TIG identified four alternatives for detailed analysis in this RP4/EA and evaluated these alternatives consistent with the OPA NRDA regulations in 15 CFR § 990.54(a). The following sections describe the OPA evaluation for each alternative.

3.2.1 WCNH1 Coastwide Habitat Acquisition

This alternative would acquire land in coastal areas for conservation that 1) have high ecological value and/or 2) where wetlands, coastal, and nearshore habitat creation, restoration, and preservation projects could be implemented in future restoration actions (for example, lands adjacent to coastal bays and estuaries). Conserving and protecting land parcels via acquisition can protect wetlands and other significant coastal, estuarine, riverine and riparian habitats; create connections between protected areas and remove direct threats of development. Once acquired, parcels would be conserved, complementing and advancing the goals of coastal management, habitat conservation, and other applicable plans. In addition, parcels may be sites for future restoration activities not currently a part of this project budget (e.g., habitat management, installation of living shorelines, intertidal and subtidal oyster reef restoration, hydrologic connectivity projects, and/or expansion/enhancement of marsh habitat using beneficial use materials). The total estimated project cost for this alternative is $5.0 million (see Table 2-1).

Table 3-1 OPA Evaluation of WCNH1 Coastwide Habitat Acquisition

OPA Standard	OPA Evaluation
Cost to Carry Out the Alternative	The MS TIG determined that the costs for the alternative are reasonable, appropriate, and comparable to similar projects involving land acquisition because the properties would be purchased at or below the Yellow Book appraised value.
Trustees' Goals and Objectives	Consistent with the PDARP/PEIS Restoration Type goals, this alternative would restore for injuries to habitats in the geographic areas where the injuries occurred, while considering approaches that provide resiliency and sustainability. The project would acquire land in coastal areas for conservation that have high ecological value and/or 2) where wetlands, coastal, and nearshore habitat creation, restoration, and preservation projects could be implemented in future restoration actions (for example, lands adjacent to coastal bays and estuaries). Conserving and protecting land parcels via acquisition can protect wetlands and other significant coastal, estuarine, riverine and riparian habitats; create connections between protected areas and remove direct threats of development. Once acquired, parcels would be conserved, complementing and advancing the goals of coastal management, habitat conservation, and other applicable plans. Acquisition would remove the threat of development, decrease habitat fragmentation, and increase habitat connectivity to other large conservation parcels in the area. As stated in Section 5.5.2.3 of the PDARP/PEIS, this project would consider projects being implemented through other funding streams (RESTORE and NFWF GEBF) in order to identify opportunities for restoring habitat complexes by expanding on habitat restoration already being conducted. In addition, acquired parcels may be sites for future restoration activities (e.g., habitat management, installation of living shorelines, intertidal and subtidal oyster reef restoration, hydrologic connectivity projects, and/or expansion/enhancement of marsh habitat using beneficial use materials).
Likelihood of Success	MDEQ (Implementing Trustee) has broad experience in implementing other DWH restoration land acquisition projects through NRDA projects (e.g., Grand Bay Land Acquisition and Habitat Management) and NFWF GEBF and RESTORE funding streams, and therefore has an established and efficient process for identifying and acquiring priority habitat parcels for acquisition in the Mississippi Restoration Area. This approach would generally follow the MDEQ-established process for DWH-funded land acquisition projects and would allow for coordination and leveraging acquisition of priority parcels and planning for future habitat restoration activities. MDEQ would implement a MAM plan (see Appendix C) that would assess progress toward project goals, help minimize risk, and address key uncertainties on an ongoing basis.
Avoid Collateral Injury	The MS TIG does not expect this alternative to cause collateral injury to natural resources, because it is limited to acquisition activities.
Benefits to Multiple Resources	Through acquisition and conservation, this alternative would benefit target habitats that may include estuarine marsh, shoreline (beach), island, and other coastal riparian habitats, and therefore could provide secondary benefits by preserving lands for species which utilize these habitats.
Public Health and Safety	The MS TIG does not anticipate impacts to public health and safety from the implementation of this alternative, since it is limited to acquisition activities.
Summary	Based on the OPA evaluation, the MS TIG has identified this project as a preferred restoration alternative in this RP4/EA at this time. The cost is reasonable, the alternative would meet Trustees' goals and objectives and would benefit target habitats that may include estuarine marsh, shoreline (beach), island, and other coastal riparian habitats, and therefore could provide secondary benefits by preserving lands for species which utilize these habitats.

3.2.2 WCNH2 Living Shoreline Bulkhead Alternative

This alternative would construct small-scale living shorelines that would reduce shoreline erosion and incorporate vegetation or other living, natural “soft” elements alone or in combination with some type of harder shoreline protection structure (e.g., oyster or mussel reefs or rock sills) for added protection and stability. The living shorelines would maintain the natural continuity of the land-water interface and retain or enhance shoreline ecological processes. The project would protect coastal wetland habitat through the construction of nearshore breakwaters parallel to the shoreline for the purpose of reducing shoreline erosion. The living shorelines would be constructed in areas with high public visibility, which would also serve to provide the public with the educational opportunity to observe the structures and learn about the benefits to shoreline protection that can be achieved by using living shorelines as alternatives to bulkheads. The total estimated project cost for this alternative is $3.0 million (see Table 2-1).

Table 3-2: OPA Evaluation of WCNH2 Living Shoreline Bulkhead Alternative

OPA Standard	OPA Evaluation
Cost to Carry out the Alternative	The MS TIG determined that the costs for the alternative are reasonable, appropriate, and comparable to similar projects.
Trustees' Goals and Objectives	This alternative would protect coastal wetland habitat through the construction of nearshore breakwaters parallel to the shoreline for the purpose of reducing shoreline erosion. Coastal wetlands are the backbone of the northern Gulf of Mexico coastal and nearshore ecosystem providing a wide range of important ecological functions and services (see PDARP/PEIS Section 5.D.1.1).
Likelihood of Success	This alternative would utilize standard approaches to living shoreline construction techniques, which have proven to be effective in providing protection from shoreline erosion in the northern Gulf of Mexico and in the Mississippi Restoration Area. For example: the Hancock County Marsh Living Shoreline Project has not only reduced rates of shoreline erosion but has, in some areas, resulted in shoreline accretion. The living shorelines would be constructed in accordance with the U.S. Army Corps of Engineers Mississippi General Permit MSGP-01.The project design would be consistent with local and regional sediment management plans and programs and include a complete understanding of the sediments and physical processes within the area where each breakwater is sited. MDEQ would implement a MAM plan (see Appendix C) that would assess progress toward project goals, help minimize risk, and address key uncertainties on an ongoing basis.
Avoid Collateral Injury	Established protocols and methods for invasive species management would be used to avoid incidental mortality and collateral injury to native species of plants and wildlife. The project area would be monitored for presence of invasive species of vegetation for a minimum of five years from completion of construction in accordance with Mississippi Department of Marine Resources (MDMR) Waiver for Alternative Bulkhead Designs/Living Shorelines in Mississippi's State Waters.
Benefits to Multiple Resources	Reduction of wave energies and currents acting on shorelines induces sediment deposition and provides shelter for wetland plants and shoreline habitats (see PDARP/PEIS Section 5.D.1.1). The project could provide secondary benefits to species which utilize these coastal wetland habitats (e.g., birds and oysters).
Public Health and Safety	The MS TIG does not anticipate negative impacts to public health and safety. The Implementing Trustee would comply with all relevant safety measures, practices, and regulations during construction of the living shorelines. The Implementing Trustee would maintain a safe, protective environment for those involved with the project.
Summary	Based on the OPA evaluation, the MS TIG has identified this project as a preferred alternative in this RP4/EA at this time. The cost is reasonable, the alternative would meet Trustees' goals and objectives, and would provide benefits to multiple resources benefits by providing shelter for wetland plants and shoreline habitats and secondary benefits to species which utilize these coastal wetland habitats (e.g., birds and oysters).

3.2.3 WCNH3 Hancock County Marsh Living Shoreline Phase 6 Breakwater

This alternative would construct a 1.7-mile-long segmented riprap breakwater in the Mississippi Sound and would be Phase 6 of the existing Hancock County Marsh Living Shoreline (HCMLS) Project, an ongoing Early Restoration DWH NRDA Project which already includes the following components:

Phases 1-3: 5.9 miles of breakwater

Phase 4: a 46-acre subtidal reef

Phase 5: a 46-acre created marsh, the construction of which is ongoing.

Historic erosion rates from 1850 to 2001 along Hancock County Marsh from Pearl River to Bayou Bolan range from 6 to 10 feet per year (Schmid 2002) and shoreline position monitoring data have shown the existing breakwaters' success in decreasing shoreline erosion, suggesting that an extension of the HCMLS Project from its current location to Bayou Caddy is needed to complete and maximize protection of this sensitive marsh complex. The purpose of the project is to protect the Hancock County Marsh Preserve shoreline and salt marsh habitat from erosion and to create habitat for secondary benthic productivity. The project would extend the shoreline protection and enhance secondary benthic productivity benefits already provided by the breakwaters (which originate at the Louisiana/Mississippi state line and extend to Bayou Bolan). The total estimated project cost for this alternative is $10.5 million (Table 2-1).

Table 3-3: OPA Evaluation of WCNH3 Hancock County Marsh Living Shoreline Phase 6 Breakwater

OPA Standard	OPA Evaluation
Cost to Carry out the Alternative	The MS TIG determined that the costs for the alternative are reasonable, appropriate, and comparable based upon the existing phases of the project that have already been constructed and the current construction market. This alternative would partially fund construction of the an additional 1.7-mile segment of the HCMLS Project, which has already constructed 5.9 miles of living shoreline breakwater along the Hancock County Marsh Coastal Preserve in the Mississippi Sound between the East Pearl River and Bayou Bolan. Costs for living shoreline construction are reasonable and, considering inflation and current construction costs, are comparable to the construction cost of the existing 5.9 miles of breakwaters completed in 2018.
Trustees' Goals and Objectives	This alternative would restore and conserve habitat by constructing breakwaters parallel to the shoreline for the purpose of reducing shoreline erosion and protecting coastal wetland habitat. The purpose of the project is to protect the Hancock County Marsh Preserve shoreline and salt marsh habitat from erosion and to create habitat for secondary benthic productivity.
Likelihood of Success	This alternative would utilize the same construction methodology as the existing HCMLS Project breakwaters, which have proven to be effective in providing shoreline erosion protection along the Hancock County Marsh Preserve. The HCMLS Project has not only reduced rates of shoreline erosion but has, in some areas, resulted in shoreline accretion. MDEQ and NOAA would implement a MAM plan (see Appendix C) that would assess progress toward project goals, help minimize risk, and address key uncertainties on an ongoing basis.
Avoid Collateral Injury	This alternative would involve in-water nearshore marine construction activities involving heavy equipment. Construction would be designed, or required via applicable and relevant permits and consultations, to avoid or minimize impacts to all biological, physical, and cultural resources. The Implementing Trustee (MDEQ) would also use BMPs and protective measures to avoid collateral injury.
Benefits to Multiple Resources	Reduction of wave energies and currents acting on shorelines induces sediment deposition and provides shelter for wetland plants and shoreline habitats (see PDARP/PEIS Section 5.D.1.1). The project would extend the shoreline protection and enhanced secondary benthic productivity benefits already provided by the HCMLS Project which originate at the Louisiana/Mississippi state line and extend to Bayou Bolan. The project could provide secondary benefits to species which utilize these coastal wetland habitats (e.g., birds and oysters).
Public Health and Safety	The MS TIG does not anticipate negative impacts to public health and safety. The Implementing Trustees (MDEQ and NOAA) would comply with all relevant safety measures, practices, and regulations during construction of the living shoreline and would maintain a safe, protective environment for those involved with the project.
Summary	Based on the OPA evaluation, the MS TIG has identified this project as a preferred alternative in this RP4/EA at this time. The cost is reasonable and the alternative has a high probability of success as proven by the demonstrated success of the existing HCMLS breakwaters in reducing the rate of shoreline erosion. The alternative would meet Trustees' goals and objectives and would provide multiple resource benefits.

3.2.4 WCNH4 Sand Dune Restoration

The purpose of the coastwide Sand Dune Restoration Project is to support the restoration and enhancement of coastal and nearshore habitat by creating and planting sand dunes in various coastal locations across Mississippi, up to 900 acres. Mississippi coastal beaches are predominantly man-made and county-maintained and are subject to sand migration onto U.S. Highway 90 and other adjacent roads. This project provides habitat by mitigating beach erosion and would promote the health and integrity of the beach ecosystem by utilizing methods that accelerate and maximize dune formation, such as planting native plants and installing sand fencing. The total estimated project cost for this alternative is $2.0 million (see Table 2-1).

Table 3-4: OPA Evaluation of WCNH4 Sand Dune Restoration

OPA Standard	OPA Evaluation
Cost to Carry out the Alternative	The MS TIG determined that the costs for the alternative are reasonable, appropriate, and comparable to similar projects in the Mississippi Restoration Area. However, similar projects are currently underway on Mississippi coastal beaches (RESTORE Act Beachfront Resilience Project and the USACE Sand Dune Restoration Project).
Trustees' Goals and Objectives	This alternative would restore and conserve habitat by supporting the restoration and enhancement of coastal and nearshore habitat by creating and planting sand dunes in various coastal locations. This project would provide habitat by mitigating beach erosion and would promote the health and integrity of the beach ecosystem by utilizing methods that accelerate and maximize dune formation, such as planting native plants and installing sand fencing.
Likelihood of Success	This alternative would utilize standard approaches to sand dune restoration in the Mississippi Restoration Area. Previous dune restoration projects, such as the USACE Harrison County Dune Restoration Phase II, have proven successful in providing reserves of sand that act as a buffer to resist erosive events and reduce the amount of sand migration from the beach onto the highway and adjacent roads and medians.
Avoid Collateral Injury	Established protocols and methods for invasive species management would be used to avoid incidental mortality and collateral injury to native species of plants and wildlife. The project area would be monitored for presence of invasive species of vegetation for a minimum of five years from completion of construction.
Benefits to Multiple Resources	Previous sand dune projects conducted on Mississippi Beaches USACE Harrison County Dune Restoration Phase II have proven successful in providing reserves of sand that act as a buffer to resist erosive events and reduce the amount of wind-blown sand leaving the project. In addition, the vegetated dunes would be designed to provide foraging and roosting habitats for various shore and migratory birds, including species of special concern, such as piping plovers and least terns. The sand dunes are critical in a providing habitat for nesting shorebirds and reducing the amount of wind-blown sand that is transported onto the adjacent highway.
Public Health and Safety	The MS TIG does not anticipate negative impacts to public health and safety. MDEQ would comply with all relevant safety measures, practices, and regulations during native plantings and sand fence installation. The Implementing Trustee would maintain a safe, protective environment for those involved with the project.
Summary	Based on the OPA evaluation, the MS TIG has identified this project as a non-preferred alternative in this RP4/EA because there is uncertainty regarding locations where the work would still need to be done. The MS TIG prefers to evaluate the effectiveness of current similar projects underway on Mississippi beaches (RESTORE Act Beachfront Resilience Project and the USACE Sand Dune Restoration Project).

3.3 OPA Evaluation: Nutrient Reduction (Nonpoint Source) Alternatives

The MS TIG identified three nutrient reduction alternatives for detailed analysis in the RP4/EA and evaluated these alternatives consistent with the OPA NRDA regulations in 15 CFR § 990.54(a). The following sections summarize the OPA evaluation results for each nutrient reduction alternative.

3.3.1 NR1 Back Bay – Davis Bayou Nutrient Reduction

This alternative would improve water quality by implementing conservation practices to reduce nutrients and sediment runoff in coastal watersheds. The MDEQ Non-Point Source Program identified two priority HUC 12 watersheds for this project: Back Bay of Biloxi (031700090605) and Davis Bayou-Biloxi Bay (0317000906060). MDEQ and its watershed stakeholders would develop conservation plans to identify conservation practices that reduce nutrient runoff and sediment and then implement those practices. Practices could include low-impact development practices, stormwater control measures, erosion control measures, streambank stabilization, wetlands habitat management, and other conservation practices. Nutrient reduction conservation practices are included in Appendix A. The total estimated project cost for this alternative is $2.5 million (see Table 2-1).

Table 3-5 OPA Evaluation of NR1 Back Bay – Davis Bayou Nutrient Reduction

OPA Standard	OPA Evaluation
Cost to Carry out the Alternative	The MS TIG determined that the costs for the alternative are reasonable, appropriate, and comparable to similar projects. The costs to carry out this alternative are based upon a similar project under implementation in the Mississippi Restoration Area, the Upper Pascagoula Water Quality Enhancement Project.
Trustees' Goals and Objectives	Implementation of this alternative would contribute to the Trustees' goal of restoring water quality by reducing nutrient loading and sediment runoff into Gulf of Mexico coastal watersheds.
Likelihood of Success	The alternative would utilize proven techniques and established methods to reduce nutrient loads and sediment runoff.
Avoid Collateral injury	The USDA-NRCS Nutrient Reduction Exemplar Practices were developed according to standards that require use of associated and mitigating practices in a "systems approach" to ensure new injuries do not occur, and those practice standards would be followed.
Benefits to Multiple Resources	Through a coordinated and integrated watershed approach, benefits to multiple resources are anticipated from reductions in nutrient and sediment losses to two priority HUC 12 coastal watersheds: Back Bay of Biloxi and Davis Bayou-Biloxi Bay. In addition to these direct coastal watershed benefits, benefits to downstream marine resources would be expected, for example, benefits to the Mississippi Sound which contains Gulf sturgeon Critical Habitat, Essential Fish Habitat, and oyster habitat.
Public Health and Safety	The MS TIG does not anticipate any adverse impacts on public health and safety. Relevant safety measures andpractices for the implementation of conservation practices would be followed.
Summary	Based on the OPA evaluation, the MS TIG has identified this project as a preferred restoration alternative in this RP4/EA at this time. The cost is reasonable and the project would meet Trustees' goals and objectives of restoring water quality by reducing nutrient loading and sediment runoff into Gulf of Mexico coastal watersheds. In addition, benefits to multiple resources would be expected, for example, benefits to the Mississippi Sound which contains Gulf sturgeon Critical Habitat, Essential Fish Habitat, and oyster habitat.

3.3.2 NR2 Big Cedar Creek – Rocky Creek Nutrient Reduction

This alternative would improve water quality in the Big Cedar Creek and Rocky Creek watersheds, which include four (4) HUC 12 watersheds—Red Creek-Escatawpa River (031700080402), Juniper Bay-Escatawpa River (031700080403), Spring Creek-Escatawpa River (031700080405), and Little Cedar Creek (031700060106)—by implementing conservation practices to reduce nutrient and sediment runoff. Runoff from cropland, grassland, forest, and urban sources contributes nutrients and sediments that adversely affect the health of coastal waters of the Gulf. While agricultural and forested lands are not the sole contributors (and in many instances, not the leading contributors) of nutrients to coastal waters, there are opportunities to address this resource concern at these sources within the Big Cedar Creek and Rocky Creek watersheds. USDA and its conservation partners would help landowners on a voluntary basis to adopt management strategies to manage nutrients and sediments from their farming operations. Exemplar practices are included in Appendix A. The total estimated project cost for this alternative is $2.5 million (See Table 2-1).

Table 3-6 OPA Evaluation of NR2 Big Cedar Creek – Rocky Creek Nutrient Reduction

OPA Standard	OPA Evaluation
Cost to Carry out the Alternative	The MS TIG determined that the costs for the alternative are reasonable, appropriate, and comparable to similar projects. The costs to carry out this alternative are based upon a similar project under implementation in the Mississippi Restoration Area, the Upper Pascagoula Water Quality Enhancement Project.
Trustees' Goals and Objectives	Runoff from cropland, grassland, forest, and urban sources contributes nutrients and sediments that adversely affect the health of coastal waters of the Gulf. Implementation of this alternative would contribute to the Trustees' goal of restoring water quality impacted by the DWH oil spill by reducing nutrient loading and sediment runoff into Gulf of Mexico coastal watersheds.
Likelihood of Success	The alternative would utilize proven techniques and established methods to reduce nutrient loads and sediment runoff. The Upper Pascagoula Water Quality Enhancement Project has demonstrated success in developing and implementing these conservation practices in the Mississippi Restoration Area, using Exemplar Nutrient Reduction Practices. Given their extensive experience and expertise in conservation practices, the success and legacy of the USDA-NRCS Farm Bill programs, and their established level of trust and cooperation with private landowners, there is a significant opportunity to implement conservation practices on private lands that would reduce the levels of nutrients and sediments entering watersheds that could provide benefits to marine resources and coastal watersheds.
Avoid Collateral Injury	The conservation practices identified for this alternative were developed by USDA-NRCS according to standards that require use of associated and mitigating practices in a "systems approach" to ensure new injuries do not occur and those practice standards would be followed. In addition, the MS TIG would ensure compliance with all applicable federal laws, regulations, and executive orders prior to implementing the alternative by using a site-specific environmental evaluation process carried out during the conservation planning effort. This process would include conducting any necessary agency consultations and obtaining any required permits. Among other things, the environmental evaluation would identify mitigation measures needed and determine whether there is potential for significant adverse effects to be created. If such potential exists, that particular project would be abandoned or redesigned to minimize the impacts.
Benefits to Multiple Resources	Through a coordinated and integrated watershed approach, benefits to multiple resources are anticipated from reductions in nutrient and sediment losses in the four priority watersheds. The proposed conservation practices would reduce nutrient and sediment losses from the landscape, reduce nutrient and sediment loads to streams and downstream receiving waters, and reduce water quality degradation in watersheds that could provide benefits to coastal watersheds and marine resources, including Gulf Sturgeon spawning habitat in the Upper Pascagoula River and tributaries and Gulf Sturgeon critical habitat in the Mississippi Sound.
Public Health and Safety	The MS TIG does not anticipate any adverse impacts on public health and safety. Relevant safety measures and practices for the implementation of conservation practices would be followed.
Summary	Based on the OPA evaluation, the MS TIG has identified this project as a preferred alternative in this RP4/EA at this time. The cost is reasonable and the alternative has a high probability of success. The alternative would meet Trustees' goals and objectives, provide multiple resource benefits, and is anticipated to have optimal landowner participation within the watershed.

3.3.3 NR3 Big Cedar Creek – West Pascagoula River Nutrient Reduction

This alternative would improve water quality in the Big Cedar Creek and West Pascagoula River watersheds by implementing conservation practices to reduce nutrient and sediment runoff. USDA and its conservation partners would help landowners on a voluntary basis to adopt management strategies to manage nutrients and sediments from their farming operations. The project would focus on the enrollment of targeted tracts of agricultural and forested lands within the boundaries of four 12-digit HUC watersheds to reduce sediment and nutrient loading at the watershed level. Exemplar practices are in Appendix A. The total estimated project cost for this alternative is $2.5 million (See Table 2-1).

Table 3-7 OPA Evaluation of NR3 Big Cedar Creek –West Pascagoula River Nutrient Reduction

OPA Standard	OPA Evaluation
Cost to Carry out the Alternative	The MS TIG determined that the costs for the alternative are reasonable, appropriate, and comparable to similar projects. The costs to carry out this alternative are based upon a similar project under implementation in the Mississippi Restoration Area, the Upper Pascagoula Water Quality Enhancement Project.
Trustees' Goals and Objectives	Runoff from cropland, grassland, forest, and urban sources contributes nutrients and sediments that adversely affect the health of Gulf coastal waters. Implementation of this alternative would contribute to the Trustees' goal of restoring water quality impacted by the DWH oil spill by reducing nutrient loading and sediment runoff into Gulf of Mexico coastal watersheds. Agricultural and forested lands are not the sole contributors (and in many instances, not the leading contributors) of nutrients to coastal waters. However, agricultural and forested lands within the Big Cedar Creek and West Pascagoula watersheds were identified as nutrient sources that, if addressed, could improve the health of coastal waters.
Likelihood of success	The alternative would utilize proven techniques and established methods to reduce nutrient loads and sediment runoff. The Upper Pascagoula Water Quality Enhancement Project has demonstrated success in developing and implementing these conservation practices in the Mississippi Restoration Area, using Exemplar Nutrient Reduction Practices. Given their extensive experience and expertise in conservation practices, the success and legacy of the USDA-NRCS Farm Bill programs, and their established level of trust and cooperation with private landowners, there is a significant opportunity to implement conservation practices on private lands that would reduce the levels of nutrients and sediments entering watersheds that could provide benefits to marine resources and coastal watersheds.
Avoid collateral injury	The conservation practices identified for this alternative were developed by USDA-NRCS according to standards that require use of associated and mitigating practices in a "systems approach" to ensure new injuries do not occur, and those practice standards would be followed. In addition, the MS TIG would ensure compliance with all applicable federal laws, regulations, and executive orders prior to implementation of the alternative by using a site-specific environmental evaluation process carried out during the conservation planning effort. This process would include conducting any necessary agency consultations and obtaining any required permits. Among other things, the environmental evaluation would identify mitigation measures needed and determine whether there is potential for significant adverse effects to be created. If such potential exists, that particular project would be abandoned or redesigned to minimize the impacts.
Benefits to Multiple Resources	Through a coordinated and integrated watershed approach, benefits to multiple resources are anticipated from reductions in nutrient and sediment losses in the four priority watersheds. The proposed conservation practices would reduce nutrient and sediment losses from the landscape, reduce nutrient and sediment loads to streams and downstream receiving waters, and reduce water quality degradation in watersheds that could provide benefits to coastal watersheds and marine resources, including Gulf Sturgeon spawning habitat in the Upper Pascagoula River and tributaries and Gulf Sturgeon critical habitat in the Mississippi Sound.
Public Health and safety	The MS TIG does not anticipate any adverse impacts on public health and safety. Relevant safety measures andpractices for the implementation of conservation practices would be followed.
Summary	Based on the OPA evaluation, the MS TIG has identified this project as a non-preferred alternative in this RP4/EA at this time. Although the alternative would meet the Trustees' goals and objectives and would benefit multiple resources, there are uncertainties related to landowner participation within the selected watersheds when compared to other evaluated nutrient reduction alternatives in the RP4/EA.

3.4 OPA Evaluation: Provide and Enhance Recreational Opportunities Alternatives

The MS TIG identified three recreational opportunities alternatives for detailed analysis in this RP4/EA and evaluated these alternatives consistent with OPA NRDA regulations in 15 CFR § 990.54(a). The following sections summarize the OPA evaluation results for each recreational opportunities alternative.

3.4.1 REC1 Jourdan River Boardwalk

This alternative would fund construction of a public boardwalk along the Jourdan River to provide residents and visitors with access to and information about this tidal estuarine ecosystem in Coastal Mississippi. The project includes a boardwalk, nature observatory, seating areas, and educational signage about the wetlands, coastal, and nearshore habitats including the tidal Jourdan River, adjacent estuarine marsh, and resources (e.g., birds) that use these habitats. The total estimated project cost for this alternative is $2.1 million (See Table 2-1).

Table 3-8 OPA Evaluation for REC1 Jourdan River Boardwalk

OPA Criterion	OPA Evaluation
Cost to Carry out the Alternative	The MS TIG reviewed the estimated cost of this project and determined that it was reasonable and appropriate based on current construction costs and the costs of recent successful recreational use projects in Mississippi. The MS TIG has completed comparable projects with similar boardwalk components including INFINITY Science Center, Pascagoula Beachfront Promenade and Popp's Ferry Causeway Park. Additionally, this project would complement the adjacent independent Noma Drive Phase I Project (which utilizes non-NRDA funding that the City of Diamondhead has already secured) that includes free public parking, an access boardwalk from the parking lot to the Jourdan River Boardwalk, and a free public boat ramp.
Trustees' Goals and Objectives	This alternative would provide and enhance recreational opportunities and would promote environmental stewardship, education, and outreach. Specifically, it would fund the construction of a public boardwalk with an elevated Nature Observatory and several seating areas, with educational signage to describe the ecosystem and species of the Jourdan River/St. Louis Bay estuarine habitat.
Likelihood of Success	This project would utilize current standard construction practices to construct the public boardwalk and would be implemented in a currently underdeveloped area in Diamondhead, MS, adjacent to the Jourdan River. Sustainable flow-through decking is preferred if budget allows, for increased resilience during storm surge events. The City is working on increasing public access to the waterfront in this area, and has already secured other funding for Phase 1 of the Noma Drive Public Access Improvements Project, which includes a free public parking lot, an access boardwalk from the parking lot to the Jourdan River Boardwalk, and a free public boat ramp. It is anticipated that the Jourdan River Boardwalk would be utilized by the public, including local residents of Diamondhead as well as rural Hancock County, an area with limited public access to the waterfront. Schools and other education institutions would be encouraged to bring students here for field trips.
Avoid Collateral injury	This alternative would include construction activities which would be designed, or required via applicable and relevant permits, to avoid or minimize impacts to natural resources. The Implementing Trustee (MDEQ) would use BMPs and protective measures to avoid collateral injury.
Benefits to Multiple Resources	Benefits to multiple resources are not anticipated for this project. Construction of infrastructure (boardwalk) and educational signage would restore recreational opportunities that were lost as a result of the oil spill.
Public Health and Safety	Construction activities are not expected to negatively affect public health and safety. MDEQ would comply with all relevant safety measures, practices, and regulations during implementation to maintain a safe, protective environment for those involved with the project.
Summary	Based on the OPA evaluation, the MS TIG has identified this project as a preferred restoration alternative in this RP4/EA at this time. The cost is reasonable, and the project has a high likelihood of success. The project would meet Trustees' goals and objectives by providing and enhancing recreational opportunities and promoting environmental stewardship, education, and outreach.

3.4.2 REC2 Shepard State Park Enhancements

This alternative would provide funding to create new facilities and improve existing facilities to enhance recreational use and enhance access to natural resources at the Shepard State Park. It would provide funding for the renovation of the existing Gray House into an Environmental Education Center where nature-based classes and events could be held and where students could come for field trips. Also included is the development of educational programs and installation of educational signage, as well as trail enhancement and maintenance. The total estimated project cost for this alternative is $735,000 (See Table 2-1).

Table 3-9 OPA Evaluation for REC2 Shepard State Park Recreational Enhancements

OPA Criterion	OPA Evaluation
Cost to Carry out the Alternative	The MS TIG reviewed the estimated cost of this project and determined that it was reasonable and appropriate based on current construction costs and the costs of recent successful recreational use projects in Mississippi. The MS TIG has completed comparable projects with similar components including INFINITY Science Center, Popp's Ferry Causeway Park and Pascagoula Beachfront Promenade.
Trustees' Goals and Objectives	This alternative would provide and enhance recreational opportunities and would promote environmental stewardship, education, and outreach. Specifically, through renovation of the existing Gray House, it would fund the creation of an Environmental Education Center for hosting nature-based classes and events and where students could come for field trips. Also included is the development of educational programs, installation of educational signage, and trail enhancement and maintenance.
Likelihood of Success	This project would utilize current standard construction practices and would be part of the existing Shepard State Park, operated and managed by the City of Gautier. The City of Gautier would build upon their current relationship with the Pascagoula-Gautier School District to bring students to Shepard State Park for field trips and would provide an enhanced learning experience. The park is open year-round and currently has a mix of developed campsites and primitive camping sites. It also offers approximately eight miles of trails over five distinct locations and traverses coastal habitats including maritime forest, bottomland hardwood, pine savanna, and estuarine marsh. Other recreational opportunities include but are not limited to an RV park, a disc golf course, and a marsh walk. The park also is part of the National Audubon Society's Mississippi Coastal Birding Trail.
Avoid Collateral injury	This alternative would include construction activities which would be required via applicable and relevant permits or otherwise designed to avoid or minimize impacts to natural resources. The Implementing Trustee (MDEQ) would use BMPs and protective measures to avoid collateral injury.
Benefits to Multiple Resources	This alternative would focus on park improvements and environmental stewardship, education, and outreach in order to restore recreational opportunities that were lost as a result of the oil spill.
Public Health and Safety	MDEQ would comply with all relevant safety measures, practices, and regulations during implementation to maintain a safe, protective environment for those involved with the project.
Summary	Based on the OPA evaluation, the MS TIG has identified this project as a preferred restoration alternative in this RP4/EA at this time. The cost is reasonable, and the project has a high likelihood of success. It would meet Trustees' goals and objectives by providing and enhancing recreational opportunities and promoting environmental stewardship, education, and outreach.

3.4.3 REC3 Shepard State Park Recreational Enhancements

This alternative would provide funding to create new facilities and improve existing facilities to enhance recreational use and enhance access to natural resources at the Shepard State Park. It would provide funding for the creation of an Environmental Education Center for hosting nature-based classes and events and where students could come for field trips. Also included is the installation of educational signage; replacement of the existing wooden stage at the festival area; playground enhancements (including a splash pad); construction of a second pavilion in the festival area; construction of up to ten glamping sites; dog park enhancements (replacement of fencing, upgrades to dog exercise/play structures); trail maintenance and/or hiring a contractor to clear trails once every two to three years for a four-to-six-year period; playing field enhancements (lighting rehabilitation); and improvements to the 16-hole Disc Golf Course. The total project cost for this alternative is $3,045,000. (See Section 2.4.3.3).

Table 3-10 OPA Evaluation for REC3 Shephard State Park Recreational Enhancements

OPA Criterion	OPA Evaluation
Cost to Carry out the Alternative	The MS TIG reviewed the estimated cost of this project and determined that it was reasonable and appropriate; however, the TIG decided to fund only those restoration components which would maximize restoration benefits at this location while taking into consideration other potential recreational opportunity projects.
Trustees' Goals and Objectives	This alternative would provide and enhance recreational opportunities and would promote environmental stewardship, education, and outreach. Specifically, through renovation of the existing Gray House, it would fund the creation of an Environmental Education Center for hosting nature-based classes and events where students could come for field trips, as well as the development of educational programs, installation of educational signage and the replacement of the existing wooden stage at the festival area. Project activities would also include playground enhancements (including a splash pad); construction of a second pavilion in the festival area; construction of up to ten glamping sites; dog park enhancements (replacement of fencing, upgrades to dog exercise/play structures); trail maintenance and/or hiring a contractor to clear trails once every two to three years for a four-to-six-year period; playing field enhancements (lighting rehabilitation); and improvements to the 16-hole Disc Golf Course.
Likelihood of Success	This project would utilize current standard construction practices and would be part of the existing Shepard State Park, operated and managed by the City of Gautier. The City of Gautier would build upon their current relationship with the Pascagoula-Gautier School District to bring students to Shepard State Park for field trips and would provide an enhanced learning experience. The park is open year-round and currently has a mix of developed campsites and primitive camping sites, and offers approximately eight miles of trails over five distinct locations and traverses coastal habitats including maritime forest, bottomland hardwood, pine savanna, and estuarine marsh. Other recreational opportunities include an RV park, a disc golf course, a marsh walk, and other recreational opportunities. The park also is part of the National Audubon Society's Mississippi Coastal Birding Trail.
Avoid Collateral injury	This alternative would include construction activities in an urban environment which would be required to obtain applicable and relevant permits, or otherwise designed to avoid or minimize impacts to natural resources. The Implementing Trustee (MDEQ) would use BMPs and protective measures to avoid collateral injury.
Benefits to Multiple Resources	Benefits to multiple resources are not anticipated. This alternative would focus on park improvements and environmental stewardship, education, and outreach in order to restore recreational opportunities that were lost as a result of the oil spill.
Public Health and Safety	MDEQ would comply with all relevant safety measures, practices, and regulations during implementation to maintain a safe, protective environment for those involved with the project.
Summary	Based on the OPA evaluation, specifically the Cost to Carry out the Alternative, the MS TIG has identified this project as a non-preferred alternative in this RP4/EA at this time.

3.5 Natural Recovery/No Action

Pursuant to the OPA NRDA regulations, the PDARP/PEIS (5.8.2) considered a "natural recovery alternative in which no human intervention would be taken to directly restore injured natural resources and services to baseline" (15 CFR § 990.53(b)(2)). Under this alternative, the Trustees would allow natural recovery processes to occur, which could result in one of four outcomes for injured resources: (1) gradual recovery, (2) partial recovery, (3) no recovery, or (4) further degradation. Although injured resources could presumably recover to or near baseline conditions under this scenario, recovery would take much longer compared to a scenario in which restoration actions were undertaken. Given that technically feasible restoration approaches are available to compensate for interim natural resource and service losses, the Trustees rejected this alternative from further OPA evaluation within the PDARP/PEIS. Based on this determination, tiering this RP4/EA from the PDARP/PEIS, and incorporating that analysis by reference, the MS TIG did not find natural recovery to be an alternative under OPA. Natural recovery is not considered further in this RP4/EA.

A No Action Alternative is included in the RP4/EA analysis pursuant to NEPA as a "benchmark, enabling decisionmakers to compare the magnitude of environmental effects of the action alternatives." The No Action alternative is analyzed for each Restoration Type in Chapter 4 of this RP4/EA.

3.6 OPA Evaluation and Determination of the Proposed Action for this RP4/EA

Through the screening process described in Section 2.3 of this RP4/EA, the MS TIG identified a reasonable range of 10 alternatives for evaluation under OPA across three Restoration Types (See Table 2-1). The evaluation to identify preferred alternatives was based on the OPA evaluation standards and on the MS TIG's specific goals and objectives for this RP4/EA. Based on the results of these analyses, the MS TIG proposes to select seven preferred alternatives for implementation (Table 3-11). All seven of the preferred restoration alternatives, collectively referred to as the Proposed Action, are consistent with the PDARP/PEIS Restoration Goals and Types and the six OPA evaluation standards the Trustees utilized as set forth in 15 CFR § 990.54(a)(1)-(6) and are the Proposed Action for this RP4/EA (See Table 1-2).

Table 3-11 Preferred alternatives for each Restoration Type that make up the Proposed Action for this RP4/EA

Proposed Preferred Restoration Alternatives		Estimated Project Cost
Restoration Type: Wetlands, Coastal, and Nearshore Habitats (WCNH)		
WCNH1. Coastwide Habitat Acquisition	Preferred	$5,000,000
WCNH2. Living Shoreline Bulkhead Alternative	Preferred	$3,000,000
WCNH3. Hancock County Marsh Living Shoreline Phase 6 Breakwater	Preferred	$10,500,000
Restoration Type: Nutrient Reduction (Nonpoint Source) (NR)		
NR1. Back Bay – Davis Bayou Nutrient Reduction	Preferred	$2,500,000
NR2. Big Cedar Creek – West Pascagoula River Nutrient Reduction	Preferred	$2,500,000
Restoration Type: Provide and Enhance Recreational Opportunities (REC)		
REC1. Jourdan River Boardwalk	Preferred	$2,118,000
REC2. Shepard State Park Recreational Enhancements-1	Preferred	$735,000

<u>Estimated Project Costs</u>: Estimated costs of alternatives included in this RP4/EA are based on the most current designs and information available to the MS TIG. Estimated costs reflect all costs associated with implementing the project, potentially including, but not limited to, E&D, permitting, studies, construction/implementation, monitoring, Trustee oversight, and contingencies.

<u>BMPs</u>: The MS TIG incorporates appropriate BMPs into planning and design to avoid or minimize impacts on natural resources, including protected and listed species and their habitats. BMPs are identified in required permits, consultations, or environmental reviews, including those described in Appendix 6.A of the PDARP/PEIS. Once selected for funding, project implementation plans are prepared for each project, outlining roles, responsibilities, and project implementation. The Implementing Trustee is responsible for ensuring that

E&D, construction, and implementation of projects would fall within the general scope of the purpose and need, and is consistent with the anticipated benefits as addressed in the OPA evaluation.

Project Monitoring: MAM plans for each of the preferred alternatives can be found in Appendix C. These MAM plans outline the monitoring needed to evaluate each alternative's progress toward meeting site-specific objectives and the appropriate corrective actions and adaptive management, as applicable. The MAM plans are consistent with the requirements and guidelines set forth in the PDARP/PEIS, the TC SOPs and the Trustees' MAM Manual (DWH Trustees 2017d). The MAM plans are intended to be updated as needed to reflect changing conditions and to incorporate new information as it becomes available. Updates to MAM plans and any additional details concerning the status of monitoring activities would be made publicly available through DIVER.

Should a corrective action become necessary as a result of unanticipated conditions, the Implementing Trustee will evaluate the corrective action for consistency with the OPA and NEPA analyses conducted in this plan in accordance with Section 9.5.2 of the Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the Deepwater Horizon (DWH) Oil Spill.

3.7 Summary of OPA Evaluation

The MS TIG completed the OPA evaluation of 10 alternatives across three Restoration Types in the Mississippi Restoration Area (see Table 2-1). The MS TIG identified seven preferred alternatives, three focused on restoring wetlands, coastal, and nearshore habitats (WCNH), two focused on nutrient reduction (non-point source) (NR), and two focused on providing and enhancing recreational opportunities (REC).

Wetlands, Coastal, and Nearshore Habitats:

The four WCNH projects considered in the reasonable range of alternatives would all provide benefits with a strong nexus to that injury from the DWH spill. Acquisition of coastwide habitat would set aside land in coastal areas for conservation that 1) have high ecological value and/or 2) where wetlands, coastal, and nearshore habitat creation, restoration, and preservation projects could be implemented in future restoration actions (for example, lands adjacent to coastal bays and estuaries). Conserving and protecting land parcels via acquisition can protect wetlands and other significant coastal, estuarine, riverine and riparian habitats, create connections between protected areas, and remove direct threats of development. Creation of a 1.7-mile living shoreline breakwater and small-scale living shorelines would enhance wetlands and provide shoreline protection. The living shoreline breakwater would also provide enhanced benthic secondary productivity benefits. The Sand Dune Restoration Project would create and enhance coastal and nearshore habitats using dune fencing and plantings. All of the proposed WCNH alternatives would use proven approaches and techniques with established methods and would be implemented at a cost that is reasonable, appropriate, and comparable to similar projects. All four alternatives would provide benefits to multiple resources and are not expected to pose any risk to public health and safety. While construction may result in impacts to some resources, these would be temporary and localized to the construction area and would be offset by the project benefits. All four alternatives would achieve the restoration goals laid out by the Trustees in the PDARP/PEIS for the WCNH Restoration Type. Based on the OPA evaluation, the MS TIG has identified the Sand Dune Restoration project (WCNH-4) as a non-preferred alternative in this RP4/EA because there is uncertainty regarding locations where the work would still need to be done. The MS TIG prefers to evaluate the effectiveness of similar projects currently underway on Mississippi beaches (RESTORE Act Beachfront Resilience Project and the USACE Sand Dune Restoration Project). The Sand Dune Restoration (WCHN-4) project alternative could still be considered for construction funding in subsequent restoration planning efforts by the MS TIG.

Nutrient Reduction (Nonpoint Source):

The three NR projects considered in the reasonable range of alternatives would all provide benefits with a nexus to that injury from the DWH spill. They would improve water quality by implementing conservation practices to reduce nutrients and sediment runoff at the watershed level. All of the proposed NR alternatives would use proven approaches and techniques with established methods. While construction may result in impacts to some resources, these would be temporary and localized to construction areas and would be offset by the project benefits. All three alternatives would achieve the restoration goals laid out by the Trustees in the PDARP/PEIS for the NR Restoration Type. Based on the OPA evaluation, the MS TIG has identified the Big Cedar Creek – West Pascagoula River Nutrient Reduction project (NR-3) as a non-preferred alternative in this RP4/EA because there are uncertainties related to landowner participation within the selected watersheds when compared to other evaluated nutrient reduction alternatives in the RP4/EA. NR-3 could still be considered for funding in subsequent restoration planning efforts by the MS TIG.

Provide and Enhance Recreational Opportunities:

The three REC projects considered in the reasonable range of alternatives would all provide benefits with a nexus to that injury from the DWH oil spill, and would provide and enhance recreational opportunities and promote environmental stewardship, education, and outreach. All of the proposed REC alternatives would use proven approaches and techniques with established methods and would be implemented at a cost that is reasonable, appropriate, and comparable to similar projects. While construction may result in impacts to some resources, these would be temporary and localized to the construction area and would be offset by the project benefits. Based on the OPA evaluation, Shepard State Park Recreational Enhancements-2 project was identified as a non-preferred alternative because the MS TIG decided to fund only those restoration components which would maximize restoration benefits at this location (Shepard State Park Recreational Enhancements-1) while taking into consideration other potential recreational opportunity projects.

4.0 NEPA ANALYSIS

Under NEPA (42 USC § 4321 *et seq*.), federal agencies must comparatively evaluate the environmental effects of the alternatives being considered, including but not limited to impacts on social, cultural, and economic resources, as well as natural resources. To determine whether an action has the potential to result in significant impacts, agencies analyze the potentially affected environment and degree of the effects of the action. In considering the degree of the effects, agencies should consider both short- and long-term effects; both beneficial and adverse effects; effects on public health and safety; and effects that would violate Federal, State, Tribal, or local law protecting the environment. 40 CFR § 1501.3(b)(2).

The methodology for determining impacts and the definitions of thresholds for each resource category are consistent with those described in Table 6.3-2 (Guidelines for NEPA impact determinations) of the Final PDARP/PEIS, (to which this NEPA analysis is tiered). The Final PDARP/PEIS Table 6.3-2 is included in Appendix D.

"Adverse" is used in this chapter only to describe the federal Trustees' evaluation under NEPA. This term is defined and applied differently in consultations conducted pursuant to the Endangered Species Act (ESA) and other protected resource statutes. Current compliance status for all proposed alternatives described in this RP4/EA are provided in Table 5-1.

This chapter provides NEPA analysis for the reasonable range of alternatives considered in the Draft RP4/EA, and pursuant to NEPA includes a No Action alternative analysis for comparative purposes. Restoration Types addressed by the action alternatives are: Wetlands, Coastal, and Nearshore Habitats; Nutrient Reduction (Nonpoint Source); and Provide and Enhance Recreational Opportunities. For each resource category, the analysis in this chapter addresses impacts by discussing any background or methodology that is applicable to all sites. The analysis below provides a site-specific affected environment for each project (alternative) evaluated, including the no action alternative as well as a discussion of environmental consequences.

4.1 Resources Carried Forward and Not Carried Forward for Further Analysis

Table 4-1 provides a summary of the following:

- To avoid redundancy, resource categories that are not expected to be affected or to be only minimally affected by a proposed restoration alternative in RP4/EA are not evaluated elsewhere in this document. Resource categories that are unaffected or minimally affected by the restoration alternatives proposed in this RP4/EA are discussed briefly below, and the reasons for not carrying forward for detailed analysis are noted. These resource categories are briefly noted where applicable in the summary section describing impacts analysis incorporated by reference from other DWH restoration plans (Section 4.2) and are consistent with Table 4-1.
- Table 4-1 also notes those resources for which potential adverse impacts are expected and therefore are carried forward for further analysis under each restoration type below in Sections 4.3, 4.4 and 4.5.

Table 4-1: NEPA analysis approach

Project Activities/Resources	Wetlands, Coastal, and Nearshore Habitats	Nutrient Reduction (Nonpoint Source)	Provide and Enhance Recreational Opportunities
Project Activities	Proposed projects include property acquisition, construction of small-scale living shorelines, construction of a 1.7-mile breakwater, and installation/repair of sand fencing and planting of native plants on existing beaches or dunes. Project activities would occur in Hancock, Harrison and Jackson counties, MS.	Implementation of conservation practices in the Back Bay-Davis Bayou watershed in Harrison and Jackson County, MS and on agricultural lands in Big Cedar Creek-Rocky Creek and Big Cedar Creek-West Pascagoula River in George and Jackson counties, MS.	Projects activities include implementation of educational programs, minor construction activities including renovation of an existing building, installation of educational signage, amenities to an existing marsh walk, replacement of an outdoor stage, playground enhancements, construction of a pavilion, construction of glamping sites, dog park enhancements, trail enhancement and maintenance, playing field enhancements, disc golf improvements, and construction of an in-water boardwalk. Project activities would occur in Hancock and Jackson counties, MS.
Physical Resources—Geology and Substrates	Carried forward for detailed analysis.	Carried forward for detailed analysis.	Carried forward for detailed analysis.
Physical Resources—Hydrology, Water Quality, Wetlands and Floodplains	Carried forward for detailed analysis.	Carried forward for detailed analysis.	Carried forward for detailed analysis.
Physical Resources—Air Quality and Green House Gases	This resource category was not carried forward for detailed analysis beyond what is presented here. Projects would involve either property acquisition or construction projects of limited scope and duration and would occur in Jackson, Harrison, and Hancock counties which are classified as in attainment, meaning criteria air pollutants do not exceed National Ambient Air Quality Standards (NAAQS). Implementation of these projects would not adversely affect regional air quality because the acquired properties would be held in conservation and no timber would be harvested. During implementation of construction projects, there could be localized, short-term, minor, adverse impacts to air quality and greenhouse gases from use of heavy equipment, equipment	This resource category was not carried forward for detailed analysis beyond what is presented here. Counties where the proposed alternative project areas are located are classified as in attainment (Harrison, Jackson and George counties, MS), meaning criteria air pollutants do not exceed NAAQS. The primary sources of emissions during project implementation would include equipment operation such as tractors, dozers, and all-terrain vehicles associated with earth moving, seeding, planting, habitat management, and small construction. Implementation of conservation practices would be limited in duration and scale and would not impact air quality. Conservation practices would occur	This resource category was not carried forward for detailed analysis beyond what is presented here. Counties where the proposed alternative project areas are located are classified as in attainment (Hancock and Jackson counties, MS), meaning criteria air pollutants do not exceed NAAQS. Because of the small scale and short duration of the construction/implementation of restoration activities, only short-term minor adverse effects are anticipated. Therefore, implementation of the REC projects is not expected to result in a substantial contribution to local or regional air pollution.

Project Activities/Resources	Wetlands, Coastal, and Nearshore Habitats	Nutrient Reduction (Nonpoint Source)	Provide and Enhance Recreational Opportunities
	exhaust, fine particulate matter (fugitive dust) associated with the deployment of breakwater materials and work on sand beaches. However, implementation of the WCNH projects would be short-term and localized and is not expected to result in a substantial contribution to local or regional air pollution There could be long term benefits to air quality (carbon sequestration) from the creation of vegetated dunes and small vegetated areas associated with small-scale living shoreline restoration.	seasonally and would likely not occur simultaneously. Whether activities occurred simultaneously or incrementally, the proposed alternatives would have no long-term adverse impacts on air quality or to emissions of greenhouse gases. Conservation practices on forested areas could result in a long-term beneficial impact on air quality resulting from more vigorous long-standing forested areas, which help to sequester carbon.	
Physical Resources—Noise	This resource category was not carried forward for detailed analysis beyond what is presented here. Construction and implementation activities (deployment of breakwater and living shoreline materials) would result in short-term, minor noise impacts. The construction activities would occur either in water or on publicly owned beaches. Living resources such as fish, birds, and other wildlife would likely move away from noise generated from the construction activities. For all projects, noise would be kept to a minimum using BMPs. The noise impacts produced by the activities would not exceed typical temporary construction noise.	This resource category was not carried forward for detailed analysis beyond what is presented here. Nutrient Reduction Projects would be implemented on agricultural lands in rural areas or on publicly owned municipal lands, including recreational parks, rights-of-way, etc. in suburban areas. These activities would result in short-term, minor, and localized noise impacts that could provide annoyance to people in the area during construction operations; however, the long-term character of the existing soundscape would remain the same. The noise impacts produced by the activities would not exceed normal farmstead noise or typical temporary construction noise in a suburban setting.	This resource category was not carried forward for detailed analysis beyond what is presented here. Construction of the Recreational Opportunities projects activities would result in short-term, minor and localized adverse noise impacts from construction. All projects are in remote locations so it is not likely that residences and businesses would be affected by construction noise. Wildlife, fish, and birds are expected to move away from construction activities. The long-term effect of increased visitor trips on noise over the term of the project would be essentially negligible.
Biological Resources— Habitats and Wildlife Species (including birds)	Carried forward for detailed analysis.	Carried forward for detailed analysis.	Carried forward for detailed analysis.
Biological Resources— Marine and Estuarine Fauna (Fish, shellfish, benthic organisms) and	Carried forward for detailed analysis.	This resource category was not carried forward for detailed analysis beyond what is presented here. There would be no short- or long-term, adverse impacts to marine and estuarine	For the Recreational Opportunities Restoration alternatives, only one proposed project (REC1) includes work in an estuarine environment, and was therefore, carried forward for detailed analysis.

Project Activities/Resources	Wetlands, Coastal, and Nearshore Habitats	Nutrient Reduction (Nonpoint Source)	Provide and Enhance Recreational Opportunities
Federally Managed Fisheries		resources or to EFH as a result of the implementation of these Nutrient Reduction alternatives because there would be no activities conducted in marine or estuarine waters. Beneficial impacts to these resources would be anticipated due to reduced sediment and nutrient loading.	The REC2 alternative was not carried forward for detailed analysis beyond what is presented here. There would be no short- or long-term, adverse impacts to marine and estuarine resources or to EFH as a result of the implementation of the REC2 alternative because there would be no activities conducted in marine or estuarine waters.
Biological Resources—Protected Species	Carried forward for detailed analysis.	Carried forward for detailed analysis.	Carried forward for detailed analysis.
Socioeconomic Resources—Socioeconomics and Environmental Justice	This resource was not carried forward for detailed analysis beyond what is presented here. Implementation of all the projects involving construction may result in short-term, beneficial economic impacts on local employment. For the alternatives evaluated in RP4/EA, there are no activities that would disproportionately impact or adversely affect minority and low-income populations. Additionally, the WCNH1 Coastwide Habitat Acquisition alternative would have no measurable adverse effect on the counties' tax bases as properties targeted for acquisition are undeveloped marsh and wetlands with low to no potential for developability.	This resource was not carried forward for detailed analysis beyond what is presented here. Implementation of all the projects involving construction may result in short-term, beneficial economic impacts on local employment and to private landowners who enroll in the program. For the alternatives evaluated in RP4/EA, there are no activities that would disproportionately impact or adversely affect minority and low-income populations.	This resource was not carried forward for detailed analysis beyond what is presented here. Implementation of projects may result in short-term, beneficial economic impacts on local employment during project construction. For the alternatives evaluated in RP4/EA, there are no activities that would disproportionately impact or adversely affect minority and low-income populations.
Socioeconomic Resources— Cultural Resources	Carried forward for detailed analysis.	Carried forward for detailed analysis.	Carried forward for detailed analysis.
Socioeconomic Resources—Infrastructure	This resource was not carried forward for detailed analysis beyond what is presented here. None of the alternatives evaluated in RP4/EA would create increased demands on area infrastructure that could not be accommodated by existing infrastructure or would affect traffic and transportation in the areas where projects are proposed.	This resource topic was not carried forward for detailed analysis beyond what is presented here. None of the alternatives evaluated in RP4/EA would create increased demands on area infrastructure that could not be accommodated by existing infrastructure or would affect traffic	This resource topic was not carried forward for detailed analysis beyond what is presented here. None of the Recreational Opportunities alternatives evaluated in RP4/EA are anticipated to create increased demands on area infrastructure that could not be accommodated by existing or planned infrastructure or would affect traffic and

Project Activities/Resources	Wetlands, Coastal, and Nearshore Habitats	Nutrient Reduction (Nonpoint Source)	Provide and Enhance Recreational Opportunities
		and transportation in the areas where projects are proposed.	transportation in the areas where projects are proposed.
Socioeconomic Resources—Land and Marine Management	This resource topic was not carried forward for detailed analysis beyond what is presented here. No adverse impacts on land and marine management are expected since land acquired would remain in its natural state and be placed into conservation through restrictive covenants. The HCMLS Phase 6 Breakwater location was changed from a General Use District and a Preservation Use District to an S6 Special Use-Restoration District through the MDMR Permit to Conduct Regulated Activities for this alternative.	This resource topic was not carried forward for detailed analysis beyond what is presented here. For projects related to the Nutrient Reduction Restoration Type, no impacts on land or marine management are expected because there would be no change in use of the land and there would be no in-water work.	This resource topic was not carried forward for detailed analysis beyond what is presented here. For projects related to the Recreational Opportunities Restoration Type, no impacts on land or marine management are expected because there would be no change in land or marine use.
Socioeconomic Resources—Tourism and Recreation	Tourism and recreation were not carried forward for detailed analysis beyond what is presented here. WCNH construction activities could result in short-term, minor, adverse impacts to recreational activities, primarily fishing, boating along the shoreline, and access to small areas of man-made beach where construction activities are ongoing. Access to the restored areas may be restricted during vegetation establishment. Long-term, beneficial effects of the projects could include increased fishing opportunities and wildlife viewing (e.g., birds) around breakwaters, educational opportunities regarding alternative bulkhead approaches and dune creation which could result in enhanced and increased visitation in the vicinity of dunes.	This resource topic was not carried forward for detailed analysis beyond what is presented here. For the Back Bay – Davis Bayou Nutrient Reduction Alternative (NR1) projects would be conducted in publicly owned and operated areas (e.g., Hiller Park). For sites like these, project areas would be restricted during construction, potentially resulting in short-term, minor, adverse impacts to recreational activities in certain areas in the park. The Big Cedar Creek – Rocky Creek Nutrient Reduction Alternative (NR2) and the Big Cedar Creek – West Pascagoula River Nutrient Reduction Alternative (NR3) would be carried out by the voluntary application of practices by land owners on their own land, so there would be no impacts to tourism or recreation.	This resource topic was not carried forward for detailed analysis beyond what is presented here. For the Jourdan River Boardwalk Alternative (REC1), there could be minor, short-term, adverse effects to tourism and recreational use of the planned boat ramp/parking area project during the temporary construction of the boardwalk. For the Shepard State Park Recreational Enhancement Alternatives (REC2 and REC3), there would be similar short-term, minor, adverse impacts to tourism and recreation as facilities in the park (Gray House and trails) are closed temporarily while construction and enhancements are underway. Closures of public areas for construction/staging of equipment, placement of materials and barriers to protect public safety, and construction-related dust, could temporarily adversely affect visitors. There would be a long-term benefit to tourism and recreational use from construction of the boardwalk (REC1) as well as recreational enhancements (REC2 and REC3). Benefits could include additional recreational activities including the new Gray House Environmental Education Center, hiking improved

Project Activities/Resources	Wetlands, Coastal, and Nearshore Habitats	Nutrient Reduction (Nonpoint Source)	Provide and Enhance Recreational Opportunities
			trails, walking along the riverfront, and wildlife viewing.
Socioeconomic Resources—Fisheries and Aquaculture and Marine Transportation	Fisheries and aquaculture and marine transportation were not carried forward for detailed analysis beyond what is presented here. For the Living Shoreline Bulkhead Alternative (WCNH2), and the HCMLS Phase 6 Breakwater Alternative (WCNH3), there could be short-term, minor impacts to recreational fisheries in the localized project area. There would be long-term benefits to fisheries as a result of the project construction resulting from creation of habitat in the area. For the Sand Dune Restoration Alternative (WCNH4) there would be no adverse impacts to fisheries and aquaculture; there would be no in-water work. For the Living Shoreline Bulkhead Alternative (WCNH2), and the HCMLS Phase 6 Breakwater Alternative (WCNH3), no impacts on marine transportation are anticipated. There could be negligible increases in local daily marine traffic volumes during breakwater deployment resulting in perceived inconvenience to operators but no actual disruptions to transportation. For the Sand Dune Restoration Alternative (WCNH4) there would be no adverse impacts to marine transportation; there would be no in-water work. There would be no long-term adverse impacts from the projects.	This resource topic was not carried forward for detailed analysis beyond what is presented here. For the Nutrient Reduction Restoration Type alternatives, there would be no adverse impact to fisheries and aquaculture or marine transportation. There would be no in-water work in marine waterways or estuarine habitats.	This resource topic was not carried forward for detailed analysis beyond what is presented here. REC1 would occur along the bank of the Jourdan River north of I-10. There would be no impact to fisheries, aquaculture, or marine transportation. For REC2 and REC3, there would be no in-water work in marine waterways or estuarine habitats and therefore no impacts.
Socioeconomic Resources—Aesthetics and Visual Resources	Carried forward for detailed analysis.	Carried forward for detailed analysis.	Carried forward for detailed analysis.
Socioeconomic Resources—Public Health and Safety	This resource topic was not carried forward for detailed analysis beyond what is presented here. For the WCNH alternatives, safety risks would be mitigated by using applicable standard	This resource topic was not carried forward for detailed analysis beyond what is presented here.	This resource topic was not carried forward for detailed analysis beyond what is presented here. None of the Recreational Opportunities project activities would adversely affect public health and

Project Activities/Resources	Wetlands, Coastal, and Nearshore Habitats	Nutrient Reduction (Nonpoint Source)	Provide and Enhance Recreational Opportunities
Including Flooding and Shoreline Protection	construction safety procedures including notification to MDMR Marine Patrol, notification to mariners, and installation of markers as required by regulatory agencies. No long-term adverse impacts from implementation of the WCNH projects are anticipated. There could be long term beneficial effects to shoreline protection from living shorelines by reducing shoreline erosion/wetland losses and from sand dune restoration.	None of the Nutrient Reduction Restoration Type activities would adversely affect public health and safety because construction areas would be temporarily restricted from public access. There would be beneficial impacts to public health and safety by improving water quality in the watershed. Therefore, this resource category was not carried forward for detailed analysis beyond what is presented here.	safety because construction areas would be temporarily restricted from public access.

4.2 Incorporation by Reference of Previous NEPA Analyses

Through the planning process, the MS TIG considered the NEPA analysis conducted for previous phases of restoration planning, including the following documents, for the projects discussed below:

- 2009 Mississippi Coastal Improvements Program Comprehensive Plan and Integrated Programmatic Environmental Impact Statement
- DWH Trustees 2012. Phase I Early Restoration Plan and Environmental Assessment
- DWH Trustees 2014. Programmatic and Phase III Early Restoration Plan and Early Restoration Programmatic Environmental Impact Statement
- DWH Trustees 2016. Final Programmatic Damage Assessment and Restoration Plan/Programmatic Environmental Impact Statement

The locations and/or actions for the projects discussed below have been previously analyzed. The MS TIG expects similar activities in similar environments to produce similar impacts. The following sections discuss how these previous analyses have been incorporated by reference for five projects:

- Hancock County Marsh Living Shoreline Phase 6 Breakwater
- Sand Dune Restoration
- Back Bay – Davis Bayou Nutrient Reduction
- Big Cedar Creek – Rocky Creek Nutrient Reduction
- Big Cedar Creek – West Pascagoula River Nutrient Reduction

4.2.1 WCNH3 – Hancock County Marsh Living Shoreline Phase 6 Breakwater

Under this alternative, MDEQ would construct an approximately 1.7-mile-long segmented riprap breakwater parallel to the shoreline in the Mississippi Sound between Bayou Bolan and Bayou Caddy. This structure would be Phase 6 of the existing Hancock County Marsh Living Shoreline Project (HCMLS), an ongoing DWH NRDA Project which includes, in part, 5.9 miles of constructed breakwater constructed immediately adjacent to the northeast of the HCMLS breakwater. This project would be a continuation of the breakwater towards Bayou Caddy. For further project details regarding the original project and this new alternative, see Section 2.4.1.

The types of activities for this project are the same as those evaluated for the original HCMLS Project. The affected environment and the environmental consequences for this alternative are similar to those evaluated under the Programmatic and Phase III Early Restoration Plan and Early Restoration Programmatic Environmental Impact Statement (Phase III ERP/PEIS), except this alternative has a smaller footprint at 1.7 miles long and would therefore have lesser impacts than the 5.9-mile long HCMLS project evaluated in the Phase III ERP/EIS. Thus, much information from the Phase III ERP/EIS is incorporated by reference and summarized below. For a detailed description of the affected environment and environmental consequences for the Phase III HCMLS project, please refer to Chapter 10 of the Phase III ERP/PEIS, which is summarized below.

4.2.1.1 Affected Environment Summary

The restoration activities proposed for this project would occur in western Hancock County, Mississippi, between Bayou Bolan and Bayou Caddy (Figure 2-3). This marsh complex is part of the extensive Pearl River estuary where the land is largely in public ownership and is managed by the MDMR as part of the

Coastal Preserves of the State of Mississippi. The total area designated as the Hancock County Marsh Coastal Preserve is 20,909 acres. A total of 12,837 acres in Hancock County Marsh Coastal Preserve is owned by the state, with the remainder owned by various other entities or private landowners. The Preserve, which represents one of the largest marsh habitats in Mississippi, consists of marsh, including tidal channels, lagoons, and bays. Historically, extensive and prolific reefs of the American oyster in the shore zone and nearshore areas of lower Hancock County provided natural protection to the shore from erosion. High erosion rates make this shoreline a priority for protection.

The project area includes the nearshore subtidal area of the Hancock County marsh between Bayou Bolan and Bayou Caddy, which is composed largely of estuarine emergent marsh and estuarine shallow water intertwined by a network of tidal creeks. Bathymetry in the project area ranges from approximately -3.0 feet to -6.0 feet NAVD88. The habitat in the project area includes the Mississippi Sound and Gulf of Mexico waters and consists primarily of soft bottom and sandy substrate consistent with sediment along the northern Gulf of Mexico. There are no impaired waters in the project area (MDEQ, 2022). Due to the nature of the structures being in-water, all project locations are within FEMA Special Flood Hazard Areas (SFHAs) designated as Zone "VE", which FEMA describes as a "coastal area with a 1% or greater chance of flooding and an additional hazard associated with storm waves."

A submerged aquatic vegetation (SAV) and oyster survey was conducted on December 9, 2020. No SAV or oysters were observed or collected within the project area. Essential Fish Habitat (EFH) for various species is present within the project area, and Gulf Sturgeon Critical Habitat also overlaps with the project boundary. ESA listed species which may be present in the project area include the five species of sea turtle (green, Kemp's ridley, leatherback, loggerhead, and hawksbill), Gulf sturgeon, West Indian manatee, piping plover, red knot, gopher tortoise, eastern black rail, and dusky gopher frog. Migratory bird guilds that could have presence in the HCMLS Phase 6 breakwater project area include wading birds, seabirds, waterfowl, raptors, rails, and coots.

Previously recorded cultural resources such as archaeological sites, shipwrecks, ruins, and obstructions were reviewed in the project area during the development of the Phase III ERP/PEIS. The review of the previously recorded archaeological sites using Mississippi Department of Archives and History (MDAH) records revealed seven archaeological sites located within one mile of the project. Five of the sites are known shell middens, one site is of prehistoric significance, and one site has both historic significance and is a shell midden. Within one mile of the project area there are eight charted shipwrecks, one submerged ruin, and five obstructions.

Cultural resources include historic properties listed in, or eligible for listing in, the National Register of Historic Places NRHP (36 CFR § 60.4(a)-(d)). The National Historical Preservation Act (NHPA), as amended (NHPA; 54 USC § 300101 *et seq.*), defines a historic property as "any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion on the National Register [of Historic Places]." 54 USC § 300308. Historic properties include built resources (bridges, buildings, piers, etc.), archaeological sites, and traditional cultural properties that are significant for their association with practices or beliefs of a living community that are both fundamental to that community's history and a piece of the community's cultural identity. Although often associated with Native American traditions, these properties also may be important for their significance to other ethnic groups or communities. Historic properties also include submerged resources. This project is undergoing the Section 106 consultation review process under the NHPA.

Visual and aesthetic resources consist of the marsh shoreline for approximately 1.7 miles extending from Bayou Bolan to Bayou Caddy and current open water areas seaward of the shoreline as well as areas visible from the footprint. Near Bayou Caddy, existing living shorelines, breakwaters, shoreline protection, and emergent reef structures as well as the Silver Slipper Casino and Resort are outside of the project area but would be visible. Visual receptors include boaters in the Mississippi Sound and visitors at the Silver Slipper Casino and Resort.

4.2.1.2 Environmental Consequences Summary

The Phase III ERP/PEIS analyzed the HCMLS Project for environmental consequences to nineteen resource categories (Section 10.3). Additional analysis was performed in the Evaluation of Changes to Phase III Early Restoration Project: Hancock County Marsh Living Shoreline Project.[20] The Phase III ERP/PEIS analysis concluded that during project construction there would be short-term, minor, adverse impacts to air quality and greenhouse gases, noise, water quality, hydrology, wetlands, habitats, wildlife (including birds), federally managed fisheries/EFH, tourism and recreation, and aesthetic and visual resources. The previous Phase III ERP/PEIS analysis concluded that no adverse impacts were anticipated for the following resources: floodplains, socioeconomic resources, cultural resources, infrastructure, land and marine management, public health and safety, and shoreline protection. There would be no disproportionate impacts to minority, low-income, or underserved populations. The project would provide long-term benefits to salt marsh habitat and to secondary benthic productivity. There would be long-term, moderate, adverse impacts to geology and substrates in a relatively small footprint, as well as long-term beneficial impact on geology and substrates due to the slowing of shoreline and marsh erosion and protection of the Hancock County Marsh Preserve. There would be long-term, minor, adverse impacts to benthic communities due to the conversion of soft-bottom habitat to hard substrate for breakwater construction.

This project is anticipated to have similar, and possibly fewer, impacts than the Phase III ERP/PEIS HCMLS project because it would be undertaken in a similar habitat with a smaller footprint (1.7 miles instead of 5.9 miles). This project is also not anticipated to have adverse impacts to the resource categories not impacted by the Phase III ERP/PEIS HCMLS Project. Based on the previous Phase III ERP/PEIS analysis, creation of the additional 1.7-mile HCMLS Phase 6 Breakwater Alternative would result in long-term benefits to the following resources: geology and substrates, hydrology, wetlands, floodplains, habitats, living coastal marine resources (marine and estuarine fauna), EFH, and shoreline protection. Long-term benefits similar in nature to those in the Phase III ERP/PEIS would also be anticipated.

Overall, the project is consistent with previous analyses and is not expected to have impacts to any resource categories that exceed the PDARP/PEIS definition of short-term, minor to long-term, moderate, and adverse.

4.2.2 WCNH4 – Sand Dune Restoration

Under this alternative, MDEQ would create sand dunes and plant vegetation in various coastal locations across Mississippi. For further project details, see Section 2.4.1. See also, the Phase III ERP/PEIS, and the

[20] https://www.fws.gov/doiddata/dwh-ar-documents/1088/DWH-ARZ000025.pdf

2009 Mississippi Coastal Improvements Program Comprehensive Plan and Integrated Programmatic Environmental Impact Statement (MsCIP CP/PEIS). The affected environment for this project would be the same as described by the Coast-wide Beach and Dune Restoration project in the 2009 MsCIP CP/PEIS (man-made sand beach dune habitat in Mississippi). Additionally, the activities for this project (creating and planting vegetation on sand dunes and installation of sand fencing) would be similar to the Florida Perdido Key Dune Restoration project in the Phase III ERP/PEIS, and as such, the environmental consequences are anticipated to be similar as well. These previous programmatic analyses are incorporated here by reference. A brief summary of the affected environment and associated environmental consequences is provided below.

4.2.2.1 Affected Environment Summary

The restoration activities proposed for this project would be located on man-made Mississippi coastal beaches in Hancock, Harrison, and Jackson counties. Mississippi coastal beaches are predominantly man-made, county-maintained, and subject to sand migration and beach erosion. Section 3.3.2 of the PDARP/PEIS addresses the impacts of river flows on the Northern Gulf geography and water quality. Mississippi's water quality standards specify the appropriate levels for which various water quality parameters or indicators support a water body's designated use(s) across the three coastal counties. Impaired waters on the 303(d) list for each county are listed at: https://www.mdeq.ms.gov/wp-content/uploads/2022/03/ADOPTED-2022-303d-List-Report-02242022-Proposed.pdf. Restoration activities would occur primarily in FEMA SFHAs designated as "VE", which FEMA describes as a "coastal area with a 1% or greater chance of flooding and an additional hazard associated with storm waves."

Mississippi coastal ecosystems range in elevation from sea level to about 3 feet above mean sea level. Beaches are considered "Estuarine and Marine Wetland habitat," consisting of sandy substrates in the intertidal zone. A single daily diurnal tidal cycle influences the Mississippi coast.

Dune plants tolerate harsh beach conditions including wind, salt spray, storms, scarce nutrients, limited freshwater, and intense sunlight and heat. The plants and/or seedlings provide feeding sources to a variety of animals while also providing nesting and roosting habitat.

Many biological resources utilize beach and dune habitat in Mississippi, including threatened and endangered species and migratory birds including piping plover, red knot, and eastern black rail.

Cultural resources are limited in the project area as nearly all of the beaches are man-made. Visual and aesthetic resources are beach habitats, existing dunes, and the Mississippi Sound.

4.2.2.2 Environmental Consequences Summary

The Harrison County Beach Dune Restoration project (2011) was constructed to restore the dune systems destroyed by Hurricane Katrina in 2005. Five different species of grasses (625,000 plugs) were planted in the second phase over 26 miles of shoreline to restore these dune systems destroyed by Hurricane Katrina in 2005. Additionally, fencing was installed perpendicular to the beach to promote accretion. The 2009 MsCIP CP/PEIS evaluated environmental consequences of the beach and dune restoration project on Mississippi beaches as follows, which is incorporated here by reference. Some resource types were not applicable to the implementation of beach and dune restoration because they were not part of the affected environment, and therefore, the project would have no effect on fish, wetlands, SAV, commercial and recreational fishing, EFH and shellfish habitats, marine sanctuaries, and socioeconomic factors such as vehicular, railroad, and marine vessel traffic. The following resources were determined to not be adversely impacted: benthos and terrestrial invertebrates, geology, meteorology, water quality, land and water use, and socioeconomic factors such as utilities, economy, demographics, and environmental justice. Beach and dune restoration was determined to have “no change” on marine mammal communities.

There were determined to be short-term, minor, adverse impacts to noise and air quality during construction activities, but the current levels would resume following construction.

The remaining effects of beach and dune restoration on analyzed resources were determined to be positive. The project would provide valuable nesting, roosting, and breeding habitat for marine and coastal birds, threatened and endangered species, and migratory birds. Restoring beach and dune habitat would also restore historical soil profiles. The project would protect cultural resource sites along the mainland by providing storm surge protection. The project would benefit public safety by restoring the beaches and dunes which protect the mainland. Overall, the project would restore the coastal ecotone by providing habitat for coastal birds and protecting valuable mainland components. Since the drafting of the 2009 MsCIP CP/PEIS, conditions of Mississippi beaches and species which utilize them have not significantly changed; the beaches are nearly all man-made and are periodically renourished by the placement of dredged materials from designated offshore borrow areas or in some cases, brought in by truck. The beaches are maintained by the use of vehicular equipment.

The Phase III FERP/PEIS NEPA analysis of the environmental consequences of the Florida Perdido Key Dune Restoration project suggested that while short-term minor adverse impacts may occur to some resource categories including geology and substrates, hydrology and water resources, noise, air quality and greenhouse gases, living coastal and marine resources, protected species, habitats, terrestrial wildlife species, migratory birds, aesthetics and visual resources, tourism and recreational use. Of these resources, beneficial impacts were also anticipated for living coastal and marine resources, protected species, habitats, aesthetics and visual resources, and tourism and recreational use. No long-term adverse impacts were anticipated to result, and the same conclusion is made for this project.

4.2.3 NR1 – Back Bay – Davis Bayou Nutrient Reduction

Under this alternative, MDEQ would implement conservation practices to reduce nutrients and sediment runoff in two priority watersheds: Back Bay of Biloxi (HUC12 – 031700090605) and Davis Bayou-Biloxi Bay (HUC12 – 0317000906060). The project proposes to implement clusters of practices within the smallest watershed practicable with the goal of making a discernable difference in water quality at the watershed level. For further project details, see Section 2.4.2. An affected environment summary for this project area is presented below in Section 4.2.3.1. The Mississippi TIG 2016-2017 Restoration Plan, Environmental Assessment (MS TIG RP1/EA) provides an analysis of practices that could also be implemented in RP4/EA. The suite of USDA Conservation Practices that would be implemented for the NR1 Back Bay-Davis Bayou Nutrient Reduction Alternative would be similar to those analyzed in MS TIG RP1/EA and the environmental consequences from that plan are incorporated by reference (Section 4.2.3.2).

Table 4-2: Back Bay-Davis Bayou Project activities and USDA Conservation Practices that are Parallel in Scope

Back Bay-Davis Bayou Project Activities[21]	Corresponding USDA Conservation Practice
Streambank Stabilization	Streambank and Shoreline Protection (580)
Removal of Invasive/Non-Native Plants Establishment of Check Dams	Brush Management (314)
	Herbaceous Weed Treatment (315)
	Dike and Levee (356)
Detention Pond Enhancement	Sediment Basin (350)
Planting of Native Vegetation	Critical Area Planting (342)
Low-Impact Development Practices	Stormwater Runoff Control (570) Stream Habitat Improvement and Management (395)
Stormwater Control Measures and Stormwater Management	
Stream Restoration	
Wetlands Creation and Enhancement Stormwater Conveyance Stabilization	Wetland Enhancement (659)
	Wetland Creation (658)
	Water and Sediment Control Basin (638)

4.2.3.1 Affected Environment Summary

The project area consists of two HUC12 watersheds: The Back Bay of Biloxi (HUC12 – 031700090605) and the Davis Bayou-Biloxi Bay (HUC12 – 031700090606). Of the approximately 30,971 acres encompassed by these two watersheds, approximately 15,639 acres are categorized as "Developed" land use, encompassing Low, Medium, and High Intensity areas and Developed Open Space (Dewitz and USGS 2021).

Both watersheds primarily contain soils derived from sandy and loamy marine and fluviomarine deposits (Holocene to upper Pleistocene) derived from sedimentary rock (according to the United States Geological Survey). The USDA Natural Resource Conservation Service (NRCS) Web Soil Survey identifies 53 soil-mapping units within these two watersheds. These soils include loams, silt loams, sandy loams, sand, loamy sand, and urban land complex soils. Slopes range from zero to 17 percent with hydrology regimes ranging from well drained in high relief areas to frequently flooded in low relief areas in estuarine marsh, brackish marsh, depressions, and along drainageways.

Approximately 23.1% of the project area is open water, the majority of which is tidally influenced. The Back Bay of Biloxi and Davis Bayou are both adjacent to Biloxi Bay, which is adjacent to the Mississippi

[21] The MS TIG evaluated the Back Bay-Davis Bayou project activities for their potential impacts to the affected environment (Back Bay-Davis Bayou watershed). The Back Bay-Davis Bayou project activities are similar in scope to USDA-NRCS conservation practices that address water quality and soil erosion concerns. The purpose, condition, and criteria for applying the specific conservation practices to reduce nutrient and sediment runoff in an urban landscape are considered. Information on the practices considered can be found here (https://www.nrcs.usda.gov/getting-assistance/conservation-practices#standard). For the purposes of this RP4/EA, environmental consequences are based on the USDA Conservation Practice descriptions, as well as anticipated construction and maintenance activities that could be implemented for the Back Bay-Davis Bayou Nutrient Reduction Alternative.

Sound. The two watersheds include the cities of Biloxi, Gulfport, D'Iberville, St. Martin, and Ocean Springs. As of 2022, neither the Back Bay nor Davis Bayou was listed as an impaired waterbody on the Section 303(d) List of Impaired Waterbodies (MDEQ 2022).

Approximately 11,605 acres of land are mapped as wetlands according to the USFWS National Wetlands Inventory (NWI). The majority of this project area is uplands mapped as 0.2-Percent-Annual-Chance (or 500-year) flood areas, or as Zone X, which are higher elevations than the 500-Year Flood areas. The next largest portion of the area is mapped as Zone VE. Zone VE is defined as Coastal flood zone with velocity hazard. This includes beach areas, open water and most estuarine marsh. The next largest portion of the area is mapped as Zone AE, which are areas defined as "Base Flood Elevations Determined." These are primarily areas of estuarine marsh, streams, and other riparian areas.

PDARP/PEIS Sections 3.4, 3.5, and 3.6 discuss coastal habitats and wildlife in detail. A general description of specific habitat types in the project area is provided in Section 6.2.7.2 of the Final Phase IV ERP/PEIS. Table 4-3 shows the habitat types in the Back Bay of Biloxi and Davis Bayou-Biloxi Bay by percentage of land cover.

Table 4-3: Habitat Types in Back Bay – Biloxi Davis Bayou HUC12 Watersheds

Habitat Type	Percent
Open Water	23.1%
Developed, Low Intensity	21.2%
Developed, Open Space	14.1%
Developed, Medium Intensity	12.0%
Woody Wetlands	11.6%
Emergent Herbaceous Wetlands	6.9%
Evergreen Forest	6.0%
Developed, High Intensity	3.2%
Shrub or Scrub	0.9%
Grassland or Herbaceous	0.4%
Barren Land	0.3%
Mixed Forest	0.2%
Pasture or Hay	<0.1%
Deciduous Forest	<0.1%
TOTAL	**100.0%**

Where present, seagrasses and other marine vegetation present typically occur along low marsh fringes. Mammal species present in the immediate vicinity of specific project locations would be limited to those adapted to disturbances including habitat fragmentation, development, and frequent nearby human presence and noise. As described in the Final Phase IV ERP-EA Section 7.2.6.2.1, common smaller native mammal species with the potential to be found in the larger Biloxi Bay-Davis Bayou watershed area include marsh rabbit, eastern cottontail rabbit, opossum, squirrel, skunk, gray fox, red fox, raccoon, eastern wood rat, hispid cotton rat, eastern mole, southeastern pocket gopher, short-tailed shrew, and a variety of bats. River otter can also be found in Davis Bayou. Nonnative mammal species found in Davis Bayou include Norway rat, nine-banded armadillo, wild hog, and black rat.

ESA listed species potentially present in the project area include Gulf sturgeon, West Indian manatee, piping plover, red knot, gopher tortoise, green sea turtle, hawksbill sea turtle, Kemp's ridley sea turtle, eastern black rail, Mississippi sandhill crane, red-cockaded woodpecker, Alabama red-bellied turtle, alligator snapping turtle, black pine snake, dusky gopher frog, Louisiana quillwort, and monarch butterfly. Critical Habitat exists in the project area for Gulf sturgeon, piping plover, and the Mississippi sandhill crane.

Although the project area as a whole is rich with cultural resources, direct implementation of project components would be focused in suburban environments in areas of prior disturbance.

The general landscape of the locations of direct implementation are urban environments with preexisting structures, stormwater conveyance channels, pavement, and/or urban landscaping.

4.2.3.2 Environmental Consequences Summary

MS TIG RP1/EA included an analysis of 13 resource categories related to conservation practices (Section 3.9.1). Based on the MS TIG RP1/EA analysis of representative conservation practices there would be short-term, minor to moderate, adverse impacts to soil, hydrology, water quality, wetlands, habitats, and wildlife. Impacts to protected species are not expected to exceed the short-term, minor threshold. There would be long-term benefits to soil because once implemented, conservation practices would reduce nutrient runoff and sedimentation of drainageways and tributaries. Conservation practices would have long-term benefits to habitats and wildlife from stream bank restoration and other conservation practices that would enhance habitat. There would be long-term benefits to hydrology and water quality from streambank stabilization, construction of grassed waterways, installation of grade stabilization, and other conservation practices. There would be no disproportionate impacts to low-income or minority populations that would result from implementation of the preferred Alternative in MS TIG RP1/EA. For site-specific conservation practices, potential effects to historic properties would be considered when the undertaking is the type of activity that has the potential to cause effects on these resources. Resources that are eligible for the NRHP would be avoided in the design of the conservation practices, to the extent practicable. There would be no adverse impact to public health and safety. There would be long-term beneficial impacts to public health due to improved water quality in the watershed.

The NR1-Back Bay-Davis Bayou Nutrient Reduction Alternative proposed in RP4/EA would include implementation of conservation practices in two priority watersheds: Back Bay of Biloxi (HUC12 – 031700090605) and Davis Bayou-Biloxi Bay (HUC12 – 0317000906060). Two potential project areas have been identified for implementation of appropriate conservation practices adjacent to waterways that discharge into Back Bay:

- D'Iberville Lamey Street Bank Stabilization: Includes conservation practices to reduce sediment and nutrient contributions on publicly owned lands adjacent to a waterway that discharges into Biglin Bayou.
- Hiller Park and Keesler AFB Drainage Area 9 Nutrient and Stormwater Control Project: Includes conservation practices to reduce sediment and nutrient contributions on publicly owned lands adjacent to a waterway that drains into Bayou Laporte.

Other project locations could be identified during stakeholder outreach.

For the NR1-Back Bay-Davis Bayou Nutrient Reduction Alternative, conservation practices that would be used for site-specific project implementation are similar in scope to those evaluated in MS TIG RP1/EA and would not exceed the adverse impact thresholds identified for the practices identified in that plan, as follows:

- Short-term, minor, adverse noise impacts from equipment and operations associated with the installation of various conservation practices
- Short-term, minor to moderate, adverse impacts to geology and substrates during implementation of conservation practices
- Short-term, minor, adverse impacts to water quality due to construction activities or implementation of conservation practices
- Short-term to long-term, minor to moderate, adverse impacts to habitats and wildlife from soil disturbing activities
- No adverse impacts to socioeconomic resource categories

Site-specific planning would be conducted to determine which particular practices are appropriate to use given the conditions at that site. For further project details, see Section 2.4.2. Table 4-3 above provides a comparison of Back Bay-Davis Bayou Project proposed activities typical in a suburban setting with defined USDA Conservation Practices that are parallel in scope (Appendix A).

When site-specific conservation practices with the potential to affect cultural or historic resources are proposed, technical assistance with the relevant State and Tribal Historic Preservation Offices will be sought to determine how best to avoid impacts to those resources. Resources that are eligible for the NRHP would be avoided in the design of the conservation practices as required by State or Federal law. Therefore, no adverse impacts to cultural or historic resources are anticipated from this project.

Overall, the project would not have impacts to any of the resource categories that exceed the PDARP/PEIS definition of short-term, minor to moderate, and adverse.

4.2.4 NR2 – Big Cedar Creek – Rocky Creek Nutrient Reduction

Under this alternative, USDA would conduct outreach and provide financial and technical assistance to voluntary participants to implement USDA conservation practices, especially those that avoid, control, and trap sediment losses on agricultural lands within the identified priority watersheds. For further project details, see Section 2.4.2. An affected environment summary for this project is presented in Section 4.2.4.1. The MS TIG RP1/EA provides an analysis of practices that could be implemented for similar alternatives in MS TIG RP4/EA. The suite of USDA Conservation Practices that would be implemented for the NR2-Big Cedar Creek-Rocky Creek Nutrient Reduction Alternative would be the same as those analyzed in the MS TIG RP1/EA, and the environmental consequences from that plan are hereby incorporated by reference (Section 4.2.4.2).

4.2.4.1 Affected Environment Summary

The project area consists of four HUC12 watersheds: Little Cedar Creek (HUC12 – 031700060106), Red Creek-Escatawpa River (HUC12 – 031700080402), Juniper Bay-Escatawpa River (HUC12 – 031700080403), and Spring Creek-Escatawpa River (HUC12 – 031700080405). Of the 71,031 acres encompassed by the project area, 68.5% is categorized as forestland, 15.4% is pastureland, 11.5% is cropland, and 4.6% is developed (Dewitz and USGS 2021). The dominant soil types within the area are considered well drained sandy loams. Rivers and creeks in the project boundary are not tidally influenced. Approximately 12 miles from the southern end of the action area, the Escatawpa River transitions to being tidally influenced. Although individual locations for implementation have not been selected, all locations would be on agricultural lands.

Common native mammal species with the potential to be found in the larger watershed area include white tailed deer, eastern cottontail rabbit, opossum, squirrel, skunk, red fox, raccoon, eastern wood rat, hispid cotton rat, eastern mole, southeastern pocket gopher, short-tailed shrew, and a variety of bats. Nonnative mammal species found in the project area include Norway rat, nine-banded armadillo, wild hog, and black rat. ESA listed species potentially present in the project area include the pearl darter, alligator snapping turtle, black pinesnake, eastern indigo snake, gopher tortoise, yellow-blotched map turtle, dusky gopher frog, monarch butterfly, and the eastern black rail.

Although the project area as a whole is rich with cultural resources, direct implementation of project components would be focused in farmstead environments, primarily in areas of prior disturbance. Aesthetic and visual resources include preexisting structures, stormwater conveyance ditches, farm buildings, transportation routes (e.g., paved and dirt roads), streams, tributaries, riparian corridors, pastures, and agricultural fields.

4.2.4.2 Environmental Consequences Summary

MS TIG RP1/EA provided an analysis of six exemplar practices representing the broader suite of over 50 practices that could be implemented for alternatives in that plan (Appendix A). As stated above, the suite of practices used for the NR2-Big Cedar Creek-Rocky Creek Nutrient Reduction Alternative would be the same. MS TIG RP1/EA included an analysis of 13 impact topics related to conservation practices (Section 3.9.1) which is summarized in Section 4.2.3.2 of this plan and are hereby incorporated by reference for the NR2-Big Cedar Creek-Rocky Creek Nutrient Reduction Alternative.

The NR2-Big Cedar Creek-Rocky Creek Nutrient Reduction Alternative proposed in this RP4/EA would focus on the enrollment of targeted tracts of agricultural and associated forested lands within the boundaries of four 12-digit HUC watersheds to reduce sediment and nutrient loading at the watershed level. Conservation practices are included in Appendix A. For the NR2-Big Cedar Creek-Rocky Creek Nutrient Reduction Alternative, conservation practices that would be used for site-specific project implementation are similar in scope to those identified in MS TIG RP1/EA and would not exceed the adverse impact thresholds identified for the practices identified in that plan, as follows:

- Short-term, minor to moderate, adverse impacts to geology and substrates during implementation of conservations practices
- Short-term, minor, adverse impacts to water quality due to construction activities or implementation of conservation practices
- Short-term to long-term, minor to moderate, adverse impacts to habitats and wildlife from soil disturbing activities
- No adverse impacts to socioeconomic resource categories

Site-specific planning would be conducted to determine which particular practices are appropriate to use given the conditions at that site. For further project details, see Section 2.4.2.

The RP4/EA NR2-Big Cedar Creek-Rocky Creek Nutrient Reduction Alternative is not anticipated to have adverse effects on protected species.

During project design, the Implementing Trustees would identify measures to avoid, minimize, or mitigate any adverse impacts on historic properties located within the project area in consultation with the appropriate State and Tribal Historic Preservation Offices. Resources that are eligible for the NRHP would be avoided in the design of the projects. The projects would be implemented in accordance with all applicable laws and regulations concerning the protection of cultural and historic resources. Therefore, no adverse effects to cultural or historic resources are anticipated from this project.

Overall, the project would not have impacts to any of the resource categories that exceed the PDARP/PEIS definition of short-term, minor to moderate, and adverse.

4.2.5 NR3 – Big Cedar Creek – West Pascagoula River Nutrient Reduction

Under this alternative, USDA would conduct outreach and provide financial and technical assistance to voluntary participants to implement USDA conservation practices, especially those that avoid, control, and trap sediment losses on agricultural lands within the identified priority watersheds. For further project details, see Section 2.4.2. An affected environment summary for this project is presented in Section 4.2.5.1. MS TIG RP1/EA provided an analysis of practices that could be implemented for similar alternatives in MS TIG RP4/EA. The suite of USDA Conservation Practices that would be implemented for the NR3-Big Cedar Creek-West Pascagoula Nutrient Reduction Alternative would be the same as those analyzed in MS TIG RP1/EA and the environmental consequences from that plan are hereby incorporated by reference (Section 4.2.3.2).

4.2.5.1 Affected Environment Summary

The project area consists of four HUC12 watersheds: Plum Bluff Cutoff-White Creek (HUC12 – 031700060104), Lyons Creek-Big Cedar Creek (HUC12 – 031700060107), Indian Creek-Pascagoula River (HUC12 – 031700060108), and Black Creek-Pascagoula River (HUC12 – 031700060301). Of the 102,577 acres encompassed by the project area, 47.8% is categorized as wetlands, 27.9% is forestland, 12.1% is pastureland, 6.2% is developed, and 4.2% is cropland (Dewitz & USGS 2021). The dominant soil types within the area are considered well drained sandy loams. Rivers and creeks in the project boundary are not tidally influenced. Although individual locations for implementation have not been selected, all locations would be on agricultural lands.

Common native mammal species with the potential to be found in the larger watershed area include white tailed deer, eastern cottontail rabbit, opossum, squirrel, skunk, red fox, raccoon, eastern wood rat, hispid cotton rat, eastern mole, southeastern pocket gopher, short-tailed shrew, and a variety of bats. Nonnative mammal species found in the project area include Norway rat, nine-banded armadillo, wild hog, and black rat. ESA listed species potentially present in the project area include the West Indian manatee, eastern black rail, Alabama red-bellied turtle, alligator snapping turtle, black pinesnake, eastern indigo snake, gopher tortoise, yellow-blotched map turtle, green sea turtle, dusky gopher frog, Gulf sturgeon, pearl darter, monarch butterfly, and Louisiana quillwort.

Although the project area as a whole is rich with cultural resources, direct implementation of project components would be focused in farmstead environments, primarily in areas of prior disturbance. Aesthetic and visual resources include preexisting structures, stormwater conveyance ditches, farm buildings, transportation routes (e.g., paved and dirt roads), streams, tributaries, riparian corridors, pastures, and agricultural fields.

4.2.5.2 Environmental Consequences Summary

MS TIG RP1/EA provides an analysis of six exemplar practices which represent the broader suite of over 50 practices that could be implemented for alternatives in that plan (Appendix A). As stated above, the suite of practices used for the NR3-Big Cedar Creek-West Pascagoula River Nutrient Reduction Alternative would be the same. MS TIG RP1/EA included an analysis of 13 impact topics related to conservation practices (Section 3.9.1) which is summarized in Section 4.2.3.2 of this plan and are hereby incorporated by reference for the NR3-Big Cedar Creek-West Pascagoula River Nutrient Reduction Alternative.

The NR3-Big Cedar Creek-West Pascagoula Creek Nutrient Reduction Alternative proposed in this RP4/EA would focus on the enrollment of targeted tracts of agricultural and associated forested lands within the boundaries of four 12-digit HUC watersheds to reduce sediment and nutrient loading at the watershed level. Conservation practices are included in Appendix A. For the NR3-Big Cedar Creek-West Pascagoula Creek Nutrient Reduction Alternative, conservation practices that would be used for site-specific project implementation are similar in scope to those identified in MS TIG RP1/EA and would not exceed the adverse impact thresholds identified for the practices identified in that plan, as follows:

- Short-term, minor to moderate, adverse impacts to geology and substrates during implementation of conservations practices
- Short-term, minor, adverse impacts to water quality due to construction activities or implementation of conservation practices
- Short-term to long-term, minor to moderate, adverse impacts to habitats and wildlife from soil disturbing activities
- No adverse impacts to socioeconomic resource categories

Site-specific planning would be conducted to determine which particular practices are appropriate to use given the conditions at that site. For further project details, see Section 2.4.2.

During project design, the Implementing Trustee would identify measures to avoid, minimize, or mitigate any adverse impacts on historic properties located within the project area in consultation with the appropriate State and Tribal Historic Preservation Offices. Resources that are eligible for the NRHP would be avoided in the design of the projects. The projects would be implemented in accordance with all applicable laws and regulations concerning the protection of cultural and historic resources. Therefore, no adverse effects to cultural or historic resources are anticipated from this project.

Overall, the project would not have impacts to any of the resource categories that exceed the PDARP/PEIS definition of short- term, minor to moderate, and adverse.

4.2.6 MS TIG Approach to Site-Specific Environmental Review

Prior to implementation of the Nutrient Reduction alternatives identified in this RP4/EA, the Implementing Trustee would confirm that the impacts expected from a planned site-specific action would not exceed adverse impacts described in this RP4/EA by completing an Environmental Evaluation Worksheet. Examples of the Environmental Evaluation Worksheets used to document the review are attached as Appendix B. If the Environmental Evaluation Worksheet indicates effects are likely to exceed the maximum adverse impacts described in this RP4/EA, the MS TIG would undertake additional site-specific environmental review consistent with NEPA requirements and other requirements for protection of the environment, or would alter the planned site-specific action so that impacts would not exceed the maximum adverse impacts described in this RP4/EA.

4.3 Analysis of Alternatives Not Previously Analyzed

4.3.1 Wetlands, Coastal, and Nearshore Habitats

This section includes the following alternatives:

- Coastwide Habitat Acquisition
- Living Shoreline Bulkhead Alternative

4.3.1.1 WCNH1 – Coastwide Habitat Acquisition

Under this alternative, the Implementing Trustee would acquire land in coastal areas in the three coastal counties. Acquisition and conservation could serve to decrease habitat fragmentation and increase habitat connectivity to other large conservation parcels in the area. Target habitats include estuarine marsh, dune/shoreline (beach), islands, and other coastal riparian habitats. The project would restore injuries to wetlands, coastal, and nearshore habitats in Mississippi through multiple targeted/strategic land acquisitions that would help maximize ecological functions. The project could help facilitate future habitat restoration potential (e.g., habitat enhancement/management, beneficial use, living shorelines), on or adjacent to acquired lands. Acquisitions would be implemented with available funding for up to 10 years. No adverse impacts to natural resources are anticipated because the project is limited to acquisition and conservation. The following summary is provided for reference.

- **Physical Resources: Geology and Substrates – Affected Environment**

Project areas primarily contain soils derived from sandy and loamy marine and fluviomarine deposits (Holocene to upper Pleistocene) derived from sedimentary rock (USGS). The nearshore subtidal benthic habitat is composed mostly of unconsolidated bottom types including sand, muddy sand, and mud bottom.

- **Physical Resources: Geology and Substrates – Environmental Consequences**

No adverse effects to geology and substrates are anticipated as a result of acquisition and preservation of habitat. There would be long-term benefits to soils from preservation of acquired lands and protection of habitats.

- **Physical Resources: Hydrology, Water Quality, Wetlands, and Floodplains – Affected Environment**

Hydrology and Water Quality. Section 3.3.2 of the PDARP/PEIS addresses the effects of river flows on the Northern Gulf geography and water quality. Section 6.14.2 discusses future sea level rise, storm surge, and storm intensity projections and is incorporated by reference here. For the proposed alternative, the affected resources consist of shallow water within bays, bayous, and wetlands within Hancock, Harrison and Jackson Counties. Mississippi's water quality standards specify the appropriate levels for which various water quality parameters or indicators support a water body's designated use(s). Each use assessed for a water body is determined to be either "Attaining" or "Not Attaining" in accordance with the applicable water quality standards and EPA guidelines for assessments pursuant to Clean Water Act Section 305(b) (33 USC § 1315). A water body's use is said to be impaired when based on current and reliable site-specific data of sufficient quantity, quality, and frequency of collection it is not attaining its designated use(s).

Wetlands. Land acquisition would take place on uplands, freshwater wetlands, and estuarine wetlands within the three coastal counties. Acquisition boundaries would not include tidally influenced waters and water bottoms below MHW, which are owned by the State of Mississippi. Some parcels may include other waterbodies such as non-tidal creeks, streams, ponds, etc.

Floodplains. Floodplain classifications across the coastal county project area would vary with elevations and landscape position. Generally, floodplain classifications include:

- Upland areas: Most upland areas are Zone X. Zone X are defined by FEMA as "Areas of 0.2% annual change flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood."
- Estuarine marshes, streams, and riparian areas: Some estuarine marshes, streams, and riparian areas are mapped as Zone AE. Zone AE is defined as "Base Flood Elevations Determined." Beaches, Open Waters, and most estuarine marshes: A large portion of the project area where acquisitions would occur area is mapped as Zone VE. Zone VE is defined as "Coastal flood zone with velocity hazard."

- **Physical Resources: Hydrology, Water Quality, Wetlands, and Floodplains – Environmental Consequences**

Hydrology and Water Quality: Acquisition and conservation of lands would provide long-term benefits to hydrology and water quality by preventing development and land disturbance. Natural hydrologic patterns would be maintained, and stormwater infiltration rates and surface water runoff rates would not change.

Wetlands: There would be long-term benefits to wetlands habitats from acquisition and preservation. Various wetlands including pine savannas and flatwoods, freshwater and estuarine marsh, scrub shrub habitat, bottomland hardwood, and other wetlands would benefit from the preservation of large tracts which would likely be a mosaic of uplands and wetlands.

Floodplains: There would be a long-term benefit to floodplains. Acquisition and conservation of land would prevent land development including filling of floodplains.

- **Biological Resources: Habitats and Wildlife (Including Birds) – Affected Environment**

Coastal wetland and nearshore habitats within the project area include, but may not be limited to estuarine marsh, freshwater forested wetland, beach, beech-magnolia forest, coastal plain small stream forest, and fire-suppressed pine savanna, which are previously described in MS TIG RP1/EA (Section 3.3.1.3.1).

- **Biological Resources: Habitats and Wildlife (Including Birds) – Environmental Consequences**

Acquisition and conservation of habitat would provide a long-term benefit to habitat and wildlife, including birds. The project would preserve habitat connectivity and prevent development, which would potentially result in habitat loss and fragmentation.

- **Biological Resources: Marine and Estuarine Fauna (Fish, Shellfish, Benthic Organisms) And Federally Managed Fisheries – Affected Environment**

Land acquisition would be limited to areas above the naturally occurring MHW mark; therefore, this resource category is not present within the project area.

- **Biological Resources: Marine and Estuarine Fauna (Fish, Shellfish, Benthic Organisms) and Federally Managed Fisheries – Environmental Consequences**

There would be no impacts to this resource category, because land acquisition would be limited to areas above the MHW mark.

- **Biological Resources: Rare and Protected Species – Affected Environment**

A number of species listed as endangered or threatened under the ESA occur in coastal Mississippi and may be present in the project areas. Federally protected species that are known to occur or could occur in the project areas include: piping plover, red knot, eastern black rail, gopher tortoise, Louisiana quillwort, Alabama red-bellied turtle, Mississippi sandhill crane, wood stork, and monarch butterfly.

- **Biological Resources: Rare and Protected Species – Environmental Consequences**

There would be no adverse effect to protected species as a result of acquisition and preservation. Acquisition and preservation of habitat would provide a long-term benefit to protected species by preserving habitat connectivity, preventing development and the potential resulting habitat loss and fragmentation.

- **Socioeconomic Resources: Cultural Resources – Affected Environment**

Cultural resources are evidence of past human activity and encompass a range of traditional, archaeological, and built assets, including culturally important landscapes and present-day culturally significant uses of the environment. Cultural resources include historic properties listed in, or eligible for listing in, the NRHP (36 CFR 60.4(a)-(d)). The NHPA defines a historic property as "any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion on the National Register [of Historic Places]." 54 USC § 300308. Historic properties include built resources (bridges, buildings, piers, etc.), archaeological sites, and traditional cultural properties that are significant for their association with practices or beliefs of a living community that are both fundamental to that community's history and a piece of the community's cultural identity. Although often associated with Native American traditions, these properties also may be important for their significance to other ethnic groups or communities. Historic properties also include submerged resources.

Along the Mississippi Gulf Coast, historic properties can be roughly defined within two categories: the built environment (standing structures) and archaeological sites. Most historic properties listed on the NRHP are those of the built environment. There are 175 listings in the NRHP within the three coastal counties of Hancock, Harrison, and Jackson. Most are houses and buildings, but there are also archaeological sites, shipwreck sites, shell middens, cemeteries, forts, and historic districts. Many more standing structures are considered eligible for the NRHP but have not been formally nominated. These are also considered potential historic properties. Historic districts have been designated in Bay Saint Louis, Biloxi, Gulfport, Pass Christian, Ocean Springs, Gautier, Pascagoula, and Moss Point.

In addition to NRHP eligible properties, the Mississippi Coast also contains several National Historic Landmarks and designated Mississippi Landmarks. These include the Beauvoir estate in Biloxi and the Rocket Propulsion Test Complex in Hancock County.

– **Socioeconomic Resources: Cultural Resources – Environmental Consequences**

A complete review of this project under Section 106 of the NHPA is underway; no project activities would be conducted until the review is complete. No adverse impacts to this resource category are anticipated because the project is limited to land acquisition. There could be long-term beneficial impacts to cultural resources if they were located on acquired land which was ultimately conserved instead of being developed.

– **Socioeconomic Resources: Aesthetics and Visual Resources – Affected Environment**

Visual and aesthetic resources include the landscape in the vicinity of the proposed project area which is characterized by a mosaic of uplands, freshwater wetlands, riparian areas, freshwater and estuarine marsh wetlands with patches of mature coastal forest, beaches and shoreline environments. Landscapes have the effect of providing visual components and/or barriers around existing communities and infrastructure. Unobstructed views of open water exist generally only from the shoreline. Visual receptors include the public travelling on roads, boaters in various coastal waterways and the Mississippi Sound, residences and occupants of commercial facilities.

– **Socioeconomic Resources: Aesthetics and Visual Resources – Environmental Consequences**

There would be no adverse effect on aesthetics and visual resources. There would be long-term benefits to these resources as parcels would be acquired and preserved in their natural state.

4.3.1.2 WCNH2 – Living Shoreline Bulkhead Alternative

Under this alternative, MDEQ would construct small-scale living shorelines that would reduce shoreline erosion and incorporate vegetation or other living, natural "soft" elements alone or in combination with some type of harder shoreline protection structure (e.g., oyster or mussel reefs or rock sills) for added habitat, protection, and stability. Projects would be located adjacent to properties with public shoreline access to view the demonstration projects. Projects would protect coastal wetland habitat through the construction of nearshore breakwaters parallel to the shoreline for the purpose of reducing shoreline erosion.

Three locations have been identified for this project in the following water bodies: Saint Louis Bay, Bayou Bernard, and Pascagoula River in Hancock, Harrison and Jackson Counties, Mississippi. Proposed locations as follows:

- Land Trust Parcel, Pass Christian, Harrison, County, MS

  The site is on the eastern shore of St. Louis Bay and is adjacent to land owned by the Land Trust for the Mississippi Coastal Plain. The living shoreline length would be a maximum of 500 linear feet.

- James Hill Park, Gulfport, Harrison County, MS

  The site is located in Bayou Bernard and is adjacent to land owned by the City of Gulfport. The living shoreline length would be a maximum of 500 linear feet.

- River Park Site, Pascagoula, Jackson County, MS

  The site is located on the shore of the western fork of the Pascagoula River. The park is owned by the Mississippi Secretary of State. The living shoreline length would be a maximum of 500 linear feet.

Other project locations may be identified in further project planning. If future locations are identified, the Implementing Trustee will complete an Environmental Evaluation Worksheet to ensure that there are no additional adverse impacts.

– **Physical Resources: Geology and Substrates – Affected Environment**

Project areas primarily contain soils derived from sandy and loamy marine and fluviomarine deposits (Holocene to upper Pleistocene) derived from sedimentary rock (USGS). The nearshore subtidal benthic habitat is composed mostly of unconsolidated bottom types including sand, muddy sand, and mud bottom.

– **Physical Resources: Geology and Substrates – Environmental Consequences**

There would be long-term, minor, adverse impacts as a result of permanent filling of up to 0.30 acres of soft bottom substrate at three locations. There would be a long-term benefit to geology and substrates from the construction of the breakwater due to reduction of shoreline erosion and creation of hard bottom substrates.

– **Physical Resources: Hydrology, Water Quality, Wetlands, and Floodplains – Affected Environment**

Hydrology. Winds and tides deliver Gulf waters from the south, and the Mississippi Coastal Streams watershed delivers freshwater from the north. A single daily diurnal tidal cycle influences these bodies of water. Demonstration projects would consist of living shorelines constructed in the intertidal, nearshore environment (depths of 1-3 feet) not more than 30 feet from the shoreline.

Water Quality. Three locations have been identified for this project in the following water bodies: Saint Louis Bay, Bayou Bernard, and Pascagoula River.

- St. Louis Bay: St. Louis Bay is a vital waterbody in the Mississippi Gulf Coast Region with designated uses of shellfish harvesting and primary contact recreation. The western half of the Coastal Streams HUC 03170009 drains into St. Louis Bay. The total area of the St. Louis Bay Watershed is approximately 800 square miles. As of 2022, the St. Louis Bay was not listed as an impaired waterbody (MDEQ 2022).
- Bayou Bernard: Bayou Bernard is a waterbody segment in the Biloxi Bay Watershed. The metropolitan areas of Biloxi, Gulfport, Ocean Springs, and D'Iberville are included in the Biloxi Bay Watershed. As of 2022, the segment of Bayou Bernard where the proposed project is located (Bayou Bernard Segment 4) was not listed as an impaired waterbody (MDEQ 2022).
- Pascagoula River: As of 2022, the Pascagoula River is not listed as an impaired waterbody (MDEQ 2022).

Wetlands. All projects would be constructed in the intertidal, nearshore environment in water depths of 1-3 feet. These locations are considered "Estuarine and Marine Deepwater" wetlands. Project locations may have adjacent beaches or tidal wetlands vegetated by herbaceous hydrophytes.

Floodplains. Due to the nature of the structures being in-water, all project locations are within FEMA SFHAs. The Pass Christian and Pascagoula project locations are within Zone VE, which FEMA describes as a "coastal area with a 1% or greater chance of flooding and an additional hazard associated with storm waves." The Gulfport project location is within Zone AE/Floodway. This area is a designated 100-Year floodplain. The floodway is the area where most conveyance and high velocity flows occur. Due to the limited elevation of the living shorelines, there would be no adverse impacts to the natural beneficial function of the floodplain.

- **Physical Resources: Hydrology, Water Quality, Wetlands, and Floodplains – Environmental Consequences**

Hydrology: The construction of living shorelines would require the filling of intertidal and subtidal areas to establish proper elevations for marsh plants and the placement of rock structures. Therefore, there would be short-term, minor, adverse impacts to hydrology resulting from the construction of the living shoreline.

Water Quality: Although construction methodology would vary based on the site location, water depths, and accessibility, there would be short-term, minor, adverse impacts to water quality from disturbance of sediments associated with the placement of fill material for the construction of the living shorelines.

Wetlands: During construction, there would be short-term, minor, localized, adverse impacts from sediment movement that could temporarily impact wetlands along the shoreline edge near the project. There would be long-term, beneficial impacts to salt marsh by reducing shoreline erosion and resulting marsh degradation. There would be no long-term, adverse impacts to wetlands as a result of constructing the living shoreline on unvegetated substrate.

Floodplains: Due to the scale of the projects, and the minimal fill involved, there would be no significant short- or long-term, adverse impacts to floodplains. There would be long-term benefits to floodplains resulting from reduced shoreline erosion.

- **Biological Resources: Habitats and Wildlife (Including Birds) – Affected Environment**

The project areas are all in subtidal environments; however, differences in environmental variables (salinity, water depth, and substrate) exist across the project areas. The estuarine embayments of the Gulfport and Pass Christian consist of mud or muddy sand bottoms, whereas the Pascagoula location exhibits more sand in the substrates. Salinity ranges from oligohaline in the low season to mesohaline in the high season and can approach polyhaline levels near the Pascagoula Bay.

Marine mammals such as dolphins and manatees may be present in the various project areas. Wading birds, seabirds, waterfowl, and raptors may be in the general project vicinities for foraging and feeding.

- **Biological Resources: Habitats and Wildlife (Including Birds) – Environmental Consequences**

There would be short-term, minor, adverse impacts to benthic and intertidal habitats in the project area (e.g., estuarine marsh, benthic soft bottom, and SAV) from construction activities including filling of up to 0.30 acres in three locations, and temporary localized sedimentation to SAV and estuarine marsh in the project area. Prior to construction activities, SAV surveys would be completed in the project component areas, as required by regulatory agencies. Construction of the breakwaters could protect areas conducive to SAV growth which could provide long-term benefits to established or newly developing SAV beds in these waterbodies. The breakwater would result in long-term benefits to shorelines/associated marsh by reducing wave energy/erosion. In addition, native plantings installed in the vicinity of the breakwater could result in increased acreage of wetlands including salt marsh.

There could be short-term, minor, adverse impacts to wildlife during construction activities including elevated noise levels from construction of the breakwaters. These species are mobile and would likely exit the area during construction; therefore, there are no impacts anticipated to wildlife populations. Impacts to wildlife are expected to be short-term, adverse, localized, and minor. This project would occur in open water and intertidal zones away from potential nesting areas; therefore, it is not anticipated to impact nests for marsh birds or shorebirds in the area. There are no golden eagles in the project footprint. No bald or golden eagles are known to nest within 660 feet of the project area. Pre-construction nesting surveys for migratory birds and raptors on adjacent land would be conducted, if required, and if evidence of nesting is found, coordination with the USFWS would be initiated to develop and implement appropriate conservation measures.

– **Biological Resources: Marine and Estuarine Fauna (Fish, Shellfish, Benthic Organisms) And Federally Managed Fisheries – Affected Environment**

Many common fish species, shellfish, and benthic organisms utilize the intertidal, nearshore environment where the project activities would occur and are expected to potentially be present in the proposed project areas.

EFH is present in the project area, which encompasses bays, wetlands, and rivers which flow into the Mississippi Sound and the larger Gulf. EFH in the project area would primarily apply to aquatic habitat where fish feed or grow to maturity. EFH species potentially present in the project areas include all life stages of shrimp, red drum, reef fish, coastal migratory pelagic species (mackerels); neonate, juvenile, and adult Atlantic sharpnose shark; neonate, juvenile, and adult bullnose shark; neonate spinner shark; and neonate blacktip shark.

– **Biological Resources: Marine and Estuarine Fauna (Fish, Shellfish, Benthic Organisms) and Federally Managed Fisheries – Environmental Consequences**

Marine and Estuarine Fauna: There could be short-term, minor, adverse impacts to fish, shellfish, and benthic organisms which could occur from increased turbidity, substrate disturbance, or siltation during construction. Mobile species including fish, shrimp, and crabs would likely move from the area during construction and could experience a short-term, minor, adverse impact related to placement of breakwaters, native plantings, equipment movement, noise, and suspended sediments during the construction of the project. There would be long-term benefits to fish, shellfish, and benthic organisms as soft-bottom habitat would be replaced by a three-dimensional breakwater (reef) that would be colonized by shellfish (e.g., oysters, clams, barnacles). The reef would be colonized by infauna and other epifauna (e.g., crabs, benthic invertebrates) and also utilized for forage and cover by estuarine fish species. SAV beds could establish in the zone between the breakwater and the existing eroded shoreline providing additional habitat for infauna and could be used by estuarine fish species for foraging.

Federally Managed Fisheries: Project construction would have short-term, minor, adverse impacts on Fishery Management Plan (FMP) species that are managed by the National Marine Fisheries Service (NMFS) and the Gulf of Mexico Fishery Management Council (GMFMC) that utilize estuarine habitats primarily for nursery (e.g., growth, feeding). Installation of the living shoreline and associated equipment operation would result in short-term, minor, adverse impacts that could include temporary disturbance to soft bottom and sandy substrate and estuarine marsh habitat (EFH). There would be long-term benefits to federally managed species that would utilize these habitats which support various life stages (e.g., fish and shellfish eggs, larvae, and juvenile stages).

– Biological Resources: Rare and Protected Species – Affected Environment

A number of species listed as endangered or threatened under the ESA occur in coastal Mississippi and may be present in the project areas. Federally protected species that are known to occur or could occur in the project areas include:

- **Green sea turtle:** present in Mississippi coastal waters and could occur in the various project locations on occasion; the project area does not provide suitable sea turtle nesting habitat
- **Hawksbill sea turtle:** present in Mississippi coastal waters and could occur in the various project locations on occasion
- **Kemp's ridley sea turtle:** present in Mississippi coastal waters and could occur in the various project locations on occasion; the project area does not provide suitable sea turtle nesting habitat
- **Leatherback sea turtle:** present in Mississippi coastal waters and could occur in the various project locations on occasion
- **Loggerhead sea turtle:** present in Mississippi coastal waters and could occur in the various project locations on occasion; the project area does not provide suitable sea turtle nesting habitat
- **West Indian manatee:** present in Mississippi coastal waters and likely to be near the project locations on occasion
- **Gulf sturgeon:** potentially present in the project areas, especially near Pascagoula

Additionally, Gulf sturgeon Critical Habitat Unit 2 overlaps with the Pascagoula project location. Other protected and rare species that could occur in the project area include piping plover, red knot, eastern black rail, gopher tortoise, Louisiana quillwort, Alabama red-bellied turtle, dusky gopher frog, Mississippi sandhill crane, wood stork, and monarch butterfly.

– Biological Resources: Rare and Protected Species – Environmental Consequences

While there is the potential for short-term, minor, adverse impacts from interactions with protected species (Gulf sturgeon, loggerhead sea turtle; Kemp's ridley sea turtle; hawksbill sea turtle; and green sea turtle and West Indian manatee) during construction, it is anticipated these impacts would resolve once interaction has ceased. All activities would take place in shallow waters near the shoreline allowing sufficient area for passage of individuals. Normal behavior patterns are not likely to be disrupted by the project activities because of the short-term, localized nature of the activities and the ability of the species to avoid the immediate area. All species likely to be present in the project areas are highly mobile and would likely avoid the areas due to project activity and noise. If individuals are encountered during construction, work would cease until the individuals have vacated the area of their own volition. Potential avoidance and minimization measures have been included in the biological evaluation (BE) form.

The project would have no effect on piping plover, red knot, eastern black rail, gopher tortoise, Louisiana quillwort, Alabama red-bellied turtle, dusky gopher frog, Mississippi sandhill crane, wood stork, and monarch butterfly because the project would be limited to in-water habitats and no terrestrial activities would occur.

- **Socioeconomic Resources: Cultural Resources – Affected Environment**

The locations selected for the proposed project components are situated in nearshore intertidal waters, within 30 feet of the shoreline. No submerged cultural resources have been mapped in any of the proposed project locations, but these areas have likely not been subjected to formal cultural resources surveys. Recent nautical charts indicate that one submerged wreck, likely a small shallow draft vessel, lies on the north side of Bayou Bernard near the proposed Gulfport project location. Few other submerged obstructions mapped along the shorelines of the proposed project areas are all located well away from the project areas (NOAA ENC Viewer, 2023). Based on the nautical chart analysis, all proposed project locations have a low probability of preserving significant cultural resources either due to tidal wave action or high marine traffic from proximity to major ports, shipping lanes, and dredged navigational channels.

- **Socioeconomic Resources: Cultural Resources – Environmental Consequences**

A complete review of this project under Section 106 of the NHPA would be completed prior to implementation of any project activities. During project design, the Implementing Trustees would identify measures to avoid any adverse impacts on historic properties located within the project area in consultation with the appropriate State and Tribal Historic Preservation Offices. Resources that are eligible for the NRHP would be avoided in the design of the projects. The projects would be implemented in accordance with all applicable laws and regulations concerning the protection of cultural and historic resources. Therefore, no effects on cultural or historic resources are anticipated from this project.

- **Socioeconomic Resources: Aesthetics and Visual Resources – Affected Environment**

The general landscape of the project areas is characterized by open water adjacent to a sandy beach area in the Pass Christian location and estuarine marsh in the Gulfport and Pascagoula locations. Numerous private homes with private piers and bulkheads exist along the shorelines to the north and south of the project area in Pass Christian and across the bayou in Gulfport. In Pascagoula, the nearby shorelines are primarily owned by private maritime industry companies. The US Highway 90 bridge passes to the north of the Pass Christian project area and south of the Pascagoula project area.

- **Socioeconomic Resources: Aesthetics and Visual Resources – Environmental Consequences**

During construction, there would be short-term, minor, adverse impacts to aesthetics and visual resources for recreational boaters and fishermen due to construction equipment in and around the project area. Residents, people who use the bays for recreation, and businesses along the shoreline would experience changes to aesthetics and visual resources including the presence of construction equipment and the actual construction of the breakwaters. After construction is completed, the breakwater and/or the reefs may be exposed at mean low water (MLW). The outer surface of these reefs consists of natural material such as bagged shells or artificial material such as riprap. Both of these materials are present in the existing environment. The deployed materials would blend well with the surrounding substrate, which would not have a long-term adverse effect on aesthetics and visual resources. In addition, navigation signs in the project area would alert boaters to the presence of the breakwater (including gaps in the breakwater) and reefs. Because the areas are already used by recreational and commercial boaters, the addition of navigation signs would be consistent with other navigational signage/aids already present in the project vicinity. The implementation of the project would not result in a long-term, adverse impact to visual and aesthetic resources. In fact, this project is intended to provide the public with a shoreline access viewing opportunity, resulting in long-term benefits to aesthetic and visual resources.

4.3.1.3 WCNH - No Action Alternative

- **Environmental Consequences Summary**

In addition to the proposed alternatives previously discussed for the WCNH Restoration Type, the MS TIG evaluated the No Action Alternative as a benchmark and basis for comparison of potential environmental consequences with the action alternatives.

Under the No Action Alternative, the MS TIG would not implement any projects for the WCNH Restoration Type at this time, and would instead allow natural recovery processes to occur, which could result in one of four outcomes for injured resources: 1) gradual recovery; 2) partial recovery; 3) no recovery; or 4) further deterioration. Although injured resources could presumably recover to or near baseline conditions under this scenario, recovery would take much longer compared to a scenario in which restoration actions were undertaken.

The No Action Alternative would have no beneficial impacts to WCNH through preservation of habitats by acquisition, restoration using living shoreline techniques, or from sand dune restoration because this alternative would largely result in a continuation of the conditions described in the PDARP/PEIS Chapters 3, Ecosystem Setting and Chapter 4, Injury to Natural Resources, and there would be no associated benefits to water quality through the reduction of sediments and nutrient loading. Furthermore, long-term, minor, adverse impacts to wetland, coastal, and nearshore habitats would continue to occur under the No Action Alternative due to erosion and water quality degradation. The full suite of restoration benefits would not be realized solely with natural processes and without the benefit of leveraged funding opportunities and opportunity for robust monitoring and adaptive management. The No Action Alternative does not meet the MS TIG's goals and objectives and clearly does not provide the significant restoration benefit to WCNH through restoration activities (e.g., acquisition, living shoreline techniques, dune restoration) that would occur through the action alternatives.

When analyzed in combination with other past, present, and reasonably foreseeable future actions, the No Action Alternative would provide no beneficial impacts, because existing conditions would not change in a predictable way. This alternative is not expected to contribute to short-term or long term, cumulative adverse impacts to physical resources, biological resources, or socioeconomics.

4.3.2 Nutrient Reduction (Nonpoint Source)

4.3.2.1 NR1, NR2, NR3 Alternatives

The Reasonable Range of Alternatives for the Nutrient Reduction Restoration Type were previously analyzed and incorporated into this RP4 by reference. NEPA discussions for each project are discussed in sections 4.2.3, 4.24, and 4.2.5, respectively.

4.3.2.2 NR - No Action Alternative

– **Environmental Consequences Summary**

In addition to the proposed alternatives previously discussed for the NR (Nonpoint Source) Restoration Type, the MS TIG evaluated the No Action Alternative as a benchmark and basis for comparison of potential environmental consequences with the action alternatives.

Under the No Action Alternative, the MS TIG would not implement any projects for the NR (Nonpoint Source) Restoration Type at this time, and would instead allow natural recovery processes to occur, which could result in one of four outcomes for injured resources: 1) gradual recovery; 2) partial recovery; 3) no recovery; or 4) further deterioration. Although injured resources could presumably recover to or near baseline conditions under this scenario, recovery would take much longer compared to a scenario in which restoration actions were undertaken.

The No Action Alternative would have no beneficial impacts to water quality through nutrient reduction because this alternative would largely result in a continuation of the conditions described in the PDARP/PEIS Chapters 3, Ecosystem Setting and Chapter 4, Injury to Natural Resources, and there would be no associated benefits to water quality by the reduction of sediments and nutrient loading. Furthermore, long-term, minor, adverse impacts to coastal watersheds would continue to occur from non-point source pollution under the No Action Alternative. The full suite of restoration benefits would not be realized solely with natural processes and without the benefit of leveraged funding opportunities and opportunity for robust monitoring and adaptive management. The No Action Alternative does not meet the MS TIG's goals and objectives and clearly does not provide the significant restoration benefit to water quality through nutrient reduction that would occur through the action alternatives.

When analyzed in combination with other past, present, and reasonably foreseeable future actions, the No Action Alternative would provide no beneficial impacts, because existing conditions would not change in a predictable way. This alternative is not expected to contribute to short-term or long term, cumulative adverse impacts to physical resources, biological resources, or socioeconomics.

4.3.3 Provide and Enhance Recreational Opportunities

4.3.3.1 REC1 – Jourdan River Boardwalk

– **Physical Resources: Geology and Substrates – Affected Environment**

The proposed project area contains soils derived from sandy and loamy marine and fluviomarine deposits (Holocene to upper Pleistocene) derived from sedimentary rock (USGS). The nearshore subtidal benthic habitat is composed mostly of unconsolidated bottom types including sand, muddy sand, and mud bottom.

– **Physical Resources: Geology and Substrates – Environmental Consequences**

There would be long-term, minor, adverse impacts from driving of pilings into soft sediments to install piling/structures for the boardwalk.

- **Physical Resources: Hydrology, Water Quality, Wetlands, and Floodplains – Affected Environment**

Hydrology. The project is located along the east bank of the Jourdan River north of Interstate Highway 10 and extends into a man-made canal in Diamondhead, Mississippi. Inland freshwater drainage from northern portions of the Jourdan River and its tributaries, combined with saltwater from the Mississippi Sound, creates an estuarine environment in the Saint Louis Bay and lower Jourdan River. The Jourdan River empties into the west side of the Saint Louis Bay just north of the city of Bay Saint Louis. A single daily diurnal tidal cycle influences this body of water.

Water Quality. The Jourdan River is one of the primary fresh water sources for the Saint Louis Bay. As of 2022, this segment of the Jourdan River was not listed as an impaired waterbody (MDEQ 2022).

Wetlands. Estuarine wetlands are present in the project area. The oligohaline stretch of the mid-Jourdan River is a transition zone with a mixed marsh of saltgrass and needle rush north of Interstate 10 (I-10) with the saltgrass rapidly declining to the south of the interstate (within one mile). The oligohaline marshes of the lower Jourdan River are dominated by needle rush with scattered pure stands of big cordgrass and common reed.

Floodplains. Due to the nature of the proposed structure being over water, the project location is within FEMA SFHAs. The proposed project location is within Zone AE (Base Flood Elevations 17 and 19 feet) and borders Zone AE/Floodway. This area is a designated 100-Year floodplain. The floodway is the area where most conveyance and high velocity flows occur.

- **Physical Resources: Hydrology, Water Quality, Wetlands, and Floodplains – Environmental Consequences**

Hydrology: There would be no adverse effects to hydrology from the implementation of the project.

Water Quality and Wetlands: There would be short-term, minor, adverse impacts to water quality and wetlands from construction activities. Equipment use could result in sediment movement in the water column for short durations within a localized area. There could be short-term, minor, adverse impacts to estuarine marsh adjacent to the project area from equipment use, but this would be limited to temporary construction activities and any adverse impacts from construction would be expected to resolve naturally once the boardwalk is completed.

Floodplains: There would be no effects to floodplains.

- **Biological Resources: Habitats and Wildlife (Including Birds) – Affected Environment**

The project would be constructed in subtidal estuarine wetlands. Marine mammals such as manatees and dolphins may be present in the project area. Marine and estuarine fauna present in the Jourdan River include finfish and shellfish species such as shrimp, crabs and other similar type species. Common reptiles that may be present in the proposed project area include American alligator, turtles, and snakes. Coastal shorebirds, water birds, and migratory birds may be present in the general project vicinity for foraging, resting, and/or feeding.

– **Biological Resources: Habitats and Wildlife (Including Birds) – Environmental Consequences**

Habitats: There would be short-term, minor, adverse impacts to fluvial sediments in a relatively small project footprint in a localized area due to pile driving and construction equipment movement during boardwalk construction. There could be short-term, minor, adverse impacts if sediment is displaced and settles in nearby SAV beds or marsh areas adjacent to the project. Short-term, minor, adverse impacts to wildlife may occur from human presence on the boardwalk after construction, but species are likely to temporarily vacate the area and return at a later time.

Wildlife (Including Birds): Elevated noise levels during construction could cause short-term, minor, adverse effects to terrestrial wildlife and birds in the vicinity of the project. The wildlife in the vicinity of the project activities would likely avoid the area during activities and return when activities cease.

– **Biological Resources: Marine and Estuarine Fauna (Fish, Shellfish, Benthic Organisms) and Federally Managed Fisheries – Affected Environment**

Many common fish species, shellfish, and benthic organisms utilize the environment where the project activities would occur and are expected to potentially be present in the proposed project area.

EFH is present in the project area, which encompasses bays, wetlands, and rivers which flow into the Mississippi Sound and the larger Gulf. EFH in the project area would primarily apply to aquatic habitat where fish feed or grow to maturity. EFH for red drum ((larvae, early juveniles, adults), grey snapper (adults), Spanish mackerel (adults), cobia (eggs, larvae), lane snapper (larvae, post larvae, early juvenile), brown shrimp (all life stages), pink shrimp (all life stages), and white shrimp (all life stages) is present in the project area. Primary categories of affected EFH would include estuarine water bottoms, estuarine water column, submerged aquatic vegetation, and estuarine emergent marsh.

– **Biological Resources: Marine and Estuarine Fauna (Fish, Shellfish, Benthic Organisms) and Federally Managed Fisheries – Environmental Consequences**

Marine and Estuarine Fauna: There would be short-term, minor, adverse impacts to fish, shellfish, and benthic organisms which would occur from increased turbidity, substrate disturbance, or siltation during construction. Mobile species including fish, shrimp, and crabs would likely move from the area during construction and would experience a short-term, minor, adverse impact related to pile driving, equipment movement, noise, and suspended sediments during the construction of the project.

Federally Managed Fisheries: Project construction would have short-term, minor, impacts on FMP species that are managed by NMFS and GMFMC that utilize estuarine habitats primarily for nursery (e.g., growth, feeding). Installation of the boardwalk pilings and associated equipment operation would result in short-term, minor, adverse impacts that would include temporary disturbance to soft bottom and sandy substrate and EFH.

The MS TIG made preliminary EFH determinations for species that could occur in the project area. The MS TIG has shared resource information with USFWS and NMFS and has completed technical assistance with impact determinations. An EFH Assessment with benthic/submerged aquatic vegetation survey has been initiated by the MS TIG and agency consultations would be completed prior to project implementation.

– **Biological Resources: Rare and Protected Species – Affected Environment**

A number of species listed as endangered or threatened under the ESA occur in coastal Mississippi and may be present in the project areas. Federally protected species that are known to occur or could occur in the project areas include:

- **West Indian manatee:** present in Mississippi coastal waters and likely to be near the project on occasion**.**
- **Eastern black rail:** potentially present in coastal marshes near the project area during the winter months (non-nesting season).
- **Alligator snapping turtle:** potentially present in the project area on occasion.
- **Green sea turtle:** present in Mississippi coastal waters and could occur in the project area on occasion; the project area does not provide suitable sea turtle nesting habitat.
- **Loggerhead sea turtle:** present in Mississippi coastal waters and could occur in the project area on occasion; the project area does not provide suitable sea turtle nesting habitat.
- **Kemp's ridley sea turtle:** present in Mississippi coastal waters and could occur in the project area on occasion; the project area does not provide suitable sea turtle nesting habitat.
- **Gulf sturgeon:** potentially present in the project area on occasion.

No Critical Habitats overlap with the proposed project location. Other protected and rare species that could occur in the project area include black pinesnake, gopher tortoise, Louisiana quillwort, and monarch butterfly.

– **Biological Resources: Rare and Protected Species – Environmental Consequences**

Protected species which could potentially occur in the project area (Gulf sturgeon, West Indian manatee, eastern black rail, alligator snapping turtle, green sea turtle, loggerhead sea turtle, and Kemp's ridley sea turtle) are highly mobile and likely to avoid the area during construction. The final structure and usage are not anticipated to adversely affect these species. The project would have no effect on black pinesnake, gopher tortoise, Louisiana quillwort, and monarch butterfly because the project would be limited to aquatic habitats, and no terrestrial activities would occur.

– **Socioeconomic Resources: Cultural Resources – Affected Environment**

The location selected for the proposed project is situated in intertidal estuarine wetlands. No terrestrial or submerged cultural resources have been mapped in the proposed project location (MDAH 2023). Due to the adjacent wetland soils and nearby marsh, it is unlikely this location was suitable for human occupation, and therefore, has little potential for the occurrence of archeological resources.

Recent nautical charts do not indicate the presence of submerged wrecks or obstructions in the proposed project location (NOAA ENC Viewer, 2023). Additionally, the canal was man-made by dredging in the 1970s to allow for the development of a public boat launch, which is no longer in use. Former dredging activities would likely have moved or displaced any cultural resources in the immediate vicinity.

– **Socioeconomic Resources: Cultural Resources – Environmental Consequences**

A complete review of this project under Section 106 of the NHPA would be completed prior to implementation of any project activities. During project design, the Implementing Trustees will identify measures to avoid, minimize or mitigate any adverse impacts on cultural or historic resources located within the project area in consultation with the relevant State and Tribal Historic Preservation Offices. Resources that are eligible for the NRHP would be avoided in the design of the project. The project would be implemented in accordance with all applicable laws and regulations concerning the protection of cultural and historic resources. Therefore, no adverse impacts to cultural or historic resources are anticipated from this project.

– **Socioeconomic Resources: Aesthetics and Visual Resources – Affected Environment**

The general landscape of the project area is characterized by open water adjacent to forested wetlands and estuarine marsh. There are low density residential homes with piers approximately 0.3 miles across the Jourdan River from the project area, but otherwise there are no developments in the immediate vicinity. The I-10 bridge passes to the south of the project area. The Phase 1 Noma Drive Public Access Improvements project to be implemented by the City of Diamondhead, separate from this NRDA project alternative and further described in Section 2.4.3.1, would include both a public parking lot and a public boardwalk providing access to the REC1 Jourdan River Boardwalk alternative.

– **Socioeconomic Resources: Aesthetics and Visual Resources – Environmental Consequences**

There would be minor, short-term adverse effects to aesthetics and visual resources during construction of the boardwalk and elevated nature observatory. Staging of equipment and placement of materials and barriers to protect public safety would temporarily change the aesthetic and visual character of the area. Construction of the boardwalk would provide visitors with a vantage point/viewshed of the Jourdan River and adjacent habitats (e.g., marsh, forested habitats) that was not previously accessible by pedestrians.

4.3.3.2 REC2 – Shepard State Park Recreational Enhancements-1

– **Physical Resources: Geology and Substrates – Affected Environment**

The project area primarily contains soils derived from sandy and loamy marine and fluviomarine deposits (Holocene to upper Pleistocene) derived from sedimentary rock. The USDA NRCS Web Soil Survey identifies thirteen soil-mapping units within the project boundary, over half of which are categorized as very fine sandy loams and loamy fine sands. Additional soil types include loams, silt loams, sandy loams, and clay loams. Slopes range from zero to five percent with hydrology regimes ranging from well drained in high relief areas to frequently flooded in low relief areas in estuarine marshes, depressions, and along drainageways (USDA NRCS 2023).

– **Physical Resources: Geology and Substrates – Environmental Consequences**

Environmental Education Center/Gray House Renovation: There would be no effect to geology and substrates as a result of renovation of the Gray House to develop an Environmental Education Center.

Educational Signage and/or Educational Programs: There would be long-term, minor, adverse impacts from driving of signposts into soils for the installation of educational signage.

Trail Enhancement and Maintenance: There would be short-term, minor, adverse impacts from activities associated with clearing of trails, including disturbance of soils by vehicles used to access areas and also from mechanical clearing or chemical treatment. Mechanical clearing would likely be hand clearing and operation of chainsaws and other small equipment.

- **Physical Resources: Hydrology, Water Quality, Wetlands, and Floodplains – Affected Environment**

Hydrology: There are water bodies within the 400-acre park, but not within the project footprint (existing trails and existing Gray House)

Water Quality: There are water bodies within the 400-acre park, but not within the project footprint (existing trails and existing Gray House).

Wetlands: Within the 400-acre park, 53.1 acres are mapped as Estuarine and Marine Wetlands; 33.2 acres are mapped as Freshwater Forested/Shrub Wetlands; 13.6 acres are mapped as Estuarine and Marine Deepwater; and 1.6 acres are mapped as Riverine.

Floodplains: Elevations at the park range from 0-18 feet above sea level. All areas within the project area are mapped FEMA SFHAs. 170.5 acres within the project area are mapped as having a 0.2 percent annual chance flood hazard. 226.8 acres within the project area are mapped Zone AE, the 100-year floodplain. 3.3 acres within the project area are mapped as Zone VE, a "coastal area with a 1% or greater chance of flooding and an additional hazard associated with storm waves."

- **Physical Resources: Hydrology, Water Quality, Wetlands, and Floodplains – Environmental Consequences**

There would be no effect to hydrology, water quality, wetlands, or floodplains from implementation of the Environmental Education Center/Gray House Renovation, Educational Signage and/or Educational Programs, and the Trail Enhancement and Maintenance project components. Renovation of the Gray House would occur within the footprint of the existing building. Signage placement and trail enhancement and maintenance are minor, localized activities that are similar to other routine park maintenance (e.g., mowing, trail clearing) that would have negligible effects on hydrology, water quality, wetlands or floodplains.

- **Biological Resources: Habitats and Wildlife (Including Birds)– Affected Environment**

The habitats found in the park largely consist of forest and wetlands. Table 4-4, below, shows the habitat types in the park by percentage of land cover (Dewitz and USGS 2021). Estuarine marsh consists largely of black needle rush. Smooth cordgrass occurs largely as narrow (1-3 m) bands along the creeks and bayous. Forested habitats present within the park include beech-magnolia forests, coastal plain small stream forests, and fire-suppressed pine savannas. Common vegetation in these forested habitats is described in detail in the MS-TIG RP/EA 1 in Section 3.3.1.3.1.

Table 4-4

Habitat Type / Land Use Categories	Percent
Evergreen Forest	39.9%
Woody Wetlands	37.2%
Developed, Open Space	9.3%
Emergent Herbaceous Wetlands	8.2%
Developed, Low Intensity	3.6%
Barren Land	0.8%
Open Water	0.4%

Habitat Type / Land Use Categories	Percent
Developed, Medium Intensity	0.3%
Shrub or Scrub	0.3%
TOTAL	100.0%

The upland areas and freshwater wetlands support a range of species including, but not limited to, river otter, white-tailed deer, nine-banded armadillo, squirrel, rabbit, and small rodent.

– Biological Resources: Habitats and Wildlife (Including Birds) – Environmental Consequences

Habitats:

Environmental Education Center/Gray House Renovation: There would be no effect to habitats; the project footprint is limited to the footprint of the building, and the area surrounding the existing Gray House is mowed lawn.

Educational Signage and/or Educational Programs: There could be short-term, minor, adverse impacts as a result of disturbance to habitats during hand clearing and installation of signposts in or near forested, herbaceous, and other habitats.

Trail Enhancement and Maintenance: There would be short-term, minor, adverse effects to habitats as a result of hand-clearing, mechanical clearing, and chemical treatment to maintain and enhance trails and remove vegetation from the trail path.

Wildlife (Including Birds): There would be elevated noise levels during construction that could cause short-term, minor, adverse effects to terrestrial wildlife and birds in the vicinity of the project. The wildlife in the vicinity of the project is highly mobile and would likely avoid the area during activities and return when activities cease.

– Biological Resources: Rare and Protected Species – Affected Environment

A number of species listed as endangered or threatened under the ESA occur in coastal Mississippi and may be present in the project areas. Federally protected species that are known to occur or could occur in the project areas include:

- **Piping plover:** Present on beaches and mudflats in southeastern coastal areas. Critical Habitat exists in Jackson County, but is not in the proposed alternative area.
- **Red knot:** Present in marine intertidal habitats including inlets, estuaries, and bays feeding in mud and sand flats on beaches and barrier islands.
- **Eastern black rail:** Present in salt and brackish marshes with dense cover but can also be found in upland areas of these marshes.
- **Gopher tortoise:** Present in well-drained, sandy soils, which allow easy burrowing. The species is often present in areas with an abundance of diverse herbaceous ground cover, and in areas with an open canopy and sparse shrub cover, which allows sunlight to reach the ground floor.
- **Alabama red-bellied turtle:** Present in fresh and brackish habitats, riverbanks, submerged and emergent aquatic vegetation. Also uses upland habitat for nesting.
- **Mississippi sandhill crane:** Present in open wetland habitats surrounded by shrubs or trees. Critical Habitat has been established on and adjacent to the Mississippi Sandhill Crane National Wildlife Refuge in Jackson County, which is not within the proposed alternative area.

Other protected and rare species that occur nearby but would not occur in the project area include green sea turtle, hawksbill sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, loggerhead sea turtle, Gulf sturgeon, wood stork, and monarch butterfly.

– **Biological Resources: Rare and Protected Species – Environmental Consequences**

Project construction activities would be limited to trail maintenance/enhancement and renovation of a building within its existing footprint, and therefore, would be unlikely to adversely impact protected species in the area (gopher tortoise, eastern black rail, or Mississippi sandhill crane). If any protected species happen to traverse the project area, they would likely avoid the area due to project activity and noise from trail clearing, but could experience minor, short term adverse impacts from construction noise or the noise of equipment used for trail maintenance, such as ATVs, weed eaters, or chainsaws. Gopher tortoises are less able to leave an area quickly than eastern black rails or Mississippi sandhill cranes. As such, prior to project activities a qualified biologist would conduct surveys of the area to identify any burrows or individuals, and tortoises found within the project area would be relocated using standard procedures.

The project would not impact Gulf sturgeon, piping plover, red knot, green sea turtle, hawksbill sea turtle, Kemp's ridley sea turtle, leather back sea turtle, loggerhead sea turtle, West Indian manatee, Alabama red-bellied turtle, monarch butterfly, or wood stork because the project area does not contain suitable habitat for these species.

– **Socioeconomic Resources: Cultural Resources – Affected Environment**

Previously recorded historical standing structures, NRHP properties, National Register Districts, and National Historic Landmarks in proximity to the proposed project location were reviewed (MDAH, 2023). The preliminary review of historic properties using MDAH records revealed the presence of the Gautier Beachfront National Register District less than 0.5 mile from the project area boundary. This district contains nine National Register District properties. No historic properties have been recorded within the park boundaries.

Previously recorded shipwrecks were not reviewed as no project elements include in-water work. A review of archaeological sites would be conducted during NHPA Section 106 review.

– **Socioeconomic Resources: Cultural Resources – Environmental Consequences**

A complete review of this project under Section 106 of the NHPA would be completed prior to implementation of any project activities. During project design, the Implementing Trustees would identify measures to avoid, minimize, or mitigate any adverse impacts on cultural or historic resources located within the project area in consultation with the relevant State and Tribal Historic Preservation Offices. Resources that are eligible for the NRHP would be avoided in the design of the project. The project would be implemented in accordance with all applicable laws and regulations concerning the protection of cultural and historic resources. Therefore, no adverse impacts to cultural or historic resources are anticipated from this project.

– **Socioeconomic Resources: Aesthetics and Visual Resources – Affected Environment**

The general landscape of the project area is characterized by forested uplands, forested wetlands, and estuarine marshes. Infrastructure in the park includes paved roads, a boardwalk over marsh, walking trails, picnic shelters and benches, playground structures, an archery range, campgrounds and RV park, a dog park, a disc golf course, a welcome center, restrooms, and maintenance buildings. Medium density residential homes surround the park boundaries but are not visible from within the park.

– **Socioeconomic Resources: Aesthetics and Visual Resources – Environmental Consequences**

There would be minor, short-term adverse effects to aesthetics and visual resources during construction of new facilities and renovation of existing facilities; however, these would only be to park visitors. Staging of equipment and placement of materials and barriers to protect public safety would temporarily change the aesthetic and visual character of the area. During the construction period, visible impediments would detract from the existing viewshed and create visual contrast for observers. There would be long-term benefits to the aesthetic and visual character of the area due to renovation of existing facilities. Renovations to the existing Gray House to develop an environmental education center, educational signage, and trail enhancement and maintenance would be consistent with the current park aesthetics and/or improve visual resources in the area. This would provide a long-term benefit to visitors to Shepard State Park after the project is implemented.

4.3.3.3 REC3 – Shepard State Park Recreational Enhancements-2

The affected environment for the REC3-Shepard State Park Recreational Enhancements-2 project is the same as described in Section 4.3.3.2, REC2-Shepard State Park Recreational Enhancements-1. In addition, the environmental consequences for the REC3-Shepard State Park Recreational Enhancements-2 project are the same as described in Section 4.3.3.2, REC2-Shepard State Park Recreational Enhancements-1 for the Environmental Education Center/Gray House Renovation, Educational Signage and/or Educational Programs, and Trail Enhancement and Maintenance. The section below therefore addresses just the environmental consequences for the following components that are unique to REC3-Shepard State Park Recreational Enhancements-2:

- Outdoor Stage: This component includes replacing the existing wooden stage at the festival area. This would facilitate live performances in the festival area.
- Playground Enhancements: Playground enhancements would include upgrading the existing playground and adding a splash pad to the playground area.
- Pavilion: This component includes construction of a second pavilion in the festival area.
- Glamping Sites: Up to ten glamping sites would be constructed to attract a group of visitors that are currently not using the current camping facilities (e.g., RV sites; primitive camping).
- Existing Dog Park Enhancements: Dog park enhancements would include replacing fencing, and upgrades to dog exercise/play structures.
- Playing Field Enhancements: Playing field enhancement would include lighting rehabilitation in the playing field/green space area.
- Disc Golf Improvements: Disc Golf Course Improvements would be funded for the 16-hole Disc Golf course in cooperation with local golfers who are active in maintaining the course.

– **Physical Resources: Geology and Substrates – Environmental Consequences**

In addition to the environmental consequences for all components included in REC2, this alternative includes the environmental consequences described here.

- Outdoor Stage: There would be negligible to short-term, minor, adverse disturbance of soil during the construction of an outdoor stage on a previously impacted site.

- Playground Enhancements: There would be negligible to short-term, minor, adverse disturbance for the upgrading of the existing playground and long-term, minor, adverse impacts as a result of filling less than one acre of ground for the construction of an additional splash pad/waterlines in the playground area.
- Pavilion: There would be long-term, minor, adverse impacts to substrates as a result of filling of less than one acre of ground for the construction of pavilion in an existing festival area.
- Glamping Sites: There would be long-term, minor, adverse impacts to substrates as a result of filling less than 2.0 acres of ground for the construction of 10 glamping pads in an existing maintained/mowed upland area.
- Existing Dog Park Enhancements: There would be no effect to geology and substrates from the implementation of the dog park enhancement; disturbance would primarily be restricted to existing equipment or installation of equipment in an upland that is currently maintained/mowed.
- Playing Field Enhancements: There could be short-term, minor, adverse impacts to soils from rehabilitation of playing field and the green space area including localized, temporary soil disturbance.
- Disc Golf Improvements: There could be long-term, minor, adverse impacts to substrates from installing disc golf "holes" and fairway signposts in new/currently undisturbed areas.

– **Physical Resources: Hydrology, Water Quality, Wetlands, and Floodplains – Environmental Consequences**

In addition to the environmental consequences for all components included in REC2, this alternative includes the environmental consequences described here. There would be no effect to hydrology, water quality, wetlands, or floodplains from implementation of the outdoor stage, playground enhancements, pavilion, glamping sites, existing dog park enhancements, playing field enhancements, and disc golf improvements project components. The construction activities are restricted to small areas on currently disturbed and maintained sites. Hydrology would not be affected as none of the project components are located in or would affect waterways. Appropriate erosion and sediment control measures would be implemented to avoid water quality impacts from erosion or sediment movement. The project components would not be conducted in wetlands and would not cause a rise in base floodplain elevations.

– **Biological Resources: Habitats and Wildlife (Including Birds) – Environmental Consequences**

In addition to the environmental consequences for all components included in REC2, this alternative includes the environmental consequences described here.

Habitats: There would be no effect to habitats from the implementation of the outdoor stage, playground enhancements, pavilion, glamping sites, existing dog park enhancements, playing field enhancements. These elements would be constructed in previously disturbed, high-traffic areas in the existing park. For the disc golf improvements there could be short-term, minor, adverse impacts to habitats including hand clearing, excavation/installation of disc golf baskets, signage, and tee areas in or near to forested, herbaceous, and other habitats.

Wildlife (Including Birds): Elevated noise levels during construction could cause short-term, minor, adverse effects to terrestrial wildlife and birds in the vicinity of the project components that are in or near habitats. The wildlife in the vicinity of the project is highly mobile and would likely avoid the area during activities and return when activities cease.

- **Biological Resources: Rare and Protected Species – Environmental Consequences**

The REC3 - Shepard State Park Recreational Enhancements-2 project environmental consequences for protected species are the same as described in Section 4.3.3.2 for the REC-2 Shepard State Park Recreational Enhancements-1. Accordingly, impacts to protected species in the project area (piping plover, red knot, eastern black rail, gopher tortoise, Louisiana quillwort, Alabama red-bellied turtle, dusky gopher frog, Mississippi sandhill crane, wood stork, and monarch butterfly) would not exceed the threshold of minor, short-term, adverse, and avoidance and minimization measures for protected species would be implemented. The project would have no effect on green sea turtle, hawksbill sea turtle, Kemp's ridley sea turtle, leatherback sea turtle, loggerhead sea turtle, Gulf sturgeon because the project would be limited to terrestrial habitats, and no in-water activities would occur.

- **Socioeconomic Resources: Cultural Resources – Environmental Consequences**

A complete review of this project under Section 106 of the NHPA would be completed prior to implementation of any project activities. During project design, the MDEQ would identify measures to avoid any adverse impacts on cultural or historic resources located within the project area in consultation with the relevant State and Tribal Historic Preservation Offices. Resources that are eligible for the NRHP would be avoided in the design of the projects. The project would be implemented in accordance with all applicable laws and regulations concerning the protection of cultural and historic resources. No adverse impacts to cultural or historic resources are anticipated from this project.

- **Socioeconomic Resources: Aesthetics and Visual Resources – Environmental Consequences**

The REC3-Shepard State Park Recreational Enhancements-2 project environmental consequences for aesthetics and visual resources would encompass the same as described in Section 4.3.3.2 for the REC2-Shepard State Park Recreational Enhancements-1. While REC3 contains additional project components, only short-term, minor, adverse impacts are anticipated from this alternative as well. Long-term benefits would also result from the construction of new facilities (e.g., glamping spots) the renovation of existing facilities (e.g., dog park), and other improvements that would be consistent with the current park aesthetics and/or improve visual resources in the area.

4.3.3.4 REC - No Action Alternative

- **Environmental Consequences Summary**

In addition to the proposed alternatives previously discussed for the Provide Recreational Opportunities Restoration Type, the MS TIG evaluated the No Action Alternative as a benchmark and basis for comparison of potential environmental consequences with the action alternatives.

Under the No Action Alternative, the MS TIG would not implement any projects for the Provide Recreational Opportunities Restoration Type at this time, and would instead allow natural recovery processes to occur, which could result in one of four outcomes for injured resources: 1) gradual recovery; 2) partial recovery; 3) no recovery; or 4) further deterioration. Although injured resources could presumably recover to or near baseline conditions under this scenario, recovery would take much longer compared to a scenario in which restoration actions were undertaken.

The No Action Alternative would have no beneficial impacts to providing recreational opportunities because this alternative would largely result in a continuation of the conditions described in the

PDARP/PEIS Chapters 3, Ecosystem Setting and Chapter 4, Injury to Natural Resources, and there would be no associated benefits to providing recreational opportunities by enhancing public access to natural resources, creation/enhancement of educational facilities, or creating/enhancing educational programs.

When analyzed in combination with other past, present, and reasonably foreseeable future actions, the No Action Alternative would provide no beneficial impacts, because existing conditions would not change in a predictable way. This alternative is not expected to contribute to short-term or long term, cumulative adverse impacts to physical resources, biological resources, or socioeconomics.

4.4 Comparison of Alternatives

A summary of environmental consequences of the evaluated alternatives is provided below in Tables 4-5, 4-6, and 4-7.

Table 4-5: Summary of Environmental Consequences for Wetlands, Coastal, and Nearshore Habitats Projects

Project Activities/Resources	WCNH1. Coastwide Habitat Acquisition	WCNH2. Living Shoreline Bulkhead Alternative	WCNH3. Hancock County Marsh Living Shoreline Phase 6 Breakwater	WCNH4. Sand Dune Restoration
Project Activities	Acquisition of privately owned coastal lands in all three coastal counties.	Construction of up to three living shorelines across the Mississippi Gulf Coast. Coir logs, coir mats, stone, native oyster shell native wood debris and other structural materials would be used and the structures would have a substantial biological component.	Construction of approximately 1.7-miles of segmented riprap breakwater in the Mississippi Sound between Bayou Bolan and Bayou Caddy.	Planting of native plants (e.g., sea oats) on existing beaches or dunes; installation, maintenance, and repair of sand fencing; replanting of storm or otherwise damaged areas.
Physical Resources— Geology and Substrates	No adverse effects to geology and substrates are anticipated as a result of acquisition and preservation of habitat. There would be long-term benefits to soils from preservation of acquired lands and protection of habitats.	There would be long-term, minor, adverse impacts as a result of filling up to 0.70 acres of soft bottom substrate. There would be a long-term benefit to geology and substrates resulting from reduced shoreline erosion.	There would be long-term minor adverse impacts to geology and substrates in a relatively small footprint (17 acres). There would be a long-term benefit to geology and substrates resulting from reduced shoreline erosion.	There would be short-term, negligible to minor, adverse impacts from installation of dune fencing/fence maintenance; replanting of damaged areas (e.g., storm or other); and disturbance of sand from replanting of areas. There would be long-term benefits including substrate (sand/beach) stabilization from dune development and from planting and also a reduction in loss of sand from high wind events.
Physical Resources— Hydrology, Water Quality, Wetlands and Floodplains	**Hydrology and Water Quality**: Acquisition and preservation of lands would provide long-term benefits to hydrology and water quality by preventing development and land disturbance, which can maintain increased infiltration of stormwater and reduce the rate of surface water runoff and maintain natural hydrologic patterns. **Wetlands**: There would be long-term benefits to wetlands habitats from acquisition and preservation. Various wetlands including pine savannas and flatwoods, freshwater and estuarine marsh, scrub shrub habitat, bottomland hardwoods and other wetlands would benefit from the preservation of large tracts which would likely be a mosaic of uplands and wetlands. **Floodplains**: There would be a long-term benefit to floodplains. Acquisition and preservation of land would prevent land development including filling of floodplains.	**Hydrology**: Short-term, minor, adverse impact to hydrology resulting from the construction of the living shoreline. Long-term benefit to hydrology in the immediate vicinity of the project; gaps in the structure would allow tidal exchange. **Water Quality**: Short-term, minor, adverse impacts to water quality from disturbance of sediments associated with the construction of the living shoreline. **Wetlands**: Short-term, minor, localized, adverse impacts from sediment movement during construction that could temporarily impact wetlands/the shoreline edge. Long-term, beneficial impacts to salt marsh by reducing shoreline erosion/marsh degradation, proposed plantings, accretion and proposed plantings could increase the area of wetlands, including SAVs. **Floodplains**: Due to the limited elevation of the living shorelines, there would be no adverse impacts to the beneficial function of the floodplain. Long-term benefits to floodplains resulting from reduced shoreline erosion.	**Water Quality and Hydrology**: Short-term, minor, adverse impacts to water quality from disturbance of sediments associated with the construction of the living shoreline. Short-term, minor, adverse impact to hydrology resulting from the construction of the living shoreline. Gaps would be present between breakwater segments and created marsh areas that would allow tidal exchange flows and waterway access resulting in a long-term benefit to hydrology in the immediate vicinity of the project. **Wetlands**: During construction, there would be short-term, minor, localized, adverse impacts from sediment movement that could temporarily impact the shoreline edge near the project components. There would be long-term, beneficial impacts to salt marsh by reducing shoreline erosion and resulting marsh degradation. Accretion and proposed plantings associated with the design of the shoreline could increase the area of wetlands in the vicinity of the breakwater. There would be no long-term, adverse impacts to wetlands as a result of constructing the living shoreline on unvegetated substrate. **Floodplains**: There would be long-term benefits to floodplains resulting from reduced shoreline erosion.	**Water Quality and Hydrology**: There would be little to no adverse impact on hydrology and water quality since all work would be confined to the man-made beach/created dune area and no additional fill or excavation would be necessary to accomplish the goal of the restoration. Impacts to hydrology and water quality would be short-term and would have little to no adverse impact. If required, all appropriate permits would be obtained prior to beginning construction, and all BMPs and conditions set forth would be followed. **Wetlands**: There would be no effect to wetlands as a result of project implementation. **Floodplains**: Due to the limited elevation of the dunes, there would be no adverse impacts to the beneficial function of the floodplain.
Biological Resources— Habitats and Wildlife Species (including birds)	Acquisition and preservation of habitat would provide a long-term benefit to the habitat and wildlife, including birds. The project would preserve habitat connectivity, prevent development and resulting habitat loss and fragmentation.	**Habitats**: There would be short-term, minor, adverse impacts to benthic and intertidal habitats in the project area (e.g., estuarine marsh, benthic soft bottom, SAVs) from construction activities including filling of up to 0.30 acres in 3 locations, and temporary localized sedimentation to SAVs and estuarine marsh in the project area. Construction of the breakwaters result in long-term benefits to established or newly developing SAV beds, shorelines/associated marsh by reducing wave energy/erosion, and increased acreage of estuarine marsh from native plantings. **Wildlife**: Impacts to wildlife are expected to be short-term, localized, and minor. There are no impacts anticipated to	**Habitats**: Prior to construction activities, SAV surveys would be completed in the project component areas. If any SAV beds are found, the project would be modified to avoid the beds if possible. Even with surveys prior to construction, the deployment of the breakwater material could result in short-term, minor, adverse impacts to SAVs in the vicinity of the project resulting from temporary sedimentation in beds. Any disturbance would be short-term in nature; it is anticipated that SAV beds would recover naturally. Construction of the breakwaters could protect areas conducive to SAV growth which could provide long-term benefits to established or newly developing SAV beds in these waterbodies. The breakwater would result in long-term benefits to shorelines/associated marsh by reducing wave energy/erosion. **Wildlife**: Noise and other activity associated with proposed construction may	**Habitats**: There would be short-term minor adverse impacts to man-made beach habitat from the installation of dune fencing and planting activities. There would be long-term benefits to habitats from the creation of vegetated dune habitat as a resulting from the implementation of the project. **Wildlife (Including Birds)**: There would be a long-term benefit to wildlife from the creation of vegetated habitat that could be utilized for nesting, roosting, and breeding habitat.

Project Activities/Resources	WCNH1. Coastwide Habitat Acquisition	WCNH2. Living Shoreline Bulkhead Alternative	WCNH3. Hancock County Marsh Living Shoreline Phase 6 Breakwater	WCNH4. Sand Dune Restoration
		wildlife populations. The project would occur in open water and intertidal zones away from potential nesting areas; therefore, it is not anticipated to impact nests for marsh birds or shorebirds in the area. There are no golden eagles in the project footprint. No bald or golden eagles are known to nest within 660 ft. of the project area.	temporarily disturb certain dolphin species and manatee in the vicinity of the project area through short-term impacts on prey abundance, water quality (turbidity), and underwater noise, and may temporarily increase the potential for boat collisions with certain species in the project area. However, the mobility of these species reduces the risk of injury due to construction activity. Based on the mobility of these species, the short duration of construction activities, and the proposed construction methodology, effects on dolphin species are not anticipated.	
Biological Resources-Marine and Estuarine Fauna (Fish, shellfish, benthic organisms) and Federally Managed Fisheries	Land acquisition and habitat preservation would provide a long-term benefit to marine and estuarine fauna, federally managed fisheries, estuarine habitat, and EFH. There would be no in-water work. Estuarine marsh (EFH) could be acquired and preserved, but there are no management activities planned in this habitat for the proposed alternative. Acquisition and preservation of habitat would prevent development and preclude habitat removal or stresses that could result from shoreline development.	**Marine and Estuarine Fauna**: There could be short-term, minor, adverse impacts to fish, shellfish, and benthic organisms which could occur from increased turbidity, substrate disturbance, or siltation during construction including mobile species (e.g., fish, shrimp, crabs) that would likely move from the area during construction. There would be long-term benefits to fish, shellfish, and benthic organisms from creating three-dimensional breakwater (reef), that would be colonized by infauna, and other epifauna (e.g., crabs, benthic invertebrates) and also utilized for forage and cover by estuarine fish species. SAV beds could establish in the zone between the breakwater and the existing eroded shoreline providing additional habitat for infauna and could be used by estuarine fish species for foraging. **Federally Managed Fisheries**: Project construction would have short-term, minor, impacts on FMP species that are managed by NMFS and GMFMC that utilize estuarine habitats primarily for nursery (e.g., growth, feeding). Installation of the breakwater and associated equipment operation would result in short-term, minor, adverse impacts that could include temporary disturbance to soft bottom and sandy substrate and estuarine marsh habitat (EFH). There would be long-term benefits from creation of EFH including creation of approximately 3.0 acres of high-relief reef, native plantings, and the protection of approximately 1,500 linear feet of shoreline/associated marsh, and potential SAV development between the breakwater and the marsh area. There would be long-term benefits to federally managed species that would utilize these habitats which support various life stages (e.g., fish and shellfish eggs, larvae, and juvenile stages).	**Living Coastal and Marine Resources (Marine and Estuarine Fauna)**: There would be a long-term impact to benthic communities in the 17.9 acres of soft-bottom habitat converted to hard substrate for breakwater and marsh creation. However, soft-sediment areas are prolific in the proposed project area and the proposed reef footprint would not result in a substantive change in available habitat in the region. Therefore, impacts to the benthic community would be minor. Mollusks and crustaceans such as shrimp and crab are likely limited in soft-sediment areas where construction would occur. These mobile invertebrates would experience a short-term minor impact and would be positively impacted by the placement of hardened structure. The project would result in three-dimensional high-relief breakwater that would be colonized by oysters, infauna, and other epifauna. **Federally Managed Fisheries/EFH**: The NOAA Fisheries has identified EFH habitats for the Gulf of Mexico in its Fishery Management Plan Amendments. The habitat in the project area includes the Mississippi Sound and Gulf of Mexico waters and consists primarily of soft bottom and sandy substrate consistent with sediment along the northern Gulf of Mexico. The proposed action would not result in long-term adverse effects to EFH. The project is anticipated to result in long-term benefits to EFH.	**Marine and Estuarine Resources/Federally Managed Fish Species**: There would be no in-water work. There would be no adverse impacts to marine and estuarine or impacts to federally managed fisheries or their essential habitat.
Biological Resources— Protected Species	There would be no short- or long-term adverse effects to protected species as a result of acquisition and preservation. Acquisition and preservation of habitat would provide a long-term benefit to the protected species by preserving habitat connectivity, preventing development and resulting habitat loss and fragmentation.	Potential interactions with protected species (Gulf sturgeon, loggerhead sea turtle; Kemp's ridley sea turtle; hawksbill sea turtle; and green sea turtle and West Indian manatee) during construction may result in short-term, minor adverse impacts to protected species; it is anticipated these impacts would resolve once interaction has ceased.	Potential interactions with protected species (Gulf sturgeon, loggerhead sea turtle; Kemp's ridley sea turtle; hawksbill sea turtle; and green sea turtle and West Indian manatee) during construction may result in short-term, minor adverse impacts to protected species; it is anticipated these impacts would resolve once interaction has ceased.	No adverse impacts are anticipated to protected species during construction due to the implementation of BMPs. Beneficial impacts would be anticipated because the project would provide valuable nesting, roosting, and breeding habitat for marine and coastal birds, threatened and endangered species, and migratory birds.
Socioeconomic Resources—Cultural Resources	Resources that are eligible for the NRHP would be avoided in the design of the projects, to the extent practicable. The projects would be implemented in accordance with all applicable	Resources that are eligible for the NRHP would be avoided in the design of the projects, to the extent practicable. The projects would be implemented in accordance with all applicable laws and regulations concerning the protection of	Resources that are eligible for the NRHP would be avoided in the design of the projects, to the extent practicable. The projects would be implemented in accordance with all applicable laws and regulations concerning the protection of cultural and historic resources.	Resources that are eligible for the NRHP Places would be avoided in the design of the projects, to the extent practicable. The projects would be implemented in accordance with all applicable laws and regulations concerning the protection of

Project Activities/Resources	WCNH1. Coastwide Habitat Acquisition	WCNH2. Living Shoreline Bulkhead Alternative	WCNH3. Hancock County Marsh Living Shoreline Phase 6 Breakwater	WCNH4. Sand Dune Restoration
	laws and regulations concerning the protection of cultural and historic resources.	cultural and historic resources.		cultural and historic resources.
Socioeconomic Resources—Aesthetics and Visual Resources	There would be no adverse effect on aesthetics and visual resources as parcels would be acquired and preserved.	During construction, there would be short-term, minor, adverse impacts to aesthetics and visual resources for recreational boaters and fishermen due to construction equipment in and around the project area. The breakwater and/or the reefs may be exposed at MLW and could be marked with navigational signs typical of those in the project area(s). The implementation of the project would not result in a long-term, adverse impact to visual and aesthetic resources. Prevention of development would result in long-term benefits to these resources.	During construction, there would be short-term, minor, adverse impacts to aesthetics and visual resources for recreational boaters and fishermen due to construction equipment in and around the project area. Residents, people who use the bays for recreation, and businesses along the shoreline would experience minor adverse aesthetics and visual impacts during construction. After construction is completed, the breakwater and/or the reefs may be exposed at MLW. The deployed materials would blend well with the surrounding substrate, which would not have a long-term adverse effect on aesthetics and visual resources. In addition, navigation signs in the project area would alert boaters to the presence of the breakwater (including gaps in the breakwater) and reefs. Because this is an area already used by recreational and commercial boaters, the addition of navigation signs would be consistent with other navigational signage/aids already present in the project vicinity. There would be no long-term impact from sign placement.	Impacts to aesthetics and visual resources would be limited to the construction window. There would be short-term, minor, impacts from implementation activities including worker activities and equipment staged on the beach as needed to complete the restoration activities. Created, vegetated dunes are expected to provide a long-term benefit to aesthetics and visual resources.

Table 4-6: Summary of Environmental Consequences for Nutrient Reduction Projects

Project Activities/Resources	NR1-Back Bay-Davis Bayou Nutrient Reduction [22]	NR2-Big Cedar Creek-Rocky Creek Nutrient Reduction [23]	NR3-Big Cedar Creek-West Pascagoula River Nutrient Reduction (see Footnote 7)
Project Activities	Two potential project areas have been identified to implement appropriate conservation practices adjacent to waterways that discharge into Back Bay: • D'Iberville Lamey Street Bank Stabilization: Includes conservation practices to reduce sediment and nutrient contributions on publicly owned lands adjacent to a waterway that discharges into Biglin Bayou. • Hiller Park and Keesler AFB Drainage Area 9 Nutrient and Stormwater Control Project: Includes conservation practices to reduce sediment and nutrient contributions on publicly owned lands adjacent to a waterway that drains into Bayou Laporte. Other projects or conservation practices could be identified during stakeholder outreach.	The NR2-Big Cedar Creek-Rocky Creek Nutrient Reduction Alternative would focus on the enrollment of targeted tracts of agricultural and associated forested lands within the boundaries of four HUC12 watersheds to reduce sediment and nutrient loading at the watershed level. USDA Conservation Practices are included here: Conservation Practice Standards Information | Natural Resources Conservation Service (usda.gov)	The NR3-Big Cedar Creek-West Pascagoula Creek Nutrient Reduction Alternative would focus on the enrollment of targeted tracts of agricultural and associated forested lands within the boundaries of four HUC12 watersheds to reduce sediment and nutrient loading at the watershed level. USDA Conservation Practices are included here: Conservation Practice Standards Information | Natural Resources Conservation Service (usda.gov)
Physical Resources— Geology and Substrates	**Streambank and Shoreline Protection (580)**: There would be short-term, minor to moderate adverse impacts activities associated with various conservation practices from grading, reshaping, and planting of stream banks, ponds, lakes, and other aquatic systems. There would be long-term beneficial impacts as stabilization would result in reducing the off-site, downstream effects of sediment, nutrients, and organic material into surface waters. **Grade Stabilization Structure (410)**: There would be short-term minor to moderate adverse impacts from soil excavation, grading, to construct or install grade stabilization structures including berms, rip rap, and hard structures. The majority of these would be installed in agricultural fields and could be installed in drainageways or tributaries. There would be long-term beneficial impacts to geology and soils from prevention of gully formation, reduction of soils, and drainageway stabilization. **Forest Stand Improvement (666)**: There would be short-term, minor impacts to soils from use of small equipment to access and complete operations which would include use of chainsaws to cut or kill trees or selected understory vegetation and dragging of felled materials.		

[22] The MS TIG evaluated the Back Bay-Davis Bayou project activities for their potential impacts to the affected environment (Back Bay-Davis Bayou watershed). The Back Bay-Davis Bayou project activities are similar in scope to USDA-NRCS conservation practices that address water quality and soil erosion concerns. The purpose, condition, and criteria for applying the specific conservation practices to reduce nutrient and sediment runoff in an urban landscape are considered. Information on the practices considered can be found here (https://www.nrcs.usda.gov/getting-assistance/conservation-practices#standard). For the purposes of this RP4/EA, environmental consequences are based on the USDA Conservation Practice descriptions, as well as anticipated construction and maintenance activities that could be implemented for the Back Bay-Davis Bayou Nutrient Reduction Alternative.

[23] The MS TIG RP1/EA provides an analysis of six (6) exemplar practices which represent the broader suite of over 50 practices that could be implemented for alternatives in that plan (Appendix A). The suite of practices used for the NR2-Big Cedar Creek-Rocky Creek Nutrient Reduction Alternative and for the NR3-Big Cedar Creek-West Pascagoula River Nutrient Reduction Alternative would be the same. The MS TIG RP1/EA analysis has been incorporated by reference in this MS TIG RP4/EA.

Project Activities/Resources	NR1-Back Bay-Davis Bayou Nutrient Reduction [22]	NR2-Big Cedar Creek-Rocky Creek Nutrient Reduction [23]	NR3-Big Cedar Creek-West Pascagoula River Nutrient Reduction (see Footnote 7)
	Grassed Waterway (412): There would be short-term, minor to moderate adverse impacts from shaping or grading a channel and grading to form or install a stable outlet. The area would be replanted, where possible, with vegetation that would serve to reduce erosion and provide benefit to wildlife. There would be long-term benefit from controlling and managing flow to prevent soil erosion, increases in soil infiltration and increased soil biological activity, and trapping of sediments in the waterways. **Stream Crossing (578)**: There would be short-term, minor to moderate impacts to the streambed from stabilizing an area for designated crossing and installing culverts or small bridges. In some cases, fences would be constructed to direct livestock or people to crossing. There would be long-term beneficial impacts resulting from livestock traversing the stream at one stabilized location versus traversing the stream in various location. Fences would prevent riparian area grazing and resultant animal waste/nutrient contribution in and near waterways. **Terrace (600)**: There would be short-term minor to moderate, adverse impacts from soil excavation, grading, to construct or install terraces. The majority of these would be installed in agricultural fields. There would be long-term beneficial impacts to geology and soils from prevention of gully formation and reduction of soils erosion.		
Physical Resources— Hydrology, Water Quality, Wetlands and Floodplains	**Streambank and Shoreline Protection (580)** **Water Quality**: There would be short- term, minor, adverse impacts from the potential for increased erosion during grading, reshaping, and planting of stream banks, ponds, lakes, and other aquatic systems. There would be long-term, beneficial impacts as this practice would result in stabilizing the waterbody and preventing further erosion. **Hydrology**: There would be short- term, minor, adverse impacts from grading, reshaping, and planting of stream banks, ponds, lakes, and other aquatic systems. These impacts would result from altered hydrologic flow in the stream during construction. There would be long-term beneficial impacts as this practice would result in restoring stream hydrology and provide the hydrologic benefits of riparian vegetation including staging of stormwater flows. **Grade Stabilization Structure (410)** **Water Quality**: There would be short-term, minor adverse impacts from the potential for increased erosion resulting from soil excavation, grading, to construct or install grade stabilization structures including berms, rip rap, and hard structures. Grade stabilization could be installed in agricultural fields and/or in drainageways or tributaries. There would be long-term, beneficial impacts from drainageway stabilization. **Hydrology**: There would be short-term, minor, adverse impacts from soil excavation, grading, to construct or install grade stabilization structures including berms, rip rap, and hard structures. The majority of these would be installed in agricultural fields and/or could be installed in drainageways or tributaries. There would be long-term, beneficial impacts to hydrology from prevention of gully formation, prevention of headcutting, and drainageway destabilization. **Forest Stand Improvement (666**) **Water Quality**: There would be no adverse impacts to water quality. There would be long-term benefits as a result of this practice including slowing runoff and increased filtration. **Hydrology**: There would be short-term, minor, impacts to hydrology from use of small equipment to access and complete operations which would include use of chainsaws to cut or kill trees or selected understory vegetation, and dragging of felled materials. There would be long-term beneficial impacts from healthier forest stands including slowing runoff and increasing infiltration. **Grassed Waterway (412)** **Water Quality**: There would be short-term, minor to moderate, adverse impacts from the potential of increased erosion as a result of shaping or grading a channel and grading to form or install a stable outlet. These impacts would last until vegetation regrows. The area would be replanted, where possible, with vegetation that would serve to reduce erosion and provide benefit to wildlife. There would be long-term benefits from increased infiltration, filtration of water before it reaches the waterway, and erosion prevention. **Hydrology**: There would be no adverse impacts to hydrology from shaping or grading a channel and grading to form or install a stable outlet. The area would be replanted, where possible, with vegetation that would serve to reduce erosion and provide benefit to wildlife. There would be long-term benefits from controlling, managing, and slowing hydrologic flow and preventing soil erosion. **Stream Crossing (578)** **Water Quality**: There would be short-term, minor impacts to water quality from the potential of increased erosion as a result of earth moving required to install a stream crossing. There would be long-term, beneficial impacts resulting from livestock traversing the stream at one stabilized location versus traversing the stream in various locations. If fences were installed with the practice, they would prevent riparian area grazing and ground cover grazing that would result in decreased infiltration. In urban settings there would be long-term beneficial effects to water quality where crossings serve to establish stream grade/stage stream flow, prevent erosion of streambeds, and prevent erosion of adjacent streambanks. **Hydrology**: There would be long-term, minor, adverse impacts to the streambed from stabilizing an area for designated crossing, installation of culverts or small bridges. There would be long-term beneficial impacts resulting from livestock traversing the stream at one stabilized location versus traversing the stream in various locations which could result in compromise of stream banks. **Terrace (600)** **Water Quality**: There would be short-term, minor to moderate, adverse impacts to water quality from the potential of increased erosion during soil excavation and grading to construct or install terraces. There would be long-term, beneficial impacts from the reduction of runoff that could contain contaminants, and prevention of erosion. **Hydrology**: There would be short-term, minor to moderate, adverse impacts from increased erosion during soil excavation and grading to construct or install terraces. There would be long-term, beneficial impacts from the reduction of runoff that could contain contaminants, and prevention of erosion. **Wetland (All Exemplar Practices)**: There could be short-term, minor to moderate, adverse impacts to wetlands depending on the location of the conservation practice. Wetlands would be avoided to the greatest extent possible. Any impacts would be localized to the conservation practice area. All conservation practices are intended to conserve and enhance important resources such as wetlands. The practices would typically have a long-term, beneficial, impact on wetlands, water quality, hydrology, and species composition in wetlands. **Floodplains (All Exemplar Practices)**: Conservation practices would not result in a detectable change to natural and beneficial floodplain values. Stream crossings and grade stabilization structures installed in streams would be designed and constructed so as not to cause an appreciable rise in floodwaters.		
Biological Resources— Habitats and Wildlife Species (including birds)	**Streambank and Shoreline Protection (580)**: There would be short-term, minor to moderate adverse impacts to habitats resulting from grading, reshaping, and planting of stream banks, ponds, lakes, and other aquatic systems. There would be long-term benefits to biodiversity by revegetating areas with native species. This practice would improve or enhance the stream corridor for fish and wildlife habitat. **Grade Stabilization Structure (410)**: There would be short-term, minor to moderate, adverse impacts to habitats from soil excavation, grading, to construct or install grade stabilization structures including berms, rip rap, and hard structures. Most of these grade stabilization structures would be installed in agricultural fields and could be installed in drainageways or tributaries. There would be long-term, beneficial impacts to aquatic wildlife by stabilizing stream and waterbody habitat and preventing sediment from entering waterways. **Forest Stand Improvement (666**): There would be short-term, minor impacts to wildlife and habitat from use of small equipment to access and complete operations which would include use of chainsaws to cut or kill trees or selected understory vegetation and dragging of felled materials. The use of equipment could damage vegetation and the noise of and activity in the area would cause wildlife to vacate the area during implementation. Wildlife would return after the practice is completed. As a result of this practice, plant health and productivity would improve; invasive species would be removed; and health and vigor of desirable plants and biodiversity would increase. This conservation practice would be designed to have a long-term benefit to habitat and wildlife. **Grassed Waterway (412)**: There would be short-term, minor, adverse impacts to habitats and wildlife from noise and activity disturbance during construction. Wildlife would vacate the area during construction but return after construction is finished. This practice would be done primarily on cropland and would not impact wildlife habitat. The area would be replanted, where possible, with vegetation that would serve to reduce erosion and provide a long-term benefit to wildlife. **Stream Crossing (578)**: There would be short-term, minor impacts to wildlife and habitat from noise and potential vegetation clearing during stream crossing construction. Wildlife would vacate the area during construction but return after construction is		

Project Activities/Resources	NR1-Back Bay-Davis Bayou Nutrient Reduction [22]	NR2-Big Cedar Creek-Rocky Creek Nutrient Reduction [23]	NR3-Big Cedar Creek-West Pascagoula River Nutrient Reduction (see Footnote 7)
	finished. **Terrace (600)**: There would be short-term, minor, adverse impacts to wildlife and habitat due to potential vegetation clearing and noise disturbance from the use of equipment. Wildlife would vacate the area during construction but return after construction is finished.		
Biological Resources— Protected Species	**NR1**: Because the proposed project activities would be conducted in previously disturbed suburban settings with minimal suitable habitat, impacts to protected species are not expected to exceed the threshold of short-term, minor adverse.	**NR2**: Existing programmatic ESA consultation between USFW/USDA is in place. Because the proposed project activities would be conducted in previously disturbed agricultural settings with minimal suitable habitat, impacts to protected species are not expected to exceed the threshold of short-term, minor adverse. Any environmental consequences are anticipated to fall within those evaluated in this RP4/EA. USDA environmental assessment (CPA-52 form; See Appendix B) would be conducted at each contract site.	**NR3:** Existing programmatic consultation between USFW/USDA is in place. Because the proposed project activities would be conducted in previously disturbed agricultural settings with minimal suitable habitat, impacts to protected species are not expected to exceed the threshold of short-term, minor adverse. Any environmental consequences are anticipated to fall within those evaluated in this RP4/EA. USDA environmental assessment (CPA-52 form; See Appendix B) would be conducted at each contract site.
Socioeconomic Resources— Cultural Resources	Resources that are eligible for the NRHP would be avoided in the design of the projects, to the extent practicable. The projects would be implemented in accordance with all applicable laws and regulations concerning the protection of cultural and historic resources.		
Socioeconomic Resources— Aesthetics and Visual Resources	In urban settings (NR1), conservation practices would occur in and near stream corridors, drainage easements, and publicly owned lands. For NR2 and NR3, conservation practices would be implemented on cropland, associated agriculture lands, pasture/grassland, and forestland. Conservation practices would be consistent with current land uses (NR1) and with farming practices (NR2 and NR3) and would have a negligible effect on aesthetic and visual resources.		

Table 4-7: Summary of Environmental Consequences for Provide and Enhance Recreational Opportunities Projects

Project Activities/Resources	REC1 Jourdan River Boardwalk	REC2 Shepard State Park Recreational Enhancements	REC3 Shepard State Recreational Enhancements
Project Activities	The project includes the installation of approximately 1,800 linear feet (LF) of 8-foot-wide timber pile supported pier and walkway, 1-20'x20' elevated nature observatory (with upper level deck), 3-20'x20' seating areas, associated low level lighting and safety railing	Environmental Education Center/Gray House Renovation: Renovate the "Gray House" for use as an interactive Environmental Education Center for hosting nature-based classes and events. Includes interactive components to help children/visitors to learn about natural resources at Shepard State Park. **Educational Signage and/or Educational Programs**: Educational signage and/or educational programs would highlight habitats and resources that were injured by the spill and/or are being restored by the Trustees (e.g., Wetlands, Coastal, and Nearshore Habitats; Birds). The City has partnered with a local ecologist in the past for educational projects at Shepard State Park. **Trail Enhancement and Maintenance**: Funding would be used to complete trail maintenance and/or hiring a contractor to clear trails once every two years for a four-year period.	Includes all REC2 components and the following: **Outdoor Stage**: This component includes replacing the existing wooden stage at the festival area. This would facilitate live performances in the festival area. **Playground Enhancements**: Playground enhancements would include upgrading the existing playground and adding a splash pad to the playground area. **Pavilion:** This component includes construction of a second pavilion in the festival area. **Glamping Sites:** Up to ten (10) glamping sites would be constructed to attract a group of visitors that are currently not using the current camping facilities (e.g., RV sites; primitive camping). Based on inquiries, there is a high demand for these sites and the City of Gautier expects high occupancy. Visitors would be provided with glamping sites that are nestled into surrounding maritime forests and walking distance to the existing marsh walk. **Existing Dog Park Enhancements**: Dog Park Enhancements would include replacing fencing, and upgrades to dog exercise/play structures. This would enhance the visitor experience and could increase use of the park by pet owners. **Playing Field Enhancements**: Playing field enhancement would include lighting rehabilitation in the playing field/green space area. **Disc Golf Improvements**: Disc Golf Course Improvements would be funded for the 16-hole Disc Golf course in cooperation with local golfers who are active in maintaining the course.
Physical Resources— Geology and Substrates	There would be long-term, minor, adverse impacts from driving of pilings into soft sediments to install piling/structures for the boardwalk.	Environmental Education Center/Gray House Renovation: There would be no effect to geology and substrates. **Educational Signage and/or Educational Programs**: There would be long-term, minor, adverse impacts from driving of sign posts into soils for the installation of educational signage. **Trail Enhancement and Maintenance:** There would be short-term, minor, adverse impacts from activities associated with clearing of trails, including disturbance of soils by vehicles used to access areas for vegetation management including mechanical clearing using small equipment or hand tools.	In addition to the environmental consequences for all components included in REC2 this alternative includes the environmental consequences described here. **Outdoor Stage**: There would be negligible to short-term, minor disturbance of soil during the construction of an outdoor stage on a previously impacted site. **Playground Enhancements**: There would be negligible to short-term, minor disturbance for the upgrading of the existing playground and long-term, minor, adverse impacts as a result of filling less than one acre of ground for the construction of an additional splash pad/waterlines in the playground area. **Pavilion**: There would be long-term, minor, adverse impacts to substrates as a result of filling of less than one acre of ground for the construction of pavilion in an existing festival area. **Glamping Sites**: There would be long-term, minor, adverse impacts to substrates as a result of filling less than 2.0 acres of ground for the construction of 10 glamping pads in an existing maintained/mowed upland area. **Existing Dog Park Enhancements**: There would be no effect to geology and substrates from the implementation of the Dog Park Enhancement; disturbance would primarily be restricted to existing equipment or installation of equipment in an

Project Activities/Resources	REC1 Jourdan River Boardwalk	REC2 Shepard State Park Recreational Enhancements	REC3 Shepard State Recreational Enhancements
			upland that is currently maintained/mowed. **Playing Field Enhancements**: There could be short-term, minor, adverse impacts to soils from rehabilitation of playing field and the green space area including localized, short-term soil disturbance. **Disc Golf Improvements**: There could be long-term, minor, adverse impacts to substrates from installing of disc golf "holes" and fairway sign posts in new/currently undisturbed areas.
Physical Resources—Hydrology, Water Quality, Wetlands and Floodplains	**Hydrology, Water Quality, and Wetlands:** Short-term, minor, adverse impacts to hydrology, water quality, and wetlands would occur as a result of equipment movement/sediment movement during the installation of pilings for the boardwalk and elevated nature observatory. **Floodplains:** There would be no effects to floodplains.	There would be no effect to hydrology, water quality, wetlands, or floodplains from implementation of the Environmental Education Center/Gray House Renovation, Educational Signage and/or Educational Programs, and the Trail Enhancement and Maintenance project components.	In addition to the environmental consequences for all components included in REC2 this alternative includes the environmental consequences described here. There would be no effect to hydrology, water quality, wetlands, or floodplains from implementation of the Outdoor Stage, Playground Enhancements, Pavilion, Glamping Sites, Existing Dog Park Enhancements, Playing Field Enhancements, and Disc Golf Improvements project components. The construction activities are restricted to small areas on currently disturbed and maintained sites. Hydrology would not be affected as none of the project components are located in or would affect waterways. The projects would not be conducted in wetlands and would not cause a rise in base floodplain elevations.
Biological Resources—Habitats and Wildlife Species (including birds)	**Habitats:** Short-term, minor, adverse impacts to riverbed sediments in a relatively small, project footprint in a localized area. Short-term, minor, adverse impacts if sediment is displaced and settles in nearby SAV beds or marsh areas adjacent to the project. **Wildlife (Including Birds)**: Elevated noise levels during construction could cause short-term, minor, adverse effects to terrestrial wildlife and birds in the vicinity of the project. The wildlife in the vicinity of the project is highly mobile and would likely avoid the area during activities and return when activities cease.	**Environmental Education Center/Gray House Renovation:** There would be no effect to habitats; the area surrounding the existing Gray House is mowed lawn. **Educational Signage and/or Educational Programs:** There could be short-term, minor, adverse impacts as a result of disturbance to habitats during sign installation. **Trail Enhancement and Maintenance:** There would be short-term, minor, adverse effects to habitats as a result of hand-clearing, mechanical clearing, and chemical treatments. **Wildlife (Including Birds):** There would be elevated noise levels during construction that could cause short-term, minor, adverse effects to terrestrial wildlife and birds in the vicinity of the project. The wildlife in the vicinity of the project is highly mobile and would likely avoid the area during activities and return when activities cease.	In addition to the environmental consequences for all components included in REC2, this alternative includes the environmental consequences described here. There would be no effect to habitats from the implementation of projects that are being constructed in previously disturbed or high-traffic areas that do not have habitat such as: the Outdoor Stage, Playground Enhancements, Pavilion, Glamping Site, Existing Dog Park Enhancements, and Playing Field Enhancements. For the Disc Golf Improvements there could be short-term, minor, adverse impacts to habitats including hand clearing, excavation/installation of disc golf baskets, signage, and tee areas in or near to forested, herbaceous, and other habitats. **Wildlife (Including Birds):** Elevated noise levels during construction could cause short-term, minor, adverse effects to terrestrial wildlife and birds in the vicinity of the project components that are in or near habitats. The wildlife in the vicinity of the project is highly mobile and would likely avoid the area during activities and return when activities cease.
Biological Resources—Marine and Estuarine Fauna (Fish, shellfish, benthic organisms) and Federally Managed Fisheries	**Marine and Estuarine Fauna:** There would be short-term, minor, adverse impacts to fish, shellfish, and benthic organisms which would occur from increased turbidity, substrate disturbance, or siltation during construction. Mobile species including fish, shrimp, and crabs would likely move from the area during construction and would experience a short-term, minor, adverse impact related to pile driving, equipment movement, noise, and suspended sediments during the construction of the project. **Federally Managed Fisheries:** Project construction would have short-term, minor, impacts on FMP species that are managed by NMFS and GMFMC that utilize estuarine habitats primarily for nursery (e.g., growth, feeding). Installation of the boardwalk pilings and associated equipment operation would result in short-term, minor, adverse impacts that would include temporary disturbance to soft bottom and sandy substrate and estuarine marsh habitat (EFH).	There would be no effect to marine or estuarine fauna or Federally Managed Fisheries because the project alternative does not involve in-water work.	There would be no effect to marine or estuarine fauna or Federally Managed Fisheries because the project alternative does not involve in-water work.
Biological Resources—Protected Species	Protected species which could potentially occur in the project area (Gulf sturgeon, West Indian manatee, eastern black rail, alligator snapping turtle, green sea turtle, loggerhead sea turtle, and Kemp's ridley sea turtle) are highly mobile and likely to avoid the area during construction. No impacts exceeding the threshold of minor, adverse, and short-term are	Project construction activities would be limited to trail maintenance and enhancement and renovation of a building within the existing footprint and therefore only minor short-term adverse impacts to protected species which could potentially occur in the project area (gopher tortoise, eastern black rail, and Mississippi sandhill crane) are anticipated. The BE form for the project includes avoidance and minimization measures for protected species during	During project construction, impacts to protected species which could potentially occur in the project area (gopher tortoise, eastern black rail, and Mississippi sandhill crane) would not exceed the threshold of minor short-term adverse and avoidance and minimization measures for protected species would be implemented.

Project Activities/Resources	REC1 Jourdan River Boardwalk	REC2 Shepard State Park Recreational Enhancements	REC3 Shepard State Recreational Enhancements
	anticipated and potential avoidance and minimization measures have been included in the BE form.	construction.	
Socioeconomic Resources—Cultural Resources	Resources that are eligible for the HRHP would be avoided in the design of the projects, to the extent practicable. The projects would be implemented in accordance with all applicable laws and regulations concerning the protection of cultural and historic resources.	Resources that are eligible for the NRHP would be avoided in the design of the projects, to the extent practicable. The projects would be implemented in accordance with all applicable laws and regulations concerning the protection of cultural and historic resources.	Resources that are eligible for the NRHP would be avoided in the design of the projects, to the extent practicable. The projects would be implemented in accordance with all applicable laws and regulations concerning the protection of cultural and historic resources.
Socioeconomic Resources—Aesthetics and Visual Resources	There would be minor, short-term adverse effects to aesthetics and visual resources during construction of the boardwalk and elevated nature observatory. There would be long-term benefits to the aesthetic and visual character of the area. The project would be consistent in appearance with other planned recreational improvements in the Diamondhead Noma Drive Public Access Area; the project would provide visitors with a riverside vantage point/viewshed of the Jourdan River and adjacent habitats (e.g., marsh, forested habitats) from a vantage point that was not previously accessible by pedestrians which would be a long-term benefit to visitors.	There would be minor, short-term adverse effects to aesthetics and visual resources during construction of new facilities and renovation of existing facilities. There would be long-term benefits to the aesthetic and visual character of the area from the construction of new facilities and renovation of existing facilities. Restoration activities would be consistent with the current park aesthetics and/or improve visual resources in the area.	There would be minor, short-term adverse effects to aesthetics and visual resources during construction of new facilities and renovation of existing facilities. Staging of equipment and placement of materials and barriers to protect public safety would temporarily change the aesthetic and visual character of the area. During the construction period, visible impediments would detract from the existing viewshed and create visual contrast for observers. There would be long-term benefits to the aesthetic and visual character of the area from the construction of new facilities and renovation of existing facilities.

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4.5 Potential Cumulative Impacts

Section 6.6 and Appendix 6B of the Final PDARP/PEIS are incorporated by reference into the following cumulative impacts analysis, including the methodologies for assessing cumulative impacts, identification of affected resources, and the cumulative impacts scenario. To effectively consider the potential cumulative impacts, the MS TIG identified past, present, and reasonably foreseeable future actions in Hancock, Harrison, Jackson, and George counties in Mississippi in relation to the proposed alternative project areas in this RP4/EA (Section 4.6). Many of the resources analyzed would only have negligible to minor, adverse effects and/or beneficial effects. Resources with negligible to minor effects are not included in the cumulative impacts analysis to appropriately narrow the scope of the environmental analysis to the issues that would have an influence on the decision-making process or deserve attention from an environmental perspective. The resources listed below were excluded from this cumulative impact analysis because they were not carried forward for detailed analysis based on their negligible to minor, adverse effects across all alternatives:

- Physical Resources: air quality and greenhouse gas emissions, and noise
- Biological Resources: marine and estuarine fauna, federally managed fisheries, and protected species
- Socioeconomic Resources: socioeconomics and environmental justice, cultural resources, infrastructure, land and marine management, tourism and recreation, fisheries and aquaculture, marine transportation, aesthetics and visual resources, and public health and safety including flooding and shoreline protection

The following resources were analyzed in detail for environmental consequences that could result from implementation of the proposed alternatives/projects:

Physical Resources: geology and substrates- minor to moderate impacts are expected from all the Nutrient Reduction Alternatives-NR1, NR2, and NR3, and water quality, hydrology, and wetlands-minor to moderate impacts are expected from all the Nutrient Reduction Alternatives-NR1, NR2, and NR3.

Biological Resources: habitats-minor to moderate impacts are expected from the implementation of all the Nutrient Reduction Alternatives-NR1, NR2, and NR3.

4.6 Cumulative Impact Analysis

The following section describes the cumulative impacts of the MS TIG RP4/EA alternatives being considered when combined with other past, present, and reasonably foreseeable future actions. The cumulative actions that are considered in this analysis are identified in Table 4-6.

Table 4-6: Potential Planned Actions Considered in the Cumulative Impacts Analysis

Project Category	Description	Key Resources with Potential to Contribute to Cumulative Impacts
Potential Action(s) 1 (PA-1): Restoration Related to the DWH oil spill (DWH Early Restoration, MS TIG RP 1, 2, 3, RESTORE Act, NFWF GEBF)	Projects funded by DWH NRDA, RESTORE Act, National Fish and Wildlife Foundation Gulf Environmental Benefit Fund (NFWF-GEBF) to restore habitat, water quality, and living coastal and marine resources throughout coastal Mississippi and in the greater Gulf coast region. Restoration projects that have occurred under these programs can be found at: http://www.msrestoreteam.com/ProjectStoryMap/. Projects that could overlap in geography and timeframe of implementation include: Restore Bucket 3: BU Dredge Material for Marsh Creation Restore Bucket 3: Beachfront Resilience Restore Bucket 1: Broadwater Marina Restore Bucket 3: Pascagoula Oyster Relay Project (Cultch Placement) NFWF Beneficial Use Project-Greenwood Island; Wolf River NFWF Coastal Headwaters Protection (Acquisitions) NFWF Pascagoula River Corridor (Habitat Management) NFWF West Hancock Nearshore Habitat Restoration Project NFWF Point Cadet Living Shoreline	Geology and Substrates, Water Quality, Hydrology, and Wetlands, Habitats
Potential Actions 2 (PA-2): Region-wide TIG Projects: Bird Stewardship and Habitat Enhancement and Marine Debris Removal (benefitting birds and sea turtles)	Outside of the MS TIG NRDA process, various Regionwide TIG projects including bird stewardship, and debris removal projects (to benefit birds and sea turtles) would occur in areas that could overlap with RP4/EA alternatives. Regionwide projects can be accessed at: Regionwide Restoration Area | NOAA Gulf Spill Restoration. Projects include: Regionwide Plan 1-Birds Alternative 1: Reducing Marine Debris Impacts on Birds and Sea Turtles (joint project with Sea Turtles Restoration Type) Regionwide Plan 1-Birds Alternative 2: Conservation and Enhancement of Nesting and Foraging Habitat for Birds – Component 5: Round Island, MS Regionwide Plan 1-Birds Alternative 3: Bird Nesting and Foraging Area Stewardship	Geology and Substrates, Water Quality, Habitats
Potential Actions 3 (PA-3): Coastal Access, Land Development, Infrastructure, and Watershed Management Projects	Outside of the DWH restoration process, potential public access projects including boat ramps, piers and other amenities could be funded by a variety of sources including MDMR Tidelands funding, FEMA, and Gulf of Mexico Energy Security Act (GOMESA). Land development continues in the three coastal counties and includes commercial, residential, and industrial developments and improvements to infrastructure funded by public and private funding. In George County, MS, in the vicinity of the NR2 and NR 3 projects, the George County Industrial Park is a 1,200-acre Industrial Park with parcels ranging from 5 to 1,000 acres available for industrial development with access to rail and nearby ports. Also, EPA 319 Grants for watershed management projects may include stormwater management plans, riparian corridor enhancements, and other activities similar in nature to RP4/EA Nutrient Reduction alternatives.	Geology and Substrates, Water Quality Hydrology, Wetlands, Habitats

4.6.1 Physical Resources: Geology, Substrates, Hydrology, Water Quality and Wetlands

As summarized above, the range of proposed alternatives in this RP4/EA would have short-term to long-term, minor to moderate, adverse impacts on physical resources including geology and substrates, water quality, hydrology, and wetlands in Hancock, Harrison, Jackson, and George counties. However, this cumulative analysis only considers impacts that rose to the level of short-term, moderate. For NR1-Back Bay-Davis Bayou Nutrient Reduction; NR2-Big Cedar Creek-Rocky Creek Nutrient Reduction; and NR3-Big Cedar Creek-West Pascagoula River Nutrient Reduction, there could be short-term, minor to moderate, adverse impacts to physical resources (e.g., geology and substrates, water quality, hydrology, and wetlands) associated with construction of various conservation practices such as streambank and shoreline protection (580); grade stabilization structure (410); grassed waterway (412); stream crossing (578); terrace (600) or similar conservation practices incorporated by reference in this RP4/EA.

For the WCNH3-Hancock County Marsh Living Shoreline Phase 6 Breakwater, there could be long-term, minor, adverse impacts to physical resources (geology and substrates) from construction of the 1.7-mile breakwater. There would be primarily short-term, minor, adverse impacts from construction of small-scale living shorelines in up to three locations (WCNH2), sand dune restoration activities (WCNH4), and construction of recreational opportunities including boardwalk construction and Shepard State Park Improvements (REC1, REC2, and REC3). These projects would also result in long-term, beneficial impacts by reducing nutrient and sediment contribution to coastal and estuarine waterways (i.e., NR1, NR2, and NR3), and by decreasing shoreline erosion and reducing the rate of substrate losses as well as providing hard substrate for colonization of benthic organisms and fish (i.e., the WCNH2 and WCNH3), and benefits to physical resources from preservation of land (WCNH1) and from beach habitat improvements (WCNH4).

The actions in Table 4-6 have the potential to affect physical resources with varying intensity and duration. Ongoing implementation of the projects could cause short- to long-term, minor to moderate, adverse effects to physical resources. There could be short- to long-term, minor to moderate, adverse effects to geology, substrates, water quality, and wetlands from beneficial use for marsh creation, construction of the Broadwater Marina (PA-1), residential, commercial, and industrial developments such as the George County Industrial Park (PA-3). There could be short-term, minor, adverse impacts to geology and substrates from the implementation of beach resiliency measures, oyster restoration, construction of living shorelines, habitat management (PA-1), marine debris removal, bird stewardship, and habitat restoration (PA-2). There could be long-term, minor, adverse effects to geology and substrates, water quality, and wetlands from construction of public access projects (PA-3). In most cases, physical resources would recover quickly, and the limited long-term adverse impacts would be localized to very small geographic areas. There would be long-term beneficial effects to physical resources resulting from marsh creation, beachfront resilience, oyster restoration, land acquisition, construction of living shoreline(s) (PA-1), debris removal, habitat creation/enhancement (PA-2), and watershed management projects (PA-3).

When the range of proposed alternatives in this RP4/EA is analyzed in combination with other past, present, and reasonably foreseeable future actions (Potential Planned Actions; Table 4-6), short- and long-term, adverse cumulative impacts ranging from minor to moderate as well as long-term, beneficial cumulative effects to physical resources are likely to occur.

The short- and long-term, minor to moderate, adverse impact to physical resources from the Nutrient Reduction, Wetlands, Coastal, and Nearshore Habitats, and Provide and Enhance Recreational Opportunities Restoration Types proposed in this RP4/EA, when combined with reasonably foreseeable actions (Table 4-6), would not contribute substantially to adverse cumulative impacts. Impacts would occur at different times and are geographically separate.

Projects proposed in this RP4/EA would also have beneficial impacts by reducing nutrient and sediment contribution to coastal and estuarine waterways, decreasing shoreline erosion, reducing the rate of substrate losses as well as providing hard substrate for colonization of benthic organisms and fish, and also by providing benefits from preservation of land and from beach habitat improvements. Planned actions (PA-1, PA-2, and PA-3) would provide beneficial effects to physical resources resulting from marsh creation, beachfront resilience, oyster restoration, land acquisition, constructing living shoreline(s), debris removal, habitat creation/enhancement, and watershed management projects.

4.6.2 Biological Resources: Habitats

The range of proposed alternatives in this RP4/EA would have short-term, minor to moderate, adverse impacts on habitats in Harrison, Jackson, and George Counties. For Nutrient Reduction Resource Type projects NR1-Back Bay-Davis Bayou Nutrient Reduction; NR2-Big Cedar Creek-Rocky Creek Nutrient Reduction; NR3-Big Cedar Creek-West Pascagoula River Nutrient Reduction, there could be short-term, minor to moderate, adverse impacts to habitats associated with construction of various conservation practices such as streambank and shoreline protection (580) and grade stabilization structure (410) or similar conservation practices incorporated by reference in this RP4/EA. There would be primarily short-term, minor, adverse impacts to habitats from construction of living shoreline (WCNH2, WCNH3), sand dune restoration activities (WCNH4), and construction of recreational opportunities including boardwalk construction and Shepard State Park Improvements (REC1, REC2, and REC3). These projects would also result in long-term, beneficial impacts by improving riparian and wetland habitats (NR1, NR2, and NR3), decreasing shoreline erosion/marsh loss, providing hard substrate for colonization of benthic organisms and fish (WCNH2, WCNH3), preventing habitat loss through land preservation (WCNH1) and from beach habitat improvements by sand dune restoration (WCNH4).

The actions in Table 4-6 have the potential to affect habitats with varying intensity and duration. Ongoing implementation of the projects would cause short- to long-term, minor to moderate, adverse effects to biological resources. There could be short- to long-term, minor to moderate, impacts to habitat from beneficial use for marsh creation, construction of the Broadwater Marina (PA-1), and residential, commercial, and industrial developments such as the George County Industrial Park (PA-3). There could be short-term, minor, adverse impacts to benthic, beach, and palustrine habitats from the implementation of beachfront resilience measures, oyster restoration, marsh creation, habitat management, and living shoreline construction (PA-1), marine debris removal, bird stewardship, and habitat restoration (PA-2). In most cases, biological resources (habitats) would recover quickly, and the limited long-term, adverse impacts would be localized to very small geographic areas or offset by mitigation. There would be long-term, beneficial effects to habitats resulting from marsh creation, beachfront resilience, oyster restoration, land acquisition, construction of living shoreline(s) (PA-1), debris removal, habitat creation/enhancement (PA-2), and watershed management projects (PA-3).

When the range of proposed alternatives in this RP4/EA is analyzed in combination with other past, present, and reasonably foreseeable future actions (Table 4-6), short- and long-term, adverse cumulative impacts ranging from minor to moderate as well as long-term, beneficial effects to habitats are likely to occur.

The short- and long-term, minor to moderate, adverse impacts to biological resources from the Nutrient Reduction, Wetlands, Coastal, and Nearshore Habitats, and Provide and Enhance Recreational Opportunities Restoration Types proposed in this RP4/EA, when combined with reasonably foreseeable actions (Table 4-6), would not contribute substantially to adverse cumulative impacts. Impacts would occur at different times and are geographically separate.

Projects proposed in this RP4/EA would have beneficial impacts by improving riparian and wetland habitats, decreasing shoreline erosion/marsh loss, providing hard substrate for colonization of benthic organisms and fish, preventing habitat loss through land preservation, and providing beach habitat improvements by sand dune restoration. Planned actions (PA-1, PA-2, and PA-3) would provide beneficial effects to habitats resulting from marsh creation, beachfront resilience, oyster restoration, land acquisition, constructing living shoreline(s), debris removal, habitat creation/enhancement, and watershed management projects.

4.6.3 Conclusions

The Final PDARP/PEIS found that implementation of projects in the Restoration Types analyzed in this RP4/EA is consistent with the goals of the selected alternatives and is not expected to contribute substantially to short-term or long-term, adverse cumulative impacts on physical and biological resources when analyzed in combination with other past, present, and reasonably foreseeable future actions. This RP4/EA cumulative impacts analysis is consistent with that finding.

5.0 COMPLIANCE WITH ENVIRONMENTAL LAWS AND REGULATIONS

The MS TIG has completed or is nearing completion of technical assistance reviews with relevant agencies for protected species and their habitats under the ESA, the Magnuson-Stevens Fishery Conservation and Management Act, and the Marine Mammal Protection Act; as well as consistency with the Coastal Zone Management Act (CZMA) for the preferred alternatives. Compliance with the Clean Water Act (CWA), Rivers and Harbors Act (RHA), and other federal statutes would be completed prior to project implementation. Additionally, technical assistance reviews for cultural resources under the NHPA are in progress for the preferred alternatives. The current compliance status by project at the time of this Draft RP4/EA is provided below in Table 5-1. This table will be updated at the time of the Final RP4/EA to reflect current statuses. All compliance for any projects selected in the final RP4/EA would be completed prior to implementation of regulated project activities.

Wherever existing consultations or permits exist for proposed projects, they will be reviewed to determine if the consultations/permits are still valid or if re-initiation of any consultations or permits are necessary prior to implementation. Implementing Trustees are required to implement alternative-specific mitigation measures (including BMPs) identified in the RP4/EA, BE forms, and completed consultations/permits. The Implementing Trustee(s) would provide oversight, including conducting due diligence to ensure no unanticipated effects to listed species and habitats occur and that BMPs are implemented and continue to function as intended. As noted above, pursuant to the CZMA, federal activities must be consistent to the maximum extent practicable with the federally approved coastal management programs for states where the activities would affect a coastal use or resource. The Federal Trustees have submitted consistency determinations for the selection of all preferred alternatives in RP4/EA to the state CZMA agency and are awaiting concurrence.

Federal environmental compliance responsibilities and procedures follow the Trustee Council Standard Operating Procedures (SOPs) as laid out in Section 9.4.6 of that document. The Implementing Trustee(s) for each alternative would ensure that the status of environmental compliance (e.g., completed, in progress) is tracked through the Restoration Portal. The Implementing Trustee(s) would keep a record of compliance documents (e.g., ESA letters, permits) and ensure that they are submitted for inclusion in the Administrative Record. Additional information specific to each preferred alternative regarding the environmental compliance requirements and their statuses are provided in the project-specific descriptions earlier in this chapter. Status of environmental compliance by statute and project is provided in Table 5-1 below.

Table 5-1: Current status of federal regulatory compliance reviews and approvals of preferred alternatives at release of Draft RP4/EA

Preferred alternatives	Coastal Zone Management Act (CZMA)	Endangered Species Act - Section 7 (NMFS)	Endangered Species Act - Section 7 (USFWS)	Magnuson Stevens Act (EFH) (NMFS)	Marine Mammal Protection Act (MMPA) (NMFS)	Marine Mammal Protection Act (MMPA) (USFWS)	National Historic Preservation Act (NHPA)	Rivers and Harbors Act/Clean Water Act (USACE permit)	Bald and Golden Eagle Protection Act (BGEPA)	Migratory Bird Treaty Act (MBTA)	Coastal Barrier Resources Act (CBRA)
Restoration Type: Type: Wetlands, Coastal, and Nearshore Habitats (WCNH)											
WCNH1. Coastwide Habitat Acquisition	IP	N/A	N/A	N/A	N/A	N/A	C-NE	N/A	N/A	N/A	N/A
WCNH2. Living Shoreline Bulkhead Alternative	IP	C-NLAA	C-NLAA	IP	C-NE	C-NLAA	IP	IP	C-NT	C-NT	N/A
WCNH3. Hancock County Marsh Living Shoreline Phase 6 Breakwater	IP	C-EC	C-EC	C-EC	C-NE	C-EC	IP	C	C-NT	C-NT	N/A
Restoration Type: Nutrient Reduction (Nonpoint Source) (NR)											
NR1. Back Bay – Davis Bayou Nutrient Reduction	IP	N/A	C-NLAA	N/A	N/A	N/A	IP	N/A	C-NT	C-NT	C
NR2. Big Cedar Creek – Rocky Creek Nutrient Reduction	IP	N/A	C-EC	N/A	N/A	N/A	IP	N/A	C-NT	C-NT	N/A
Restoration Type: Provide and Enhance Recreational Opportunities (REC)											
REC1. Jourdan River Boardwalk	IP	IP	C-NLAA	IP	C-NE	C-NLAA	IP	IP	N/A	C-NT	N/A
REC2. Shepard State Park Recreational Enhancements-1	IP	N/A	C-NLAA	N/A	N/A	N/A	IP	N/A	C-NT	C-NT	N/A

C-Complete
C-EC: Complete, covered by existing compliance
C-NE: Complete, no effect
C-NLAA: Complete, not likely to adversely affect
C-NT: Complete, no take
IP: In progress
IP-NLAA: In progress, not likely to adversely affect
IP-LAA: In progress, likely to adversely affect
N/A: Not applicable

5.1 Additional Laws

Examples of applicable laws and executive orders include, but are not necessarily limited to, those listed below. Additional detail on many of these can be found in the PDARP/PEIS (Chapter 6; DWH Trustees 2016a). Additional federal laws may apply to the preferred alternatives considered in this RP4/EA. Legal authorities applicable to restoration alternative development were fully described in the context of the DWH restoration planning in the PDARP/PEIS, Section 6.9 Compliance with Other Applicable Authorities and Appendix 6.D Other Laws and Executive Orders. That material is incorporated by reference here.

Endangered Species Act (16 USC § 1531 *et seq.*)

Magnuson-Stevens Fishery Conservation and Management Act (16 USC § 1801 *et seq.*)

Marine Mammal Protection Act (16 USC § 1361 *et seq.*)

Coastal Zone Management Act (16 USC § 1451 *et seq.*)

National Historic Preservation Act (54 USC § 300101 *et seq.*)

Coastal Barrier Resources Act, as amended by Coastal Barrier Improvements Act (16 USC § 3501 *et seq.*)

Migratory Bird Treaty Act (16 USC § 703 *et seq.*)

Bald and Golden Eagle Protection Act (16 USC § 668 *et seq.*)

Clean Air Act (42 USC §7401 *et seq.*)

Federal Water Pollution Control Act (Clean Water Act, 33 USC § 1251 *et seq*.) and/or Rivers and

Harbors Act (33 USC § 401 *et seq*.)

Marine Protection, Research, and Sanctuaries Act (16 USC § 1431 *et seq*. and 33 USC § 1401 *et seq*.)

Estuary Protection Act (16 USC §§ 1221-1226)

Archaeological Resources Protection Act (16 USC §§ 470aa-470mm)

National Marine Sanctuaries Act (16 USC § 1431 *et seq.*)

Farmland Protection Policy Act (7 USC §§ 4201-4209)

Executive Order 11988: Floodplain Management, as amended by EO 12148 (July 20, 1979) and EO 13690 (Jan. 30, 2015).

Executive Order 11990: Protection of Wetlands, as amended by EO 12608 (Sept. 9, 1987).

Executive Order 12898: Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, as amended by EO 12948 (Jan. 30, 1995).

Executive Order 13045: Protection of Children from Environmental Health Risks and Safety Risks, as amended by EO 13296 (Apr. 18, 2003).

Executive Order 12962: Recreational Fisheries, as amended by EO 13474 (Sept. 26, 2008).

Executive Order 13112: Safeguarding the Nation from the Impacts of Invasive Species, as amended by EO 13286 (Feb. 28, 2003) and EO 13751 (Dec. 5, 2016).

Executive Order 13175: Consultation and Coordination with Indian Tribal Governments (Nov. 6, 2000).

Executive Order 13186: Responsibilities of Federal Agencies to Protect Migratory Birds (Jan. 10, 2001).

Executive Order 13985: Advancing Racial Equity and Support for Underserved Communities Through the Federal Government (Jan. 20, 2021).

Executive Order 13990: Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis (Jan. 20, 2021).

Executive Order 14008: Tackling the Climate Crisis at Home and Abroad (Jan. 27, 2021).

Executive Order 14072: Strengthening the Nation's Forests, Communities, and Local Economies (Apr. 22, 2022).

Executive Order 14096: Revitalizing Our Nation's Commitment to Environmental Justice for All (Apr. 21, 2023).

Director's Order No.: 225 Incidental Take of Migratory Birds; U.S. Department of the Interior (Oct. 5, 2021).

6.0 LITERATURE CITED

AL TIG. 2018. Final Restoration Plan II and Environmental Assessment: Restoration of Wetlands, Coastal, and Nearshore Habitat; Habitat projects on Federally Managed Lands; Nutrient Reduction (Nonpoint Source); Sea Turtles; Marine Mammals; Birds; and Oysters. Available: https://www.fws.gov/doiddata/dwh-ar-documents/1805/DWH-ARZ001374.pdf

AL TIG. 2019. Final Restoration Plan III and Environmental Assessment: Provide and Enhance Recreational Opportunities; and Birds Available: https://www.fws.gov/doiddata/dwh-ar-documents/2604/DWH-ARZ003892.pdf

California Academy of Sciences, National Geographic. 2023. iNaturalist - Hancock County, US, MS. Available: https://www.inaturalist.org/places/hancock-county-ms-us

California Academy of Sciences, National Geographic. 2023. iNaturalist – Harrison County, US, MS. Available: https://www.inaturalist.org/places/harrison-county-ms-us

California Academy of Sciences, National Geographic. 2023. iNaturalist – Jackson County, US, MS. Available: https://www.inaturalist.org/places/jackson-county-ms-us

Dewitz, J., and U.S. Geological Survey. 2021. National Land Cover Database (NLCD) 2019 Products (ver. 2.0, June 2021): U.S. Geological Survey data release, https://doi.org/10.5066/P9KZCM54

DWH Trustees. 2012. Deepwater Horizon Oil Spill Phase I Early Restoration Plan and Environmental Assessment. Available: https://www.fws.gov/doiddata/dwh-ar-documents/1000/DWH-AR0215754.pdf

DWH Trustees. 2014. Deepwater Horizon Oil Spill Programmatic and Phase III Early Restoration Plan and Early Restoration Programmatic Environmental Impact Statement. Available: https://www.fws.gov/doiddata/dwh-ar-documents/1102/DWH-AR0212189.pdf

DWH Trustees. 2015. Deepwater Horizon Oil Spill Final Phase IV Early Restoration Plan and Environmental Assessments. Available: https://www.fws.gov/doiddata/dwh-ar-documents/1126/DWH-AR0294749.pdf

DWH Trustees. 2016. Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan (PDARP) and Final Programmatic Environmental Impact Statement (PEIS). Available: https://www.fws.gov/doiddata/dwh-ar-documents/3311/DWH-ARZ005514.pdf

DWH Trustees. 2021a. Monitoring and Adaptive Management Procedures and Guidelines Manual, Version 2.0. Available: https://www.fws.gov/doiddata/dwh-ar-documents/1222/DWH-ARZ010013.pdf

DWH Trustees. 2021b. Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the Deepwater Horizon (DWH) Oil Spill. Available: https://www.fws.gov/doiddata/dwh-ar-documents/1184/DWH-ARZ009580.pdf

Federal Emergency Management Agency (FEMA). 2023. Glossary. https://www.fema.gov/about/glossary

FEMA. 2021. National Flood Hazard Layer (NFHL) Viewer. Available: https://hazards-fema.maps.arcgis.com/apps/webappviewer/index.html

Gulf of Mexico Fishery Management Council and National Oceanic and Atmospheric Administration. 2016. Final Report 5-Year Review of Essential Fish Habitat Requirements. Available: https://gulfcouncil.org/wp-content/uploads/EFH-5-Year-Revew-plus-App-A-and-B_Final_12-2016.pdf

Hayes, Sean H. (editor) et al. 2022. NOAA Technical Memorandum NMFS-NE; 288. U.S. Atlantic and Gulf of Mexico Marine Mammal Stock Assessments 2021. Available: https://doi.org/10.25923/6tt7-kc16

LA TIG. 2022. Louisiana Trustee Implementation Group Final Restoration Plan and Environmental Assessment #8: Wetlands, Coastal, and Nearshore Habitats (August 2022) Available: https://www.fws.gov/doiddata/dwh-ar-documents/4704/DWH-ARZ010858.pdf

Mississippi Coastal Improvements Program (MsCIP). 2009. Comprehensive Plan and Integrated Programmatic Environmental Impact Statement. Available: https://www.fws.gov/doiddata/dwh-ar-documents/1162/DWH-AR0111577.pdf

Mississippi Department of Archives and History (MDAH). n.d. Historic Resources Inventory Map. Retrieved March 21-23, 2023. Available: https://www.apps.mdah.ms.gov/mapping_pub/index.html?pk=home&wid=MDAH%20Search&caller=public/search.aspx&realm=archist&scope=home&aspect=public&route=in

Mississippi Department of Environmental Quality (MDEQ). 2019. Quality Management Plan QMP-004-R2 September. Available: https://www.fws.gov/doiddata/dwh-ar-documents/6510/DWH-ARZ012025.pdf

Mississippi Department of Environmental Quality (MDEQ). 2022. Mississippi 2022 List of Impaired Water Bodies. Title 11: Mississippi Depart of Environmental Quality; Part 6: Wastewater Pollution Control Regulations; Part 6, Chapter 9: Mississippi Commission on Environmental Quality, Mississippi 2022 Section 303(d) List of Impaired Water Bodies. MDEQ Surface Water Division of the Office of Pollution Control. February. Available: https://www.fws.gov/doiddata/dwh-ar-documents/6510/DWH-ARZ012024.pdf

MDEQ Office of Pollution Control, Surface Water Division, Water Quality Modeling and Total Maximum Daily Load (TMDL) Branch. 2022. MDEQ TMDL Tool (V1.31). Available: https://opcgis.deq.state.ms.us/tmdltool/

Mississippi Department of Wildlife, Fisheries, and Parks (MDWFP). 2001. Endangered Species of Mississippi. Mississippi Museum of Natural Science. Jackson Mississippi. Available: https://www.fws.gov/doiddata/dwh-ar-documents/1278/DWH-ARZ001186.pdf

Mississippi Land Conservation Assistance Network. 2022. Jourdan River Preserve. Available: https://www.mississippilandcan.org/local-resources/Jourdan-River-Preserve/25662

MS TIG 2017. Mississippi Trustee Implementation Group 2016-2017 Restoration Plan/Environmental Assessment; Restoration of Wetlands, Coastal, and Nearshore Habitats; Birds, and Nutrient Reduction. Available: https://www.fws.gov/doiddata/dwh-ar-documents/1272/DWH-ARZ000488.pdf

NMFS. 2016. Framework Biological Opinion on Deepwater Horizon Oil Spill Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement (SER-2015- 17459). Available: https://www.fws.gov/doiddata/dwh-ar-documents/4010/DWH-ARZ009644.pdf.

NMFS. 2021. Protected Species Construction Conditions, NOAA Fisheries Southeast Regional Office. Southeast Regional Office. St. Petersburg, Florida. Available: https://www.fws.gov/doiddata/dwh-ar-documents/4722/DWH-ARZ009947.pdf

NMFS. 2021. Vessel Strike Avoidance Measures, NOAA Fisheries Southeast Regional Office. St. Petersburg, Florida. Available: https://www.fws.gov/doiddata/dwh-ar-documents/4722/DWH-ARZ009939.pdf

NMFS. 2012. Measures for Reducing Entrapment Risk to Protected Species. Southeast Regional Office. St. Petersburg, Florida. Revised May 22. Available: https://www.fws.gov/doiddata/dwh-ar-documents/3110/DWH-ARZ009591.pdf

National Oceanic and Atmospheric Administration (NOAA) Fisheries. 2023. Critical Habitat: Critical Habitat Designations, Maps, and GIS Data. Available: https://www.fisheries.noaa.gov/national/endangered-species-conservation/critical-habitat#critical-habitat-designations,-maps,-and-gis-data

NOAA Fisheries. 2020. Essential Fish Habitat Mapper: Gulf of Mexico. Available: https://www.habitat.noaa.gov/apps/efhmapper

NOAA Fisheries Southeast Region. 2021. ESA Section 7 Mapper (Beta). Available: https://noaa.maps.arcgis.com/apps/webappviewer/index.html

NOAA Office of Coast Survey. 2023. Electronic Navigational Chart (ENC) Viewer. Updated March 16, 2023. Retrieved March 21, 2023. Available: https://nauticalcharts.noaa.gov/enconline/enconline.html

Priddy, R.R., et.al., 1955. Sediments of Mississippi Sound and inshore waters: https://www.fws.gov/doiddata/dwh-ar-documents/1163/DWH-AR0131573.pdf

RW TIG. 2021. Regionwide Trustee Implementation Group Final Restoration Plan/Environmental Assessment 1: Birds, Marine Mammals, Oysters and Sea Turtles. DWH-ARZ008721.pdf (fws.gov). Available: https://www.fws.gov/doiddata/dwh-ar-documents/3904/DWH-ARZ009757.pdf

Rogillio, H.E., Ruth, R.T., Behrens, E.H., Doolittle, C.N., Granger, W.J., and Kirk, J.P. 2007. Gulf sturgeon movements in the Pearl River drainage and the Mississippi Sound. North American Journal of Fisheries Management 27: 89–95. Available: https://www.fws.gov/doiddata/dwh-ar-documents/1278/DWH-ARZ001570.pdf

Ross, S. T., W. Todd Slack, Ryan J. Heise, Mark A. Dugo, Howard Rogillio, Bryant R. Bowen, Paul Mickle and Richard W. Heard. “Estuarine and coastal habitat use of Gulf sturgeon (Acipenser oxyrinchus desotoi) in the North-Central Gulf of Mexico.” Estuaries and Coasts DOI 10.1007/s12237-008-9122-z (November 7, 2008) Available: https://www.fws.gov/doiddata/dwh-ar-documents/1278/DWH-ARZ001572.pdf

Soil Survey Staff, Natural Resources Conservation Service (NRCS). United States Department of Agriculture. Web Soil Survey. Retrieved February 15, 2023. Available at http://websoilsurvey.nrcs.usda.gov/

The Nature Conservancy. Coastal Streams and Habitat Initiative; A Conservation Action Plan for Nine Mississippi Coastal Streams. (September 2016). Available: https://www.fws.gov/doiddata/dwh-ar-documents/4722/DWH-ARZ009944.pdf

United States Army Corps of Engineers Mobile District. 2023. General Permits for Minor Structures and Activities in the State of Mississippi and Outer Continental Shelf Waters off the Coast of Mississippi within the Regulatory Boundaries of the Mobile District and Within the Regulatory Boundaries of the Vicksburg District in Hancock County, U.S. Army Corps of Engineers. Available: https://www.sam.usace.army.mil/Portals/46/2023%20Mississippi%20General%20Permits.pdf

United States Environmental Protection Agency (USEPA). 2023. Current Nonattainment Counties for All Criteria Pollutants. Available: https://www3.epa.gov/airquality/greenbook/ancl.html

United States Fish and Wildlife Service (USFWS). 2023. Environmental Conservation Online System (ECOS) USFWS Threatened & Endangered Species Active Critical Habitat Report. Available: https://ecos.fws.gov/ecp/report/table/critical-habitat.html

USFWS. 2023. Information for Planning and Consultation (IPaC). Available: https://ipac.ecosphere.fws.gov/

USFWS. 2019. Federally Endangered, Threatened, and Candidate Species in Mississippi. Mississippi Field Office. March. Available: https://www.fws.gov/doiddata/dwh-ar-documents/4722/DWH-ARZ009940.pdf

USFWS. 2011. Standard Manatee Conditions for In-water Work. Available: https://www.fws.gov/doiddata/dwh-ar-documents/3810/DWH-ARZ005450.pdf

7.0 LIST OF PREPARERS AND REVIEWERS

Table 7--1 List of Preparers and Reviewers

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U.S. Department of the Interior	Katharine Bleau	Attorney-Advisor

Appendix A
Nutrient Reduction Reference Materials

Nutrient Reduction Alternative 1:
Back Bay-Davis Bayou

Nutrient Reduction Alternative 2:
Big Cedar Creek-Rocky Creek

Nutrient Reduction Alternative 3:
Big Cedar Creek-West Pascagoula River

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Nutrient Reduction Alternative 1: Back Bay-Davis Bayou

Project Area Map
List of USDA NRCS Conservation Practices
USDA NRCS Conservation Practice Standards for Added Practices
Effects of Added NRCS Conservation Practices
Conservation Practice Network Diagrams for Added Conservation Practices


Harrison County
Jackson County
Back Bay of Biloxi
D'Iberville
Davis Bayou-Biloxi Bay
Ocean Springs
Biloxi
Deer Island
Mississippi Sound
Mississippi
Alaba
Jackson
Baton Rouge
New Orleans
N
W
E
S
0
1.25
2.5
5
Miles
HUC 12 Watershed Boundary

Code	Practice
201	Edge of Field Water Quality Monitoring Data Collection
202	Edge of Field Water Quality Monitoring System Implementation
313	Waste Storage Facility
314	Brush Management (Heavy Equipment)
315	Herbaceous Weed Control
317	Composting Facility
327	Conservation Cover
328	Conservation Crop Rotation
329	Residue Management, No-Till
338	Prescribed Burning
340	Cover Crops
342	Critical Area Planting
345	Residue and Tillage Management, Reduced Till
350	Sediment Basin
356	Dike & Levee
362	Diversion
378	Pond
381	Silvopasture Establishment
382	Fence
386	Field Border
390	Riparian Herbaceous Cover
391	Riparian Forest Buffer
393	Filter Strip
394	Firebreak (New construction)
395	Stream Habitat Improvement and Management
410	Grade Stabilization Structure
412	Grassed Waterways
422	Hedgerow Planting
430	Irrigation Pipeline
441	Irrigation System, Microirrigation
442	Irrigation System, Sprinkler
443	Irrigation System, Surface and Subsurface
449	Irrigation Water Management
460	Land Clearing
464	Irrigation Land Leveling
468	Lined Waterway Or Outlet
484	Mulching
490	Tree/Shrub Site Preparation (Chemical or Burning)
490	Tree/Shrub Site Preparation (Mechanical)
511	Forage Harvest Management
512	Pasture and Hay Planting
516	Pipeline
528A	Prescribed Grazing
554	Drainage Water Management
561	Heavy Use Area Protection
570	Stormwater Runoff Control
576	Livestock Shelter Structure
578	Stream Crossing
580	Streambank and Shoreline Protection
587	Structure For Water Control
590	Nutrient Management
595	Pest Management
600	Terrace
612	Tree/Shrub Establishment (Hand Planting)
612	Tree/Shrub Establishment (Mechanical Planting)
614	Watering Facility
642	Water Well
644	Wetland Wildlife Habitat Management
658	Wetland Creation
659	Wetland Enhancement
666	Forest Stand Improvement (Chemical/Hand Tools)
666	Forest Stand Improvement (Cutting/removal with heavy equipment)

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

BRUSH MANAGEMENT

Code 314

(Ac)

DEFINITION

The management or removal of woody (nonherbaceous or succulent) plants including those that are invasive and noxious.

PURPOSE

- Create the desired plant community consistent with the ecological site or a desired state within the site description.
- Restore or release desired vegetative cover to protect soils, control erosion, reduce sediment, improve water quality, or enhance hydrology.
- Maintain, modify, or enhance fish and wildlife habitat.
- Improve forage accessibility, quality, and quantity for livestock and wildlife.
- Manage fuel loads to achieve desired conditions.
- Pervasive plant species are controlled to a desired level of treatment that will ultimately contribute to creation or maintenance of an ecological site description "steady state" addressing the need for forage, wildlife habitat, and/or water quality.

CONDITIONS WHERE PRACTICE APPLIES

On all lands except active cropland where the removal, reduction, or manipulation of woody (nonherbaceous or succulent) plants is desired.

This practice does not apply to removal of woody vegetation by prescribed fire (use Conservation Practice Standard (CPS) Prescribed Burning (Code 338)) or removal of woody vegetation to facilitate a land-use change (use CPS Land Clearing (Code 460)).

CRITERIA

General Criteria Applicable to All Purposes

Brush management will be designed to achieve the desired plant community based on species composition, structure, density, and canopy (or foliar) cover or height.

Brush management will be applied in a manner to achieve the desired control of the target woody species and protection of desired species. This will be accomplished by mechanical, chemical, burning, or biological methods, either alone or in combination. When prescribed burning is used as a method, CPS Prescribed Burning (Code 338) will also be applied.

When the intent is to manage trees for silvicultural purposes, use CPS Forest Stand Improvement (Code 666).

NRCS will not develop biological or chemical treatment recommendations except for biological control utilizing grazing animals. In such cases, CPS Prescribed Grazing (Code 528) is used to ensure desired results are achieved and maintained. NRCS may provide clients with acceptable biological and/or chemical control references.

In cases where there is insufficient understory vegetation to provide a seed source to result in the desired plant community, use CPS Range Planting (Code 550) or CPS Forage and Biomass Planting (Code 512) to ensure the desired results are achieved and maintained.

Follow-up treatments may be necessary to achieve objectives.

Additional Criteria for Creating the Desired Plant Community Consistent with the Ecological Site

Use applicable ecological site description (ESD) state and transition models to develop specifications that are ecologically sound and defensible. Treatments must be congruent with dynamics of the ecological site(s) and keyed to state and plant community phases that have the potential and capability to support the desired plant community. If an ESD is not available, base specifications on the best approximation of the desired plant community composition, structure, and function to support resilience.

Additional treatments are planned and will be applied to achieve effective control of pervasive plant species through reapplication.

Additional Criteria for Restoring or Releasing Desired Vegetative Cover to Protect Soils, Control Erosion, Reduce Sediment, Improve Water Quality or Enhance Hydrology

Choose a method of control that results in the least amount of soil disturbance if soil erosion potential is high and revegetation is slow or uncertain leaving the site vulnerable to long-term exposure to soil loss.

In conjunction with other conservation practices, the number, sequence, and timing of soil-disturbing operations must be managed to maintain soil loss within acceptable levels using approved erosion prediction technology.

Additional Criteria to Maintain, Modify or Enhance Fish and Wildlife Habitat

Brush management will be planned and applied in a manner to meet the habitat requirements for wildlife species of concern as determined by an approved habitat evaluation procedure.

Conduct treatments during periods of the year that accommodate reproduction and other life-cycle requirements of target wildlife and pollinator species, and in accordance with specifications developed for CPS Wetland Wildlife Habitat Management (Code 644) and CPS Upland Wildlife Habitat Management (Code 645).

Additional Criteria to Improve Forage Accessibility, Quality and Quantity for Livestock and Wildlife

Timing and sequence of brush management must be planned in coordination with specifications developed for CPS Prescribed Grazing (Code 528).

Additional Criteria for Control of Pervasive Plant Species to a Desired Level of Treatment That Will Ultimately Contribute to Creation or Maintenance of an Ecological Site Description “Steady State” Addressing the Need for Forage, Wildlife Habitat, and/or Water Quality.

Additional treatments are planned and will be applied to achieve effective control of pervasive plant species through reapplication.

Additional Criteria to Manage Fuel Loads to Achieve Desired Conditions
Control undesirable woody plants in a manner that creates the desired plant community, including the desired fuel load, to reduce the risk of wildfire, and facilitate the future application of prescribed fire.

CONSIDERATIONS

Consider using CPS Integrated Pest Management (Code 595) in support of brush management.

Consider the appropriate time period for treatment. Some brush management activities can be effective when applied within a single year; others may require multiple years of treatment(s) to achieve desired objectives.

Consider impacts and consequences to obligate species (species dependent on the target woody species) when significant changes are planned to existing and adjacent plant communities.

Consider impacts to wildlife food supplies, space, nesting, and cover availability when planning the method and amount of brush management.

State-issued licenses may be required when using chemical pesticide treatments.

For air quality purposes, consider using chemical methods of brush management that minimize chemical drift and excessive chemical usage, and consider mechanical methods of brush management that minimize the entrainment of particulate matter.

PLANS AND SPECIFICATIONS

Plans and specifications for the treatment option(s) selected by the decisionmaker will be recorded for each field or management unit where brush management will be applied.

Prepare brush management plans and specifications that conform to all applicable Federal, State, and local laws. These documents will contain the following data as a minimum:

1. Goals and objectives clearly stated.
2. Pretreatment cover or density of the target plant(s) and the planned post-treatment cover or density and desired efficacy.
3. Maps, drawings, and/or narratives detailing or identifying areas to be treated, pattern of treatment (if applicable), and areas that will not be disturbed.
4. A monitoring plan that identifies what should be measured (including timing and frequency) and that documents the changes in the plant community (compare with objectives) will be implemented.

Mechanical Treatment Methods
Plans and specifications will include items 1 through 4, above, plus—

- Types of equipment and any modifications necessary to enable the equipment to adequately complete the job.
- Dates of treatment to best effect control.
- Operating instructions (if applicable).
- Techniques or procedures to be followed.

Chemical Treatment Methods
Plans and specifications will include items 1 through 4, above, plus—

- Acceptable chemical treatment references for containment and management or control of target species.
- Evaluation and interpretation of herbicide risks associated with the selected treatment(s).
- Acceptable dates or plant growth stage at application to best effect control and reduce reinvasion.

- Any special mitigation, timing considerations or other factors (such as soil texture and organic matter content) that must be considered to ensure the safest, most effective application of the herbicide.
- Reference to product label instructions.

Biological Treatment Methods

Plans and specifications will include items 1 through 4, above, plus—

- Acceptable biological treatment references for containment and management or control of target species.
- Kind of grazing animal to be used, if applicable.
- Timing, frequency, duration, and intensity of grazing or browsing.
- Desired degree of grazing or browsing use for effective control of target species.
- Maximum allowable degree of use on desirable nontarget species.
- Special mitigation, precautions, or requirements associated with the selected treatment(s).

OPERATION AND MAINTENANCE

Operation

Brush management practices must be applied using approved materials and procedures. Operations will comply with all local, State, and Federal laws and ordinances.

Success of the practice shall be determined by evaluating post-treatment regrowth of target species after sufficient time has passed to monitor the situation and gather reliable data. Length of evaluation periods will depend on the woody species being monitored, proximity of propagules (seeds, branches, and roots) to the site, transport mode of seeds (wind or animals), and methods and materials used.

The operator will develop a safety plan for individuals exposed to chemicals, including telephone numbers and addresses of emergency treatment centers and the telephone number for the nearest poison control center. The National Pesticide Information Center (NPIC) telephone number in Corvallis, Oregon, may also be given for nonemergency information: **1-800-858-7384,** Monday to Friday, 6:30 a.m. to 4:30 p.m. Pacific Time. The national Chemical Transportation Emergency Center (CHEMTRAC) telephone number is **1-800-424-9300.**

- Follow label requirements for mixing/loading setbacks from wells, intermittent streams and rivers, natural or impounded ponds and lakes, and reservoirs.
- Post signs, according to label directions and/or Federal, State, Tribal, and local laws, around fields that have been treated. Follow restricted entry intervals.
- Dispose of herbicides and herbicide containers in accordance with label directions and adhere to Federal, State, Tribal, and local regulations.
- Read and follow label directions and maintain appropriate Material Safety Data Sheets (MSDS). MSDS and pesticide labels may be accessed on the Internet at: http://www.greenbook.net/.
- Calibrate application equipment according to recommendations before each seasonal use and with each major chemical and site change.
- Replace worn nozzle tips, cracked hoses, and faulty gauges on spray equipment.
- Maintain records of brush/shrub control for at least 2 years. Herbicide application records shall be in accordance with USDA Agricultural Marketing Service's Pesticide Recordkeeping Program and State-specific requirements.

Maintenance

Following initial application, some regrowth, resprouting, or reoccurrence of brush may be expected. Spot treatment of individual plants or areas needing retreatment should be completed as needed while woody vegetation is small and most vulnerable to desired treatment procedures.

Review and update the plan periodically in order to—

- Incorporate new integrated pest management technology.
- Respond to grazing management and complex plant population changes.
- Avoid the development of plant resistance to herbicide chemicals.

REFERENCES

Branson, F.A., G.F. Gifford, K.G. Renard, R.F Hadley, and E.H. Reid, ed. 1981. Rangeland Hydrology, 2nd ed., Society for Range Management, Colorado.

Heady, H.F. and D. Child, 1994. Rangeland Ecology and Management, Westview Press, Colorado.

Holechek, J.L., R.D. Pieper and C.H. Herbel. 2000. Range management principles and practices, 5th edition. Prentice Hall, New Jersey.

Krausman, P.R., ed. 1996. Rangeland Wildlife. Society for Range Management, Colorado.

Monsen, S.B., R. Stevens, and N.L. Shaw, comps. 2004. Restoring Western Ranges and Wildlands, Volume 1. Gen. Tech. Rep. RMRS-GTR-136-1, USDA, Forest Service, Fort Collins, Colorado.

United States Department of Agriculture, Natural Resources Conservation Service. 2003. National Range and Pasture Handbook. Washington, DC.

United States Department of Agriculture, Natural Resources Conservation Service. 2008. General Manual: Title 190 – Ecological Sciences: Part 404 – Pest Management. Washington, DC.

Valentine, J.R., 1989. Range Developments and Improvements, 3rd ed. Academic Press, Massachusetts.

Vavra, M., W.A. Laycock, R.D. Pieper, eds. 1994. Ecological Implications of Livestock Herbivory in the West. Society for Range Management, Colorado.

Briske, D.D. [ed]. 2011. Conservation Benefits of Rangeland Practices: Assessment, Recommendations, and Knowledge Gaps. U.S. Department of Agriculture, Natural Resources Conservation Service. 429 pages.

Effects of NRCS Conservation Practices - National

Brush Management

The management or removal of woody (non-herbaceous or succulent) plants including those that are invasive and noxious.

Code: 314
Units: ac.

C-Crop	F-Forest	R-Range	P-Pasture	Pr-Protected	FS-Farmstead	D-Developed	W-Water	O-Other	AL-Aso Land
	F	R	P	Pr				O	AL

Typical Landuse: F R P Pr O AL

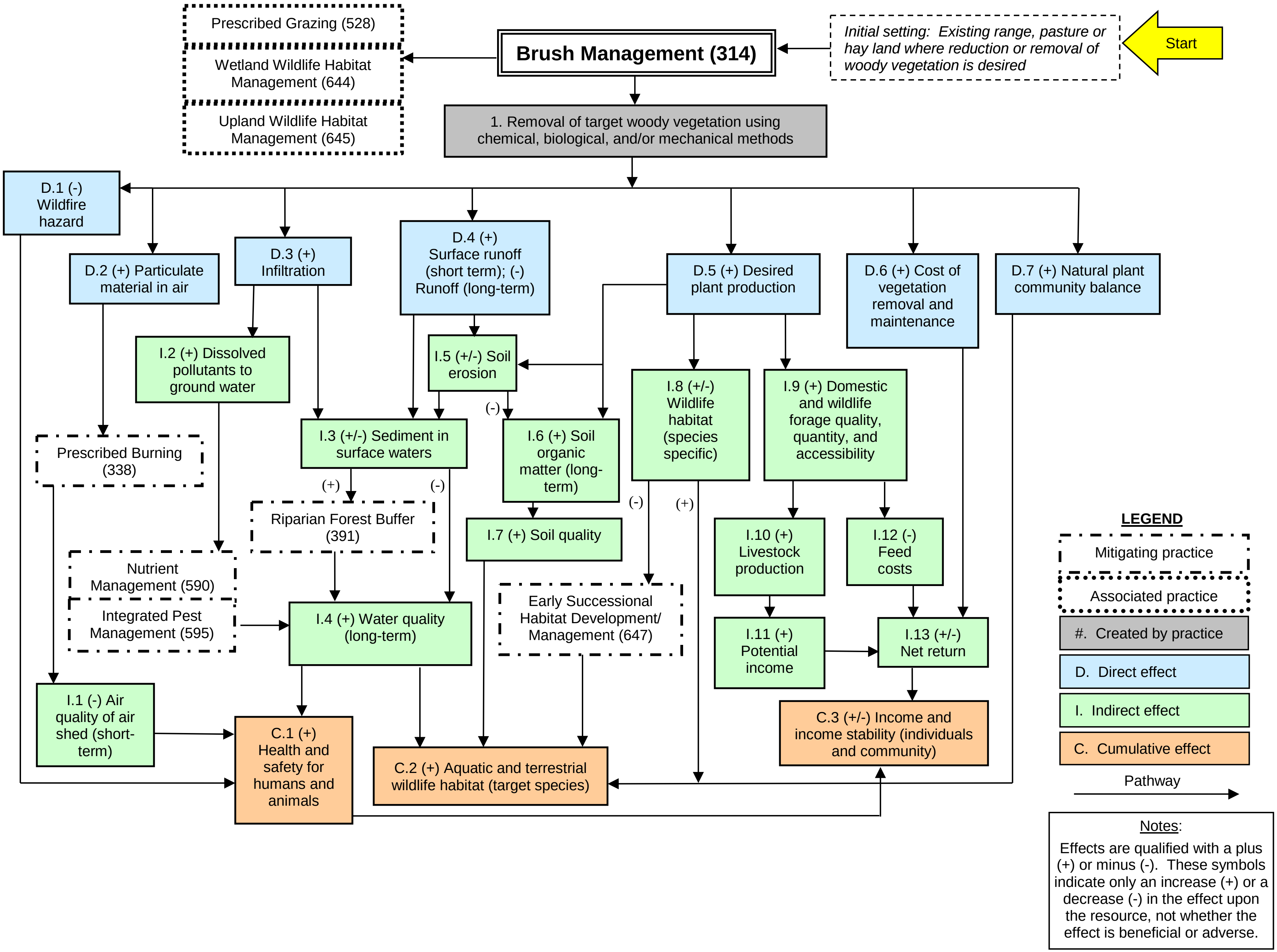
Soil Erosion	*Effect*	*Rationale*
Soil Erosion - Sheet and Rill Erosion	1	Reduction of brush canopy will increase herbaceous ground cover resulting in increased infiltration, reduced overland flow and reduced soil detachment. There may be a temporary increase in exposure of the soil surface following mechanical treatment.
Soil Erosion - Wind Erosion	1	Reduction of brush canopy will increase herbaceous ground cover resulting in increased infiltration, reduced overland flow and reduced soil detachment. There may be a temporary increase in exposure of the soil surface following mechanical treatment.
Soil Erosion - Ephemeral Gully Erosion	1	Reduction of brush canopy will increase herbaceous ground cover resulting in increased infiltration, reduced overland flow and reduced soil detachment. There may be a temporary increase in exposure of the soil surface following mechanical treatment.
Soil Erosion - Classic Gully Erosion	1	Reduction of brush canopy will increase herbaceous ground cover resulting in increased infiltration, reduced overland flow and reduced soil detachment. There may be a temporary increase in exposure of the soil surface following mechanical treatment.
Soil Erosion - Streambank, Shoreline, Water Conveyance C	0	Not applicable.
Soil Quality Degradation		
Organic Matter Depletion	0	Not applicable.
Compaction	0	Not applicable.
Subsidence	0	Not Applicable
Concentration of Salts or Other Chemicals	0	Not applicable.
Excess Water		
Excess Water - Seeps	0	Not applicable.
Excess Water - Runoff, Flooding, or Ponding	1	Runoff is reduced by increased ground cover.
Excess Water - Seasonal High Water Table	0	Not applicable.
Excess Water - Drifted Snow	0	Not Applicable
Insufficient Water		
Insufficient Water - Inefficient Use of Irrigation Water	0	Not Applicable
Insufficient Water - Inefficient Moisture Management	2	There will be increased moisture availability and plant use efficiency caused by decrease in undesirable species.
Water Quality Degradation		
Pesticides in Surface Water	-1	Pesticides may be used to control brush.
Pesticides in Groundwater	0	Not applicable.
Nutrients in Surface water	0	Not applicable.
Nutrients in Groundwater	0	Not Applicable
Salts in Surface Water	0	Not applicable.
Salts in Groundwater	0	Not applicable.
Excess Pathogens and Chemicals from Manure, Bio-solic	0	Not Applicable
Excess Pathogens and Chemicals from Manure, Bio-solic	0	Not applicable.

Excessive Sediment in Surface Water	2	The decrease is due to improved plant cover and increased infiltration, reducing overland flow and runoff.
Elevated Water Temperature	0	Not applicable.
Petroleum, Heavy Metals and Other Pollutants Transporte	0	Not applicable.
Petroleum, Heavy Metals and Other Pollutants Transporte	0	Not applicable.
Air Quality Impacts		
Emissions of Particulate Matter (PM) and PM Precursors	0	Removal of vegetation by mechanical means or burning can increase short-term PM emissions. However, there should be no long-term effect from brush management.
Emissions of Ozone Precursors	0	Removal of vegetation by chemical means or burning can increase short-term VOC and/or NOx emissions. However, there should be no long-term effect from brush management.
Emissions of Greenhouse Gases (GHGs)	1	Removal of vegetation by burning can increase short-term CO2 emissions. However, there should be a positive long-term carbon sequestration effect from brush management.
Objectionable Odors	0	Not Applicable
Degraded Plant Condition		
Undesirable Plant Productivity and Health	2	The removal of competition increases desirable plant community health, vigor, and biodiversity.
Inadequate Structure and Composition	4	Undesirable brush species will be managed by physical, chemical, or biological means to make it suitable for the desired plant community.
Excessive Plant Pest Pressure	4	There will be a removal of competition to increase desirable plant community health, vigor, and biodiversity.
Wildfire Hazard, Excessive Biomass Accumulation	4	Management reduces fuel loadings.
Fish and Wildlife - Inadequate Habitat		
Inadequate Habitat - Food	2	There will be an improvement in composition, structure, amount, and availability of plants for food.
Inadequate Habitat - Cover/Shelter	2	The degree will depend on the amount of brush removed and the enhancement of stand composition and structure.
Inadequate Habitat - Water	1	Not Applicable
Inadequate Habitat - Habitat Continuity (Space)	1	Removal or control of brush is planned to provide habitat continuity.
Livestock Production Limitation		
Inadequate Feed and Forage	4	The reduction of undesirable brush species increases production of forage that meets nutritional and productive needs for livestock.
Inadequate Shelter	0	Not applicable.
Inadequate Water	0	Not Applicable
Inefficient Energy Use		
Equipment and Facilities	0	Not Applicable
Farming/Ranching Practices and Field Operations	0	Not Applicable

CPPE Practice Effects:	*0 No Effect*
5 Substantial Improvement	*-1 Slight Worsening*
4 Moderate to Substantial Improvement	*-2 Slight to Moderate Worsening*
3 Moderate Improvement	*-3 Moderate Worsening*
2 Slight to Moderate Improvement	*-4 Moderate to Substantial Worsening*
1 Slight Improvement	*-5 Substantial Worsening*

NRCS CONSERVATION PRACTICE EFFECTS - NETWORK DIAGRAM

August 2017



Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

HERBACEOUS WEED TREATMENT

CODE 315

(ac)

DEFINITION

The removal or control of herbaceous weeds including invasive, noxious, prohibited, or undesirable plants.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Enhance accessibility, quantity, and/or quality of forage and/or browse
- Restore or release native or desired plant communities for wildlife habitat
- Protect soils and control erosion
- Reduce fine fuel loads and wildfire hazard
- Control pervasive plant species to a desired level of treatment

CONDITIONS WHERE PRACTICE APPLIES

This practice applies on all lands except active cropland where removal, reduction, or manipulation of herbaceous vegetation is desired.

This practice does not apply to removal of herbaceous vegetation for a land use change or by prescribed fire. Refer to NRCS Conservation Practice Standards (CPSs) Land Clearing (Code 460) or Prescribed Burning (Code 338), repectively.

CRITERIA

General Criteria Applicable to All Purposes

Apply herbaceous weed treatment to achieve the desired control of the target species and protection or enhancement of desired species. Desired species contribute positively to land use objectives and site potential. Use mechanical, chemical, or biological methods either alone or in combination.

Control pervasive and undesirable herbaceous vegetation to the desired level of treatment that contributes to the desired state of an ecological site.

NRCS will not develop insect biological control recommendations or chemical treatment recommendations.

NRCS can provide clients with acceptable biological and/or chemical control references to achieve desired management objectives.

NRCS can provide recommendations for biological control to manage herbaceous weeds utilizing grazing animals. Use NRCS CPS Prescribed Grazing (Code 528) to ensure desired results are achieved and maintained.

Nonchemical weed management techniques such as mowing, manually removing, or spot-flaming infestations can be effective.

When using herbicides, follow all environmental hazards and site-specific application criteria listed on herbicide labels and contained in extension service and other approved pest management references. Access the most recent herbicide labels at the Greenbook Web site (http://www.greenbook.net).

Include post-treatment measures to achieve resource management objectives.

Control livestock and human access based on management methods applied and restrictions listed on the herbicide labels.

Manage and/or dispose of treated weed species that prevents the spread of herbaceous weeds to new sites.

When the herbaceous weed treatment of undesirable species results in the need to reestablish desired herbaceous species, follow details in the appropriate vegetation establishment practices such as NRCS CPSs Pasture and Hay Planting (Code 512), Cover Crop (Code 340), Conservation Cover (Code 327), Range Planting (Code 550), Critical Area Planting (Code 342), Tree /Shrub Establishment (Code 612), or Wildlife Habitat Planting (Code 420).

Incorporate weed prevention strategies that include—

- Minimizing soil disturbance.
- Minimizing movement of equipment through weed infested areas.
- Inspecting and cleaning equipment to prevent spread of undesired vegetation.

Apply treatments during periods of the year when weed species are most vulnerable and when restoration of the native or desired plant communities have the best chance of recovery.

Adjacent land uses must be considered before chemicals are used. Also consider the residual effects of chemical use. Follow label and State guidelines on setbacks and other precautions from sensitive areas and surface water bodies or karst topography.

Additional Criteria to Enhance Accessibility, Quantity, and Quality of Forage and/or Browse

Apply herbaceous weed treatments that minimize negative impacts to forages and/or other nontargeted plants. Plan timing and sequence of treatment in coordination with specifications developed for NRCS CPS Prescribed Grazing (Code 528) or Forage Harvest Management (Code 511).

Additional Criteria to Restore or Release Native or Desired Plant Communities for Wildlife Habitat

Apply herbaceous weed treatments that protect the health and vigor of native or desired plant species to preserve and enhance habitat for pollinator insects and wildlife. Time treatments to periods of the year that accommodate reproduction and other life cycle requirements of target wildlife and pollinator species. Select treatments that maintain or enhance plant community composition and structure to meet the requirements of target wildlife and pollinator species.

Use applicable ecological site description (ESD) state and transition models, or other suitable information, to develop specifications that are ecologically sound and defensible. Treatments must be congruent with dynamics of the ecological site(s) and keyed to states and plant community phases that have the potential and capability to support the desired plant community. If an ESD is not available, base specifications on the best approximation of the desired plant community composition, structure, and function.

Use native vegetation to preserve and enhance pollinator insects as well as wildlife.

Additional Criteria to Protect Soils and Control Erosion

Herbaceous weed species shade out desired plants exposing more soil for potential erosion. Use caution when applying herbaceous weed treatments to minimize soil disturbance and soil erosion.

Apply additional treatments to protect soils and prevent erosion.

Additional Criteria to Reduce Fine Fuel Loads and Wildfire Hazard

Treat weed species to create a native or desired plant community that reduces the potential for accumulating excessive fuel loads and wildfire hazards.

Apply treatment methods that minimize the potential for unintended impacts to air resources (e.g., dust, chemical drift, etc.) that could also damage or kill plants, thereby contributing to wildfire hazard.

Additional Criteria to Control Pervasive Plant Species to a Desired Level of Treatment

When specific pervasive plant species cannot be controlled with one treatment, plan and apply additional treatments to achieve effective control through reapplication which may be more than once per growing season or multiple years.

CONSIDERATIONS

Consider using NRCS CPS Pest Management Conservation System (Code 595) in support of herbaceous weed treatment.

Consider soil erosion potential and difficulty of vegetation establishment when choosing a method of control that causes soil disturbance.

Consider the appropriate time period for treatment. Some herbaceous weed treatment activities can be effective when applied within a single year; others may require multiple years of treatments to achieve desired objectives.

Consider impacts to wildlife species. In general, weed treatments that create a mosaic pattern may be the most desirable. Leaving native grasses, forbs, and woody vegetation encourages a higher variety of wildlife and pollinators. When using selective herbicides, leaving other desired plant species also benefits wildlife and pollinators.

Consider impacts to wildlife food supplies, space, and cover availability when planning the method and amount of herbaceous weed treatment.

State-issued licenses may be required when using chemical pesticide treatments.

For air quality purposes, consider using chemical methods of herbaceous weed treatment that minimize chemical drift and excessive chemical usage. Consider mechanical methods of herbaceous weed treatment that minimize the entrainment of particulate matter.

Design and execute a plan using adaptive management to apply knowledge gained from earlier treatment applications.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for each field or treatment unit according to the criteria included in this standard. At a minimum, the herbaceous weed treatment management practice plan shall include—

- Goals and objectives statement.
- Plan map and soil map for the site.
- Pretreatment cover or density of the target plants and the planned post-treatment cover or density.
- Maps, drawings, and/or narratives detailing or identifying areas to be treated, pattern of treatment (if

applicable), and areas that will not be disturbed.

- A monitoring plan that identifies what shall be measured (including timing and frequency) and the changes in the plant community (compare with objectives) that occur.
- Apropriate revegetation conservation practice standard(s) needed following treatment (if applicable).
- For mechanical treatment methods, the first five bulleted items above, plus—
    - Type of equipment to use for management.
    - Dates of treatment for effective management.
    - Operating instructions (if applicable).
    - Techniques and procedures to be followed.
- For chemical treatment methods, the first five bulleted items above, plus—
    - Acceptable chemical treatment references for containment and management of target species.
    - Documented techniques to be used, planned dates, and rates of application.
    - Evaluation and interpretation narrative of herbicide risks associated with the selected treatment(s) using Windows Pesticide Screening Tool (WIN-PST) or other approved tools.
    - Consideration of any special mitigation, timing, or other factors (such as soil texture, distance to water, and organic matter content) to ensure the safest, most effective application of the herbicide.
    - Reference product label instructions.
- For biological treatments methods, the first five bulleted items above, plus—
    - Acceptable biological treatment references for the selected biological control livestock used to contain and manage the target species.
    - Documentation of release date, kind, and number of livestock.
    - Timing, frequency, duration, and intensity of grazing or browsing.
    - Desired degree of grazing or browsing use for effective management of target species.
    - Maximum allowable degree of use on desirable nontarget species.
    - Special mitigation, precautions, or requirements associated with the selected treatment(s).

OPERATION AND MAINTENANCE

Operation

Herbaceous weed treatment methods shall be applied using approved materials and procedures. Operations will comply with all local, State, Tribal, and Federal laws and ordinances. The landowner is responsible for obtaining any permits prior to practice implementation. Observe State and Federal restricted-use pesticides and certified pesticide applicator's license requirements.

Develop a safety plan for individuals exposed to chemicals, including telephone numbers and addresses of emergency treatment centers and the telephone number for the nearest poison control center.

The National Pesticide Information Center (NPIC) telephone number in Corvallis, OR, may also be given for nonemergency information: 1-800-858-7384, Monday to Friday, 6:30 a.m. to 4:30 p.m., Pacific Time. The national Chemical Transportation Emergency Center (CHEMTRAC) telephone number is: 1-800-424-9300.

- Follow label requirements for mixing/loading setbacks from wells, intermittent streams and rivers, natural or impounded ponds and lakes, and reservoirs.
- Post signs according to label directions and/or Federal, State, Tribal, and local laws, around fields

that have been treated. Follow restricted entry intervals.

- Dispose of herbicide and herbicide containers in accordance with label directions and adhere to Federal, State, Tribal, and local regulations.
- Read and follow label directions and maintain appropriate safety data sheets. Safety data sheets and herbicide labels can be accessed at the Greenbook Web site (http://www.greenbook.net).
- Calibrate application equipment according to recommendations before each seasonal use and with each major chemical and site change.
- Replace worn nozzle tips, cracked hoses, and faulty gauges on spray equipment.
- Maintain records of plant management for at least 2 years. Herbicide application records shall be in accordance with USDA Agricultural Marketing Service's Pesticide Recordkeeping Program and State-specific requirements.

Maintenance

Success of the practice shall be determined by evaluating regrowth or reoccurrence of target and desired species after sufficient time has passed to monitor the vegetation and gather reliable data. Length of evaluation periods depend on the herbaceous weed species being monitored, proximity of propagules (seeds, plant materials, and roots) to the site, transport mode of seeds (wind or animals), and methods and materials used.

Following initial application, regrowth, resprouting, or reoccurrence of herbaceous weeds can be expected. Complete spot treatments of individual plants or areas needing retreatment when weed vegetation is most vulnerable to desired treatment procedures.

Review and update the herbaceous weed treatment plan periodically to—

- Incorporate new integrated pest management technology,
- Respond to grazing management and complex weed population changes, and
- Follow cooperative extension service guidance to avoid the development of weed resistance to herbicide chemicals.

REFERENCES

Bamka, W., B. Barbour, L. Gladney, and C. Williams. 2013. Poisonous Weeds in Horse Pastures. Cooperative Extension Fact Sheet FS938. Rutgers University, New Brunswick, NJ. https://njaes.rutgers.edu/fs938/

Coombs, E., J. Clark, G. Piper, and A. Cofrancesco, Jr. (Eds). 2004. Biological Control of Invasive Plants in the United States. Oregon State University Press, Corvallis, OR.

Cornell University. 2019. "Plants Poisonous to Livestock and Other Animals." Department of Animal Science, Ithaca, NY. Accessed September 8, 2020. http://www.ansci.cornell.edu/plants/

Evers, R.A. and R.P. Link. 1972. Poisonous Plants of the Midwest and their Effects on Livestock. Special Publication 24. University of Illinois, College of Agriculture, Urbana, IL.

Lingenfelter, D. and W.S. Curran. 2001. Weed Management in Pasture Systems. Penn State Extension, State College, PA. https://extension.psu.edu/weed-management-in-pasture-systems

Oliver, L.B., J.P. Stovall, C.E. Comer, H.M. Williams, and M.E. Symmank. 2019. Weed Control and Overstory Reduction Improve Survival and Growth of Under-planted Oak and Hickory Seedlings. Restoration Ecology Vol. 27, Issue 1. DOI: 10.1111/rec.12826

Peachey, E., A. Hulting, T. Miller, D. Lyon, D. Morishita, and P. Hutchinson. 2020. Pacific Northwest Weed Management Handbook. Oregon State University, Corvallis. OR.

Peischel, A. and D.D. Henry, Jr. 2006. Targeted Grazing: a Natural Approach to Vegetation Management and Landscape Enhancement. American Sheep Industry Association. Englewood, CO.

Radosevich, S.R., J.S. Holt, and C.M. Ghersa. 2007. Ecology of Weeds and Invasive Plants – Relationship to Agriculture and Natural Resource Management, Third Edition. John Wiley & Sons, Inc.

Sheley, R., J. James, B. Smith, and E. Vasquez. 2010. Applying Ecologically Based Invasive-Plant Management. Rangeland Ecology & Management 63(6): 605-613. DOI: 10.2307/40961070

USDA Agricultural Research Service. 2011. Plants Poisonous to Livestock in the Western States. Agriculture Information Bulletin Number 415. Poisonous Plant Research Laboratory, Logan, UT.https://www.ars.usda.gov/is/np/poisonousplants/poisonousplants.pdf

Whitson, T.D., L.C. Burrill, S.A. Dewey, D.W. Cudney, B.E. Nelson, R.D. Lee, and R. Parker. 2012. Weeds of the West, 11th Edition. Western Society of Weed Science in cooperation with the Western United States Land Grant Universities Cooperative Extension Services and the University of Wyoming.

Effects of NRCS Conservation Practices - National

Herbaceous Weed Control

The removal or control of herbaceous weeds including invasive, noxious and prohibited plants.

Code: 315
Units: ac

C-Crop	F-Forest	R-Range	P-Pasture	Pr-Protected	FS-Farmstead	D-Developed	W-Water	O-Other	AL-Aso Land
	F	R	P	Pr	FS	D		O	AL

Typical Landuse: F R P Pr FS D O AL

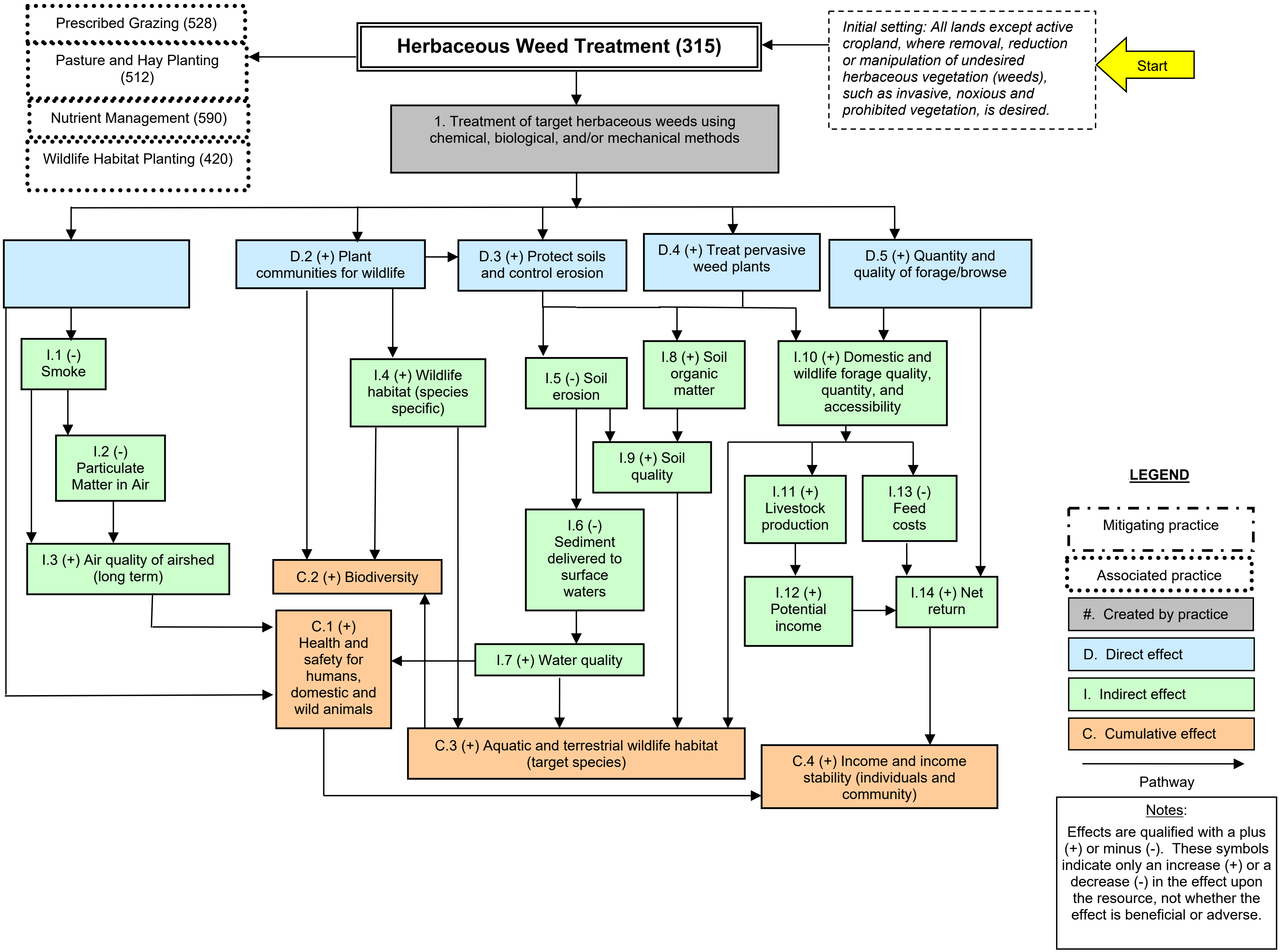
Soil Erosion	Effect	Rationale
Soil Erosion - Sheet and Rill Erosion	4	Increase health and vigor of desirable plant species increases ground cover decreasing sheet and rill erosion.
Soil Erosion - Wind Erosion	4	Increase health and vigor of desirable plant species increases ground cover decreasing wind erosion.
Soil Erosion - Ephemeral Gully Erosion	2	Increase health and vigor of desirable plant species increases ground cover decreasing erosion potential.
Soil Erosion - Classic Gully Erosion	2	Increase health and vigor of desirable plant species increases ground cover decreasing erosion potential.
Soil Erosion - Streambank, Shoreline, Water Conveyance C	4	Increase health and vigor of desirable plant species increases ground cover decreasing erosion potential.
Soil Quality Degradation		
Organic Matter Depletion	0	Not applicable.
Compaction	0	Not applicable.
Subsidence	0	Not Applicable
Concentration of Salts or Other Chemicals	0	Not applicable.
Excess Water		
Excess Water - Seeps	0	Not applicable.
Excess Water - Runoff, Flooding, or Ponding	0	Not applicable.
Excess Water - Seasonal High Water Table	0	Not applicable.
Excess Water - Drifted Snow	0	Not Applicable
Insufficient Water		
Insufficient Water - Inefficient Use of Irrigation Water	2	Based on management objective
Insufficient Water - Inefficient Moisture Management	0	Not applicable.
Water Quality Degradation		
Pesticides in Surface Water	-1	Pesticides may be used to control vegetation.
Pesticides in Groundwater	0	Not applicable.
Nutrients in Surface water	0	There may be a slight improvement due to plant community ground cover reducing overland flow.
Nutrients in Groundwater	0	Not Applicable
Salts in Surface Water	0	Not applicable.
Salts in Groundwater	0	Not applicable.
Excess Pathogens and Chemicals from Manure, Bio-solic	0	Not Applicable
Excess Pathogens and Chemicals from Manure, Bio-solic	0	Not applicable.

Excessive Sediment in Surface Water	0	There may be a slight improvement due to plant community ground cover reducing overland flow.
Elevated Water Temperature	0	Functional group change may create effect.
Petroleum, Heavy Metals and Other Pollutants Transporte	0	Not applicable.
Petroleum, Heavy Metals and Other Pollutants Transporte	0	Not applicable.
Air Quality Impacts		
Emissions of Particulate Matter (PM) and PM Precursors	0	Removal of vegetation by mechanical means or burning can increase short-term PM emissions. However, there should be no long-term effect from herbaceous weed control.
Emissions of Ozone Precursors	0	Removal of vegetation by chemical means or burning can increase short-term VOC and/or NOx emissions. However, there should be no long-term effect from herbaceous weed control.
Emissions of Greenhouse Gases (GHGs)	1	Removal of vegetation by burning can increase short-term CO2 emissions. However, there should be a positive long-term carbon sequestration effect from herbaceous weed control.
Objectionable Odors	0	Not Applicable
Degraded Plant Condition		
Undesirable Plant Productivity and Health	2	The removal of competition increases desirable plant community health, vigor, and biodiversity.
Inadequate Structure and Composition	4	Undesirable species will be removed by physical, chemical, or biological means to make it suitable for the desired plant community.
Excessive Plant Pest Pressure	4	There will be a removal of competition to increase desirable plant community health, vigor, and biodiversity.
Wildfire Hazard, Excessive Biomass Accumulation	1	Management may reduces fuel loadings.
Fish and Wildlife - Inadequate Habitat		
Inadequate Habitat - Food	2	There may be an improvement in composition, structure, amount, and availability of plants for food.
Inadequate Habitat - Cover/Shelter	2	The degree will depend on the species removed and the enhancement of stand composition and structure. There may be a slight to significant initial short-term loss of cover.
Inadequate Habitat - Water	4	Not Applicable
Inadequate Habitat - Habitat Continuity (Space)	1	Dependent on management goals for habitat characteristic.
Livestock Production Limitation		
Inadequate Feed and Forage	4	The reduction of undesirable species increases production of forage that meets nutritional and productive needs for livestock.
Inadequate Shelter	0	Not Applicable
Inadequate Water	0	Not Applicable
Inefficient Energy Use		
Equipment and Facilities	0	Not Applicable
Farming/Ranching Practices and Field Operations	0	Not Applicable

CPPE Practice Effects:	*0 No Effect*
5 Substantial Improvement	*-1 Slight Worsening*
4 Moderate to Substantial Improvement	*-2 Slight to Moderate Worsening*
3 Moderate Improvement	*-3 Moderate Worsening*
2 Slight to Moderate Improvement	*-4 Moderate to Substantial Worsening*
1 Slight Improvement	*-5 Substantial Worsening*

NRCS CONSERVATION PRACTICE EFFECTS - NETWORK DIAGRAM

October 2020



Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

Critical Area Planting

Code 342

(Ac)

DEFINITION

Establishing permanent vegetation on sites that have, or are expected to have, high erosion rates, and on sites that have physical, chemical, or biological conditions that prevent the establishment of vegetation with normal seeding/planting methods.

PURPOSE

- Stabilize areas with existing or expected high rates of soil erosion by wind or water.
- Stabilize stream and channel banks, pond and other shorelines, earthen features of structural conservation practices.
- Stabilize areas such as sand dunes and riparian areas.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to highly disturbed areas such as—

- Active or abandoned mined lands.
- Urban restoration sites.
- Construction areas.
- Conservation practice construction sites.
- Areas needing stabilization before or after natural disasters such as floods, hurricanes, tornados, and wildfires.
- Eroded banks of natural channels, banks of newly constructed channels, and lake shorelines.
- Other areas degraded by human activities or natural events.

CRITERIA

General Criteria Applicable to All Purposes

Site preparation. Conduct a site investigation to identify any physical, chemical, or biological conditions that could affect the successful establishment of vegetation.

Clear areas to be planted of unwanted materials and smooth or shape, if needed, to meet planting purpose(s).

Prepare a suitable seedbed for all seeded species. Rip compacted layers and re-firm the soil prior to seedbed preparation, as needed.

As site conditions dictate, when grading slopes, stockpile topsoil to be redistributed over area to be planted.

Species selection. Select species for seeding or planting that are suited to local site conditions and intended uses, and common to the site or location.

Selected species will have the capacity to achieve adequate density and vigor to stabilize the site within an appropriate period.

Establishment of vegetation. Plant seeds using the method or methods best suited to site and soil conditions.

Limit sod placement to areas that can naturally supply needed moisture or sites that can be irrigated during the establishment period. Place and anchor sod using techniques to ensure that it remains in place until established.

Specify species, rates of seeding or planting, legume inoculation, minimum quality of planting stock (e.g., pure live seed (PLS) or stem caliper), method of seedbed preparation, and method of establishment before application. Use only viable, high-quality seed or planting stock.

Seed or plant at a time and in a manner that best ensures establishment and growth of the selected species.

Plant during approved times for the species to be used.

Apply soil amendments (e.g., lime, fertilizer, compost) according to the requirements in the local Field Office Technical Guide.

Mulch or otherwise stabilize (e.g., polyacrylamide (PAM)) plantings as necessary to ensure successful establishment.

Additional Criteria to Stabilize Stream and Channel Banks, Pond and Other Shorelines, Earthen Features of Structural Conservation Practices

Bank and channel slopes. Shape channel side slopes so that they are stable and allow establishment and maintenance of desired vegetation.

A combination of vegetative and structural measures may be necessary on slopes steeper than 3:1 to ensure adequate stability.

Species selection. Plant material used for this purpose must—

- Be adapted to the hydrologic zone into which they will be planted.
- Be adapted and proven in the regions in which they will be used.
- Be compatible with existing vegetation in the area.
- Protect the channel banks but not restrict channel capacity.

Establishment of vegetation. Specify species, planting rates, spacing, methods and dates of planting based on local planting guides or technical notes.

Identify and protect desirable existing vegetation during practice installation.

Use a combination of vegetative and structural practices with living and inert material when flow velocities, soils, and bank stability preclude stabilization by vegetative establishment alone. Use Conservation Practice Standard (CPS) Streambank Stabilization (Code 580) for the structural measures.

Control existing vegetation on a site that will compete with species to be established vegetatively (e.g.. bare-root, containerized, ball-and-burlap, potted) to ensure successful establishment of the planted species.

Plant streambank stabilization vegetation in accordance with the NRCS Engineering Field Handbook Part 650, Chapter 16, “Streambank and Shoreline Protection,” and Chapter 18, “Soil Bioengineering for Upland Slope Protection & Erosion Reduction.”

Site protection and access control. Restrict access to planted areas until fully established.

Additional Criteria to Stabilize Areas Such As Sand Dunes and Riparian Areas

Plants for sand dunes and coastal sites must be able to survive being buried by blowing sand, sand blasting, salt spray, salt water flooding, drought, heat, and low nutrient supply.

Include sand trapping devices such as sand fences or brush matting in the revegetation/stabilization plans where applicable.

CONSIDERATIONS

Species or diverse mixes that are adapted to the site and have multiple benefits should be considered. Native species may be used when appropriate for the site.

To benefit pollinators and other wildlife, flowering shrubs and wildflowers with resilient root systems and good soil-holding capacity also should be considered for incorporation as a small percentage of a larger grass-dominated planting. Where appropriate consider a diverse mixture of forbs to support pollinator habitat.

Planning and installation of other CPSs such as Diversion (Code 362), Obstruction Removal (Code 500), Subsurface Drain (Code 606), Underground Outlet (Code 620), or Anionic Polyacrylamide Application (Code 450) may be necessary to prepare the area or ensure vegetative establishment.

Areas of vegetation established with this practice can create habitat for various type of wildlife. Maintenance activities, such as mowing or spraying, can have detrimental effects on certain species. Perform management activities at the times and in a manner that causes the least disruption to wildlife.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for each field or management unit according to the criteria and operation and maintenance sections of this standard. Record practice specifications using approved Implementation Requirements document.

Address the following elements in the plan, as applicable, to meet the intended purpose(s):

- Practice purpose(s)
- Site preparation
- Topsoil requirements
- Fertilizer application
- Seedbed/planting area preparation
- Timing and method of seeding/planting
- Selection of species
- Seed/plant source
- Seed analysis/pure live seed (PLS)
- Seeding rate/plant spacing
- Mulching, PAM, or other stabilizing materials
- Supplemental water needed for establishment
- Protection of plantings
- Describe successful establishment (e.g., minimum percent ground/canopy cover, percent survival, stand density)

OPERATION AND MAINTENANCE

- Control access to the area to ensure the site remains stable.
- Protect plantings shall be protected from pests (e.g., weeds, insects, diseases, livestock, or wildlife) as necessary to ensure long-term survival.
- Inspections, reseeding or replanting, and fertilization may be needed to ensure that this practice functions as intended throughout its expected life.
- Observe establishment progress and success at regular intervals until the practice has met the criteria for successful establishment and implementation.
- Description of successful establishment (e.g., minimum percent ground/canopy cover, percent survival, stand density).

REFERENCES

Federal Interagency Stream Restoration Working Group. 1998. Stream corridor restoration: principles, processes, and practices. USDA NRCS National Engineering Handbook, Part 653.

USDA NRCS. 2007. National Engineering Handbook, Part 654. Stream restoration guide.

USDA NRCS. 2015. The PLANTS Database (http://plants.usda.gov, 8 December 2015). National Plant Data Team, Greensboro, NC.

Effects of NRCS Conservation Practices - National

Critical Area Planting

Establishing permanent vegetation on sites that have, or are expected to have, high erosion rates, and on sites that have physical, chemical or biological conditions that prevent the establishment of vegetation with normal practices.

Code: 342
Units: ac.

C-Crop, F-Forest, R-Range, P-Pasture, Pr-Protected, FS-Farmstead, D-Developed, W-Water, O-Other, AL-Aso Land

Typical Landuse: C F R P Pr FS D O AL

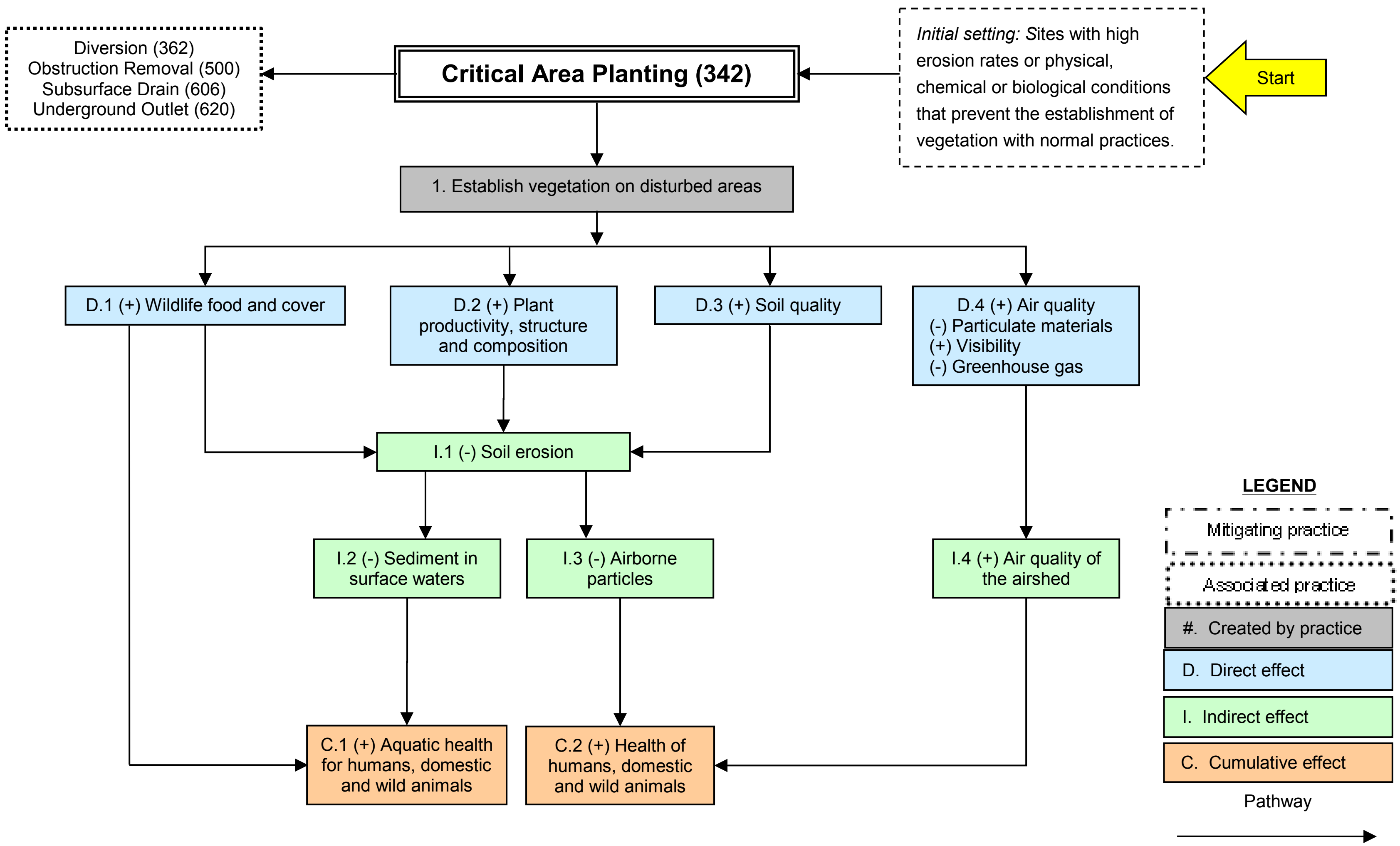
Soil Erosion	Effect	Rationale
Soil Erosion - Sheet and Rill Erosion	5	Increased vegetation and cover, and stabilization of erosive conditions will improve infiltration and decrease soil detachment by water.
Soil Erosion - Wind Erosion	5	An increase in vegetation and cover will protect the soil surface and decrease soil detachment by wind.
Soil Erosion - Ephemeral Gully Erosion	5	An increase in vegetation and cover will improve infiltration, protect the soil surface and decrease soil detachment by concentrated flow.
Soil Erosion - Classic Gully Erosion	4	Increased vegetation and cover will decrease erosion and runoff.
Soil Erosion - Streambank, Shoreline, Water Conveyance C	4	Increased vegetation and cover will decrease erosion and runoff.
Soil Quality Degradation		
Organic Matter Depletion	5	Increased cover and growing vegetation will increase soil organic matter.
Compaction	2	Increased root growth will decrease compaction.
Subsidence	0	If it affects drainage the practice can have an impact on subsidence.
Concentration of Salts or Other Chemicals	1	Increased vegetation will increase salt uptake and increased organic matter may tie up salts and other chemicals.
Excess Water		
Excess Water - Seeps	0	Growing plants will take up excess water but planting area is so small there is a neutral effect.
Excess Water - Runoff, Flooding, or Ponding	0	Growing plants will take up excess water but planting area is so small there is a neutral effect.
Excess Water - Seasonal High Water Table	0	Growing plants will take up excess water but planting area is so small there is a neutral effect.
Excess Water - Drifted Snow	0	Not Applicable
Insufficient Water		
Insufficient Water - Inefficient Use of Irrigation Water	0	Not Applicable
Insufficient Water - Inefficient Moisture Management	0	Not Applicable
Water Quality Degradation		
Pesticides in Surface Water	0	Not Applicable
Pesticides in Groundwater	0	Not Applicable
Nutrients in Surface water	2	The action reduces erosion and sediment-attached nutrient delivery to surface water. Permanent vegetation will uptake nutrients.
Nutrients in Groundwater	1	Permanent vegetation will uptake excess nutrients.
Salts in Surface Water	0	Less runoff reduces transport of soluble salts. Growing vegetation can use excess water which reduces seepage.
Salts in Groundwater	0	Vegetation takes up moisture and salts.
Excess Pathogens and Chemicals from Manure, Bio-solic	0	Not Applicable
Excess Pathogens and Chemicals from Manure, Bio-solic	0	Not Applicable

Excessive Sediment in Surface Water	4	Vegetation reduces erosion and sediment delivery.
Elevated Water Temperature	0	Not Applicable
Petroleum, Heavy Metals and Other Pollutants Transporte	0	Not Applicable
Petroleum, Heavy Metals and Other Pollutants Transporte	0	Not Applicable
Air Quality Impacts		
Emissions of Particulate Matter (PM) and PM Precursors	2	Permanent cover helps reduce wind erosion and generation of fugitive dust.
Emissions of Ozone Precursors	0	Not Applicable
Emissions of Greenhouse Gases (GHGs)	1	Vegetation removes CO2 from the air and stores it in the form of carbon in the plants and soil.
Objectionable Odors	0	Not Applicable
Degraded Plant Condition		
Undesirable Plant Productivity and Health	5	Proper plant selection, nutrient modification, and management improves plant growth and vigor.
Inadequate Structure and Composition	5	Plants selected are adapted and suited.
Excessive Plant Pest Pressure	4	Establishment of permanent vegetation may provide competition that would slow the spread of noxious plants.
Wildfire Hazard, Excessive Biomass Accumulation	0	Not Applicable
Fish and Wildlife - Inadequate Habitat		
Inadequate Habitat - Food	2	Increased quality and quantity of vegetation provides more food for wildlife.
Inadequate Habitat - Cover/Shelter	2	Increased quality and quantity of vegetation provides more cover for wildlife.
Inadequate Habitat - Water	5	Not Applicable
Inadequate Habitat - Habitat Continuity (Space)	2	Increased cover will increase space for wildlife. May be used to connect other cover areas.
Livestock Production Limitation		
Inadequate Feed and Forage	0	Not Applicable
Inadequate Shelter	0	Not Applicable
Inadequate Water	0	Not Applicable
Inefficient Energy Use		
Equipment and Facilities	0	Not Applicable
Farming/Ranching Practices and Field Operations	0	Not Applicable

CPPE Practice Effects:	*0 No Effect*
5 Substantial Improvement	*-1 Slight Worsening*
4 Moderate to Substantial Improvement	*-2 Slight to Moderate Worsening*
3 Moderate Improvement	*-3 Moderate Worsening*
2 Slight to Moderate Improvement	*-4 Moderate to Substantial Worsening*
1 Slight Improvement	*-5 Substantial Worsening*

NRCS CONSERVATION PRACTICE EFFECTS - NETWORK DIAGRAM

September 2016



Notes:

Effects are qualified with a plus (+) or minus (-). These symbols indicate only an increase (+) or a decrease (-) in the effect upon the resource, not whether the effect is beneficial or adverse.

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

SEDIMENT BASIN

Code 350

(No.)

DEFINITION

A basin constructed with an engineered outlet, formed by constructing an embankment, excavating a dugout, or a combination of both.

PURPOSE

To capture and detain sediment-laden runoff, or other debris for a sufficient length of time to allow it to settle out in the basin.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to urban land, construction sites, agricultural land, and other disturbed lands where—

- Physical conditions or land ownership preclude treatment of a sediment source by the installation of erosion-control measures.
- Failure of the basin will not result in loss of life, damage to homes, commercial or industrial buildings, main highways or railroads; or in the use of public utilities.
- The product of the storage times the effective height of the dam is less than 3,000. Storage is the volume, in acre-feet, in the reservoir below the elevation of the crest of the auxiliary spillway.
- The effective height of the dam is 35 feet or less. The effective height of the dam is the difference in elevation between the auxiliary spillway crest and the lowest point in the cross section taken along the centerline of the dam.
- The dam is classified low hazard according to section 520.21(E) of the NRCS National Engineering Manual (NEM).

CRITERIA

Plan, design, and construct the sediment basin to comply with all applicable Federal, State, and local laws and regulations.

Location

Sediment basins provide the last line of defense for capturing sediment when erosion has already occurred. When possible construct the basin prior to soil disturbance in the watershed. Choose the location of the sediment basin so that the basin intercepts as much of the runoff as possible from the disturbed area of the watershed. Choose a location that minimizes the number of entry points for runoff into the basin and interference with construction or farming activities. Do not locate sediment basins in perennial streams.

Storage Capacities
The sediment basin must have sediment storage, detention storage, and temporary flood storage capacities as follows:

- Design a minimum sediment storage capacity equal to the design life of the structure, or provide for periodic cleanout.
- For maximum sediment retention, design the basin so that the detention storage remains full of water between storm events. However, if site conditions, safety concerns, or local laws preclude a permanent pool of water, provide for dewatering of all or a portion of the detention and sediment storages between storm events.
- Design flood storage based on the required design storm for the auxiliary spillways. Provide a minimum of 1 foot in elevation between the principal and auxiliary spillways.
- Calculate the sediment storage volume from the bottom of the basin to the top of the sediment storage.
- Calculate the detention volume from the top of the sediment storage to the crest of the principal spillway.
- Calculate the flood storage between the crest of the principal spillway and the crest of the auxiliary spillway.

Principal and Auxiliary Spillway Design
Design the principal and auxiliary spillways as follows:

- Design the principal spillway to carry long-duration, continuous, or frequent flows without discharge through the auxiliary spillway.
- Design the principal spillway to drawdown the temporary flood storage within 24 hours.
- Use a principal spillway pipe 6-inches diameter or greater.
- Provide a stable outlet of the principal spillway for anticipated design flow conditions.
- Provide means such as perforations or small openings in the principal spillway riser when dewatering all or a portion of the detention and sediment storages.
- Design the auxiliary spillway to pass large storms without damage to the basin.

Refer to criteria in NRCS Conservation Practice Standard (CPS) Pond (Code 378), for the required design criteria for the principal and auxiliary spillways.

Basin Shape
Design the sediment basin with a length-to-width ratio of 2 to 1 or greater. If needed, use baffles to divert the flow in the basin to lengthen the flow path of incoming water to achieve the required length-to-width ratio.

Embankment and Side Slopes
If the sediment basin includes an embankment, refer to criteria in CPS Pond (Code 378), for design requirements.

Provide side slopes of the pool area 3 horizontal to 1 vertical, or flatter, above the permanent waterline, and 2 horizontal to 1 vertical, or flatter, below the permanent waterline.

Safety
Design measures necessary to prevent serious injury or loss of life in accordance with requirements of NRCS NEM, Part 503, Safety.

Vegetation and Soil Protection
Seed or sod the exposed surfaces of earthen embankments, earth spillways, borrow areas, and other areas disturbed during construction in accordance with the criteria in CPS Critical Area Planting (Code 342). When necessary to provide surface protection where climatic conditions preclude the use of seed or sod, use the criteria in CPS Mulching (Code 484), to install inorganic cover material such as gravel.

Cultural Resources
Evaluate the existence of cultural resources in the project area and any project impacts on such resources. Provide conservation and stabilization of archeological, historic, structural, and traditional cultural properties when appropriate.

CONSIDERATIONS

A large sediment basin may have an effect on the peak discharge rate from a watershed. Planners should consider this, and take steps to mitigate any potential negative effects this may have on riparian habitat downstream from the structure.

In many cases, the use of a sediment basin alone may not provide sufficient protection for offsite sedimentation problems. To work most effectively, the sediment basin should be the last practice in a series of erosion control and sediment capturing practices installed in the disturbed area. This incremental approach will reduce the load on the basin and improve effectiveness of the overall effort to prevent offsite sedimentation problems.

Many factors influence the efficiency of sediment removal in a basin. These include the detention time of runoff, the type of dewatering device, the presence of a permanent pool in the basin, a decrease in turbulence in the basin, and soil particle size. Use the following techniques as needed to remove clay and other fine-grained particles.

- Increase detention time by increasing the storage volume in the basin. Increased storage along with a properly designed dewatering device can significantly improve the efficiency of sediment capture.
- Dewater in a manner that removes the cleaner water above the sediment storage, without removing the sediment-laden water found deeper in the basin. The use of a skimming device that floats on the surface and adjusts to water level changes can improve the quality of the water leaving the basin. The “North Carolina Erosion and Sediment Control Planning and Design Manual” provides details for this type of dewatering device.
- Maintaining a permanent pool also improves sediment trapping by reducing the resuspension of sediment in the basin. Only dewatering the temporary flood storage or a portion of the detention storage can accomplished this goal. Removal of sediment from the basin before it reaches the sediment storage elevation will maintain the pool volume and improve trapping efficiency.
- Reduce turbulence in the basin by constructing porous baffles that extend across the entire basin. The baffles slow down flows and force water to spread across the entire width of the basin. The “North Carolina Erosion and Sediment Control Planning and Design Manual” contains a thorough discussion and design criteria for porous baffles.
- For very fine-grained sediments, add flocculants to the runoff before it enters the basin. One commonly used flocculant is anionic polyacrylamide (PAM). Do not use cationic polyacrylamide because it can be toxic to aquatic life.

Diverting runoff from undisturbed areas away from the basin will improve the function of the basin. The design storm for diversion measures should be equal to the design storm for the auxiliary spillway of the basin.

Use forebays, separate from the main basin and easily accessible for cleanout, to reduce turbulence and allow larger particles to settle out of the runoff before it enters the main basin.

Because the sediment storage capacity of a basin is finite, choose a location that allows access for sediment removal when the storage capacity is full.

Visual resource design. Carefully consider the visual design of sediment basins in areas of high public visibility and those associated with recreation. The shape and form of ponds, excavated material, and plantings are to relate visually to their surroundings and to their function.

Shape the embankment to blend with the natural topography. Shape the edge of the pond so that it is generally curvilinear rather than rectangular. Shape excavated material so that the final form is smooth, flowing, and fitting to the adjacent landscape rather than angular geometric mounds. If feasible, add islands to provide visual interest and to attract wildlife.

Changed Use. In some situations, after they have served the sediment capture function, sediment basins may remain in place to function as stormwater detention or wildlife ponds. This requires appropriate planning during the design phase to ensure that the basin can function for a different use. This may also require significant modifications to outlet structures as well as removal of accumulated sediment to convert it to a new use.

Use by Wildlife. If the basin will be used by wildlife, the use of native species is recommended to provide food and habitat diversity. Also, consider wildlife use of the basin when scheduling maintenance activities that may disrupt wildlife life cycles or negatively impact pollinators.

PLANS AND SPECIFICATIONS

Prepare plans and specifications that describe the requirements for applying the practice according to this standard. As a minimum, include the following items:

- A plan view of the layout of the sediment basin.
- Typical profiles and cross sections of sediment basin.
- Details of the outlet system.
- Structural drawings adequate to describe the construction requirements.
- Requirements for vegetative establishment and/or mulching, as needed.
- Safety features.
- Site-specific construction and material requirements.

OPERATION AND MAINTENANCE

Prepare an operation and maintenance plan for the operator.

As a minimum, include the following items in the operation and maintenance plan:

- Periodic inspections of all structures, earthen embankments, spillways, and other significant appurtenances.
- Prompt removal of trash from pipe inlets and trash racks.
- Prompt repair or replacement of damaged components.
- Prompt removal of sediment when it reaches predetermined storage elevations.
- Periodic removal of trees, brush, and undesirable species.
- Periodic inspection of safety components and immediate repair if necessary.
- Maintenance of vegetative protection and immediate seeding of bare areas as needed.

REFERENCES

American Society for Testing and Materials. Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System), ASTM D2487. West Conshohocken, PA.

California Stormwater Quality Association. 2003. California Stormwater BMP Handbook, Construction. Menlo Park, CA.

Center for Watershed Protection. 2000. Improving the Trapping Efficiency of Sediment Basins, Article 58, The Practice of Watershed Protection: Techniques for Protecting and Restoring Urban Watersheds. Ellicott City, MD.

Department of Conservation and Recreation, Commonwealth of Virginia. 1992. Virginia Erosion and Sediment Control Handbook, 3rd Edition, Richmond, VA.

Jarrett, A. R. August 1998. Controlling the Dewatering of Sedimentation Basins, Agricultural and Biological Engineering, Pennsylvania State University, University Park, PA.

North Carolina Department of Environmental and Natural Resources, Division of Land Resources. 2006. North Carolina Erosion and Sediment Control Planning and Design Manual. Raleigh, NC.

Tennessee Erosion and Sediment Control Handbook. 2002. Tennessee Department of Environment and Conservation. Nashville, TN.

USDA NRCS. Engineering Technical Releases, TR-210-60, Earth Dams and Reservoirs. Washington, DC.

USDA NRCS. National Engineering Handbook (NEH), Part 628, Dams. Washington, DC.

USDA NRCS. NEH, Part 633, Soil Engineering. Washington, DC.

USDA NRCS. NEH, Part 636, Structural Engineering. Washington, DC.

USDA NRCS. NEH, Part 650, Engineering Field Handbook. Washington, DC.

USDA NRCS. NEH, Section 3, Sedimentation. Washington, DC.

USDA NRCS. National Engineering Manual. Washington, DC.

USDA NRCS & Illinois Environmental Protection Agency. 2002. Illinois Urban Manual. Champaign, IL.

Sediment Basin

A basin constructed with an engineered outlet, formed by an embankment or excavation or a combination of the two.

Code: 350
Units: no.

C-Crop	F-Forest	R-Range	P-Pasture	Pr-Protected	FS-Farmstead	D-Developed	W-Water	O-Other	AL-Aso Land
C	F	R	P	Pr	FS	D		O	AL

Typical Landuse: C F R P Pr FS D O AL

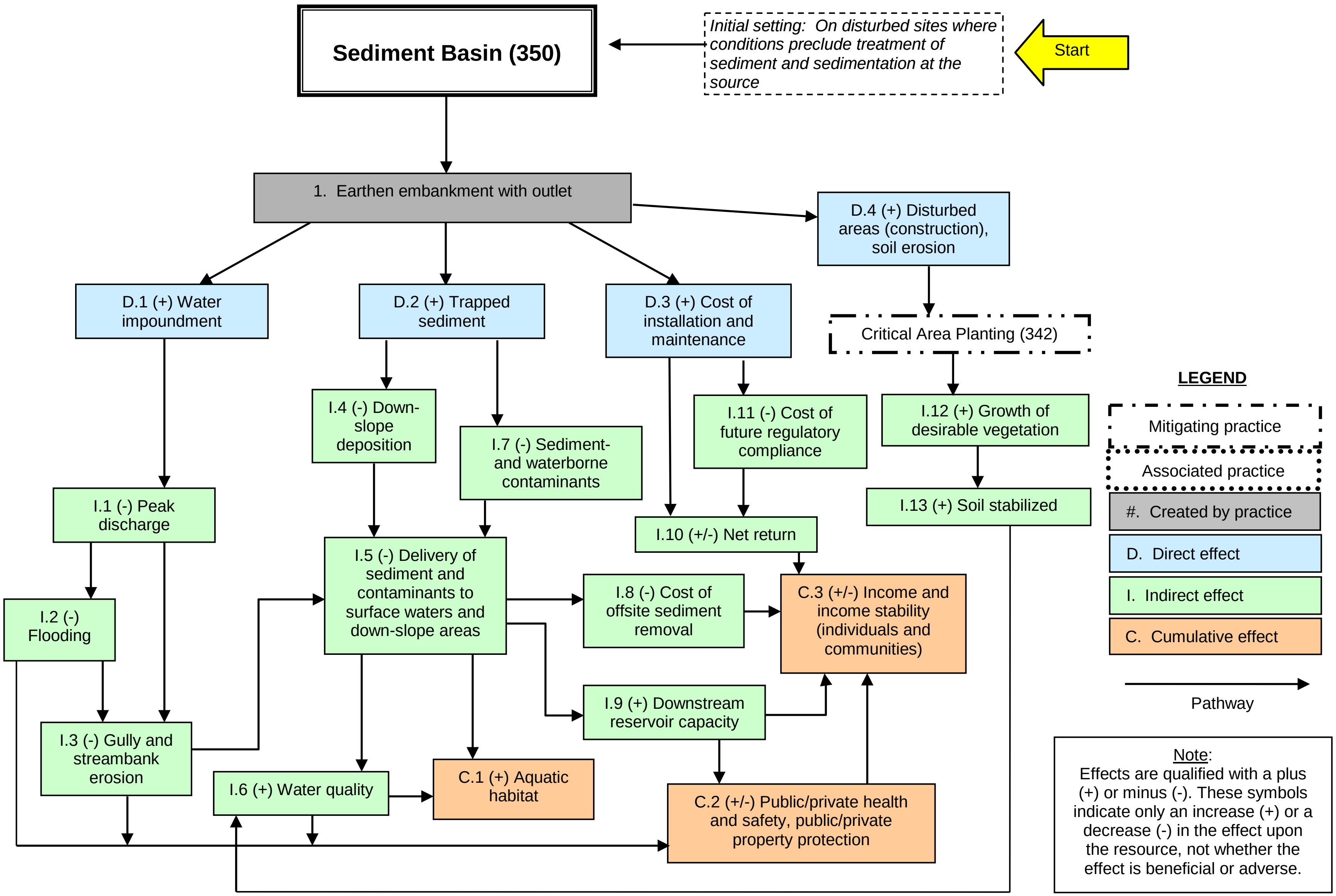
Soil Erosion	Effect	Rationale
Soil Erosion - Sheet and Rill Erosion	0	Not Applicable
Soil Erosion - Wind Erosion	0	Not Applicable
Soil Erosion - Ephemeral Gully Erosion	2	Controlled flow will reduce gulley erosion down slope of basin
Soil Erosion - Classic Gully Erosion	2	Controlled flow will reduce gulley erosion down slope of basin.
Soil Erosion - Streambank, Shoreline, Water Conveyance C	0	Stream bank erosion due to flows are reduced because of controlled flows, but 'clean' water from basin could create stream bank erosion.
Soil Quality Degradation		
Organic Matter Depletion	0	Not Applicable
Compaction	0	Not Applicable
Subsidence	0	Not Applicable
Concentration of Salts or Other Chemicals	0	Not Applicable
Excess Water		
Excess Water - Seeps	-2	Stored water in basin will infiltrate adding to seepage problem.
Excess Water - Runoff, Flooding, or Ponding	2	Basin will retard flows reducing the runoff and controlling water releases.
Excess Water - Seasonal High Water Table	-2	Retarded water in basin will infiltrate adding to subsurface water.
Excess Water - Drifted Snow	0	Not Applicable
Insufficient Water		
Insufficient Water - Inefficient Use of Irrigation Water	0	Not Applicable
Insufficient Water - Inefficient Moisture Management	0	Not Applicable
Water Quality Degradation		
Pesticides in Surface Water	2	The action collects and stores adsorbed pesticides.
Pesticides in Groundwater	-1	Water containing pesticides may seep from the basin.
Nutrients in Surface water	5	The action will tend to accumulate contaminants attached to sediments, and infiltrating waters will remove soluble contaminants.
Nutrients in Groundwater	-1	Nutrients impounded could contaminate groundwater.
Salts in Surface Water	2	Basins will tend to accumulate contaminants attached to sediments, and infiltrating waters will remove soluble contaminants.
Salts in Groundwater	-1	Infiltrating water in the basin may move soluble salts to ground water.
Excess Pathogens and Chemicals from Manure, Bio-solic	2	Basins will tend to accumulate contaminants attached to sediments, and infiltrating waters will remove soluble contaminants
Excess Pathogens and Chemicals from Manure, Bio-solic	-1	Infiltrating water in the basin may move pathogens to the ground water.

Excessive Sediment in Surface Water	**4**	**Basin retains sediment, decreasing runoff turbidity.**
Elevated Water Temperature	**0**	**Although water retained in basin is warmer than flowing surface water, discharge to surface waters is unlikely.**
Petroleum, Heavy Metals and Other Pollutants Transporte	**2**	**Basins will tend to accumulate contaminants attached to sediments.**
Petroleum, Heavy Metals and Other Pollutants Transporte	**-1**	**Infiltrating water in the basin may move soluble contaminants to the ground water.**
Air Quality Impacts		
Emissions of Particulate Matter (PM) and PM Precursors	**0**	**Not Applicable**
Emissions of Ozone Precursors	**0**	**Not Applicable**
Emissions of Greenhouse Gases (GHGs)	**0**	**Not Applicable**
Objectionable Odors	**0**	**Proper siting and management are required If used as part of an agricultural waste management system**
Degraded Plant Condition		
Undesirable Plant Productivity and Health	**0**	**Not Applicable**
Inadequate Structure and Composition	**0**	**Not Applicable**
Excessive Plant Pest Pressure	**0**	**Not Applicable**
Wildfire Hazard, Excessive Biomass Accumulation	**0**	**Not Applicable**
Fish and Wildlife - Inadequate Habitat		
Inadequate Habitat - Food	**-1**	**Any food species are eliminated in the area used for the basin.**
Inadequate Habitat - Cover/Shelter	**-1**	**Any cover is eliminated in the area used for the basin.**
Inadequate Habitat - Water	**0**	**Water is temporarily stored, and sediment and debris are removed from runoff.**
Inadequate Habitat - Habitat Continuity (Space)	**0**	**Not Applicable**
Livestock Production Limitation		
Inadequate Feed and Forage	**0**	**Not Applicable**
Inadequate Shelter	**0**	**Not Applicable**
Inadequate Water	**0**	**Captured water in basins can supplement stock water.**
Inefficient Energy Use		
Equipment and Facilities	**0**	**Not Applicable**
Farming/Ranching Practices and Field Operations	**0**	**Not Applicable**

CPPE Practice Effects:	***0 No Effect***
5 Substantial Improvement	***-1 Slight Worsening***
4 Moderate to Substantial Improvement	***-2 Slight to Moderate Worsening***
3 Moderate Improvement	***-3 Moderate Worsening***
2 Slight to Moderate Improvement	***-4 Moderate to Substantial Worsening***
1 Slight Improvement	***-5 Substantial Worsening***

NRCS CONSERVATION PRACTICE EFFECTS - NETWORK DIAGRAM

May 2016



Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

DIKE AND LEVEE

CODE 356

(ft)

DEFINITION

A barrier used to retain water on the landscape using a wetland dike; or, a barrier used to exclude water from the landscape and protect property and infrastructure from flooding using a flood control levee.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Manage water retained on the landscape using a dike
- Reduce flood risk by excluding water from a landscape using a levee

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where flooding puts land and property at risk of damage; or, where management of water levels is needed for activities, such as wetlands management, fish and wildlife habitat management, irrigation or drainage water management, and crop production.

Dikes and levees are separate and distinguishable. For purposes of this standard, the terms are not interchangeable. Failure of a dike will result in no damage to adjacent property or infrastructure. Levees protect adjacent property and infrastructure and have the potential to cause significant damage upon failure. In addition, levees will be subject to future Federal reporting requirements. Both levees and dikes may have State, Tribal, or local reporting requirements.

This practice does not apply to sites where the following NRCS Conservation Practice Standards (CPSs) are more appropriate:

- Dam (Code 402)
- Diversion (Code 362)
- Dam, Diversion (Code 348)
- Grade Stabilization Structure (Code 410)
- Pond (Code 378)
- Terrace (Code 600)
- Water and Sediment Control Basin (Code 638)

CRITERIA

General Criteria Applicable to all Purposes

Regulatory requirements

Dikes and levees must meet the requirements of all Federal, State, Tribal, and local laws or regulations. Notify landowner and contractor of their responsibility to locate all buried utilities in the project area, including drainage tile and other structural measures. The landowner is also required to obtain all necessary permits for project installation prior to construction.

Classification and design criteria

The factors determining dike and levee classification include purpose; potential hazard to life; design high water height; value of the protected land, crops, and property; and land use changes likely to occur over the life of the dike or levee. Hazard potential for levees parallels those for dams in the NRCS National Engineering Manual (NEM) (Title 210), Subpart C, Section 520.21, “Definition and Classes,” but is not the same. Classes of dikes and levees are specified below. Table 1 contains their minimum design criteria.

Class I

- All levees located on sites where a potential failure may cause loss of life or serious damage to homes, primary highways, industrial buildings, commercial buildings, major railroads, or important public utilities.
- All levees regardless of potential damage upon failure with a design high-water height of more than 12 feet above normal ground surface at the levee, exclusive of crossings of sloughs, old channels, or low areas.
- All dikes with a design high-water height of more than 12 feet above normal ground surface at dike centerline, exclusive of crossings of sloughs, old channels, or low areas.

Class II

- All levees located on sites where potential failure may cause damage to isolated homes, secondary highways, minor railroads, relatively important public facilities, high value land, or high value crops.
- All levees regardless of potential damage upon failure with a design high-water height of greater than 8 feet and up to 12 feet above normal ground surface at the levee centerline exclusive of crossings of sloughs, old channels, or low areas.
- All dikes with a design high-water height of greater than 8 feet and up to 12 feet above normal ground surface at the levee or dike centerline exclusive of crossings of sloughs, old channels, or low areas.

Class III

- All levees located on sites where failure is likely to cause minimal damage.
- All levees, regardless of potential damage upon failure with a design high-water height of greater than 6 feet and up to 8 feet above normal ground surface at the levee exclusive of crossings of sloughs, old channels, or low areas.
- All dikes with a design high-water height of greater than 6 feet and up to 8 feet above normal ground surface at the dike centerline exclusive of crossings of sloughs, old channels, or low areas.

Class IV

- All dikes located on sites where damage from overtopping is insignificant, used solely for managing water levels for purposes such as irrigation or management of wetland and wildlife areas; and with a design high-water height of 6 feet or less above normal ground surface at the dike centerline exclusive of crossings of sloughs, old channels, or low areas.

Table 1 - Minimum Design Criteria for Dikes and Levees

Classification	Material[1/]	Design High-Water Height (H) in feet[2/]	Minimum Storm Design Frequency in years	Minimum Freeboard in feet	Minimum Top Width in feet	Minimum Side-Slope Ratio[3/] (H:V)	Wave and Stability Berm Width in feet [4/]
Class I	Mineral Soils	0–6	100	H/3	10	3:1	12
		> 6–12	100	2	10	Note[4/]	Note[4/]
		>12–25	100	3	12	Note[4/]	Note[4/]
		> 25	100	3	14	Note[4/]	Note[4/]
	Manufactured	0–8	100	H/4	N/A	N/A	Note[4/]
		> 8–12	100	2	N/A	N/A	Note[4/]
		> 12	100	3	N/A	N/A	Note[4/]
Class II	Mineral Soils	0–6	25	H/3	6	3:1	12
		>6–12	25	2	8	3:1	15
	Manufactured	0–8	25	H/4	N/A	N/A	Note[4/]
		> 8–12	25	2	N/A	N/A	Note[4/]
Class III	Mineral Soils	0–3	10	H/3	4	3:1	8
		> 3–6	10	1	6	3:1	8
		> 6–12	25	2	8	3:1	8
	Organic Soils[5/]	0–2	10	H/2	4	3:1	10
		> 2–4	10	1	6	3:1	10
		> 4–6	10	2	8	3:1	15
	Manufactured	> 6–8	10	N/A	N/A	N/A	Note[4/]
Class IV	Mineral Soils or Organic Soils[5/]	< 6	10[6/]	0.5[7/]	4	3:1	N/A
	Manufactured	< 6	10[6/]	0.5[7]	N/A	N/A	N/A

[1] Earth includes rock. Manufactured materials are erosion-resistant materials, such as concrete, PVC, steel, or other materials that provide the structural strength for the dike or levee.

[2] Design high-water height is the difference between normal ground elevation at the dike or levee centerline and the design high-water elevation. When determining ground elevation, exclude crossings of channels, sloughs, low areas, small ridges, swales, or gullies.

[3] Minimum side-slope ratios are for compacted earth fill.

[4] The need for wave and stability berms is determined through embankment and stability analysis. If no analysis is performed, the values for wave and stability berm widths are defaults. Where values are not included in the table, there is no default and side-slope ratios and wave and stability berm widths are determined by the stability analysis.

[5] Organic soils are permitted only for Class III or Class IV dikes with a design high-water height of 6 feet or less.

[6] Applied only to the storm from the local drainage area and not to the watershed that is contributing to flooding of the dike.

[7] For a dike with an auxiliary spillway, this refers to the difference between the auxiliary spillway elevation and the design top of the dike elevation. For a dike without an auxiliary spillway, this refers to the difference between the highest water level control elevation and the top of the dike elevation.

Location

- Evaluate property lines, setbacks from property lines, exposure to open water, distance to streambanks, availability of gravity and pumped outlets, drainage tile, buried utilities, cultural resources, other structural measures, and natural resources such as wetlands, natural areas, and fish and wildlife.
- Identify and minimize the potential adverse impacts from installation of the dike or the levee. Include the environmental impacts of the physical presence of the dike or the levee and the potential for induced flooding in adjacent areas.
- Construct levees adjacent or parallel to streams, rivers, or other water bodies; and, not across streams, rivers, or other water bodies.

Geologic investigation

For all dikes or levees, perform a geologic subsurface investigation in sufficient detail and analysis to support the design and characterize borrow material. Describe the soil material, subgrade conditions, bearing capacity, depth to bedrock, and any geologic conditions or hazards to address in the design, construction, or operation of the dike or levee. Refer to 210-NEM, Part 531, “Geology.”

Foundation preparation

For all Class I through Class III levees or dikes, clear the foundation area of all trees, stumps, roots, brush, organic matter, and other debris. Remove unstable soil prior to the placement of levee or dike material.

For all levees or dikes, stockpile topsoil for placement of the finished dike or levee or borrow area if needed to help reestablish vegetative cover.

For a Class IV dike, remove the topsoil to a minimum depth of 0.3 feet under the entire footprint of the dike.

Constructed elevation

Flood-control levee

The constructed top elevation of a flood-control levee is the sum of—

- The design high-water height, defined as the highest water surface elevation attained by a flood or high tide of the design frequency shown in table 1 with the critical duration and timing,
- The larger of the minimum freeboard shown in table 1, or the wave height caused by wind of the design frequency shown in table 1 or boat traffic, and
- The allowance for settlement.

Water-level management dike

The constructed top elevation of a water-level management dike is the sum of—

- The water elevation at the highest water-level control,
- The rise in water surface elevation above the highest water level caused by a flood of the design frequency shown in table 1 (this is the design high-water height),
- The larger of the minimum freeboard shown in table 1 or the wave height caused by wind of the design frequency shown in table 1, and
- The allowance for settlement.

Settlement
Base the allowance for settlement on an analysis of the fill material, foundation material and condition, and compaction methods.

In lieu of an analysis, use the following minimum allowance for settlement:

- For a dike or levee constructed of compacted mineral soil (earth-fill) material—A minimum of 5 percent of the dike or levee height.
- For a dike constructed of organic material, as defined by ASTM D-2488, “Standard Practice for Description and Identification of Soils (Visual-Manual Procedures)”—A minimum of 40 percent of the dike height. Organic soils are permitted only for Class III or Class IV dikes with a design high-water height of 6 feet or less.

Top width and side slopes
Use table 1 to determine the minimum top width and side slopes for earth embankments.

Accessibility for maintenance activities
Maintain accessibility to the dike or levee for maintenance activities. Use NRCS CPS Access Road (Code 560) for access road criteria where required.

Wave and stability berms
Refer to table 1 for default widths of constructed wave and stability berms or determine the need for constructed wave or stability berms based on embankment and foundation stability analysis.

For flood control levees, construct wave and stability berms to follow the effective stream gradients (i.e., be parallel to the top of the levee) and slope them away from the levee. For dikes, construct wave and stability berms to have a constant elevation and slope them away from the dike.

For dikes, construct wave and stability berms on each side of the dike where the dike crosses channels, ditches, borrow areas, streams, sloughs, swales, gullies, etc. Construct the top elevation of these berms at least 1 foot above the average ground surface on each side of the channel, ditch, borrow area, stream, slough, swale, gully, etc., and slope the tops of the berms away from the dike.

Use table 1 to determine the minimum top width of natural or constructed berms.

Dike or levee materials
Earth materials
Obtain earth materials from required excavations and designated borrow areas. Determine the minimum distance from the toe of the dike or levee to the borrow area so as to not cause instability in the foundation or increase the potential for piping through the foundation.

Manufactured materials
Manufactured materials are erosion-resistant materials such as concrete, PVC, steel, or other material that provides the required structural strength and durability for the dike. For a dike or levee constructed of manufactured materials, perform a structural analysis for the various loads anticipated during the life of the dike or levee. These loads may include hydrostatic, ice, uplift, seismic, earth, and equipment. Analyze the stability of the dike or levee using acceptable safety factors for each loading condition.

Embankment and foundation seepage

Flood-control levee

Base embankment and foundation drainage and seepage control on site investigation, laboratory data, seepage analysis, and stability analysis. Design the embankment to minimize seepage, prevent piping or undermining, and provide a stable embankment and foundation.

Seepage analysis is required on all Class I levees with a design high-water height (H, as defined in table 1) of 6 feet or greater and Class II levees with H equal to or greater than 8 feet.

In the absence of more detailed data and analysis, the following criteria for a foundation cutoff apply for Class I levees with H less than 6 feet; Class II levees with H less than 8 feet; and all Class III dikes:

- H < 3 feet—Match height with a 1 foot minimum depth
- H $\geq$ 3 feet—Minimum of 3 feet deep
- Minimum of 4 feet bottom width
- 1:1 or flatter side slopes

Water-level management dike

For all dikes, design the embankment to minimize seepage, prevent piping, or undermining, and provide a stable embankment and foundation.

Interior drainage

For a flood prevention levee, provide an interior drainage system to prevent flood damage to the interior area from a flood of the design frequency in table 1 for both the 1-day and 10-day storm duration. Include storage areas, gravity outlets, and pumping plants (NRCS CPS Pumping Plant (Code 533)) in the interior drainage system as needed to provide the required level of flood protection.

Pipes

Protect a dike or levee from scour at the pipe inlet and outlet using appropriate measures. If pump discharge pipes are included, install through the dike or levee above the design high-water elevation, if feasible. Equip pump discharge pipes with flexible connections or similar couplings to prevent transmitting vibration from the pumping plant to the discharge pipe.

Equip pipes with flap gates to the anticipated high-water area to prevent inflow into the protected areas. Positive closures for interior drainage are needed in high risk situations.

Class I

For a dike or levee with a design high-water height of 12 feet or greater and pipes below the design high-water elevation, design the pipes in accordance with the principal spillway criteria in NRCS Technical Release No. 60, “Earth Dams and Reservoirs,” except for the minimum pipe size requirements.

For all other Class I dikes or levees with pipes, design the pipe to meet the requirements for a principal spillway in NRCS CPS Pond (Code 378).

Class II and Class III

Design pipes through a Class II levee and a Class III levee or dike according to pipe requirements in NRCS CPS Pond (Code 378). For dikes meeting the Class III exception in table 1, the pipe may be designed according to NRCS CPS Underground Outlet (Code 620).

Class IV

Design pipes through the dike according to pipe requirements in NRCS CPS Pond (Code 378) or NRCS CPS Underground Outlet (Code 620), as appropriate.

Slope protection
Protect earth dike or levee slopes from sheet, rill, and gully erosion; and erosion from flowing floodwaters, pipe outfalls, and wave action created by boat traffic or wind. Utilize appropriate erosion protection measures such as vegetation, berms, rock riprap, sand-gravel, or soil cement as needed.

At a minimum, establish a protective cover of grasses on all exposed surfaces of the levee or dike and other disturbed areas according to NRCS CPS Critical Area Planting (Code 342).

Additional Criteria for Class I Flood-control Levees with a Design High-water Height of Greater Than 12 Feet

Complete an emergency action plan meeting the requirements of NRCS National Operation and Maintenance Manual (Title 180), Part 500, Subpart F, “Emergency Action Plan,” prior to construction for all Class I flood-control levees with a design high-water height of greater than 12 feet. There should be no damages upon failure of a dike, therefore an EAP is not required. If there are damages due to failure, it is no longer a dike, but a levee.

CONSIDERATIONS

General Considerations

Flood of record
For a Class I levee consider the flood of record when establishing the top of levee elevation to ensure the level of risk is commensurate with the necessary level of protection.

Location
Consider fluvial geomorphological concepts as outlined in the NRCS National Engineering Handbook (NEH) (Title 210), Part 653, “Stream Corridor Restoration Principles, Processes, and Practices,” when placing a dike or levee near a stream.

Wave and stability berms and side slopes
To protect the dike or levee for its design life, consider using wider berms, additional setbacks, or protecting the berm side slope when adjacent to actively eroding or moving streams.

For dikes constructed for management of wetland wildlife, using side slopes flatter than 5:1 provides a range of water depths used by more wildlife species, especially shorebirds.

Beaver, Rodent, and Burrowing Animal Control
Consider the use of chain-link fence or other measures to control burrowing animals.

Source Water
Consider providing an increased level of designed treatment for sites with high priority areas for source water protection or are upstream of community drinking water withdrawal sites. Providing an increased level of safety factor can help protect these community water systems.

PLANS AND SPECIFICATIONS

Prepare plans and specifications that describe the requirements for applying the practice to achieve its intended purpose. As a minimum, include—

- Plan view of site with planned and existing features, including utilities.
- Cross sections and profiles of the planned structure.
- Detail drawings and specifications for all structures and appurtenances, including maintenance access features.
- Material and construction specifications.
- Requirements for foundation preparation, including clearing of vegetation and debris, removing stockpiling topsoil, as appropriate for the site.

- List and describe each type of material used in the various fills in the specifications and drawings.
- Safety concerns.
- Site access for maintenance.
- Vegetation requirements.

OPERATION AND MAINTENANCE

Develop and provide an operation and maintenance plan to the landowner or project sponsor. The minimum requirements to address include—

- Inspection of the dike or levee and any appurtenant structures annually and following large storm events to ensure there is no damage and that the dike or levee is operating properly.
- Inspection for damage from burrowing animals and to ensure effective rodent control and mitigation of damage caused by burrowing animals.
- Inspection for livestock damage.
- Inspection for any encroachments on the dike or levee.
- Removal of any woody material, debris, or growing timber that compromises the efficient operation or structural integrity of the dike or levee.
- Repairs to the dike or levee as soon as possible after observing damage.
- Reestablishment of vegetative cover on the dike or levee where erosion has removed established vegetation.
- Maintenance of effective erosion control on the contributing watershed drainage area to prevent siltation, as appropriate.

REFERENCES

Albanese, G. and Davis, C.A. 2015. Characteristics Within and Around Stopover Wetlands Used by Migratory Shorebirds: Is the Neighborhood Important? The Condor, Volume 117, Issue 3, Pages 328-340. https://doi.org/10.1650/CONDOR-14-166.1.

ASTM D2488, Standard Practice for Description and Identification of Soils (Visual-Manual Procedures). ASTM International, West Conshohocken, PA.

USDA NRCS. 2008. National Engineering Handbook (Title 210), Part 636, Structural Engineering. Washington, D.C. https://directives.sc.egov.usda.gov/viewerFS.aspx?hid=21425.

USDA NRCS. 2010. National Engineering Handbook (Title 210), Part 653, Stream Corridor Restoration Principles, Processes and Practices, Washington, D.C. https://directives.sc.egov.usda.gov/viewerFS.aspx?hid=34826.

USDA NRCS. 2017. National Engineering Manual (Title 210), Part 520, Soil and Water Resource Development. Washington, D.C. https://directives.sc.egov.usda.gov/

USDA NRCS. 2019. National Engineering Manual (Title 210), Part 531, Geology. Washington, D.C. https://directives.sc.egov.usda.gov/

USDA NRCS. 2019. Technical Release 60 – Earth Dams and Reservoirs. Washington, D.C. https://directives.sc.egov.usda.gov/

USDA NRCS. 2019. National Operation and Maintenance Manual (Title 180). Washington, D.C. https://directives.sc.egov.usda.gov/

Effects of NRCS Conservation Practices - National

Dike

A barrier constucted of earth or manufactured materials

Code: 356
Units: ft.

C-Crop	F-Forest	R-Range	P-Pasture	Pr-Protected	FS-Farmstead	D-Developed	W-Water	O-Other	AL-Aso Land

Typical Landuse: C F R P Pr FS D W O AL

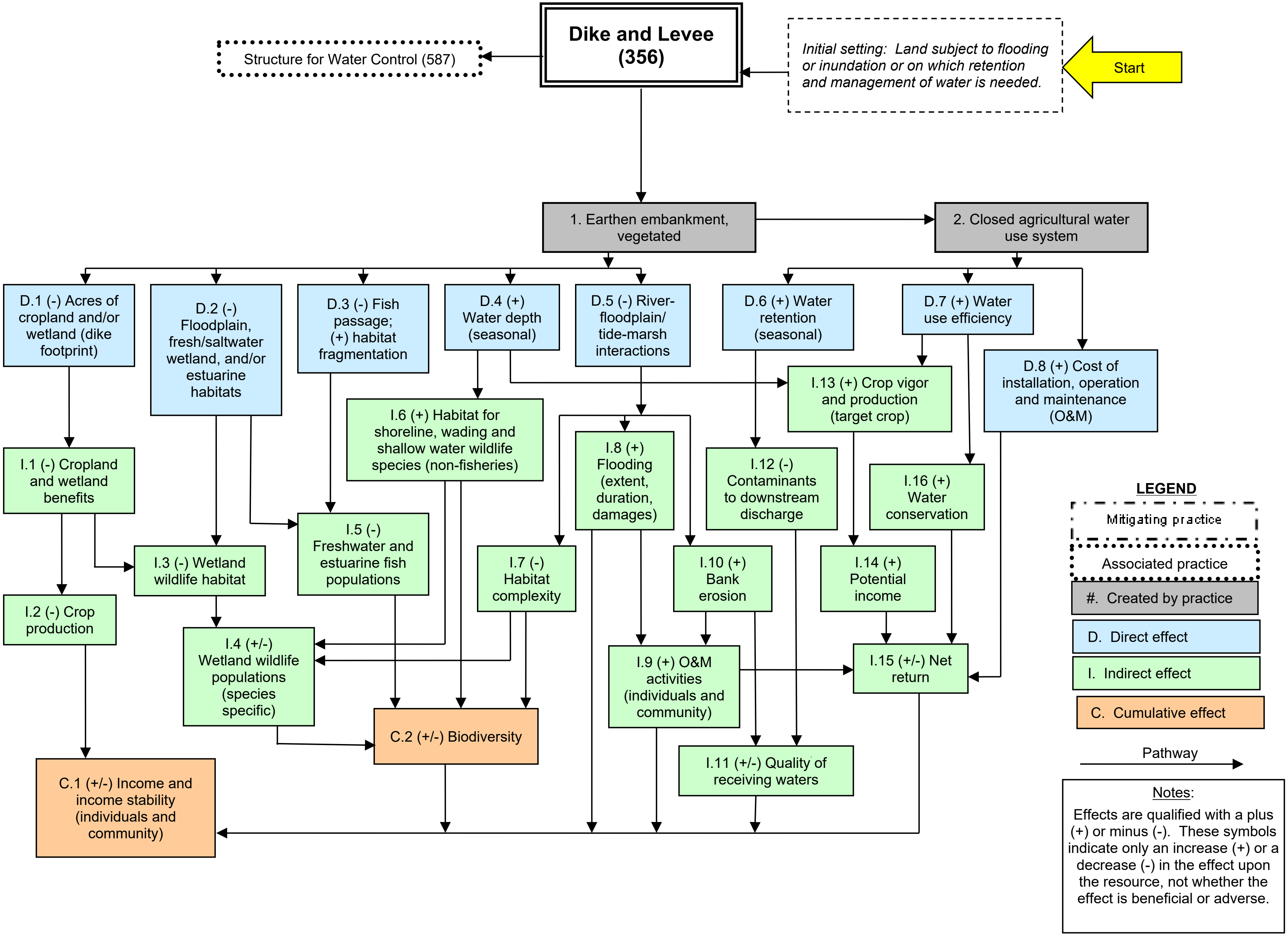
Soil Erosion	Effect	Rationale
Soil Erosion - Sheet and Rill Erosion	0	Not Applicable
Soil Erosion - Wind Erosion	0	Not Applicable
Soil Erosion - Ephemeral Gully Erosion	0	Not Applicable
Soil Erosion - Classic Gully Erosion	1	Reduces overland flow
Soil Erosion - Streambank, Shoreline, Water Conveyance C	-2	Causes higher water depths and velocities.
Soil Quality Degradation		
Organic Matter Depletion	0	Not Applicable
Compaction	0	Not Applicable
Subsidence	0	Not Applicable
Concentration of Salts or Other Chemicals	0	Not Applicable
Excess Water		
Excess Water - Seeps	-1	Seepage may increase due to temporary storage behind the dikes.
Excess Water - Runoff, Flooding, or Ponding	2	Water is kept within the channel and prevents flooding.
Excess Water - Seasonal High Water Table	-1	Seepage may increase due to temporary storage behind the dikes.
Excess Water - Drifted Snow	0	Not Applicable
Insufficient Water		
Insufficient Water - Inefficient Use of Irrigation Water	0	Not Applicable
Insufficient Water - Inefficient Moisture Management	0	Not Applicable
Water Quality Degradation		
Pesticides in Surface Water	2	The action excludes surface water from the pesticide application site.
Pesticides in Groundwater	2	The action excludes surface water from the pesticide application site.
Nutrients in Surface water	0	Not Applicable
Nutrients in Groundwater	0	Not Applicable
Salts in Surface Water	0	Not Applicable
Salts in Groundwater	0	Not Applicable
Excess Pathogens and Chemicals from Manure, Bio-solic	0	Not Applicable
Excess Pathogens and Chemicals from Manure, Bio-solic	0	Not Applicable

Excessive Sediment in Surface Water	0	If a dike is constructed to hold water, suspended sediment and turbidity decreases; if dike is constructed as flood control measure, suspended sediment and turbidity will increase because of erosive effect of flowing, channelized water.
Elevated Water Temperature	0	Surface water temperature is dependent on site conditions and location of dike.
Petroleum, Heavy Metals and Other Pollutants Transporte	0	Not Applicable
Petroleum, Heavy Metals and Other Pollutants Transporte	0	Not Applicable
Air Quality Impacts		
Emissions of Particulate Matter (PM) and PM Precursors	0	Not Applicable
Emissions of Ozone Precursors	0	Not Applicable
Emissions of Greenhouse Gases (GHGs)	0	Not Applicable
Objectionable Odors	0	Not Applicable
Degraded Plant Condition		
Undesirable Plant Productivity and Health	0	Not Applicable
Inadequate Structure and Composition	0	Not Applicable
Excessive Plant Pest Pressure	0	Not Applicable
Wildfire Hazard, Excessive Biomass Accumulation	0	Not Applicable
Fish and Wildlife - Inadequate Habitat		
Inadequate Habitat - Food	-2	Restricting floodplains eliminates refuge habitat for stream and river-dwelling wildlife species.
Inadequate Habitat - Cover/Shelter	-2	Restricting floodplains eliminates refuge habitat for stream and river-dwelling wildlife species.
Inadequate Habitat - Water	0	Dikes will retain water benefiting some species, however if placed in floodplains aquatic habitats will be fragmented.
Inadequate Habitat - Habitat Continuity (Space)	1	Dikes will retain water benefiting some species, however if placed in floodplains aquatic habitats will be fragmented.
Livestock Production Limitation		
Inadequate Feed and Forage	0	Not Applicable
Inadequate Shelter	0	Not Applicable
Inadequate Water	0	Not Applicable
Inefficient Energy Use		
Equipment and Facilities	0	Not Applicable
Farming/Ranching Practices and Field Operations	0	Not Applicable

CPPE Practice Effects:	*0 No Effect*
5 Substantial Improvement	*-1 Slight Worsening*
4 Moderate to Substantial Improvement	*-2 Slight to Moderate Worsening*
3 Moderate Improvement	*-3 Moderate Worsening*
2 Slight to Moderate Improvement	*-4 Moderate to Substantial Worsening*
1 Slight Improvement	*-5 Substantial Worsening*

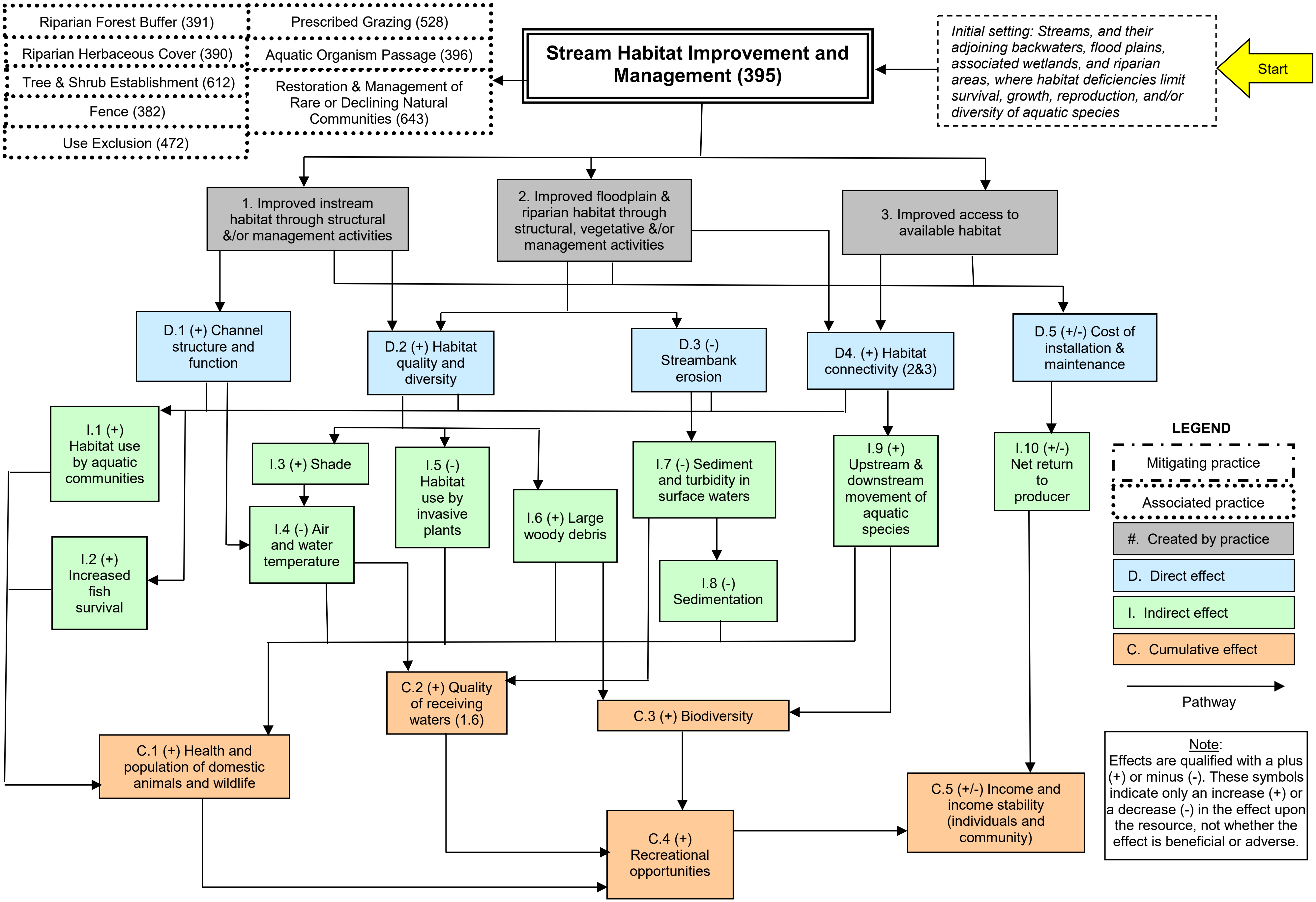
NRCS CONSERVATION PRACTICE EFFECTS - NETWORK DIAGRAM

June 2022



NRCS CONSERVATION PRACTICE EFFECTS - NETWORK DIAGRAM

May 2019



United States Department of Agriculture

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

STREAM HABITAT IMPROVEMENT AND MANAGEMENT

CODE 395

(ac)

DEFINITION

Improve, restore, or maintain the ecological functions of a stream and its adjacent floodplain and riparian area.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Improve or manage stream habitat by evaluating and addressing factors that impair stream function and structure.

CONDITIONS WHERE PRACTICE APPLIES

All streams and their associated backwaters, floodplains, wetlands, and riparian areas with impaired habitat.

This practice does not apply to—

- The management of fish and wildlife habitat on wetlands enhanced under this standard.
- Streambed or bank stabilization; instead, use Conservation Practice Standard (CPS) Streambank and Shoreline Protection (Code 580), or CPS Channel Bed Stabilization (Code 584).

This practice may be used in conjunction with other practices to address multiple resource concerns at the site.

CRITERIA

General Criteria Applicable to All Purposes

Use this practice to assess, evaluate, and prescribe a comprehensive plan for stream habitat improvement, including the use of associated practices to address functionally connected floodplains and wetlands.

Planned stream habitat improvements must—

- Be applied within the context of the overall watershed conditions and with clear objectives for stream habitat management goals.
- Be based on a site-specific assessment of local hydrology, channel morphology, geomorphic setting, fish and other aquatic species present, riparian area and floodplain conditions, and any habitat limitations including streamflow conditions, water quality, food supply, and restriction on upstream and downstream movement of aquatic species, as determined using the NRCS Stream Visual Assessment Protocol, Version 2 (SVAP2) or comparable State-approved aquatic habitat evaluation tool.

- When applied, results in a conservation system that addresses specific habitat objectives and meets or exceeds the minimum planning criteria for stream and aquatic habitat established in Section III of the Field Office Technical Guide.
- Design in-stream structures to be compatible with the dynamic nature of streams and rivers, facilitate natural geomorphic recovery where possible, and minimize disruption of recreational and other traditional uses of the stream corridor.
- Use acceptable design methodologies and criteria for in-stream structures. Coordinate with State-level technical experts to determine design methodologies applicable to your State or area.
- Enable adjoining floodplain and riparian areas to support a diverse vegetation community suitable for the site conditions and desired ecological benefits to the greatest extent possible.
- Use native plant materials in project installations to the maximum extent possible.
- Manage livestock to sustain a healthy stream corridor and associated habitats.

Structures installed for the purposes of this standard must not—

- Impede or prevent passage of fish and other aquatic organisms, unless they are intended to isolate populations of native species of conservation concern as directed by State or Federal species management plans or similar guidance.
- Cause unintentional lateral migration, aggradation, or degradation of the channel.
- Hinder channel-floodplain interactions.

CONSIDERATIONS

Restore or maintain stream habitat and channel-forming processes such as natural flow regime, meander migration, sediment transport, recruitment and storage of large wood, and stream interactions with the floodplain.

Incorporate riparian buffers to facilitate channel-forming processes, as well as encourage activities that promote riparian function to provide stream temperature moderation, recruitment of in-stream large wood and fine organic matter, input of riparian nutrients, habitat for terrestrial insects and other riparian dependent species, streambank integrity, and filtration of contaminants from surface runoff (see CPSs Riparian Forest Buffer (Code 391) and Riparian Herbaceous Cover (Code 390)).

Project design should consider risks resulting from adjustment of in-stream structures. Habitat objectives can be met as structures transition or change over time; however, consider potential damage and resulting effects on offsite property, public infrastructure, and human safety from structure movement.

Specific measures that should be considered either singularly or in combination to improve stream habitat include—

- Providing aquatic organism passage upstream and downstream to the extent possible and when compatible with State and Federal species recovery or management objectives (see CPS Aquatic Organism Passage (Code 396)).
- If possible, locating stream crossings in areas with the least effect on stream geomorphic function or aquatic habitat.
- Providing screens on water pumps, diversion ditches, or any areas that are within the landowner’s control, where unintentional entrainment of aquatic species is likely to occur .
- To the greatest extent possible, maintaining adequate in-stream flows to sustain diverse habitats for fish and other aquatic species, especially during critical life-history stages.
- Maintaining natural surface water, hyporheic, and groundwater interactions to the extent possible.
- Improving floodplain-to-channel connectivity for development of seasonal or permanent backwater, wetland, and off-channel habitats consistent with the local climate and stream hydrology.
- Restoring stream and riparian area function by utilizing natural materials and methodologies such

as, but not limited to, flexible wood placement (unanchored, unpinned), beaver habitat restoration, spawning riffles, and boulder complexes where and when practical and feasible.

- Restoring or protecting riparian area and floodplain vegetation and associated riverine wetlands.
- If planting in adjoining floodplains and riparian areas, selecting plants that provide pollen and nectar for pollinators. Maximizing plant diversity in riparian areas can result in increased populations of pollinators and other terrestrial insects upon which fish feed.
- Controlling the spread of exotic plant and animal species to the greatest extent possible.
- Reducing or managing excessive runoff due to watershed development, road construction, or land-use activities that are within the landowner's control.
- Adjusting stream management actions to address the timing, intensity, frequency, and duration of recreation, grazing, planting, fertilizing, watering, or resource removal activities for the improvement and maintenance of stream and associated floodplain and riparian area habitat.
- Integrating other closely related practices to develop a comprehensive and multidisciplinary plan for the project site.

PLANS AND SPECIFICATIONS

Develop plans and specifications for each site to implement stream habitat management and improvement actions.

As a minimum, plans must include—

- Goals and objectives of the planned actions.
- A site description, including survey data that depict existing conditions and illustrate proposed changes to a subject reach's dimension, pattern, and profile.
- Data that characterize the structure and composition of the streambed and banks.
- Design drawings and job sheets that document quality, quantity, placement, dimensions, and elevations of structures, including installation timing and location.
- All facilitating practices including their respective specifications and their operation and maintenance requirements.
- The dates and sequencing for improvements or management actions.
- If planting is a component of the project, include a vegetation planting plan that identifies species, stocking rates, planting dates, care of seed or other plant materials, acceptable rate of survival, replanting requirements; alternatively, use specifications outlined within the facilitating and component practices.
- Incorporation of permit requirements, if any, into the specifications, design, and operation and maintenance requirements of the practice.
- Responsible party for collecting any post-construction survey data.

OPERATION AND MAINTENANCE

Develop a detailed operation and maintenance plan for all applications that details periodic inspection and prompt repair or modification of any structures that are not meeting design objectives.

Provide monitoring guidelines for evaluating the effectiveness of the conservation actions in the short- and long-term.

Conduct postproject evaluation of stream and riparian habitat conditions using the same preproject evaluation tool (e.g., SVAP2, or other) to determine if the implemented actions have resulted in improved habitat or have fully addressed resource concerns.

Coordinate any needed repair actions in order to comply with State and Federal guidelines for protecting aquatic and terrestrial species.

REFERENCES

Bureau of Land Management. 1998. Riparian Area Management: A User Guide to Assessing Proper Functioning Condition and the Supporting Science for Lotic Areas. TR-1737-15.

Federal Interagency Stream Restoration Working Group (FISRWG). 1998, revised October 2010. National Engineering Handbook, Part 653, Stream Corridor Restoration: Principles, Processes and Practices.

Gregory, S V., K.L. Boyer, and A.M. Gurnell, editors. 2003. The Ecology and Management of Wood in World Rivers. American Fisheries Society, Symposium 37. Bethesda, MD.

USDA NRCS. 1998. The Practical Streambank Bioengineering Guide. https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/idpmcpu116.pdf. Accessed October 23, 2018.

USDA NRCS. 2002. Streambank Soil Bioengineering Field Guide for Low Precipitation Areas. https://www.nrcs.usda.gov/Internet/FSE_PLANTMATERIALS/publications/idpmcpussbfglpa.pdf. Accessed October 23, 2018.

USDA NRCS. 2004. National Biology Handbook, Aquatic and Terrestrial Habitat Resources.

USDA NRCS. 2008. National Engineering Handbook, Part 654, Stream Restoration Design.

USDA NRCS. 2009. National Biology Handbook, Part 614, Subpart B, Stream Visual Assessment Protocol, Version 2.

USDA NRCS. 2010. National Engineering Handbook, Part 653, Stream Corridor Restoration: Principles, Processes, and Practices.

Effects of NRCS Conservation Practices - National

Stream Habitat Improvement and Management

Maintain, improve or restore physical, chemical and biological functions of a stream, and its associated riparian zone, necessary for meeting the life history requirements of desired aquatic species.

Code: 395
Units: ft.

C-Crop	F-Forest	R-Range	P-Pasture	Pr-Protected	FS-Farmstead	D-Developed	W-Water	O-Other	AL-Aso Land

Typical Landuse: C F R P Pr FS D W O AL

Soil Erosion	Effect	Rationale
Soil Erosion - Sheet and Rill Erosion	0	Not Applicable
Soil Erosion - Wind Erosion	0	Not Applicable
Soil Erosion - Ephemeral Gully Erosion	0	Not Applicable
Soil Erosion - Classic Gully Erosion	0	Not Applicable
Soil Erosion - Streambank, Shoreline, Water Conveyance C	5	Vegetation and dense roots protects and binds the soil making it resistant to water flow erosion.
Soil Quality Degradation		
Organic Matter Depletion	0	Not Applicable
Compaction	0	Not Applicable
Subsidence	0	Not Applicable
Concentration of Salts or Other Chemicals	0	Not Applicable
Excess Water		
Excess Water - Seeps	0	Not Applicable
Excess Water - Runoff, Flooding, or Ponding	0	Not Applicable
Excess Water - Seasonal High Water Table	0	Not Applicable
Excess Water - Drifted Snow	0	Not Applicable
Insufficient Water		
Insufficient Water - Inefficient Use of Irrigation Water	0	Not Applicable
Insufficient Water - Inefficient Moisture Management	0	Not Applicable
Water Quality Degradation		
Pesticides in Surface Water	0	Not Applicable
Pesticides in Groundwater	0	Not Applicable
Nutrients in Surface water	0	Not Applicable
Nutrients in Groundwater	0	Not Applicable
Salts in Surface Water	0	Not Applicable
Salts in Groundwater	0	Not Applicable
Excess Pathogens and Chemicals from Manure, Bio-solic	0	Not Applicable
Excess Pathogens and Chemicals from Manure, Bio-solic	0	Not Applicable

Excessive Sediment in Surface Water	2	Improved vegetation and management will reduce streambank erosion and improve channel stability.
Elevated Water Temperature	2	Restoration of riparian conditions will contribute to moderation of stream temperatures.
Petroleum, Heavy Metals and Other Pollutants Transporte	0	Not Applicable
Petroleum, Heavy Metals and Other Pollutants Transporte	0	Not Applicable
Air Quality Impacts		
Emissions of Particulate Matter (PM) and PM Precursors	0	Not Applicable
Emissions of Ozone Precursors	0	Not Applicable
Emissions of Greenhouse Gases (GHGs)	1	Vegetation removes CO2 from the air and stores it in the form of carbon in the plants and soil.
Objectionable Odors	0	Not Applicable
Degraded Plant Condition		
Undesirable Plant Productivity and Health	4	Management and improvement measures create or maintain the health and vigor of desired riparian and aquatic plant communities.
Inadequate Structure and Composition	4	Management and improvement measures create or maintain the desired riparian and aquatic plant communities.
Excessive Plant Pest Pressure	4	Vegetation is installed and managed to control undesired species.
Wildfire Hazard, Excessive Biomass Accumulation	0	Not Applicable
Fish and Wildlife - Inadequate Habitat		
Inadequate Habitat - Food	2	Aquatic habitat is improved providing food for fish and wildlife.
Inadequate Habitat - Cover/Shelter	2	Aquatic habitat is improved providing cover for fish and wildlife.
Inadequate Habitat - Water	0	Riparian and instream improvements will improve water quality, and where applicable, water quantity for aquatic and riparian species and their habitats..
Inadequate Habitat - Habitat Continuity (Space)	4	Restored habitats increase suitable space for fish.
Livestock Production Limitation		
Inadequate Feed and Forage	2	Re-establishment of streamside habitat can provide additional forage.
Inadequate Shelter	4	Riparian area shrubs and trees can provide shade and protection from wind.
Inadequate Water	0	Not Applicable
Inefficient Energy Use		
Equipment and Facilities	0	Not Applicable
Farming/Ranching Practices and Field Operations	0	Not Applicable

CPPE Practice Effects:	*0 No Effect*
5 Substantial Improvement	*-1 Slight Worsening*
4 Moderate to Substantial Improvement	*-2 Slight to Moderate Worsening*
3 Moderate Improvement	*-3 Moderate Worsening*
2 Slight to Moderate Improvement	*-4 Moderate to Substantial Worsening*
1 Slight Improvement	*-5 Substantial Worsening*

United States Department of Agriculture

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

STORMWATER RUNOFF CONTROL

CODE 570

(ac)

DEFINITION

Measures or systems to control the quantity and quality of stormwater runoff.

PURPOSE

This practice is used to accomplish one or more of the following purposes in controlling stormwater runoff:

- Minimize erosion and sedimentation during and following construction activities
- Reduce the quantity of stormwater leaving developing or developed sites
- Improve the quality of stormwater leaving developing or developed sites

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to sites where stormwater runoff causes or may cause undesirable downstream conditions such as flooding due to increased flows, sedimentation, channel degradation, and/or degradation of surface or ground water quality if left untreated. This practice may apply both to sites undergoing development as well as remedial work on developed sites. This practice does not include runoff from areas of livestock facilities. For runoff from livestock facilities use practices such as NRCS Conservation Practice Standards (CPSs) Waste Storage Facility (Code 313) and Vegetated Treatment Area (Code 635).

CRITERIA

General Criteria Applicable to All Purposes

Plan, design, and construct stormwater runoff controls to comply with applicable Federal, State, and local laws and regulations, including all necessary permits and utility locations.

Develop a plan to reduce the impacts of stormwater runoff from the site based on an assessment of the downstream area. As applicable, include in the plan practices or management activities that will—

- Reduce onsite erosion.
- Reduce offsite impacts from sedimentation.
- Reduce the quantity of stormwater leaving the site to levels that will not adversely affect downstream receiving channels.
- Maintain or increase infiltration of precipitation to recharge ground water.
- Improve the quality of runoff leaving the site.
- Leave the site in a stable condition after construction.

All runoff control methods must include provisions to safely bypass runoff in excess of the design storm.

Stabilization measures
Where appropriate, stabilize all areas disturbed by construction as soon as possible after construction to reduce the potential for erosion. When vegetation is used, refer to NRCS CPSs Critical Area Planting (Code 342) or Conservation Cover (Code 327). If vegetation is not appropriate for the site, use other measures such as NRCS CPS Mulching (Code 484) that protect the soil from erosion. Include pretreatment measures in the system as necessary to protect plantings from excessive sediment, trash, debris, or other pollutants.

Safety
Detention ponds and other areas where water is detained or flows swiftly can present hazards to the public. Where necessary, include appropriate safety features to warn of potential dangers or deter entry to hazardous areas such as with fences, gates, and warning signs.

Additional Criteria for the Reduction of Water Quantity

Design stormwater control systems to control flow from the area of concern to rates and volumes that will not cause degradation of downstream areas due to erosion or sedimentation. Acceptable peak rates and volumes are dependent upon the capacity and stability of the receiving channel. Refer to local regulations that specify acceptable discharge rates and volumes for different storm frequencies. In the absence of local requirements, use the 2-year 24-hour predevelopment storm for the peak discharge rate and volume to receiving streams.

Control the peak rate of runoff by slowing the release of runoff from the site. This can be accomplished by onsite storage, increasing infiltration onsite, lengthening the flow path of runoff, or a combination of these methods. Use one or more of these methods to reduce peak rates of runoff.

All runoff control methods must include provisions to safely bypass runoff in excess of the design storm.

Additional Criteria for the Improvement of Water Quality

Runoff from developing areas, including farmsteads, access roads, and storage areas, can be contaminated with a variety of substances including sediment, oils, chemicals, and trash. Assess site conditions to determine the type of contaminants that must be controlled. Design practices that will capture or reduce these contaminants before they leave the site. These can include diversion of clean water, vegetated filtration areas, rain gardens and other biofilters, management actions to prevent spills of fuels or other contaminants, and trash guards and settling areas that are readily accessible for cleanout. Provide a minimum of 2 feet of soil depth from bedrock to the bottom of impoundments, vegetated filtration areas, rain gardens, and other biofilters.

Additional Criteria for Erosion and Sediment Control

Control erosion on the site by limiting the amount and length of time that bare soil is exposed to precipitation. This can be accomplished by staging construction and only removing vegetation from a portion of the site at a time, revegetating areas incrementally during construction or using temporary seeding and mulching to stabilize areas until permanent vegetation can be established.

Structural erosion control practices that reduce overland flow length and velocity such as NRCS CPSs Diversion (Code 362) and Terrace (Code 600), straw bale barriers, or silt fences can be used to reduce sheet and rill erosion. Refer to the current NRCS soil loss prediction methodology to determine the appropriate spacing for these practices.

When erosion cannot be stopped at the source, filter or detain sediment-laden runoff to allow sediment particles to settle out to acceptable levels before releasing runoff from the site. This can be accomplished by sediment traps, sediment basins, and other structures designed to detain or filter runoff. Refer to NRCS CPS Sediment Basin (Code 350) for design requirements for sediment basins.

CONSIDERATIONS

Research has shown that the first runoff from a site is often the most contaminated. After this initial flush, less pollutants are available for removal, and dilution lessens the impact. Consequently, treatment of this “first flush” of runoff is often sufficient to address the water quality concern. The exact amount of runoff to treat varies depending upon the surface and level of contamination. Determine the amount of runoff to treat based on appropriate research or experience.

For runoff that is known to be contaminated with substances that may be particularly harmful to the water supply or fish and wildlife, additional treatment methods may be necessary.

Stormwater control practices can affect downstream hydrology. While this is the point of most stormwater control systems, consider the effect (both positive and negative) of changing the peak rate and volume of runoff on downstream areas. Where there are multiple projects in a watershed, consider the effect of a single project in context with other projects in the watershed to determine the cumulative effect. For developed areas consider options for reducing the peak flow from the current developed condition.

Design stormwater control practices that will fit into the visual landscape as well as function for runoff control. Since stormwater control practices are generally installed in public spaces, consider the use of the space and the visual impact the practices will have.

Improving or maintaining infiltration can be an important component of controlling stormwater runoff. Base the design of infiltration measures on the permeability rate of the most restrictive layer in the soil profile within the infiltration zone. Generally, soils should have a saturated hydraulic conductivity rate greater than 0.2 inches per hour. Design storage measures such as dry wells, stone trenches, and basins to empty within 72 hours.

If properly designed, stormwater control practices can be beneficial to wildlife. When possible use native vegetation to provide food and habitat for wildlife and pollinators.

To be most effective, stormwater control should include a system of practices working together. This might include detention along with infiltration areas and the maintenance of natural, undisturbed areas. However, it can also include managing the development of the site to limit the amount of disturbed area, ensuring that revegetation occurs in a timely manner and controlling where heavy equipment that will compact soils and destroy vegetation is allowed to travel on a site.

Large storms can quickly fill stormwater runoff practices with sediment. For the practices to function correctly the sediment must be removed and properly disposed of. Consequently, design these practices for easy access and maintenance.

Since stormwater control practices are often installed in urban and public spaces, vandalism may be a problem. Consider using practices that cannot be easily vandalized such as grouting rock in place and installing barriers and locks where appropriate.

Stormwater runoff control plans are often required by local regulations. As a result, the practices will often be part of a larger construction contract. To ensure that the plans will be properly implemented it is helpful to incorporate the requirements of the stormwater runoff control plan into the plans and specifications for the larger project.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for stormwater runoff control systems that describe the requirements for applying the practice according to this standard. As a minimum the plans and specifications shall include—

- A plan view showing the extent of the practice.
- Where appropriate, cross-sections and/or profiles showing elevations and distances.

- Where appropriate, plans for structural details.
- Where appropriate, seeding requirements.
- Construction specifications that describe in writing site-specific installation requirements for the stormwater runoff control systems.

OPERATION AND MAINTENANCE

Prepare an operation and maintenance (O&M) plan for the operator. The minimum requirements to be addressed in the O&M plan are—

- Periodic inspections, especially immediately following significant rainfall events.
- Prompt repair or replacement of damaged components, especially surfaces that are subjected to wear or erosion.
- Regular inspection of settling basins, trash guards, and other practices to collect and remove accumulated sediment and debris.
- Periodic mowing, fertilization, and control of vegetation where vegetation is specified.

REFERENCES

Bannerman, R. and E. Considine. 2003. Rain Gardens: A How-to Manual for Homeowners. University of Wisconsin Extension Publication GWQ037 or Wisconsin Department of Natural Resources Publication PUB-WT-776 2003. Madison, WI.

U.S. Environmental Protection Agency. 2007. Developing Your Stormwater Pollution Prevention Plan. Washington, D.C.

U.S. Environmental Protection Agency. 2004. Stormwater Best Management Practice Design Guide, Volumes 1, 2, & 3. Washington, D.C.

U.S. Environmental Protection Agency. 1999. Stormwater Technology Fact Sheet: Bioretention. Publ. EPA-832-F-99-012. Office of Water, Washington, D.C.

Effects of NRCS Conservation Practices - National

Stormwater Runoff Control

Controlling the quantity and quality of stormwater runoff.

Code: 570
Units: no

C-Crop	F-Forest	R-Range	P-Pasture	Pr-Protected	FS-Farmstead	D-Developed	W-Water	O-Other	AL-Aso Land

Typical Landuse: C F R P Pr FS D O AL

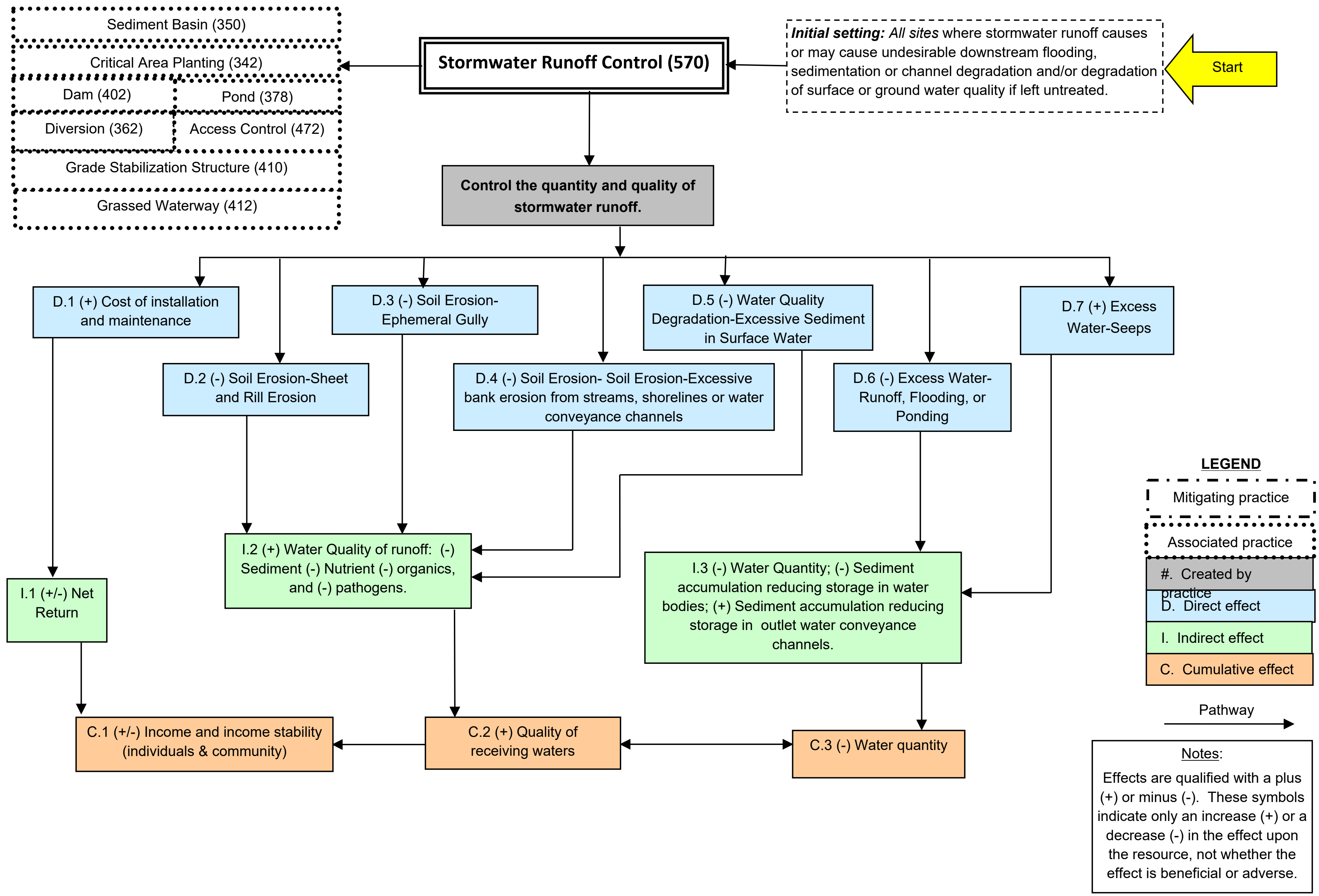
Soil Erosion	Effect	Rationale
Soil Erosion - Sheet and Rill Erosion	0	Not Applicable
Soil Erosion - Wind Erosion	0	Not Applicable
Soil Erosion - Ephemeral Gully Erosion	2	Erosion and sediment control features are a part of the practice
Soil Erosion - Classic Gully Erosion	0	Classic gullies on site are not a common feature of development site; off site gullies will receive controlled flows.
Soil Erosion - Streambank, Shoreline, Water Conveyance C	3	Stream banks on and off site will benefit from controlled flows.
Soil Quality Degradation		
Organic Matter Depletion	0	Not Applicable
Compaction	1	Controlling compaction from construction equipment
Subsidence	0	Not Applicable
Concentration of Salts or Other Chemicals	0	Not Applicable
Excess Water		
Excess Water - Seeps	-1	Any effect will tend to be an increase in seepage because of controlled runoff that may increase infiltration.
Excess Water - Runoff, Flooding, or Ponding	4	Runoff is to be controlled on the site itself.
Excess Water - Seasonal High Water Table	-1	Any effect will tend to be an increase in seepage because of controlled runoff that may increase infiltration.
Excess Water - Drifted Snow	0	Not Applicable
Insufficient Water		
Insufficient Water - Inefficient Use of Irrigation Water	0	Not Applicable
Insufficient Water - Inefficient Moisture Management	0	Not Applicable
Water Quality Degradation		
Pesticides in Surface Water	0	Not Applicable
Pesticides in Groundwater	0	Not Applicable
Nutrients in Surface water	2	Surface waters can be treated on site before release
Nutrients in Groundwater	0	Not Applicable
Salts in Surface Water	0	There could be some water contaminants on site, but overall impact of practice will be small. The action tends to increase on site infiltration/reduce runoff to off site.
Salts in Groundwater	0	There could be some water contaminants on site, but overall impact of practice will be small. The action tends to increase on site infiltration/reduce runoff to off site.
Excess Pathogens and Chemicals from Manure, Bio-solic	0	There could be some water contaminants on site, but overall impact of practice will be small/
Excess Pathogens and Chemicals from Manure, Bio-solic	0	There could be some water contaminants on site, but overall impact of practice will be small. The action tends to increase on site infiltration/reduce runoff to off site.

Excessive Sediment in Surface Water	-4	Controlling erosion and runoff will reduce off-site sediment.
Elevated Water Temperature	0	Controlled runoff could increase temperature on site, but will be little impact off site
Petroleum, Heavy Metals and Other Pollutants Transporte	2	Onsite treatment can reduce the release of heavy metals to surface waters
Petroleum, Heavy Metals and Other Pollutants Transporte	0	There could be some water contaminants on site, but overall impact of practice will be small. The action tends to increase on site infiltration/reduce runoff to off site.
Air Quality Impacts		
Emissions of Particulate Matter (PM) and PM Precursors	0	Not Applicable
Emissions of Ozone Precursors	0	Not Applicable
Emissions of Greenhouse Gases (GHGs)	0	Not Applicable
Objectionable Odors	0	Not Applicable
Degraded Plant Condition		
Undesirable Plant Productivity and Health	0	Not Applicable
Inadequate Structure and Composition	0	Not Applicable
Excessive Plant Pest Pressure	0	Not Applicable
Wildfire Hazard, Excessive Biomass Accumulation	0	Not Applicable
Fish and Wildlife - Inadequate Habitat		
Inadequate Habitat - Food	0	Not Applicable
Inadequate Habitat - Cover/Shelter	0	Not Applicable
Inadequate Habitat - Water	0	Not Applicable
Inadequate Habitat - Habitat Continuity (Space)	0	Not Applicable
Livestock Production Limitation		
Inadequate Feed and Forage	0	Not Applicable
Inadequate Shelter	0	Not Applicable
Inadequate Water	0	Not Applicable
Inefficient Energy Use		
Equipment and Facilities	0	Not Applicable
Farming/Ranching Practices and Field Operations	0	Not Applicable

CPPE Practice Effects:	*0 No Effect*
5 Substantial Improvement	*-1 Slight Worsening*
4 Moderate to Substantial Improvement	*-2 Slight to Moderate Worsening*
3 Moderate Improvement	*-3 Moderate Worsening*
2 Slight to Moderate Improvement	*-4 Moderate to Substantial Worsening*
1 Slight Improvement	*-5 Substantial Worsening*

NRCS CONSERVATION PRACTICE EFFECTS - NETWORK DIAGRAM

September 2020



Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

STREAMBANK AND SHORELINE PROTECTION

CODE 580

(ft)

DEFINITION

Treatment(s) used to stabilize and protect banks of streams or constructed channels and shorelines of lakes, reservoirs, or estuaries.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Prevent the loss of land or damage to land uses or facilities adjacent to the banks of streams or constructed channels and shorelines of lakes, reservoirs, or estuaries. This includes the protection of known historical, archaeological, and traditional cultural properties.
- Maintain the flow capacity of streams or channels.
- Reduce the offsite or downstream effects of sediment resulting from bank erosion.
- Improve or enhance the stream corridor or shoreline for fish and wildlife habitat, aesthetics, or recreation.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to streambanks of natural or constructed channels and shorelines of lakes, reservoirs, or estuaries susceptible to erosion. It does not apply to erosion problems on main ocean fronts, beaches, or similar areas of complexity.

CRITERIA

General Criteria Applicable to All Purposes

Plan, design, and construct this practice to comply with all Federal, State, and local laws, rules, and regulations. The landowner must obtain all necessary permissions from regulatory agencies, or document that no permits are required. The landowner and/or contractor is responsible for locating all buried utilities in the project area, including drainage tile and other structural measures.

Assess unstable streambank or shoreline sites in enough detail to identify the causes contributing to the instability. The assessment should provide details necessary for design of the treatments and convey reasonable confidence that the treatments will perform adequately for the design life of the measure. If the failure mechanism for a streambank is a result of the degradation or removal of riparian vegetation, if possible, implement stream corridor restoration, along with bank treatment.

Causes of instability include—

- Livestock access;
- Watershed alterations resulting in significant modifications of discharge or sediment production;
- In-channel modifications such as gravel mining;

- Head cutting;
- Water level fluctuations; and
- Boat-generated waves.

Design streambank and shoreline treatments that are compatible with—

- Existing bank or shoreline materials;
- Planned improvements or improvements installed by others;
- Water chemistry;
- Channel or lake hydraulics; and
- Slope characteristics above and below the water line.

Avoid adverse effects on—

- Endangered, threatened, and candidate species and their habitats;
- Archaeological, historical, structural, and traditional cultural properties; and
- Existing wetland functions and values.

Design treatments that result in stable slopes based on the bank or shoreline materials and the type of measure proposed. Account for anticipated ice action, wave action, and fluctuating water levels. Ensure that installations are protected from overbank flows from upslope runoff and flooding. Include internal drainage where bank seepage is a problem. Use geotextiles, designed filters, or bedding to prevent piping or erosion of material from behind the treatment. Anchor end sections into existing treatments or existing stable areas.

Revegetate all areas disturbed during construction in accordance with NRCS Conservation Practice Standard (CPS) Critical Area Planting (Code 342). If climatic conditions preclude the use of vegetation, use NRCS CPS Mulching (Code 484) to install inorganic cover materials such as gravel. Protect the area from livestock and human traffic until the site is fully stabilized.

Additional Criteria for Streambanks

Classify stream segments requiring protection according to a system deemed appropriate by the State. Evaluate incised segments or segments that contain the 5-year return period (20 percent probability) or greater flows for further degradation or aggradation.

Do not realign the channel without an assessment of upstream and downstream fluvial geomorphology that evaluates the impacts of the proposed alignment. Determine the current and future discharge-sediment regime using an assessment of the watershed upstream of the proposed channel alignment.

Do not install bank protection treatment in channel systems undergoing rapid and extensive changes in bottom grade and/or alignment unless designing the treatments to control or accommodate the changes. Construct bank treatment to a depth at or below the anticipated lowest depth of streambed scour.

Stabilize toe erosion by treatments that redirect the stream flow away from the toe or by structural treatments that armor the toe. Where toe protection alone is inadequate to stabilize the bank, shape the upper bank to a stable slope and establish vegetation, or stabilize with structural or soil bioengineering treatments.

To the extent possible, retain or replace habitat-forming elements that provide cover, food, pools, and water turbulence. This includes stumps, fallen trees, debris, and sediment bars. Only remove these stream habitat elements when they cause unacceptable bank erosion, flow restriction, or damage to structures.

Design treatments to remain functional and stable for the design flow and sustainable for higher flow conditions. Evaluate the effects of changes to flow levels compared with the preinstallation flow levels, for low and high flow conditions. Ensure treatments do not limit stream flow access to the floodplain. Do not design treatments that result in negative offsite impacts such as increased channel or bank erosion downstream.

Additional Criteria for Shorelines

For the design of structural treatments, evaluate the site characteristics below the waterline for a minimum of 50 feet horizontally from the shoreline measured at the design water surface. Base the height of the protection on the design water surface plus the computed wave height and freeboard. Use mean high tide as the design water surface in tidal areas. Limit revetments, bulkheads, or groins to no higher than 3 feet above mean high tide, or mean high water in nontidal areas. Key-in structural shoreline protective treatments to a depth that prevents scour during low water.

When using vegetation as the protective treatment, include a temporary breakwater during establishment when wave run-up could damage the vegetation.

Additional Criteria for Stream Corridor Improvement

Establish stream corridor vegetative components as necessary for ecosystem function and stability. The appropriate composition of vegetative components is a key element in preventing excess long-term channel migration in reestablished stream corridors. Establish vegetation on channel banks and associated areas according to NRCS CPS Critical Area Planting (Code 342).

Design treatments to achieve habitat and population objectives for fish and wildlife species or communities of concern as determined by a site-specific assessment or management plan. Establish objectives on the survival and reproductive needs of populations and communities, including habitat diversity, habitat linkages, daily and seasonal habitat ranges, limiting factors, and native plant communities. Develop the requirements for the type, amount, and distribution of vegetation using the requirements of the fish and wildlife species or communities of concern.

Design treatments to meet aesthetic objectives as determined by a site-specific assessment or management plan. Establish aesthetic objectives based on human needs, including visual quality, noise control, and microclimate control. Use construction materials, grading practices, and other site development elements compatible with adjacent land uses.

CONSIDERATIONS

When designing protective treatments, consider changes that may occur in the watershed hydrology and sedimentation over the design life of the treatments.

Incorporate debris removed from the channel or streambank into the treatment design when it is compatible with the intended purpose to improve benefits for fish, wildlife, and aquatic systems.

Use construction materials, grading practices, vegetation, and other site development elements that minimize visual impacts and maintain or complement existing landscape uses such as pedestrian paths, climate controls, buffers, etc. Avoid excessive disturbance and compaction of the site during installation.

Use vegetative species that are native and/or compatible with local ecosystems. Avoid introduced species that could become nuisances. Consider species that have multiple values such as those suited for biomass, nuts, fruit, browse, nesting, aesthetics, and tolerance to locally used herbicides. Avoid species that may be alternate hosts to disease or undesirable pests. Consider species diversity to avoid loss of function due to species-specific pests.

Select plant materials that provide habitat requirements for desirable wildlife and pollinators. The addition of native forbs and legumes to grass mixes will increase the value of plantings for both wildlife and pollinators. Consider and refer to NRCS CPS Wetland Wildlife Habitat Management (Code 644).

Use treatments that promote beneficial sediment deposition and the filtering of sediment and sediment-attached and dissolved substances.

Maintain or improve fish and wildlife habitat by including treatments that provide aquatic habitat in the treatment design and that may lower or moderate water temperature and improve water quality.

Stabilize side channel inlets and outlets, and outlets of tributary streams from erosion.

Maximize adjacent wetland functions and values with the project design to the extent practicable.

To maintain plant community integrity, exclude livestock during establishment of vegetative treatments and apply appropriate grazing practices after establishment.

Control wildlife during establishment of vegetative treatments. Use temporary and local population control methods with caution and within applicable regulations.

When appropriate, consider establishing a buffer strip and/or diversion at the top of the bank or shoreline protection zone to help maintain and protect installed treatments, improve their function, filter out sediments, nutrients, and pollutants from runoff, and provide additional wildlife habitat.

Consider safety hazards to boaters, swimmers, or people using the shoreline or streambank when designing treatments. Place warning signs as necessary.

Consider installing self-sustaining or minimal maintenance treatments.

PLANS AND SPECIFICATIONS

Prepare plans and specifications that describe the requirements for applying the practice according to this standard. Include provisions to minimize erosion and sediment production during construction and provisions necessary to comply with conditions of any environmental agreements, biological opinions, or other terms of applicable permits. At a minimum, include—

- A plan view of the layout of the streambank and shoreline protection.
- Typical profiles and cross sections of the streambank and shoreline protection.
- Structural drawings adequate to describe the construction requirements.
- Requirements for vegetative establishment and mulching, as needed.
- Safety features.
- Site-specific construction and material requirements.

OPERATION AND MAINTENANCE

Prepare an operation and maintenance plan for the operator.

At a minimum, include—

- Instructions for operating and maintaining the system to ensure it functions properly.
- Periodic inspections and prompt repair or replacement of damaged components.
- Periodic inspections and prompt repair of erosion.
- Instructions for maintaining healthy vegetation, when required.
- Instructions for controlling undesirable vegetation.

REFERENCES

USDA NRCS. 1996. National Engineering Handbook (Title 210), Part 650, Chapter 16, Streambank and Shoreline Protection. Washington, D.C. https://directives.sc.egov.usda.gov/

USDA NRCS. 2008. National Engineering Handbook (Title 210), Part 654, Stream Restoration Design. Washington, D.C. https://directives.sc.egov.usda.gov/

USDA NRCS. 2010. National Engineering Handbook (Title 210), Part 653, Stream Corridor Restoration: Principles, Processes, and Practices. Washington, D.C. https://directives.sc.egov.usda.gov/

USDA NRCS. 2017. National Engineering Manual (Title 210). Washington, D.C. https://directives.sc.egov.usda.gov/

Effects of NRCS Conservation Practices - National

Streambank and Shoreline Protection

Treatment(s) used to stabilize and protect banks of streams or constructed channels, and shorelines of lakes, reservoirs, or estuaries.

Code: 580
Units: ft.

C-Crop	F-Forest	R-Range	P-Pasture	Pr-Protected	FS-Farmstead	D-Developed	W-Water	O-Other	AL-Aso Land
C	F	R	P	Pr	FS	D		O	AL

Typical Landuse: C F R P Pr FS D O AL

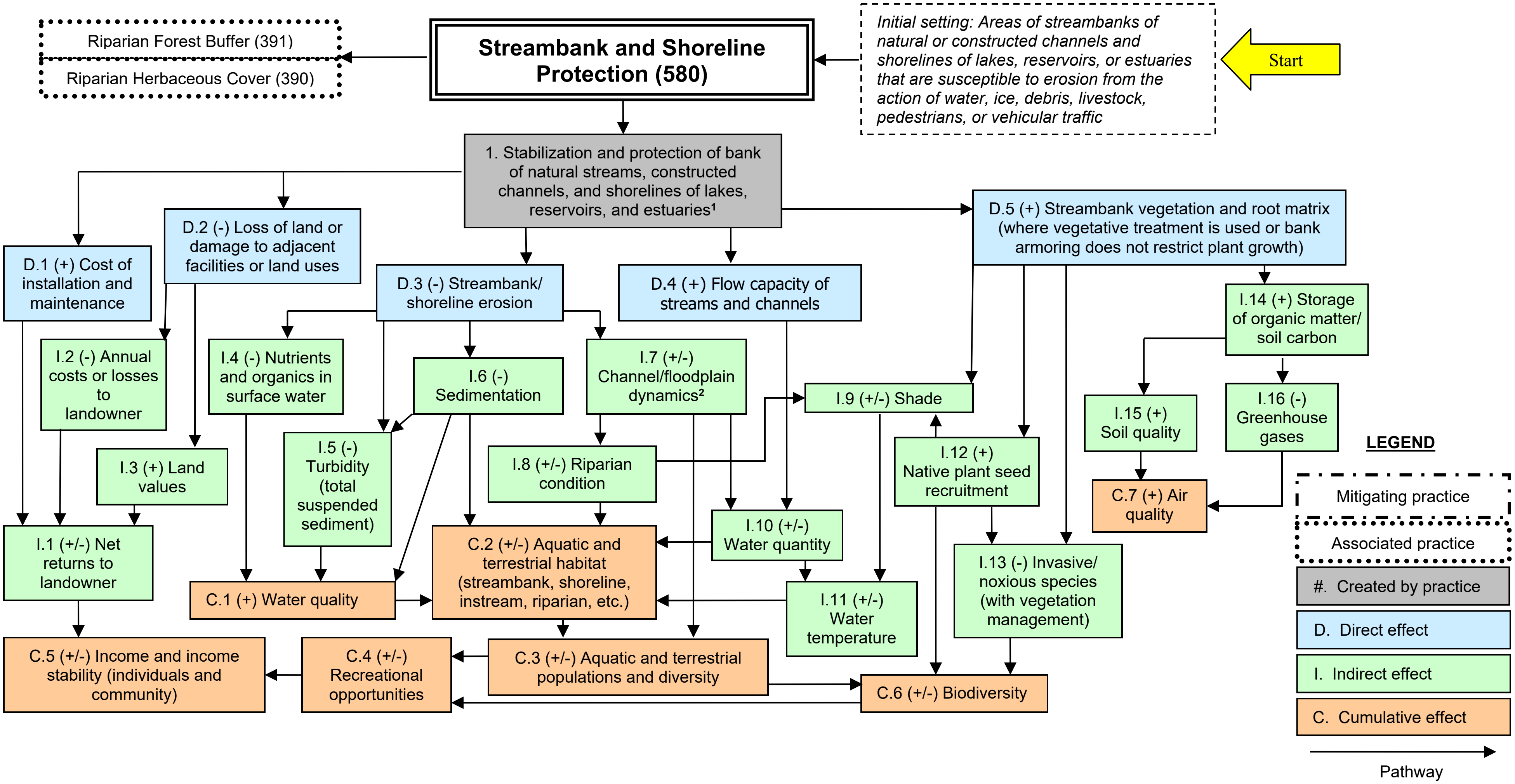
	Effect	Rationale
Soil Erosion		
Soil Erosion - Sheet and Rill Erosion	0	Not Applicable
Soil Erosion - Wind Erosion	0	Not Applicable
Soil Erosion - Ephemeral Gully Erosion	0	Not Applicable
Soil Erosion - Classic Gully Erosion	0	Not Applicable
Soil Erosion - Streambank, Shoreline, Water Conveyance C	4	Stream banks are stabilized.
Soil Quality Degradation		
Organic Matter Depletion	0	Not Applicable
Compaction	0	Not Applicable
Subsidence	0	Not Applicable
Concentration of Salts or Other Chemicals	0	Not Applicable
Excess Water		
Excess Water - Seeps	0	Not Applicable
Excess Water - Runoff, Flooding, or Ponding	0	Not Applicable
Excess Water - Seasonal High Water Table	0	Not Applicable
Excess Water - Drifted Snow	0	Not Applicable
Insufficient Water		
Insufficient Water - Inefficient Use of Irrigation Water	0	Not Applicable
Insufficient Water - Inefficient Moisture Management	0	Not Applicable
Water Quality Degradation		
Pesticides in Surface Water	0	Not Applicable
Pesticides in Groundwater	0	Not Applicable
Nutrients in Surface water	1	Stabilizing eroding banks will reduce the delivery of nutrients and organic material in the soil profile to surface water.
Nutrients in Groundwater	0	Not Applicable
Salts in Surface Water	0	Not Applicable
Salts in Groundwater	0	Not Applicable
Excess Pathogens and Chemicals from Manure, Bio-solic	1	Elimination of eroding banks in areas adjacent to feedlots and livestock stream accesses.
Excess Pathogens and Chemicals from Manure, Bio-solic	0	Not Applicable

Excessive Sediment in Surface Water	2	**Reduces erosion on banks and shorelines.**
Elevated Water Temperature	1	**The action includes vegetation along stream courses.**
Petroleum, Heavy Metals and Other Pollutants Transporte	0	**Not Applicable**
Petroleum, Heavy Metals and Other Pollutants Transporte	0	**Not Applicable**
Air Quality Impacts		
Emissions of Particulate Matter (PM) and PM Precursors	0	**Not Applicable**
Emissions of Ozone Precursors	0	**Not Applicable**
Emissions of Greenhouse Gases (GHGs)	1	**If used, vegetation residue stores carbon.**
Objectionable Odors	0	**Not Applicable**
Degraded Plant Condition		
Undesirable Plant Productivity and Health	4	**Protection measures improves site conditions to enhance plant health and vigor of the desired plant community.**
Inadequate Structure and Composition	4	**Protection measures create or maintain the desired plant community.**
Excessive Plant Pest Pressure	4	**Vegetation is installed and managed to control undesired species.**
Wildfire Hazard, Excessive Biomass Accumulation	0	**Not Applicable**
Fish and Wildlife - Inadequate Habitat		
Inadequate Habitat - Food	2	**Vegetation planted for stabilization can consist of food species.**
Inadequate Habitat - Cover/Shelter	2	**Vegetation planted for stabilization can consist of cover for wildlife.**
Inadequate Habitat - Water	0	**Measures taken are to be compatible with conservation of fish and wildlife habitat components in and adjacent to stream or shore.**
Inadequate Habitat - Habitat Continuity (Space)	2	**Stabilized banks and shoreline increase suitable space for fish.**
Livestock Production Limitation		
Inadequate Feed and Forage	1	**Re-establishment of streambank vegetation can provide additional forage.**
Inadequate Shelter	0	**Not Applicable**
Inadequate Water	0	**Not Applicable**
Inefficient Energy Use		
Equipment and Facilities	0	**Not Applicable**
Farming/Ranching Practices and Field Operations	0	**Not Applicable**

CPPE Practice Effects:	***0 No Effect***
5 Substantial Improvement	***-1 Slight Worsening***
4 Moderate to Substantial Improvement	***-2 Slight to Moderate Worsening***
3 Moderate Improvement	***-3 Moderate Worsening***
2 Slight to Moderate Improvement	***-4 Moderate to Substantial Worsening***
1 Slight Improvement	***-5 Substantial Worsening***

NRCS CONSERVATION PRACTICE EFFECTS - NETWORK DIAGRAM

October 2020



Notes:

Effects are qualified with a plus (+) or minus (-). These symbols indicate only an increase (+) or a decrease (-) in the effect upon the resource, not whether the effect is beneficial or adverse. **Projects involving long lengths of bank or shoreline, structural controls, substantial earth moving and/or fill, or sensitive waters may need to be evaluated in a site-specific EA or EIS.**

[1] Additional information about potential protection measures and their impacts is available in the EIS for the Emergency Watershed Protection (EWP) Program.

[2] Conventional bank armoring (e.g., rip rap, gabions) may result in decreased (-) channel/flood plain dynamics, and associated impacts, while other less intrusive methods (e.g., stream barbs, stone toes with sloped, vegetated banks) may result in increased (+) channel/flood plain dynamics.

United States Department of Agriculture

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

WETLAND CREATION

CODE 658

(ac)

DEFINITION

A wetland created on a site location that was historically not a wetland.

PURPOSE

This practice is used to accomplish one or more of the following primary purposes:

- Create wetland functional capacity for floodwater storage
- Create wetland functional capacity to provide fish and wildlife habitat
- Create a native plant community adapted to growth and regeneration in anaerobic conditions

In addition to one or more of the primary purposes, this practice can be applied to create wetland funtional capacity to improve water quality.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all Natural Resources Conservation Service (NRCS) land uses, where wetland hydrology can be established on a site that was historically not a wetland.

This practice does not apply to—

- Wetlands for the single purpose of treating wastewater or providing other water quality functions. Use NRCS Conservation Practice Standard (CPS) Constructed Wetland (Code 656).
- Water impoundment for the exclusive purpose of storing permeant water. Use NRCS CPS Pond (Code 378).
- The management of fish and wildlife habitat created under this standard. Use NRCS CPS Wetland Wildlife Habitat Management (Code 644).
- The management of water for the exclusive purpose of providing seasonal habitat for fish and/or wildlife. Use NRCS CPS Shallow Water Development and Management (Code 646).
- The treatment of point and nonpoint sources of water pollution. Use NRCS CPS Constructed Wetland (Code 656).
- The rehabilitation of a degraded wetland or the reestablishment of a former wetland so that soils, hydrology, vegetative community, and habitat are a close approximation of the original natural condition and boundary that existed prior to the modification. Use NRCS CPS Wetland Restoration (Code 657).
- The rehabilitation of a degraded wetland, the reestablishment of a former wetland, or the modification of an existing wetland, where specific wetland functions are augmented beyond the original natural conditions; possibly at the expense of other functions. Use NRCS CPS Wetland Enhancement (Code 659).
- Construction of a dam with significant or high hazard potential as defined in the NRCS National

Engineering Manual (Title 210), Part 520, Subpart C, “Dams,” Section 520.21.

CRITERIA

General Criteria Applicable to All Purposes

The created wetland must support wetland hydrology. For this practice, wetland hydrology is defined broadly as shallow inundation or saturation at or near the surface of the substrate (National Research Council, 1995), for a duration sufficient to create anerobic conditions within the plant rooting zone.

The hydroperiod (depth, duration, frequency, and timing of wetting events) and dominant water source must meet the wetland creation objectives.

The minimum wetland hydrology design criteria for this standard is (i) shallow inundation for 14 consecutive days during the growing season or (ii) soil saturation within 6 inches of the soil surface for 14 consecutive days during the growing season. The growing season is determined with the use of NRCS Wetlands (WETS) Climate Tables, using 28 degrees Fahrenheit and 50 percent probability and can be found at http://agacis.rcc-acis.org. Utilize DrainMod, SPAW or another NRCS approved water budget based analysis tool identified in the NRCS National Engineering Handbook (Title 210), Part 650, Chapter 19, “Hydrology Tools for Wetland Identification and Analysis”, to predict hydroperiod details for wetland creations with surface runoff hydrologic source. Design elevations need to consider water source elevations for created wetlands influenced primarily by ground water.

Soil and geologic material investigations, such as a pit trench, boring or other suitable investigations shall be conducted to characterize suitability of soil materials to support wetland hydrology.

Remove, render inoperable, or relocate any surface or subsurface drains that exist in the planned wetland area. This includes the perimeter of the wetland area for a distance equal to or greater than the lateral effect distance of the subsurface drain, as computed using methods in the NRCS National Engineering Handbook (Title 210), Part 650, Chapter 19, “Hydrology Tools for Wetland Identification and Analysis.” Treatment for subsurface drains may also include replacing perforated pipe with nonperforated pipe. Treatment for surface drains may include ditch plugs, with or without water control structures, to ensure that the site can hold water and water flow is controlled in a nonerosive manner. If ditch plugs are used, design according to the criteria in NRCS CPS Dike (Code 356).

If an embankment is needed to accomplish the wetland objectives, design the embankment according to NRCS CPS Dike (Code 356). Include a principal spillway according to NRCS CPS Structure for Water Control (Code 587) as needed for water level control and to maintain the target pool level for adequate freeboard.

For noncropped areas, ensure the created wetland supports wetland vegetation adapted for growth under prolonged periods of soil saturation or inundation. Where natural colonization of species meeting the practice purpose is expected, the created wetland may be left to revegetate naturally. Otherwise, target plant species will be established by seeding or planting using a vegetative establishment NRCS conservation practice standard meeting the project purpose. For cropped areas, modify the cropping system in consideration of the planned wetland hydrologic regime.

If tree planting is conducted, use NRCS CPS Tree/Shrub Establishment (Code 612) or Riparian Forest Buffer (Code 391).

If planting herbaceous vegetation, use NRCS CPS Conservation Cover (Code 327) or Wildlife Habitat Planting (Code 420).

If needed to meet the practice purpose, ensure adequate water rights are available (timing and amount of water).

Avoidor implement mitigation measures if the site is suspected or confirmed ofcontaining hazardous material.

Additional Criteria for Creating Wetland Functional Capacity for Floodwater Storage or Storage of Water to Reduce Downstream Flooding

If needed, install a water control structure according to NRCS CPS Structure for Water Control (Code 587).

- Manage the structure to ensure floodwater storage capacity is available prior to the normal wet season.
- Utilize WebWIMP (Matsuura et al., 2003) https://davinci.geog.udel.edu/~wimp/ or another climate-based prediction tool, to determine the normal wet portion of the year.
- Design the water control structure to allow for a maximum 7-day drawdown period, while maintaining the designed minimum wetland hydrology.
- Manage the structure to maintain wetland hydrology criteria following drawdown.

Additional Criteria for Creating Wetland Functional Capacity for Fish and Wildlife Habitat

Conduct a suitable wildlife habitat evaluation based on as-built conditions to ensure needs of target species will be met.

Utilize NRCS CPS Wildlife Habitat Planting (Code 420) for all herbaceous or shrub vegetative plantings within the wetland. If Wildlife Habitat Planting (Code 420) is not available, the use of NRCS CPS Conservation Cover (Code 327) can be utilized but be implemented with wildlife as the purpose.

If NRCS CPS Structure for Water Control (Code 587) is implemented, NRCS CPS Shallow Water Development and Management (Code 646) or NRCS CPS Wildlife Habitat Management (Code 644) will be applied to optimize the management of water for the target fish or wildlife species.

Additional Criteria for Creating a Native Plant Community Adapted to Growth and Regeneration of Anaerobic Conditions

Identify the target native plant community with the use of a local reference site, NRCS ecological site description, or another source (e.g., Nature Serve).

Additional Criteria for Creating Wetland Functional Capacity for Water Quality

For noncropped areas, establish vegetation based on the plants' ability to address the identified water quality concern (e.g., filter sediments and sequester nutrients and pesticides). For cropped areas, select a cropping system to ensure water quality function addresses the water quality concern.

When nitrate sequestration is an objective—

- Design the wetland to maximize the number of periods of anaerobic and aerobic conditions in the substrate during the growing season.
- If a cropped wetland, utilize crops with high nitrogen demand. Forego application of nitrogen fertilizer.

CONSIDERATIONS

On all wetlands being created—

- Treat excessive soil erosion within the wetland's immediate watershed to ensure the wetland functions as designed over the practice life. If this is not feasible, utilize NRCS CPS Sediment Basin (Code 350).
- Excavation, grading, mechanical compaction, or soil amendments may be needed to support wetland hydrology.
- Avoid sites with steep toporaphic gradients, consider and use sites with natural topography when possible.
- Avoid the construction on sites where large amounts of sulfur (S), iron (Fe) and aluminum (Al) or

any acid sulfate bearing minerals (examples: jarosite, pyrate) could be present.

- Adjust target conditions based on the nutrient and pesticide tolerance of the plant and animal species likely to occur where known nutrient and pesticide contamination exists.
- If soil carbon is inadequate, add coarse woody debris or sawdust, as appropriate to improve soil carbon content.
- Establish fish and wildlife corridors by linking the site to adjacent landscapes, streams, and waterbodies. This may increase the potential for colonization of the site by native flora and fauna.
- Add substrate materials from a donor wetland to provide organic matter and a seed bank of hydrophytes if the target conditions are local genotypes, and such materials are not commercially available. Inventory donor site to determine risk of introducing invasive and noxious plants.
- Control invasive and noxious plants.
- Modify design to minimize offsite impacts related to water temperature, flows, and water availability.

On created wetlands with water control capabilities—

- Assess the potential increased predation of aquatic organisms under planned water management regimes. Modify water management as needed.
- Implement NRCS CPS Aquatic Organism Passage (Code 396).

PLANS AND SPECIFICATIONS

Prepare plans and specifications in accordance with the criteria of this standard and describe the requirements for applying the practice to achieve its intended purpose. As a minimum,include—

- A site-specific plan view of the practice showing the main features of the project.
- Typical profiles and cross sections of berms, excavated side slopes, spillways, and other earthen features.
- Detail drawings of structures and appurtenances, as applicable.
- Specifications that include materials, quantities, methods, sequence, and timing of project implementation needed to create the target hydroperiod (depth, duration, timing, and frequency) of saturation or inundation.
- Conservation practice standard specifications for the vegetative establishment practice used including a schedule of the measurable or observable success criteria for target vegetative conditions.

OPERATION AND MAINTENANCE

The operation and maintenance plan will include the actions necessary to ensure installed conservation practice standards are maintained for the life of the practice. It will include—

- Inspection schedules.
- A list of items requiring inspection.
- Procedures and documentation requirements for inspections.

REFERENCES

National Research Council. 1995. Wetlands: Characteristics and Boundaries. Washington, D.C.: The National Academies Press. https://doi.org/10.17226/4766

Matsuura K., C. Willmott, and D. Legates. 2003. “WebWIMP, The Web-Based Water-Budget, Interactive, Modeling Program.” University of Delaware. Accessed July 14, 2020. https://davinci.geog.udel.edu/~wimp/

USDA NRCS. 2008. National Engineering Handbook (Title 210), Part 650, Chapter 13, Wetland Restoration, Enhancement, or Creation. Washington, D.C.https://directives.sc.egov.usda.gov/

USDA NRCS. 2015. National Engineering Handbook (Title 210), Part 650, Chapter 19, Hydrology Tools for Wetland Identification and Analysis. Washington, D.C.https://directives.sc.egov.usda.gov/

USDA NRCS. 2003. Technical Note (Title 190), Biology 15, Wetland Restoration, Enhancement, and Management. Washington, D.C.
https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_010838.pdf

Effects of NRCS Conservation Practices - National

Wetland Creation

The creation of a wetland on a site location that was historically non-wetland.

Code: 658
Units: ac.

C-Crop	F-Forest	R-Range	P-Pasture	Pr-Protected	FS-Farmstead	D-Developed	W-Water	O-Other	AL-Aso Land
C	F	R	P	Pr			W	O	AL

Typical Landuse: C F R P Pr W O AL

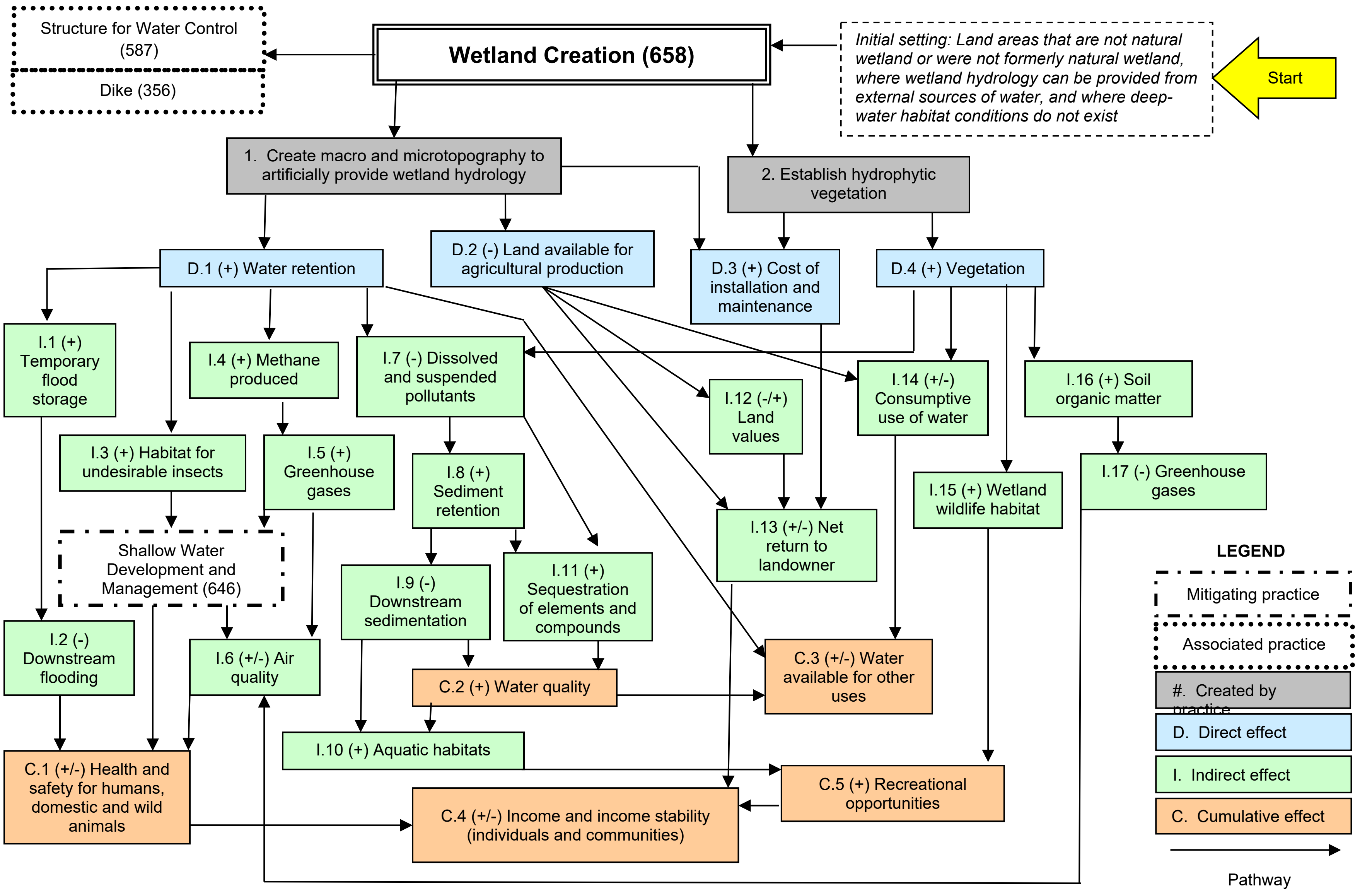
Soil Erosion	Effect	Rationale
Soil Erosion - Sheet and Rill Erosion	0	Not Applicable
Soil Erosion - Wind Erosion	0	Not Applicable
Soil Erosion - Ephemeral Gully Erosion	0	Not Applicable
Soil Erosion - Classic Gully Erosion	0	Not Applicable
Soil Erosion - Streambank, Shoreline, Water Conveyance C	0	Not Applicable
Soil Quality Degradation		
Organic Matter Depletion	2	Water ponding promotes growth of wetland vegetation and reduces decomposition of soil organic matter.
Compaction	0	Not Applicable
Subsidence	0	Not Applicable
Concentration of Salts or Other Chemicals	0	Not Applicable
Excess Water		
Excess Water - Seeps	0	Not Applicable
Excess Water - Runoff, Flooding, or Ponding	2	Provides temporary flood storage reducing flooding and ponding.
Excess Water - Seasonal High Water Table	-1	Increases infiltration to subsurface water.
Excess Water - Drifted Snow	0	Not Applicable
Insufficient Water		
Insufficient Water - Inefficient Use of Irrigation Water	0	Not Applicable
Insufficient Water - Inefficient Moisture Management	0	Not Applicable
Water Quality Degradation		
Pesticides in Surface Water	1	The action captures pesticide residues and facilitates their degradation.
Pesticides in Groundwater	1	The action captures pesticide residues and facilitates their degradation.
Nutrients in Surface water	3	Wetland systems will utilize dissolved nutrients and trap sediment-attached nutrients and organics.
Nutrients in Groundwater	1	The action traps nutrients and organics which are broken down and used by wetland plants.
Salts in Surface Water	1	Any salts in surface runoff will be detained in the wetland. Some wetland plants may take up salts.
Salts in Groundwater	0	Not Applicable
Excess Pathogens and Chemicals from Manure, Bio-solic	1	Pathogens are trapped in the wetland.
Excess Pathogens and Chemicals from Manure, Bio-solic	0	Not Applicable

Excessive Sediment in Surface Water	2	System traps sediment.
Elevated Water Temperature	0	Improved hydrological conditions are likely.
Petroleum, Heavy Metals and Other Pollutants Transporte	2	Vegetation and anaerobic conditions trap heavy metals.
Petroleum, Heavy Metals and Other Pollutants Transporte	0	Not Applicable
Air Quality Impacts		
Emissions of Particulate Matter (PM) and PM Precursors	0	Not Applicable
Emissions of Ozone Precursors	0	Not Applicable
Emissions of Greenhouse Gases (GHGs)	1	The accumulation of organic matter and sediments sequester carbon. However, anaerobic conditions can promote the generation of methane.
Objectionable Odors	-1	Anaerobic conditions can promote the generation of hydrogen sulfide and other odorous compounds.
Degraded Plant Condition		
Undesirable Plant Productivity and Health	4	Plants are selected and managed to maintain optimal productivity and health for their intended use.
Inadequate Structure and Composition	4	Plants selected are adapted and suited.
Excessive Plant Pest Pressure	4	Vegetation is installed and managed to control undesired species.
Wildfire Hazard, Excessive Biomass Accumulation	0	Not Applicable
Fish and Wildlife - Inadequate Habitat		
Inadequate Habitat - Food	5	Areas for food are created.
Inadequate Habitat - Cover/Shelter	5	Areas for cover/shelter are created.
Inadequate Habitat - Water	0	Created wetlands will benefit some species, but their creation can alter hydrology of the area.
Inadequate Habitat - Habitat Continuity (Space)	4	Additional wetland space is created.
Livestock Production Limitation		
Inadequate Feed and Forage	2	These sites may be used as feed and forage by livestock if the intended purpose is maintained.
Inadequate Shelter	0	Not Applicable
Inadequate Water	0	Not Applicable
Inefficient Energy Use		
Equipment and Facilities	0	Not Applicable
Farming/Ranching Practices and Field Operations	0	Not Applicable

CPPE Practice Effects:	*0 No Effect*
5 Substantial Improvement	*-1 Slight Worsening*
4 Moderate to Substantial Improvement	*-2 Slight to Moderate Worsening*
3 Moderate Improvement	*-3 Moderate Worsening*
2 Slight to Moderate Improvement	*-4 Moderate to Substantial Worsening*
1 Slight Improvement	*-5 Substantial Worsening*

NRCS CONSERVATION PRACTICE EFFECTS - NETWORK DIAGRAM

Date 2022



Note:

Effects are qualified with a plus (+) or minus (-). These symbols indicate only an increase (+) or a decrease (-) in the effect upon the resource, not whether the effect is beneficial or adverse.

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

WETLAND ENHANCEMENT

CODE 659

(ac)

DEFINITION

The augmentation of wetland functions beyond the original natural conditions on a former, degraded, or naturally functioning wetland site; sometimes at the expense of other functions.

PURPOSE

This practice is used to accomplish the following purposes:

- To enhance hydric soil functions (changing soil hydrodynamic and/or bio-geochemical properties).
- To enhance wetland hydrology (dominant water source, hydroperiod, and hydrodynamics).
- To enhance vegetation (including the removal of undesired species, and/or seeding or planting of desired species).
- To enhance plant and animal habitats.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to any degraded or non-degraded wetland sites with hydric soils, where the objective is to enhance selected wetland functions to conditions different than those that originally existed on the site.

This practice does not apply to:

- The treatment of point and non-point sources of water pollution (NRCS Conservation Practice Standard (CPS) Constructed Wetland (Code 656));
- The rehabilitation of a degraded wetland or the reestablishment of a former wetland so that soils, hydrology, vegetative community, and habitat are a close approximation of the original natural condition and boundary that existed prior to the modification (NRCS CPS Wetland Restoration (Code 657)).
- The creation of a wetland on a site location that was historically non-wetland. (NRCS CPS Wetland Creation (Code 658)).
- The management of fish and wildlife habitat on wetlands enhanced under this standard.

CRITERIA

General Criteria Applicable to All Purposes

The purpose, goals, and objectives of the enhancement shall be clearly defined in the enhancement plan, including soils, hydrology, vegetation, and fish and wildlife habitat criteria that are to be met and are appropriate for the site and the project objectives.

The planning process will evaluate the impact of this practice on existing non-degraded wetland functions and/or values. The relative increase or decrease in functions will be assessed with the use of a functional assessment procedure or state approved equivalent. The functions to be increased or decreased on wetlands found to be currently functioning at or near a “reference” condition will be documented.

The soils, hydrology, and vegetative conditions existing on the site, the adjacent landscape, and the contributing watershed shall be documented in the planning process.

The nutrient and pesticide tolerance of the plant and animal species likely to occur shall be evaluated where known nutrient and pesticide contamination exists. Sites suspected of containing hazardous material shall be tested to identify appropriate remedial measures. If remedial measures are not possible or practicable, the practice shall not be planned.

The availability of sufficient water rights should be reviewed prior to enhancement.

Upon completion, the site shall meet the appropriate wetland criteria and provide wetland functions as defined in the project’s objectives.

Invasive species, federal/state listed noxious plant species, and nuisance species (e.g., those whose presence or overpopulation jeopardize the practice) shall be controlled on the site as necessary to enhance wetland functions. The establishment and/or use of non-native plant species shall be discouraged.

Additional Criteria for Hydric Soil Enhancement

Enhancement sites will be located on soils that are hydric.

Changes to soil hydrodynamic and bio-geochemical properties such as permeability, porosity, pH, or soil organic carbon levels shall be made as needed to meet the planned objectives.

Additional Criteria for Hydrology Enhancement

The hydroperiod, hydrodynamics, and dominant water source of the enhanced site shall meet the project objectives. The enhancement plan shall document the adequacy of available water sources based on groundwater investigation, stream gage data, water budgeting, or other appropriate means.

The work associated with the wetland shall not adversely affect adjacent properties or other water users unless agreed to by signed written letter, easement or permit.

Timing and level setting of water control structures required for the establishment and maintenance of vegetation, soil, and wildlife and fish habitat functions shall be determined.

Other structural practices, macrotopography and/or microtopography may be used to meet the planned objectives.

Macrotopographic features, including ditch plugs installed in lieu of re-filling surface drainage ditches, shall meet the requirements of other practice standards to which they may apply due to purpose, size, water storage capacity, hazard class, or other parameters. If no other practice standard applies, they shall meet the requirements for NRCS CPS Dike (Code 356) unless there is no potential for damage to the feature or other areas on or off site due to erosion, breaching, or overtopping.

Water control structures that may impede the movement of target aquatic species or species of concern shall meet the criteria in NRCS CPS Fish Passage (Code 396).

Additional Criteria for Vegetative Enhancement

Hydrophytic vegetation restoration shall be of species typical for the wetland type(s) being established and the varying hydrologic regimes and soil types within the wetland. Preference shall be given to native wetland plants with localized genetic material.

Where natural colonization of acceptable species can realistically be expected to occur within 5 years, sites may be left to re-vegetate naturally. If not, the appropriate species will be established by seeding or planting.

Adequate substrate material and site preparation necessary for proper establishment of the selected plant species shall be included in the plan.

Where planting and/or seeding is necessary, the minimum number of native species to be established shall be based on a reference wetland unless the objectives require a different plant community.

- If the targeted hydrophytic vegetation is predominantly herbaceous, species diversity will be maximized as appropriate to meet the targeted functions. Seeding rates shall be based upon the percentage of pure live seed and labeled with a current seed tag from a registered seed laboratory identifying the germination rate, purity analysis, and other seed statistics.
- Where the dominant vegetation will be forest or woodland community types, vegetation establishment will include a mix of woody species (trees and/or shrubs) adequate to establish the reference wetland community.

CONSIDERATIONS

Soil Considerations

Consider making changes to physical soil properties, including:

- Increasing or decreasing saturated hydraulic conductivity by mechanical compaction or tillage, as appropriate
- Incorporating soil amendments.
- The effect of construction equipment on soil density, infiltration, and structure.

Consider changes in soil bio-geochemical properties, including:

- Increasing soil organic carbon by incorporating compost.
- Increasing or decreasing soil pH with lime, gypsum, or other compounds.

Hydrology Considerations

Consider the general hydrologic effects of the enhancement, including:

- Impacts on downstream stream hydrographs, volumes of surface runoff, and groundwater resources due to changes of water use and movement created by the enhancement.

Consider the impacts of water level management, including:

- Increased predation due to concentrating aquatic organisms, including herptivores, in small pool areas during draw downs.
- Increased predation of amphibians due to high water levels that can sustain predator fish.
- Decreased ability of aquatic organisms to move within the wetland and from the wetland area to adjacent habitats, including fish and amphibians, as water levels are decreased.
- Increases in water temperature on-site, and in off-site receiving waters.
- Changes in the quantity and direction of movement of subsurface flows due to increases or decreases in water depth.
- The effect changes in anaerobic conditions have on soil bio-geochemical properties; including oxidation/reduction, and maintenance of organic soils.
- The potential for water control structures, dikes, and macrotopographic features to negatively impact the movement of non-target aquatic organisms.

Vegetation Considerations

Consider:

- The relative effects of planting density on fish and wildlife habitat versus production rates in woody plantings.
- The potential for vegetative buffers to increase function by trapping sediment, cycling nutrients, and removing pesticides.
- The selection of vegetation for the protection of structural measures that is appropriate for wetland function.
- The potential for invasive or noxious plant species to establish on bare soils after construction and before the planned plant community is established.
- The use of prescribed burning to maintain wetland and adjacent upland plant communities.

Fish and Wildlife Habitat Considerations

Consider:

- The addition of coarse woody debris to provide an initial carbon source and fish and wildlife cover.
- The potential to restore habitat capable of supporting fish and wildlife with the ability to control disease vectors such as mosquitoes.
- The potential to establish fish and wildlife corridors linking the site to adjacent landscapes, streams, and water bodies and to increase the sites colonization by native flora.
- The need to provide barriers to passage for unwanted or predatory fish and wildlife species.

PLANS AND SPECIFICATIONS

Plans and specifications for this practice shall be prepared for each site. Plans and specifications shall be recorded using approved specifications sheets, job sheets, or other documentation. The plans and specifications for structural features will include, at a minimum, a plan view, quantities, and sufficient profiles and cross-sections to define the location, line, and grade for stakeout and checkout. Plans and specifications shall be reviewed and approved by staff with appropriate job approval authority.

OPERATION AND MAINTENANCE

A separate operation and maintenance plan will be prepared for sites that have structural features. The plan will include specific actions for the normal and repetitive operation of installed structural items, especially water control structures, if included in the project. The plan will also include the actions necessary to assure that constructed items are maintained for the life of the project. It will include the inspection schedule, a list of items to inspect, a checklist of potential damages to look for, recommended repairs, and procedures for documentation.

Management and monitoring activities needed to ensure the continued success of the wetland enhancement objectives may be included in the above plan, or in a separate management and monitoring plan. In addition to the monitoring schedule, this plan may include the following:

- The timing and methods for the use of fertilizers, pesticides, prescribed burning, or mechanical treatments.
- Circumstances when the use of biological control of undesirable plant species and pests (e.g. using predator or parasitic species) is appropriate, and the approved methods.
- Actions which specifically address any expected problems from invasive or noxious species
- The circumstances which require the removal of accumulated sediment.
- Conditions which indicate the need to use haying or grazing as a management tool, including timing and methods.

REFERENCES

Executive Order 13112, Invasive Species, February 3, 1999. Federal Register: Vol.64, No.25. Feb. 8, 1999. http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=1999_register&docid= 99-3184-filed.pdf

Galatowitsch, Susan, et al, 1994. Restoring Prairie Wetlands: an ecological approach. Iowa State University Press, Ames, IA. 246 pp.

Hall, C.D. and F.J. Cuthbert. 2000. Impact of a controlled wetland drawdown on Blanding's Turtles in Minnesota. Chelonian Conservation Biology. Vol. 3, No. 4, pp. 643-649Hurt, G.W.and V.W. Carlisle, 2001.

Delineating Hydric Soils, in Wetland Soils – Genesis, Hydrology, Landscapes and Classification. Edited by J.L. Richardson and M.J Vepraskas. CRC Press, Boca Raton, FL pp. 183 – 206.

Kingsbury, Bruce & Joanne Gibson, 2002. Habitat Management Guidelines for Amphibians and Reptiles of the Midwest. Partners in Amphibian & Reptile Conservation, Ft Wayne IN, 57 pp.

M.J. Vepraskas ands S. W. Sprecher editors, 1997. Aquic Conditions and Hydric Soils: The Problem Soils. Soil Science Society of America Special Publication Number 50. SSSA, Inc. Madison, WI.

Maschhoff, Justin T & James H. Dooley, 2001. Functional Requirements and Design Parameters for Restocking Coarse Woody Features in Restored Wetlands, ASAE Meeting Presentation, Paper No: 012059.

USDA, NRCS, 2003. ECS 190-15 Wetland Restoration, Enhancement, Management & Monitoring. 425 pp.

ftp://ftp-fc.sc.egov.usda.gov/WLI/wre&m.pdf

USDA, NRCS. 2002. Field Indicators of Hydric Soils in the U.S., Version 6.0. G.W. Hurt, P.M. Whited and R.F. Pringle (eds.). USDA, NRCS in cooperation with the National Technical Committee for Hydric Soils, Fort Worth, TX.

ftp://ftp-fc.sc.egov.usda.gov/NSSC/Hydric_Soils/FieldI ndicators_v6_0.pdf

USDA, NRCS. Wetland Restoration, Enhancement, or Creation, Engineering Field Handbook Chapter 13, Part 650. 121 pp. ftp://ftp-fc.sc.egov.usda.gov/WLI/wre&m.pdf

USDA-NRCS. 2000. Indiana Biology Technical Note 1.

USDA-NRCS. Hydric Soil Technical Note 13, Deliberations of the National Technical Committee for Hydric Soils (NTCHS).

ftp://ftp-fc.sc.egov.usda.gov/NSSC/Hydric_Soils/note1 3.pdf

Effects of NRCS Conservation Practices - National

Wetland Enhancement

Code: 659
Units: ac.

The augmentation of wetland functions beyond the original natural conditions on a former, degraded, or naturally functioning wetland site; sometimes at the expense of other functions.

C-Crop	F-Forest	R-Range	P-Pasture	Pr-Protected	FS-Farmstead	D-Developed	W-Water	O-Other	AL-Aso Land
C	F	R	P	Pr			W	O	AL

Typical Landuse: C F R P Pr W O AL

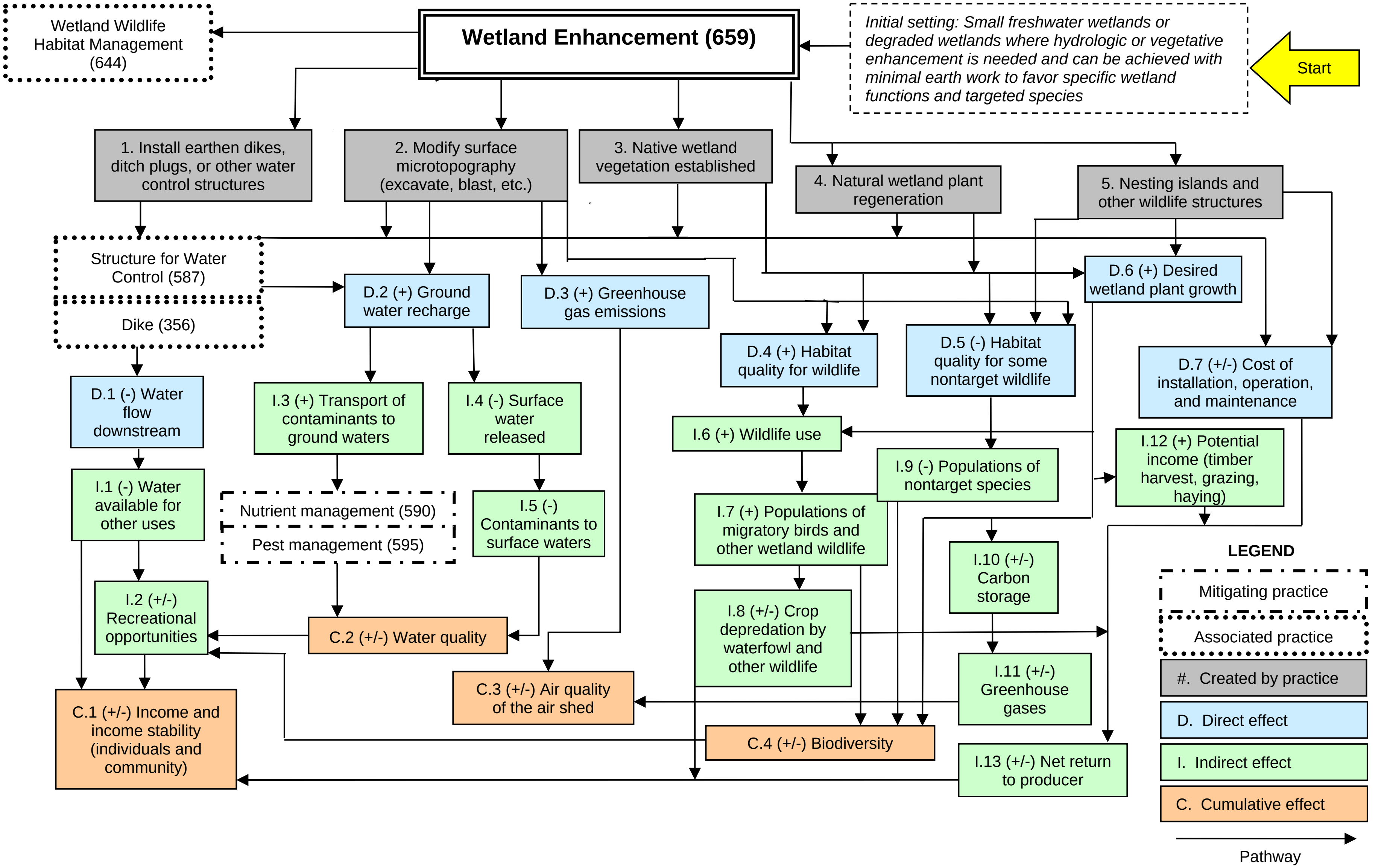
Soil Erosion	Effect	Rationale
Soil Erosion - Sheet and Rill Erosion	0	Not Applicable
Soil Erosion - Wind Erosion	0	Not Applicable
Soil Erosion - Ephemeral Gully Erosion	0	Not Applicable
Soil Erosion - Classic Gully Erosion	0	Not Applicable
Soil Erosion - Streambank, Shoreline, Water Conveyance C	0	Not Applicable
Soil Quality Degradation		
Organic Matter Depletion	1	Water ponding promotes growth of wetland vegetation and reduces decomposition of soil organic matter.
Compaction	0	Not Applicable
Subsidence	0	Not Applicable
Concentration of Salts or Other Chemicals	0	Not Applicable
Excess Water		
Excess Water - Seeps	0	Not Applicable
Excess Water - Runoff, Flooding, or Ponding	2	Provides temporary flood storage reducing flooding and ponding.
Excess Water - Seasonal High Water Table	0	Not Applicable
Excess Water - Drifted Snow	0	Not Applicable
Insufficient Water		
Insufficient Water - Inefficient Use of Irrigation Water	0	Not Applicable
Insufficient Water - Inefficient Moisture Management	0	Not Applicable
Water Quality Degradation		
Pesticides in Surface Water	1	The action captures pesticide residues and facilitates their degradation.
Pesticides in Groundwater	1	The action captures pesticide residues and facilitates their degradation.
Nutrients in Surface water	3	Wetland systems will utilize dissolved nutrients and trap sediment-attached nutrients and organics.
Nutrients in Groundwater	1	The action traps nutrients and organics which are broken down and used by wetland plants.
Salts in Surface Water	1	Any salts in surface runoff will be detained in the wetland. Some wetland plants may take up salts.
Salts in Groundwater	0	Not Applicable
Excess Pathogens and Chemicals from Manure, Bio-solic	1	Pathogens are trapped in the wetland.
Excess Pathogens and Chemicals from Manure, Bio-solic	0	Not Applicable

Excessive Sediment in Surface Water	2	System traps sediment.
Elevated Water Temperature	0	Improved hydrological conditions are likely.
Petroleum, Heavy Metals and Other Pollutants Transporte	2	Vegetation and anaerobic conditions trap heavy metals.
Petroleum, Heavy Metals and Other Pollutants Transporte	0	Not Applicable
Air Quality Impacts		
Emissions of Particulate Matter (PM) and PM Precursors	0	Not Applicable
Emissions of Ozone Precursors	0	Not Applicable
Emissions of Greenhouse Gases (GHGs)	1	The accumulation of organic matter and sediments sequester carbon. However, anaerobic conditions can promote the generation of methane.
Objectionable Odors	-1	Anaerobic conditions can promote the generation of hydrogen sulfide and other odorous compounds.
Degraded Plant Condition		
Undesirable Plant Productivity and Health	4	Plants are selected and managed to maintain optimal productivity and health for their intended use.
Inadequate Structure and Composition	4	Plants selected are adapted and suited.
Excessive Plant Pest Pressure	4	Vegetation is installed and managed to control undesired species.
Wildfire Hazard, Excessive Biomass Accumulation	0	Not Applicable
Fish and Wildlife - Inadequate Habitat		
Inadequate Habitat - Food	5	Existing areas for food are enhanced.
Inadequate Habitat - Cover/Shelter	5	Areas for cover/shelter are enhanced.
Inadequate Habitat - Water	0	Enhancement of wetlands will improve habitat and water quality for many species; the number and types of species that will benefit is dependent on the degree to which hydrological conditions are improved.
Inadequate Habitat - Habitat Continuity (Space)	4	Additional wetland space is enhanced.
Livestock Production Limitation		
Inadequate Feed and Forage	2	These sites may be used as feed and forage by livestock if the intended purpose is maintained.
Inadequate Shelter	0	Not Applicable
Inadequate Water	0	Not Applicable
Inefficient Energy Use		
Equipment and Facilities	0	Not Applicable
Farming/Ranching Practices and Field Operations	0	Not Applicable

CPPE Practice Effects:	*0 No Effect*
5 Substantial Improvement	*-1 Slight Worsening*
4 Moderate to Substantial Improvement	*-2 Slight to Moderate Worsening*
3 Moderate Improvement	*-3 Moderate Worsening*
2 Slight to Moderate Improvement	*-4 Moderate to Substantial Worsening*
1 Slight Improvement	*-5 Substantial Worsening*

NRCS CONSERVATION PRACTICE EFFECTS - NETWORK DIAGRAM

November 2022

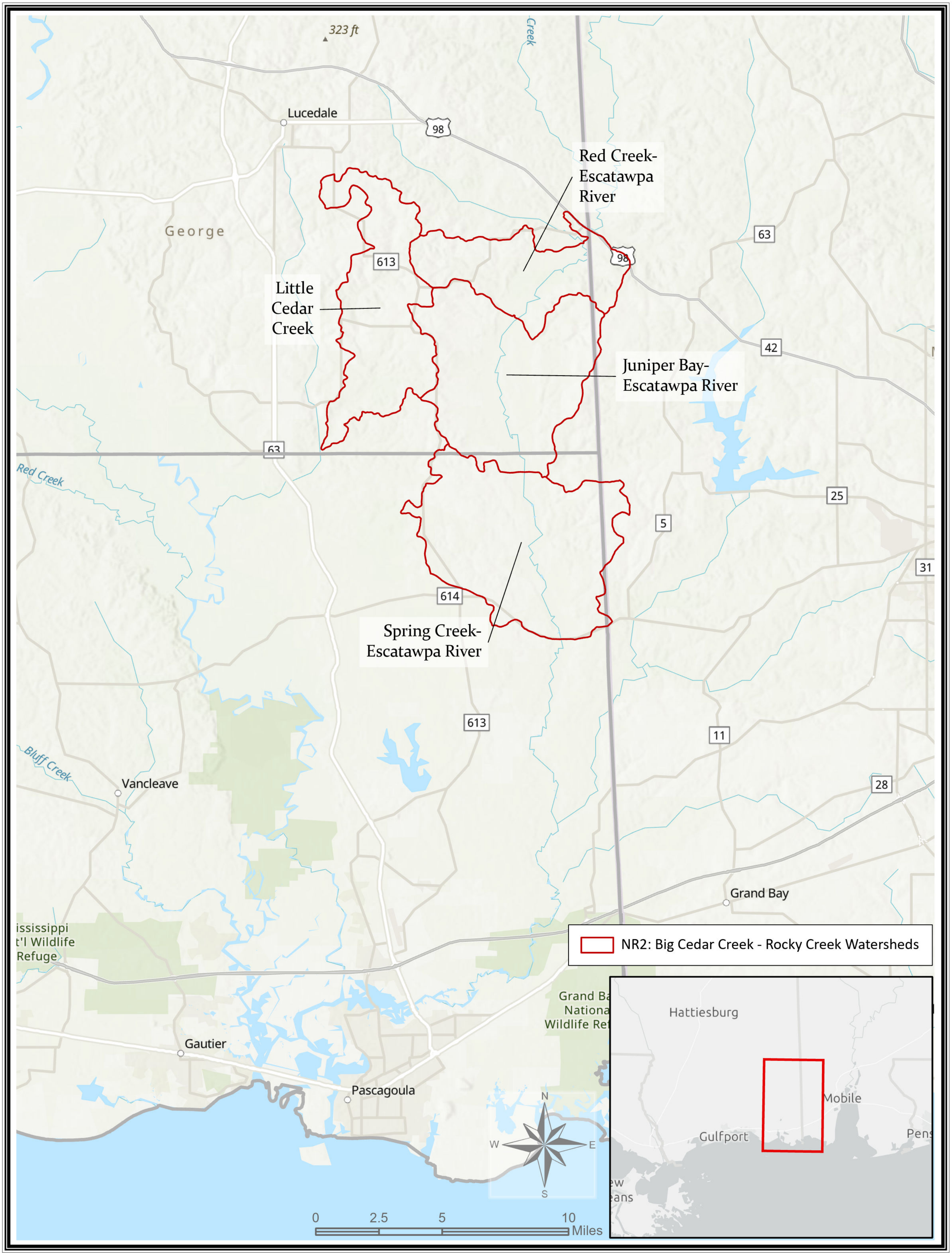


Notes:

Effects are qualified with a plus (+) or minus (-). These symbols indicate only an increase (+) or a decrease (-) in the effect upon the resource, not whether the effect is beneficial or adverse.

Nutrient Reduction Alternative 2: Big Cedar Creek-Rocky Creek

Project Area Map
List of USDA NRCS Conservation Practices
USDA NRCS Exemplar Conservation Practice Standards
Effects of Exemplar NRCS Conservation Practices
Conservation Practice Network Diagrams for Exemplar Conservation Practices


323 ft
Creek
Lucedale
98
Red Creek-
Escatawpa
River
George
63
613
Little
Cedar
Creek
42
Juniper Bay-
Escatawpa River
63
Red Creek
25
5
31
614
Spring Creek-
Escatawpa River
613
11
Bluff Creek
Vancleave
28
Grand Bay
NR2: Big Cedar Creek - Rocky Creek Watersheds
Hattiesburg
Mobile
Gulfport
Gautier
Pascagoula
N
W
E
S
0
2.5
5
10
Miles

Code	Practice
201	Edge of Field Water Quality Monitoring Data Collection
202	Edge of Field Water Quality Monitoring System Implementation
313	Waste Storage Facility
314	Brush Management (Heavy Equipment)
315	Herbaceous Weed Control
317	Composting Facility
327	Conservation Cover
328	Conservation Crop Rotation
329	Residue Management, No-Till
338	Prescribed Burning
340	Cover Crops
342	Critical Area Planting
345	Residue and Tillage Management, Reduced Till
350	Sediment Basin
356	Dike
362	Diversion
378	Pond
381	Silvopasture Establishment
382	Fence
386	Field Border
390	Riparian Herbaceous Cover
391	Riparian Forest Buffer
393	Filter Strip
394	Firebreak (New construction)
410	Grade Stabilization Structure
412	Grassed Waterways
422	Hedgerow Planting
430	Irrigation Pipeline
441	Irrigation System, Microirrigation
442	Irrigation System, Sprinkler
443	Irrigation System, Surface and Subsurface
449	Irrigation Water Management
460	Land Clearing
464	Irrigation Land Leveling
468	Lined Waterway Or Outlet
484	Mulching
490	Forest Site Preparation (Chemical or Burning)
490	Forest Site Preparation (Mechanical)
511	Forage Harvest Management
512	Pasture and Hay Planting
516	Pipeline
528A	Prescribed Grazing
554	Drainage Water Management
561	Heavy Use Area Protection
576	Livestock Shelter Structure

578	Stream Crossing
580	Streambank and Shoreline Protection
587	Structure For Water Control
590	Nutrient Management
595	Pest Management
600	Terrace
612	Tree/Shrub Establishment (Hand Planting)
612	Tree/Shrub Establishment (Mechanical Planting)
614	Watering Facility
642	Water Well
644	Wetland Wildlife Habitat Management
666	Forest Stand Improvement (Chemical/Hand Tools)
666	Forest Stand Improvement (Cutting/removal with heavy equipment)

United States Department of Agriculture

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

RESIDUE AND TILLAGE MANAGEMENT, NO TILL

CODE 329

(ac)

DEFINITION

Limiting soil disturbance to manage the amount, orientation and distribution of crop and plant residue on the soil surface year around.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Reduce sheet, rill and wind erosion and excessive sediment in surface waters
- Reduce tillage-induced particulate emissions
- Maintain or increase soil health and organic matter content
- Increase plant-available moisture
- Reduce energy use
- Provide food and escape cover for wildlife

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all cropland.

CRITERIA

General Criteria Applicable to All Purposes

Residue shall not be burned.

Distribute all residues uniformly over the entire field. Removing residue from directly within the seeding or transplanting area prior to or as part of the planting operation is acceptable.

This practice only involves an in-row soil disturbance operation during strip tillage, the planting operation, and a seed row/furrow closing device. There is no full-width soil disturbance performed from the time immediately following harvest or termination of one cash crop through harvest or termination of the next cash crop in the rotation regardless of the depth of the tillage operation. The soil tillage intensity rating (STIR) value shall include all field operations that are performed during the crop interval between harvest and termination of the previous cash crop and harvest or termination of the current cash crop (includes fallow periods). The crop interval STIR value shall be no greater than 20.

Additional Criteria to Reduce Sheet, Rill and Wind Erosion, Reduce Excessive Sediment in Surface Waters, and Reduce Tillage-Induced Particulate Emissions

Use the current approved water and wind erosion prediction technology to determine the if field operations planned provide the amount of randomly distributed surface residue needed, time of year residue needs to be present in the field, and amount of surface soil disturbance allowed to reduce erosion to the desired level. Calculations shall account for the effects of other practices in the management system.

Additional Criteria to Maintain or Increase Soil Health and Organic Matter Content

Ensure the soil condition index (SCI) for the cropping system results in a positive rating.

Additional Criteria to Increase Plant-Available Moisture

Maintain a minimum of 60 percent residue cover on the soil surface throughout the year.

Trapping snow

Minimum crop stubble height during the time significant snowfall is expected to occur shall be—

- At least 10 inches for crops with a row spacing of less than 15 inches.
- At least 15 inches for crops with a row spacing of 15 inches or greater.

Additional Criteria to Reduce Energy Use

Reduce the total energy consumption associated with field operations by at least 25 percent compared to the benchmark condition. Use the current approved NRCS tool for determining energy use to document energy use reductions.

Additional Criteria to Provide Food and Escape Cover for Wildlife

Use an approved habitat evaluation procedure to determine when residue needs to be present, and the amount, orientation, and stubble height needed to provide adequate food and cover for target species.

CONSIDERATIONS

General Considerations

Removal of crop residue, such as by baling or grazing, can have a negative impact on resources. These activities should not be performed without full evaluation of impacts on soil, water, animal, plant, and air resources.

Production of adequate crop residues to achieve the purpose(s) of this practice can be enhanced through the use of high residue crops and crop varieties, use of cover crops, double cropping, and adjustment of plant populations through seeding rates and row spacing.

When providing technical assistance to organic producers, ensure residue and tillage management, activities are consistent with the USDA Agricultural Marketing Service National Organic Program regulations.

Residue should not be shredded after harvest. Shredding residue makes it more susceptible to movement by wind or water, and areas where residue accumulates may interfere with planting the next crop.

Using residue management - no till for all crops in the rotation or cropping system can enhance the positive effects of this practice by—

- Increasing the rate of soil organic matter accumulation.
- Keeping soil in a consolidated condition and improved aggregate stability.
- Sequestering additional carbon in the soil.
- Further reducing the amount of particulate matter generated by field operations.
- Reduce energy inputs to establish crops.
- Forming root channels and other near-surface voids that increase infiltration.

Considerations to Increase Soil Health and Organic Matter Content

Carbon loss is directly related to the volume of soil disturbed, intensity of the disturbance and soil moisture content and soil temperature at the time the disturbance occurs. To make this practice more effective—

- When deep soil disturbance is performed, such as by subsoiling or fertilizer injection, make sure the vertical slot created by these implements is closed at the surface.

- Planting with a single disk or slot opener no-till drill will release less CO_2 and oxidize less organic matter than planting with a wide-point hoe/chisel opener seeder drill.
- Soil disturbance that occurs when soil temperatures are below 50° F will oxidize less organic matter and release less CO_2 than operations done when the soil is warmer.
- Maximizing year-round coverage of the soil with living vegetation (e.g., cover crops) and/or crop residues builds organic matter and reduces soil temperature, thereby slowing organic matter oxidation.
- Use a diverse crop rotation, incorporating multiple crop types (cool-season grass, cool-season legume/forb, warm-season grass, warm-season legume/forb) into the crop rotation.
- Plant a cover crop after every cash crop in the rotation. Multispecies cover crop mixes provide greater benefits than single-specie cover crops.

Considerations to Increase Plant-Available Moisture

Leaving stubble taller than the 10-inch minimum will trap more snow.

Variable-height stubble patterns may be created to further increase snow storage.

Performing all field operations on the contour will slow overland flow and allow more opportunity for infiltration.

Considerations for Wildlife Food and Cover

Leaving rows of unharvested crop standing at intervals across the field or adjacent to permanent cover will enhance the value of residues for wildlife food and cover. Leaving unharvested crop rows for two growing seasons will further enhance the value of these areas for wildlife.

Leave crop residues undisturbed after harvest (e.g., no shredding or baling) to maximize the cover and food source benefits for wildlife.

PLANS AND SPECIFICATIONS

Specifications for establishment and operation of this practice shall be prepared for each field or treatment unit. Record the specifications using the practice implementation requirements document. The specifications shall identify, as appropriate—

- Purpose for applying the practice.
- Planned crop(s).
- Amount of residue produced by each crop.
- All field operations or activities that affect—
  - Residue orientation including height (where applicable).
  - Surface disturbance.
  - The amount of residue (pounds/acre or percent surface cover) required to accomplish the purpose, and the time of year it must be present.
- Planned soil tillage intensity rating STIR value, soil condition index value, and erosion rate.
- Target species of wildlife, if applicable.
- Benchmark and planned fuel consumption, if applicable.

OPERATION AND MAINTENANCE

Evaluate/measure the crop residues cover and orientation after each crop to ensure the planned amounts and orientation are being achieved. Adjust management as needed to either plan a new residue amount and orientation or adjust the planting and/or harvesting equipment.

Limited tillage is allowed to close or level ruts from harvesting equipment. No more than 10 percent of the field may be tilled for this purpose.

If there are areas of heavy residue accumulation (because of movement by water or wind) in the field, spread the residue prior to planting so it does not interfere with planter operation.

REFERENCES

Bolton, Ryan. 2003. Impact of the surface residue layer on decomposition, soil water properties and nitrogen dynamics. M.S. thesis. Univ. of Saskatchewan, Saskatoon, Saskatchewan, CA.

Reicosky, D.C., M.J. Lindstrom, T.E. Schumacher, D.E. Lobb and D.D. Malo. 2005. Tillage-induced CO2 loss across an eroded landscape. Soil Tillage Res. 81:183-194.

Reicosky, D.C. 2004. Tillage-induced soil properties and chamber mixing effects on gas exchange. Proc. 16th Triennial Conf., Int. Soil Till. Org. (ISTRO).

Renard, K.G., G.R. Foster, G.A. Weesies, D.K. McCool, and D.C. Yoder, coordinators. 1997. Predicting soil erosion by water: A guide to conservation planning with the Revised Universal Soil Loss Equation (RUSLE). U.S. Department of Agriculture, Agriculture Handbook No. 703.

Shaffer, M.J., and W.E. Larson (ed.). 1987. Tillage and surface-residue sensitive potential evaporation submodel. In NTRM, a soil-crop simulation model for nitrogen, tillage and crop residue management. USDA Conserv. Res. Rep. 34-1. USDA-ARS.

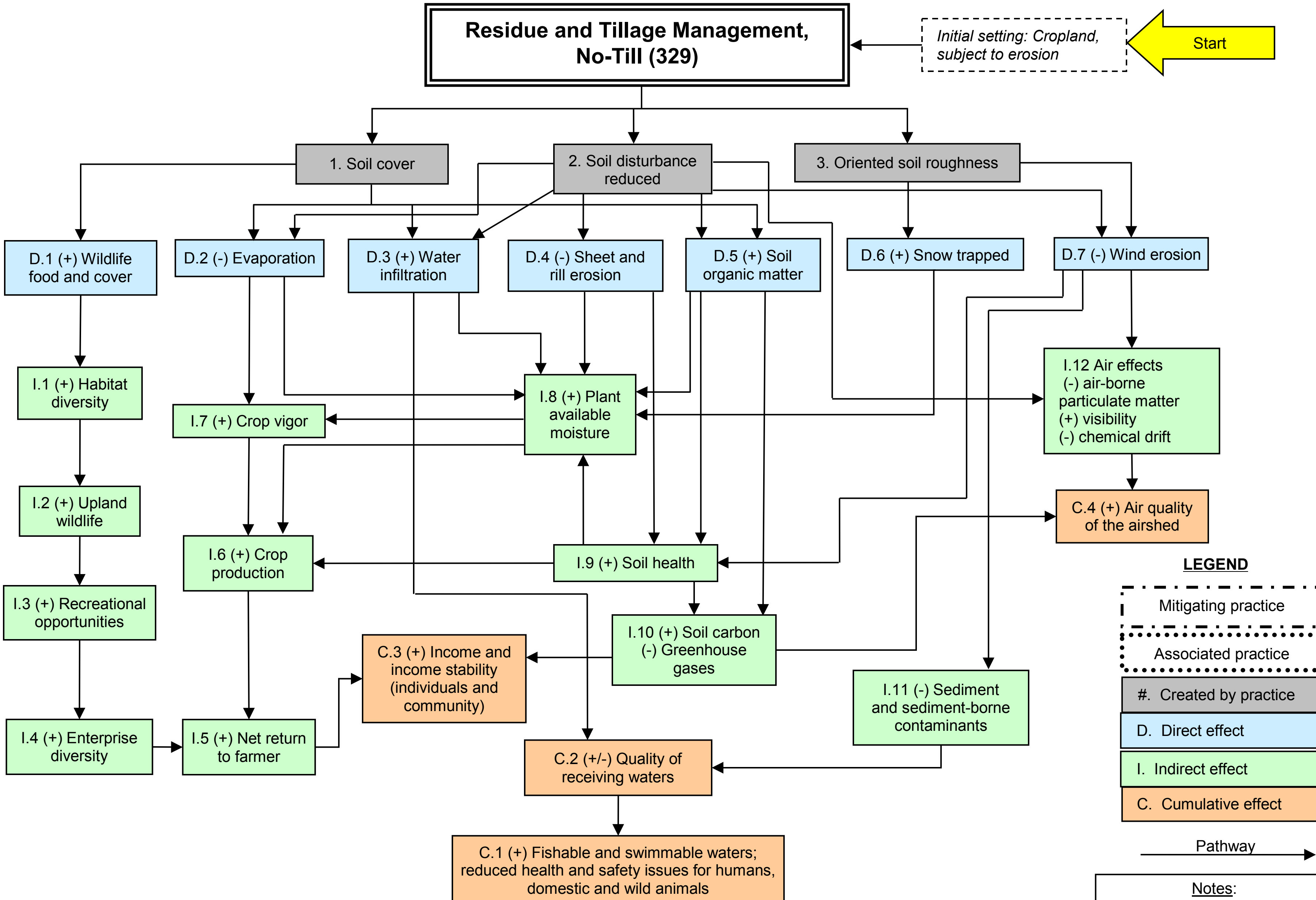
Skidmore, E.L. and N.P. Woodruff. 1968. Wind erosion forces in the United States and their use in predicting soil loss. U.S. Department of Agriculture. Agriculture Handbook No. 346.

USDA Natural Resources Conservation Service. 2011. National Agronomy Manual. 190-V. 4th Ed.

S.J. van Donk, D. L. Martin, S. Irmak, S. R. Melvin, J. L. Petersen, D. R. Davison, 2010. Crop Residue Cover Effects on Evaporation, Soil Water Content, and Yield of Deficit-Irrigated Corn in West-Central Nebraska. http://watercenter.unl.edu/ResearchDB/publications/Crop_Residue_Cover_Effects.pdf.

NRCS CONSERVATION PRACTICE EFFECTS - NETWORK DIAGRAM

September 2016



Notes:

Effects are qualified with a plus (+) or minus (-). These symbols indicate only an increase (+) or a decrease (-) in the effect upon the resource, not whether the effect is beneficial or adverse.

Effects of NRCS Conservation Practices - National

Residue and Tillage Management, No Till/Strip Till/Direct Seed

Managing the amount, orientation and distribution of crop and other plant residue on the soil surface year round, limiting soil-disturbing activities to those necessary to place nutrients, condition residue and plant crops.

Code: 329
Units: ac.

	C-Crop	F-Forest	R-Range	P-Pasture	Pr-Protected	FS-Farmstead	D-Developed	W-Water	O-Other	AL-Aso Land
Typical Landuse:	C			P					O	

Soil Erosion	Effect	Rationale
Soil Erosion - Sheet and Rill Erosion	4	Managing residue to reduce soil disturbance and increase residue cover reduces erosion by water.
Soil Erosion - Wind Erosion	4	Managing residue to reduce soil disturbance and increase residue cover reduces erosion by wind.
Soil Erosion - Ephemeral Gully Erosion	4	Managing residue to reduce soil disturbance and increase residue cover reduces erosion by water.
Soil Erosion - Classic Gully Erosion	0	Not Applicable
Soil Erosion - Streambank, Shoreline, Water Conveyance C	0	Not Applicable
Soil Quality Degradation		
Organic Matter Depletion	2	Decreased erosion and less oxidation from lack of soil disturbance will increase or maintain organic matter.
Compaction	2	Fewer field operations and less tillage reduce the potential for soil compaction.
Subsidence	0	Not Applicable
Concentration of Salts or Other Chemicals	1	Low disturbance and high residue cropping systems increase organic matter which will buffer salts.
Excess Water		
Excess Water - Seeps	-1	No-till increases infiltration resulting in more water moving through the profile.
Excess Water - Runoff, Flooding, or Ponding	2	No-till increases infiltration, reducing runoff and ponding.
Excess Water - Seasonal High Water Table	-1	Can reduce evaporation and increase infiltration of water
Excess Water - Drifted Snow	0	Not Applicable
Insufficient Water		
Insufficient Water - Inefficient Use of Irrigation Water	2	No-till increases infiltration and decreases evaporation resulting in more available water. However, increased infiltration reduces the efficiency of flood and furrow irrigation.
Insufficient Water - Inefficient Moisture Management	2	No-till increases infiltration and decreases evaporation resulting in more available water.
Water Quality Degradation		
Pesticides in Surface Water	4	The action decreases runoff and erosion.
Pesticides in Groundwater	0	Not Applicable
Nutrients in Surface water	2	Less erosion and runoff reduces transport of nutrients.
Nutrients in Groundwater	-1	The action increases infiltration that contributes to nutrient leaching. Also, high organic carbon will cause microbes to immobilize nutrients.
Salts in Surface Water	1	Less runoff reduces transport of soluble salts. However increased infiltration results in more seepage which can carry soluble salts to the surface.
Salts in Groundwater	-1	Better infiltration may increase leaching potential.
Excess Pathogens and Chemicals from Manure, Bio-solic	1	Less erosion and runoff reduces delivery of pathogens.
Excess Pathogens and Chemicals from Manure, Bio-solic	0	Not Applicable

Excessive Sediment in Surface Water	4	Less erosion and runoff reduces transport of sediment.
Elevated Water Temperature	0	Not Applicable
Petroleum, Heavy Metals and Other Pollutants Transporte	0	Not Applicable
Petroleum, Heavy Metals and Other Pollutants Transporte	0	Not Applicable
Air Quality Impacts		
Emissions of Particulate Matter (PM) and PM Precursors	4	Less soil disturbance, increased residue on the surface and fewer field operations reduce the generation of particulate matter.
Emissions of Ozone Precursors	2	Reduced use of machinery reduces ozone precursor emissions.
Emissions of Greenhouse Gases (GHGs)	4	Reduced use of machinery reduces CO2 emissions and increases soil carbon storage.
Objectionable Odors	0	Not Applicable
Degraded Plant Condition		
Undesirable Plant Productivity and Health	2	Conserving moisture and improving soil conditions contribute to enhanced plant productivity and health. However, on cold and wet soils there may be a delay in emergence and early growth.
Inadequate Structure and Composition	0	Not Applicable
Excessive Plant Pest Pressure	0	Not Applicable
Wildfire Hazard, Excessive Biomass Accumulation	0	Not Applicable
Fish and Wildlife - Inadequate Habitat		
Inadequate Habitat - Food	2	Crop residue provides some food for wildlife.
Inadequate Habitat - Cover/Shelter	2	Crop residue provides some cover/shelter.
Inadequate Habitat - Water	4	Not Applicable
Inadequate Habitat - Habitat Continuity (Space)	1	Residue restores some habitat/space.
Livestock Production Limitation		
Inadequate Feed and Forage	0	Not Applicable
Inadequate Shelter	0	Not Applicable
Inadequate Water	0	Not Applicable
Inefficient Energy Use		
Equipment and Facilities	4	No tillage equipment needed
Farming/Ranching Practices and Field Operations	4	No tillage operations

CPPE Practice Effects:	*0 No Effect*
5 Substantial Improvement	*-1 Slight Worsening*
4 Moderate to Substantial Improvement	*-2 Slight to Moderate Worsening*
3 Moderate Improvement	*-3 Moderate Worsening*
2 Slight to Moderate Improvement	*-4 Moderate to Substantial Worsening*
1 Slight Improvement	*-5 Substantial Worsening*

United States Department of Agriculture

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

COVER CROP

CODE 340

(ac)

DEFINITION

Grasses, legumes, and forbs planted for seasonal vegetative cover.

PURPOSE

This practice is applied to support one or more of the following purposes:

- Reduce erosion from wind and water
- Maintain or increase soil health and organic matter content
- Reduce water quality degradation by utilizing excessive soil nutrients
- Suppress excessive weed pressures and break pest cycles
- Improve soil moisture use efficiency
- Minimize soil compaction

CONDITIONS WHERE PRACTICE APPLIES

All lands requiring seasonal vegetative cover for natural resource protection or improvement.

CRITERIA

General Criteria Applicable to All Purposes

Plant species, seedbed preparation, seeding rates, seeding dates, seeding depths, fertility requirements, and planting methods will be consistent with applicable local criteria and soil/site conditions.

Select species that are compatible with other components of the cropping system.

Ensure herbicides used with crops are compatible with cover crop selections and purpose(s).

Cover crops may be established between successive production crops, or companion- planted or relay-planted into production crops. Select species and planting dates that will not compete with the production crop yield or harvest.

Do not burn cover crop residue.

Determine the method and timing of termination to meet the grower's objective and the current NRCS Cover Crop Termination Guidelines.

When a cover crop will be grazed or hayed ensure that crop selection(s) comply with pesticide label rotational crop restrictions and that the planned management will not compromise the selected conservation purpose(s).

Do not harvest cover crops for seed.

If the specific rhizobium bacteria for the selected legume are not present in the soil, treat the seed with the appropriate inoculum at the time of planting.

Additional Criteria to Reduce Erosion from Wind and Water

Time the cover crop establishment in conjunction with other practices to adequately protect the soil during the critical erosion period(s).

Select cover crops that will have the physical characteristics necessary to provide adequate erosion protection.

Use the current erosion prediction technology to determine the amount of surface and/or canopy cover needed from the cover crop to achieve the erosion objective.

Additional Criteria to Maintain or Increase Soil Health and Organic Matter Content

Cover crop species will be selected on the basis of producing higher volumes of organic material and root mass to maintain or increase soil organic matter.

The planned crop rotation including the cover crop and associated management activities will score a Soil Conditioning Index (SCI) value > 0, as determined using the current approved NRCS Soil Conditioning Index (SCI) procedure, with appropriate adjustments for additions to and or subtractions from plant biomass.

The cover crop shall be planted as early as possible and be terminated as late as practical for the producer's cropping system to maximize plant biomass production, considering crop insurance criteria, the time needed to prepare the field for planting the next crop, and soil moisture depletion.

Additional Criteria Reduce Water Quality Degradation by Utilizing Excessive Soil Nutrients

Establish cover crops as soon as practical prior to or after harvest of the production crop. (i.e. before or after harvest)

Select cover crop species for their ability to effectively utilize nutrients.

Terminate the cover crop as late as practical to maximize plant biomass production and nutrient uptake. Practical considerations for termination date may include crop insurance criteria, the amount of time needed to prepare the field for planting the next crop, weather conditions, and cover crop effects on soil moisture and nutrient availability to the following crop.

If the cover crop will be harvested for feed (hay/balage/etc.), choose species that are suitable for the planned livestock, and capable of removing the excess nutrients present.

Additional Criteria to Suppress Excessive Weed Pressures and Break Pest Cycles

Select cover crop species for their life cycles, growth habits, and other biological, chemical

and or physical characteristics to provide one or more of the following:

- To suppress weeds, or compete with weeds.
- Break pest life cycles or suppress of plant pests or pathogens.
- Provide food or habitat for natural enemies of pests.
- Release compounds such as glucosinolates that suppress soil borne pathogens or pests.

Select cover crop species that do not harbor pests or diseases of subsequent crops in the rotation.

Additional Criteria to Improve Soil Moisture Use Efficiency

In areas of limited soil moisture, terminate growth of the cover crop sufficiently early to conserve soil moisture for the subsequent crop. Cover crops established for moisture conservation shall be left on the soil surface.

In areas of potential excess soil moisture, allow the cover crop to grow as long as possible to maximize soil moisture removal.

Additional Criteria to Minimize Soil Compaction

Select cover crop species that have the ability to root deeply and the capacity to penetrate or prevent compacted layers.

CONSIDERATIONS

Plant cover crops in a timely matter and when there is adequate moisture to establish a good stand.

To ensure cover crops are managed and compatible with the client's crop insurance criteria, terminate cover crops at or within 5 days after planting but before crop emergence.

Maintain an actively growing cover crop as late as feasible to maximize plant growth, allowing time to prepare the field for the next crop and to optimize soil moisture.

Select cover crops that are compatible with the production system, well adapted to the region's climate and soils, and resistant to prevalent pests, weeds, and diseases. Avoid cover crop species that harbor or carry over potentially damaging diseases or insects.

Cover crops may be used to improve site conditions for establishment of perennial species.

When cover crops are used for grazing, select species that will have desired forage traits, be palatable to livestock, and not interfere with the production of the subsequent crop.

Use plant species that enhance forage opportunities for pollinators by using diverse legumes and other forbs.

Cover crops may be selected to provide food or habitat for natural enemies of production crop pests.

Cover crops residues should be left on the soil surface to maximize allelopathic (chemical) and mulching (physical) effects.

Seed a higher density cover crop stand to promote rapid canopy closure and greater weed suppression. Increased seeding rates (1.5 to 2 times normal) can improve weed- competitiveness.

Cover crops may be selected that release biofumigation compounds that inhibit soil-borne plant pests and pathogens.

Species can be selected to serve as trap crops to divert pests from production crops.

Select a mixture of two or more cover crop species from different plant families to achieve one or more of the following: (1) species mix with different maturity dates, (2) attract beneficial insects, (3) attract pollinators, (4) increase soil biological diversity, (5) serve as a trap crop for insect pests, or (6) provide food and cover for wildlife habitat management.

Plant legumes or mixtures of legumes with grasses, crucifers, and/or other forbs to achieve biological nitrogen fixation. Select cover crop species or mixture, and timing and method of termination that will maximize efficiency of nitrogen utilization by the following crop, considering soil type and conditions, season and weather conditions, cropping system, C:N ratio of the cover crop at termination, and anticipated nitrogen needs of the subsequent crop. Use LGU- recommended nitrogen credits from the legume and reduce nitrogen applications to the subsequent crop accordingly. “If the specific rhizobium bacteria for the selected legume are not present in the soil, treat the seed with the appropriate inoculum at the time of planting.

Time the termination of cover crops to meet nutrient release goals. Termination at early vegetative stages may cause a more rapid release compared to termination at a more mature stage.

Both residue decomposition rates and soil fertility can affect nutrient availability following termination of cover crops

Allelopathic effects to the subsequent crop should be evaluated when selecting the appropriate cover crop.

Legumes add the most plant-available N if terminated when about 30% of the crop is in bloom.

Additional Considerations to Reduce Erosion by Wind or Water

To reduce erosion, best results are achieved when the combined canopy and surface residue cover attains 90 percent or greater during the period of potentially erosive wind or rainfall.

Additional Considerations to Reduce Water Quality Degradation by Utilizing Excessive Soil Nutrients

Use deep-rooted species to maximize nutrient recovery.

When appropriate for the crop production system, mowing certain grass cover crops (e.g., sorghum-sudangrass, pearl millet) prior to heading and allowing the cover crop to regrow can enhance rooting depth and density, thereby increasing their subsoiling and nutrient-recycling efficacy.

Additional Considerations to Increase Soil Health and Organic Matter Content

Increase the diversity of cover crops (e.g., mixtures of several plant species) to promote a wider diversity of soil organisms, and thereby promote increased soil organic matter.

Plant legumes or mixtures of legumes with grasses, crucifers, and/or other forbs to provide nitrogen through biological nitrogen fixation.

Legumes add the most plant-available N if terminated when about 30% of the crop is in bloom.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for each field or treatment unit according to the planning criteria and operation and maintenance requirements of this standard. Specifications shall describe the requirements to apply the practice to achieve the intended purpose for the practice site. Plans for the establishment of cover crops shall, as a minimum, include the following specification components in an approved Cover Crop, 340, Implementation Requirements document:

- Field number and acres
- Species of plant(s) to be established.
- Seeding rates.
- Seeding dates.
- Establishment procedure.
- Rates, timing, and forms of nutrient application (if needed).
- Dates and method to terminate the cover crop.
- Other information pertinent to establishing and managing the cover crop e.g., if haying or grazing is planned specify the planned management for haying or grazing.

OPERATION AND MAINTENANCE

Evaluate the cover crop to determine if the cover crop is meeting the planned purpose(s). If the cover crop is not meeting the purpose(s) adjust the management, change the species of cover crop, or choose a different technology.

REFERENCES

A. Clark (ed.). 2007. Managing cover crops profitably. 3rd ed. Sustainable Agriculture Network Handbook Series; bk 9.

Hargrove, W.L., ed. Cover crops for clean water. SWCS, 1991.

Magdoff, F. and H. van Es. Cover Crops. 2000. p. 87-96 *In* Building soils for better crops. 2nd ed. Sustainable Agriculture Network Handbook Series; bk 4. National Agriculture Library. Beltsville, MD.

Reeves, D.W. 1994. Cover crops and erosion. p. 125-172 *In* J.L. Hatfield and B.A. Stewart (eds.) Crops Residue Management. CRC Press, Boca Raton, FL.

NRCS Cover Crop Termination Guidelines:
http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/climatechange/?cid=stelprdb1077238

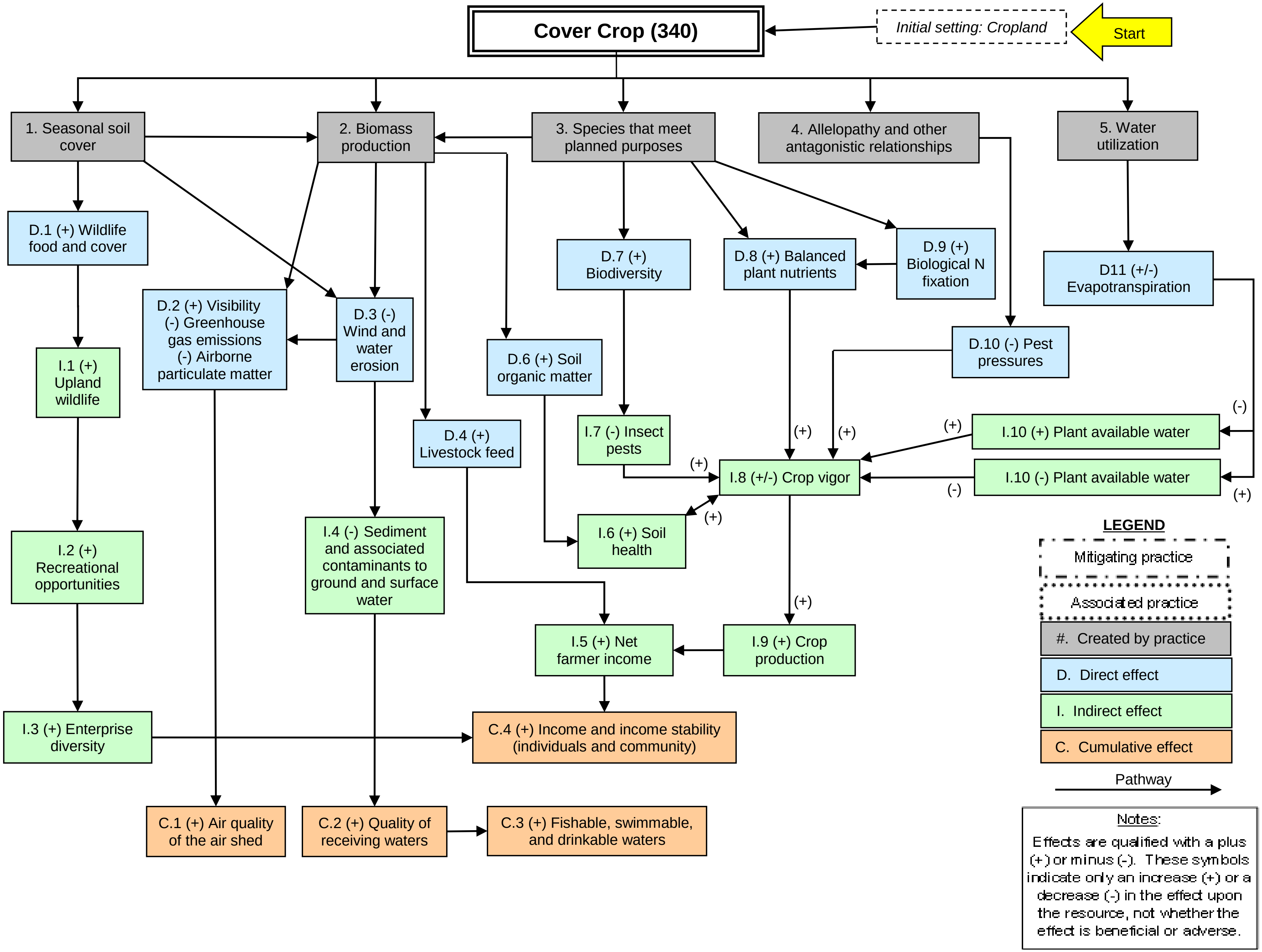
Revised Universal Soil Loss Equation Version 2 (RUSLE2) website:
http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/tools/rusle2/

Wind Erosion Prediction System (WEPS) website:
http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/tools/weps/

USDA, Natural Resources Conservation Service, National Agronomy Manual, 4th Edition, Feb. 2011. Website: http://directives.sc.egov.usda.gov/ Under Manuals and Title 190.

NRCS CONSERVATION PRACTICE EFFECTS - NETWORK DIAGRAM

September 2014



Effects of NRCS Conservation Practices - National

Cover Crop

Crops including grasses, legumes, and forbs for seasonal cover and other conservation purposes.

Code: 340
Units: ac.

Typical Landuse:	C-Crop	F-Forest	R-Range	P-Pasture	Pr-Protected	FS-Farmstead	D-Developed	W-Water	O-Other	AL-Aso Land
	C	F	R	P	Pr				O	AL

Soil Erosion	Effect	Rationale
Soil Erosion - Sheet and Rill Erosion	4	Increased cover during erosive periods will reduce soil detachment by water.
Soil Erosion - Wind Erosion	4	Increased cover during erosive periods will reduce soil detachment by wind.
Soil Erosion - Ephemeral Gully Erosion	3	Increased cover during erosive periods will reduce concentrated flow and associated soil detachment.
Soil Erosion - Classic Gully Erosion	0	Not Applicable
Soil Erosion - Streambank, Shoreline, Water Conveyance C	0	Not Applicable
Soil Quality Degradation		
Organic Matter Depletion	2	More biomass produced will increase organic matter.
Compaction	2	Increased biomass and roots improve aggregation, which gives better resistance to compaction.
Subsidence	0	If it affects drainage the practice can have an impact on subsidence.
Concentration of Salts or Other Chemicals	1	Increased organic matter will buffer salts.
Excess Water		
Excess Water - Seeps	1	Growing plants will take up excess water. However, infiltration will increase, which may offset some of the benefits.
Excess Water - Runoff, Flooding, or Ponding	2	Growing plants will reduce runoff and increase infiltration.
Excess Water - Seasonal High Water Table	1	Growing plants will take up excess water. However, infiltration will increase, which may offset some of the benefits.
Excess Water - Drifted Snow	0	Not Applicable
Insufficient Water		
Insufficient Water - Inefficient Use of Irrigation Water	1	Improves infiltration
Insufficient Water - Inefficient Moisture Management	2	Improves infiltration, soil structure, and winter water use that may otherwise be lost. For dry climates (<20 inches/year); cover crops will compete for main crop's moisture.
Water Quality Degradation		
Pesticides in Surface Water	2	The action reduces runoff and erosion.
Pesticides in Groundwater	2	The action increases soil organic matter, biological activity, and pesticide uptake.
Nutrients in Surface water	2	The action reduces erosion and runoff and transport of nutrients. Cover crops can uptake excess nutrients.
Nutrients in Groundwater	2	The action utilizes excess nutrients and increases organic matter. The additional organic matter will increase cation exchange capacity which will hold nutrients.
Salts in Surface Water	0	Less runoff reduces transport of soluble salts. Growing vegetation can use excess water which reduces seepage.
Salts in Groundwater	1	Cover crops can take up salts and water reducing the leaching potential of salts.
Excess Pathogens and Chemicals from Manure, Bio-solic	1	Less erosion and runoff reduces delivery of pathogens.
Excess Pathogens and Chemicals from Manure, Bio-solic	2	The action increases organic matter promoting microbial activity which competes with pathogens.

Excessive Sediment in Surface Water	2	Vegetation will reduce erosion and transport of sediment.
Elevated Water Temperature	0	Not Applicable
Petroleum, Heavy Metals and Other Pollutants Transporte	0	Not Applicable
Petroleum, Heavy Metals and Other Pollutants Transporte	0	Not Applicable
Air Quality Impacts		
Emissions of Particulate Matter (PM) and PM Precursors	3	Ground cover helps reduce wind erosion and generation of fugitive dust.
Emissions of Ozone Precursors	0	Not Applicable
Emissions of Greenhouse Gases (GHGs)	2	Vegetation removes CO2 from the air and stores it in the form of carbon in the plants and soil.
Objectionable Odors	0	Not Applicable
Degraded Plant Condition		
Undesirable Plant Productivity and Health	2	Plants are selected and managed to maintain optimal productivity and health and can contribute to subsequent crop health and productivity.
Inadequate Structure and Composition	5	Plants selected are adapted and suited.
Excessive Plant Pest Pressure	4	Vegetation is installed and managed to control undesired species.
Wildfire Hazard, Excessive Biomass Accumulation	0	Not Applicable
Fish and Wildlife - Inadequate Habitat		
Inadequate Habitat - Food	2	Increased quality and quantity of vegetation provides more food for wildlife.
Inadequate Habitat - Cover/Shelter	2	Increased quality and quantity of vegetation provides more cover for wildlife.
Inadequate Habitat - Water	4	Not Applicable
Inadequate Habitat - Habitat Continuity (Space)	2	Increased cover will increase space for wildlife. May be used to connect other cover areas.
Livestock Production Limitation		
Inadequate Feed and Forage	2	Cover crops will add supplemental forage.
Inadequate Shelter	0	Not Applicable
Inadequate Water	0	Not Applicable
Inefficient Energy Use		
Equipment and Facilities	0	Not Applicable
Farming/Ranching Practices and Field Operations	2	Cover crops can reduce nitrogen inputs.

CPPE Practice Effects:	*0 No Effect*
5 Substantial Improvement	*-1 Slight Worsening*
4 Moderate to Substantial Improvement	*-2 Slight to Moderate Worsening*
3 Moderate Improvement	*-3 Moderate Worsening*
2 Slight to Moderate Improvement	*-4 Moderate to Substantial Worsening*
1 Slight Improvement	*-5 Substantial Worsening*

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

FENCE

CODE 382

(ft)

DEFINITION

A constructed barrier to animals or people.

PURPOSE

This practice is used to accomplish one or more of the following purposes–

- This practice facilitates the accomplishment of conservation objectives by providing a means to control movement of animals and people, including vehicles

CONDITIONS WHERE PRACTICE APPLIES

This practice may be applied on any area where management of animal or human movement is needed.

CRITERIA

General Criteria Applicable to All Purposes

Fencing materials, type and design of fence installed shall be of a high quality and durability. The type and design of fence installed will meet the management objectives and site challenges. Based on objectives, fences may be permanent, portable, or temporary.

Fences shall be positioned to facilitate management requirements. Ingress/egress features such as gates and cattle guards shall be planned. The fence design and installation should have the life expectancy appropriate for management objectives and shall follow all federal, state and local laws and regulations.

Height, size, spacing and type of materials used will provide the desired control, life expectancy, and management of animals and people of concern.

Fences shall be designed, located, and installed to meet appropriate local wildlife and land management needs and requirements.

CONSIDERATIONS

The fence design and location should consider: topography, soil properties, livestock management, animal safety, livestock trailing, access to water facilities, development of potential grazing systems, human access and safety, landscape aesthetics, erosion problems, soil moisture conditions, flooding potential, stream crossings, and durability of materials.

When appropriate, natural barriers should be utilized instead of fencing.

Where applicable, cleared rights-of-way may be established which would facilitate fence construction and maintenance. Avoid clearing of vegetation during the nesting season for migratory birds.

Where applicable, fences should be marked to enhance visibility as a safety measure for animals or people.

Fences across gullies, canyons or streams may require special bracing, designs or approaches.

Fence design and location should consider ease of access for construction, repair and maintenance.

Fence construction requiring the removal of existing fencing materials should provide for proper disposal to prevent harm to animals, people and equipment.

PLANS AND SPECIFICATIONS

Plans and specifications are to be prepared for all fence types, installations and specific sites. Requirements for applying the practice to achieve all of its intended purposes shall be described.

OPERATION AND MAINTENANCE

Regular inspection of fences should be part of an ongoing maintenance program to ensure continuing proper function of the fence. Operation and Maintenance (O&M) includes the following:

A schedule for regular inspections and after storms and other disturbance events.

Maintenance activities:

- Repair or replacement of loose or broken material, gates and other forms of ingress/egress
- Removal of trees/limbs
- Replacement of water gaps as necessary
- Repair of eroded areas as necessary
- Repair or replacement of markers or other safety and control features as required.

REFERENCES

Bell, H.M. 1973. Rangeland management for livestock production. University of Oklahoma Press.

Heady, H.F. and R.D. Child. 1994. Rangeland ecology and management. Western Press.

Holechek, J.L., R.D. Pieper, and C.H. Herbel. 2001. Range management: principles and practices. Prentice Hall.

Paige, C. 2012. A Landowner's Guide to Fences and Wildlife: Practical Tips to Make Your Fences Wildlife Friendly. Wyoming Land Trust, Pinedale, WY.

Stoddard, L.A., A.D. Smith, and T.W. Box. 1975. Range management. McGraw-Hill Book Company.

United States Department of Interior, Bureau of Land Management and United States Department of Agriculture, Forest Service. 1988. Fences. Missoula Technology and Development Center.

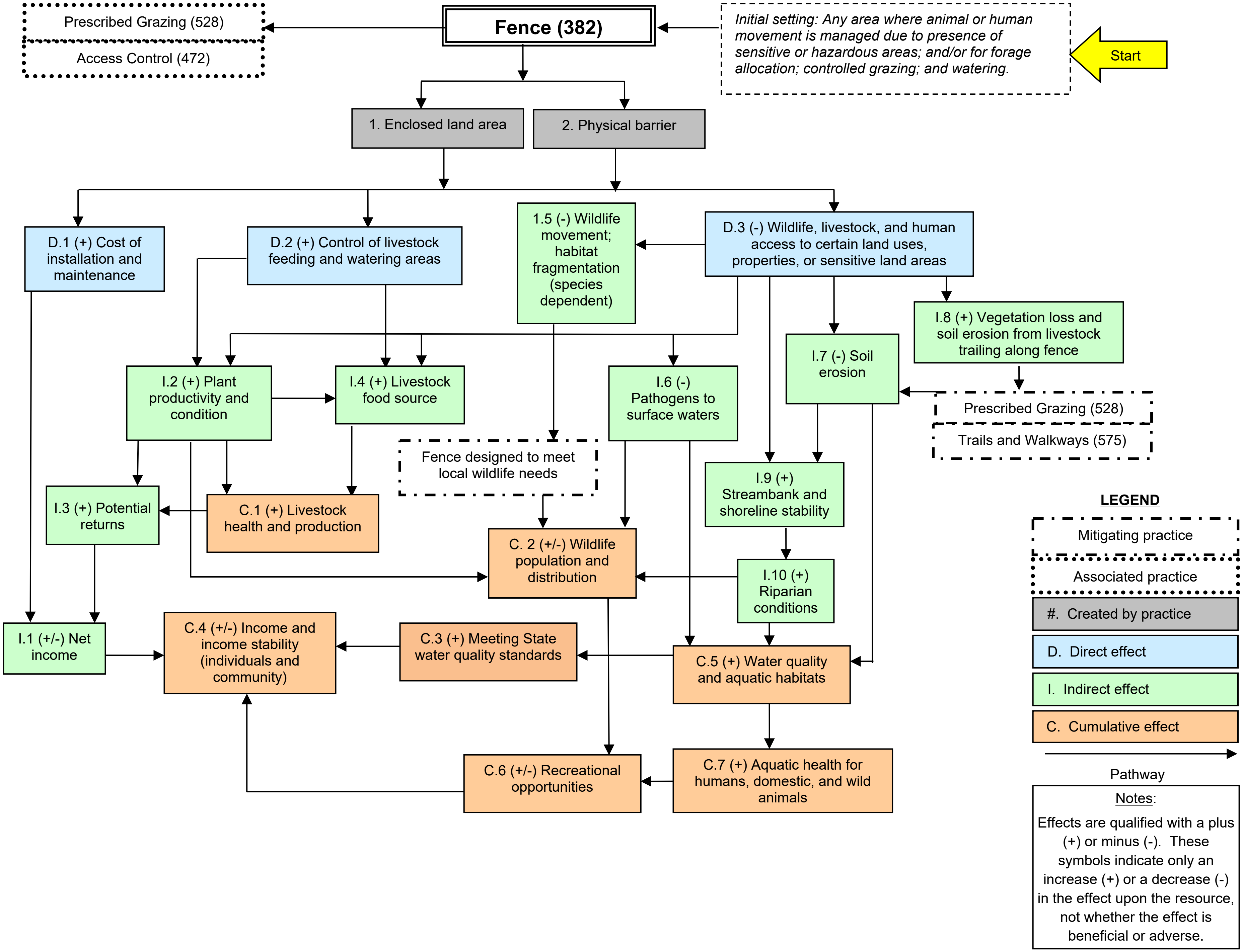
United States Department of Agriculture, Natural Resources Conservation Service. 2005. Electric fencing for serious graziers. Columbia, Mo.

United States Department of Agriculture, Natural Resources Conservation Service. 2003. National range and pasture handbook, revision 1. Washington, DC.

Vallentine, J.F. 1971. Range development and improvement. Brigham Young University Press.

NRCS CONSERVATION PRACTICE EFFECTS - NETWORK DIAGRAM

July 2021



Fence

Effects of NRCS Conservation Practices - National

Fence

A constructed barrier to animals or people.

Code: 382
Units: ft.

C-Crop, F-Forest, R-Range, P-Pasture, Pr-Protected, FS-Farmstead, D-Developed, W-Water, O-Other, AL-Aso Land

Typical Landuse: C F R P Pr FS D W O AL

	Effect	Rationale
Soil Erosion		
Soil Erosion - Sheet and Rill Erosion	1	Barriers reduce the excessive disturbance of soil and vegetation by facilitating the effective control of timing, frequency, duration and intensity of use of an area by animals or people.
Soil Erosion - Wind Erosion	0	Barriers reduce the excessive disturbance of soil and vegetation by facilitating the effective control of timing, frequency, duration and intensity of use of an area by animals or people.
Soil Erosion - Ephemeral Gully Erosion	0	Barriers reduce the excessive disturbance of soil and vegetation by facilitating the effective control of timing, frequency, duration and intensity of use of an area by animals or people.
Soil Erosion - Classic Gully Erosion	0	Barriers reduce the excessive disturbance of soil and vegetation by facilitating the effective control of timing, frequency, duration and intensity of use of an area by animals or people.
Soil Erosion - Streambank, Shoreline, Water Conveyance	0	Barriers reduce the excessive disturbance of soil and vegetation by facilitating the effective control of timing, frequency, duration and intensity of use of an area by animals or people. This promotes vegetative growth and streambank stabilization.
Soil Quality Degradation		
Organic Matter Depletion	0	Not applicable.
Compaction	1	Not applicable.
Subsidence	0	Not applicable.
Concentration of Salts or Other Chemicals	0	Not applicable.
Excess Water		
Excess Water - Seeps	0	Not Applicable
Excess Water - Runoff, Flooding, or Ponding	0	Not applicable.
Excess Water - Seasonal High Water Table	0	Not Applicable
Excess Water - Drifted Snow	0	Not applicable.
Insufficient Water		
Insufficient Water - Inefficient Use of Irrigation Water	0	Not Applicable
Insufficient Water - Inefficient Moisture Management	0	Not applicable.
Water Quality Degradation		
Pesticides in Surface Water	0	Not Applicable
Pesticides in Groundwater	0	Not Applicable
Nutrients in Surface water	0	Not applicable.
Nutrients in Groundwater	0	Not applicable.
Salts in Surface Water	0	Not Applicable
Salts in Groundwater	0	Not applicable.
Excess Pathogens and Chemicals from Manure, Bio-so	2	Control access of animals and/or people to stream areas.
Excess Pathogens and Chemicals from Manure, Bio-so	0	Not Applicable
Excessive Sediment in Surface Water	0	Not applicable.
Elevated Water Temperature	0	Not Applicable
Petroleum, Heavy Metals and Other Pollutants Transpo	0	Not applicable.
Petroleum, Heavy Metals and Other Pollutants Transpo	0	Not Applicable
Air Quality Impacts		
Emissions of Particulate Matter (PM) and PM Precursors	0	Not Applicable
Emissions of Ozone Precursors	0	Not Applicable
Emissions of Greenhouse Gases (GHGs)	1	Fencing can be used to protect and/or improve vegetation.
Objectionable Odors	0	Not Applicable
Degraded Plant Condition		
Undesirable Plant Productivity and Health	2	Control of animals facilitates grazing management enhancing health and vigor of desired plant communities.
Inadequate Structure and Composition	0	Control of animals facilitates grazing management which encourages growth of plants that are adapted and suitable for the site.
Excessive Plant Pest Pressure	0	Not applicable.
Wildfire Hazard, Excessive Biomass Accumulation	0	Not Applicable
Fish and Wildlife - Inadequate Habitat		
Inadequate Habitat - Food	0	Not Applicable
Inadequate Habitat - Cover/Shelter	0	Not Applicable
Inadequate Habitat - Water	1	Not Applicable
Inadequate Habitat - Habitat Continuity (Space)	0	Species dependent.
Livestock Production Limitation		
Inadequate Feed and Forage	3	Control of animals influences vigor and health of vegetation.
Inadequate Shelter	0	Not applicable.
Inadequate Water	0	Not Applicable
Inefficient Energy Use		
Equipment and Facilities	0	Not Applicable
Farming/Ranching Practices and Field Operations	0	Not Applicable

CPPE Practice Effects: *0 No Effect*

	5 Substantial Improvement	*-1 Slight Worsening*
	4 Moderate to Substantial Improvement	*-2 Slight to Moderate Worsening*
	3 Moderate Improvement	*-3 Moderate Worsening*
	2 Slight to Moderate Improvement	*-4 Moderate to Substantial Worsening*
	1 Slight Improvement	*-5 Substantial Worsening*

Source: National Conservation Practices Physical Effects
Hal Gordon, WNTSC Economist, Portland, Oregon
May-13

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

FIELD BORDER

CODE 386

(ac)

DEFINITION

A strip of permanent vegetation established at the edge or around the perimeter of a field.

PURPOSE

This practice is used to accomplish one or more of the following purposes–

- Reduce erosion from wind and water and reduce excessive sediment to surface waters (soil erosion)
- Reduce sedimentation offsite and protect water quality and nutrients in surface and ground waters (water quality degradation)
- Provide food and cover for wildlife and pollinators or other beneficial organisms (inadequate habitat for fish and wildlife)
- Reduce greenhouse gases and increase carbon storage (air quality impact)
- Reduce emissions of particulate matter (air quality impact)

CONDITIONS WHERE PRACTICE APPLIES

This practice is applied around the inside perimeter of fields. Its use can support or connect other buffer practices within and between fields. This practice applies to cropland and pasture fields.

CRITERIA

General Criteria Applicable to All Purposes

Establish field borders at field edges to the extent needed to meet the resource needs and producer objectives. Minimum field border widths shall be based on local design criteria specific to the purpose or purposes for installing the practice.

Establish field borders to adapted species of permanent grass, forbs and/or shrubs that accomplish the design objective.

Plants selected for field borders will have the physical characteristics necessary to control wind and water erosion to tolerable levels on the field border area. For portions of the border that will be subject to equipment traffic, establish species tolerant to equipment such traffic.

Seedbed preparation, seeding rates, seeding dates, seeding depths, fertility requirements, and planting methods will be consistent with approved local criteria and site conditions.

Ephemeral gullies and rills present in the planned border area will be eliminated as part of seedbed preparation. If present, ephemeral gullies and rills located immediately upslope from the planned border area need to be treated to ensure more sheet flow and less concentrated flow enters the field border area.

Break up or redirect concentrated water flow within the field borders to prevent gully erosion.

Additional Criteria to Reduce Erosion from Wind and Water and Reduce Excessive Sediment to Surface Waters

Field border establishment will be timed so that the soil will be adequately protected during the critical erosion period(s).

Establish permanent species that create a dense cover.

Establish stiff-stemmed, upright grasses, grass/legumes or forbs to trap wind or waterborne soil particles.

The amount of surface and/or canopy cover needed from the field border shall be determined using current approved water and wind erosion prediction technology. Soil erosion estimates shall account for the effects of other practices in the management system.

Wind erosion reduction

Locate borders to provide a stable area on the windward edge of the field as determined by prevailing wind direction data during the critical erosion period(s).

Minimum height of grass or forbs shall be one foot during the critical wind erosion period.

Water erosion reduction

Locate borders to eliminate sloping end rows, headlands, and other areas where concentrated water flows will enter or exit the field.

Orient plant rows as closely as possible to be perpendicular to sheet flow direction.

Additional Criteria for to Reduce Sedimentation Offsite and Protect Water Quality and Excess Nutrients in Surface and Ground Waters

Do not burn the field border.

As a minimum, locate field borders along the edge(s) of the field where runoff enters or leaves the field. The minimum width for this purpose shall be 30 feet and have a dense vegetative stand (similar to a dense sod).

Design border widths to comply with all applicable State and local regulations regarding manure and chemical application setbacks.

Establish stiff-stemmed, upright grasses, grass/legumes or forbs to trap wind or waterborne soil particles.

Additional Criteria to Provide Wildlife Food and Cover and Pollinator or Other Beneficial Organisms

Use an approved habitat evaluation procedure to determine the appropriate amount, arrangement and composition of habitat resources needed to provide adequate food and cover for target wildlife species.

Select species that provide adequate habitat, food source and/or cover for the wildlife species of interest.

The minimum width for this purpose shall be 30 feet.

Schedule mowing, harvest, weed control, and other management activities within the field border to accommodate reproduction and other life-cycle requirements of target wildlife species.

When possible, disturb no more than 1/3 of the field border at any given time. Avoid vehicle traffic in the field border area.

For beneficial organisms (e.g., predatory and parasitic insects, spiders, insectivorous birds and bats, raptors, and terrestrial rodent predators) that prey on target pests, select diverse plant species that meet dietary, nesting and cover requirements for the intended species, at least during the critical period for control of target pests, and ideally year-round. Avoid exposure of the field border to pesticides and other chemicals that are potentially harmful to wildlife, pollinators, and other beneficial organisms.

When wildlife and/or pollinators are a concern, a lower percent groundcover than would be needed if protecting soil and water quality is acceptable as long as the soil resource concern is also adequately addressed (i.e., no excessive soil loss). This may be achieved by simply increasing the field border width.

Additional Criteria to Reduce Greenhouse Gases and Increase Carbon Storage

Establish plant species that will produce adequate above- and below-ground biomass for the site (i.e., a positive soil conditioning index will be achieved).

Maximize the width and length of the field border to fit the site and increase total biomass production.

Do not burn the field border.

Do not disturb the roots of the established vegetation with tillage.

Additional Criteria to Reduce Emissions of Particulate Matter

Establish plant species with morphological characteristics that optimize interception and adhesion of airborne particulates. Select plants with persistent roots and residue that stabilize soil aggregates and mitigate the generation of airborne particulates.

Do not burn the field border.

Establish species resistant to damage from equipment traffic.

CONSIDERATIONS

Applicable to All Purposes

Design border widths to comply with all applicable State and local regulations regarding manure and chemical application setbacks.

Plant field borders around the entire field, not just on the field edges where water enters or leaves the field, to maximize resource conservation benefits.

Establishing a narrow strip of stiff-stemmed upright grass at the crop/field border interface can increase soil particle and other airborne particulate trapping efficiency of the field border.

Native plants are best suited for wildlife and pollinator habitat enhancement, and provide other ecological benefits where adapted to site conditions and when consistent with producer objectives.

When enhancement of wildlife habitat is a purpose, plant species diversity should be encouraged. Plantings that result in multiple structural levels of vegetation will maximize wildlife use.

Include native plants that provide diverse pollen and nectar sources to encourage local pollinator populations. Where possible, re-establish the native plant community for the site.

Overseed the field border with forbs for increased plant diversity, soil quality, pollinators, and wildlife benefits.

In selecting plant species consider the plant’s tolerance to—

- Sediment deposition and chemicals planned for application.
- Drought in arid areas or where evapotranspiration can potentially exceed precipitation during the field border’s active growing period(s).

- Equipment traffic.

Establish plant species that will have the desired visual effects and that will not interfere with field operations or field border maintenance.

Establish plant species taking into account shading from adjacent vegetation.

The use of native perennial plant species as opposed to introduced species provides a longer period of resource protection.

Conservation Practice Standards Prescribed Burning (Code 338), Prescribed Grazing (Code 528), and Early Successional Habitat Development and Management (Code 647) are management practices that can be used to maintain suitable habitat for specifically desired wildlife species, provided those practices are applied following specifications that do not compromise the purpose(s) of the practice.

To minimize wildlife mortality and habitat degradation, turn or drive machinery on field borders only when necessary, at low speed, and with implements fully raised. If extensive turning/traffic will be necessary on the field border during the nesting season, mortality may be reduced by mowing it early to reduce its attractiveness as a nesting site, if alternative nesting cover is available.

Design border widths to match the required field application setback widths for easier management (i.e., land-use and management changes occur in the same location).

Consider installing a contour buffer system, no till practice, or other conservation practices on adjacent upland areas to reduce surface runoff and excessive sedimentation of field borders.

Organic producers may have to submit plans and specifications to their certifying agent for approval prior to installation, as part of the organic producer’s organic system plan.

Where genetic drift is a concern, use buffer vegetation to create a barrier between the pollen-producing crop and the crop that must be protected, or increase the distance between them so that cross-pollination is less likely.

Border widths can be designed to accommodate equipment turning, parking, loading/unloading equipment, grain harvest operations, etc. to minimize soil compaction on the high-traffic field edges.

Water bars or berms may be needed to breakup or redirect concentrated water flow within the field borders.

PLANS AND SPECIFICATIONS

Specifications shall be prepared for each site and purpose and recorded in the approved implementation requirements document.

- Practice purpose(s).
- Field border widths and lengths based on local design criteria.
- Field border location(s) within the field(s) or farm boundary.
- Species to be used and the location and planting density of the species used.
- Site preparation requirements.
- Timing of planting and planting method.
- Liming or fertilizer requirements.
- Operation and maintenance requirements.

OPERATION AND MAINTENANCE

Field borders require careful management and maintenance for performance and longevity. The following O&M activities will be planned and applied as needed:

- Repair storm damage.
- Remove sediment from above, within, and along the leading edge of the field border when accumulated sediment either alters the function of the field border or threatens the degradation of the planted species.
- Shut off pesticide sprayers and raise tillage equipment to avoid damage to field borders.
- Shape and reseed border areas damaged by animals, chemicals, tillage, or equipment traffic.
- Do not use the field border as a hay yard or machinery parking lot for any extended period of time, especially if doing so will damage or impair the function of the field border.
- Maintain desired vegetative communities and plant vigor by liming, fertilizing, mowing, disking, or burning and controlling noxious and invasive weeds to sustain effectiveness of the border.
- Repair and reseed ephemeral gullies and rills that develop in the border.
- Minimally invasive vertical tillage (e.g., paraplowing) may be performed in rare cases where compaction and vehicle traffic have degraded the field border function. The purpose of the tillage is strictly to relieve soil compaction and increase infiltration rates so as to provide a better media for reestablishment of vegetation and field border function.
- When managing for wildlife, maintenance activities that result in disturbance of vegetation should not be conducted during the primary nesting, fawning and calving seasons. In addition, when managing for wildlife, pollinator, and beneficial habitat, conduct any pesticide spray operations in the production area in a manner that prevents exposure of the field border to the pesticides, taking into account toxicity of the materials used to non-pest organisms, and weather conditions. Activities should be timed to allow for regrowth before the growing season ends whenever possible. The optimal vegetative successional state shall be maintained to accommodate target wildlife species' requirements.
- Periodic removal of some products such as medicinal herbs, nuts, and fruits is permitted provided the conservation purpose is not compromised by the loss of vegetation or harvesting disturbance.
- Avoid vehicle traffic when soil moisture conditions are saturated.
- Maintain records of the field border maintenance as needed by the land user.

REFERENCES

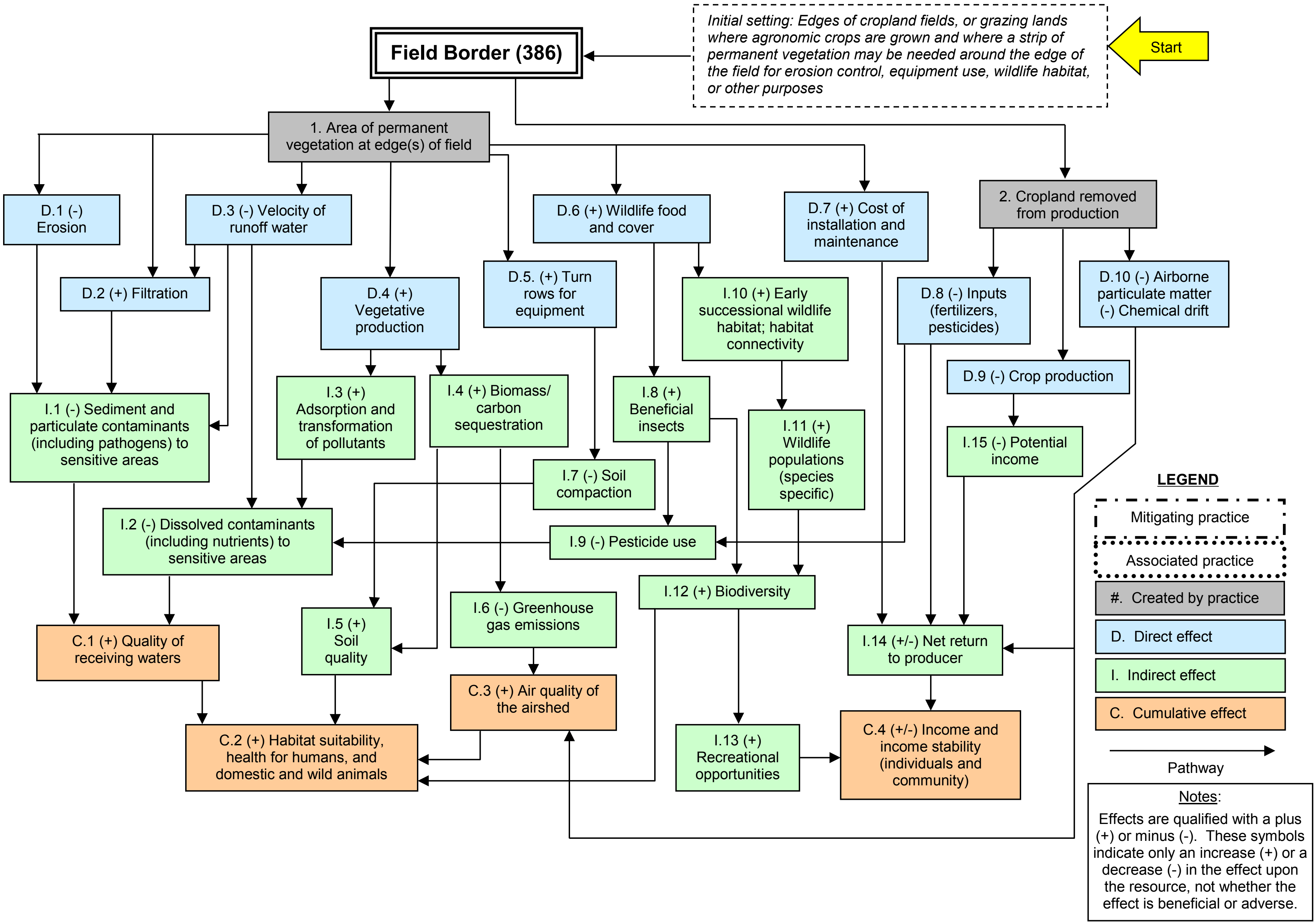
Baumgartner, J. et al. Biodiversity Conservation – An Organic Farmer's Guide. 2005. Wild Farm Alliance. http://www.wildfarmalliance.org.

K. G. Renard, G.R. Foster, G.A. Weesies, K.D.K. McCool and D.C. Yoder. 1997. Predicting Soil Erosion by Water: A Guide to Conservation Planning with the Revised Universal Soil Loss Equation (RUSLE), Agricultural Handbook Number 703.

Revised Universal Soil Loss Equation Version 2 (RUSLE2) Web site (checked May 2007): http://fargo.nserl.purdue.edu/rusle2_dataweb/RUSLE2_Index.htm.

NRCS CONSERVATION PRACTICE EFFECTS - NETWORK DIAGRAM

September 2016



Effects of NRCS Conservation Practices - National

Field Border

A stripe of permanent vegetation established at the edge or around the perimeter or a field.

Code: 386
Units: ft.

C-Crop	F-Forest	R-Range	P-Pasture	Pr-Protected	FS-Farmstead	D-Developed	W-Water	O-Other	AL-Aso Land
C			P					O	

Typical Landuse:

Soil Erosion	Effect	Rationale
Soil Erosion - Sheet and Rill Erosion	4	Permanent vegetation planted across the slope reduces erosive water energy.
Soil Erosion - Wind Erosion	4	Stiff-stemmed, permanent vegetation traps saltating particles. More roughened surface slows wind velocities.
Soil Erosion - Ephemeral Gully Erosion	1	Vegetation across the slope reduces erosive energy of concentrated flows where they exit the field.
Soil Erosion - Classic Gully Erosion	0	Not Applicable
Soil Erosion - Streambank, Shoreline, Water Conveyance C	1	Increased vegetation can reduce concentrated runoff flowing over streambanks.
Soil Quality Degradation		
Organic Matter Depletion	4	Permanent cover and lack of soil disturbance reduces decomposition of soil organic materials such as roots and allows accumulation.
Compaction	2	Root penetration and organic matter helps restore soil structure.
Subsidence	0	Drainage has the predominant impact on subsidence.
Concentration of Salts or Other Chemicals	0	Not Applicable
Excess Water		
Excess Water - Seeps	0	Not Applicable
Excess Water - Runoff, Flooding, or Ponding	1	Permanent vegetation will reduce runoff and increase infiltration.
Excess Water - Seasonal High Water Table	0	Not Applicable
Excess Water - Drifted Snow	0	Not Applicable
Insufficient Water		
Insufficient Water - Inefficient Use of Irrigation Water	0	Not Applicable
Insufficient Water - Inefficient Moisture Management	0	Not Applicable
Water Quality Degradation		
Pesticides in Surface Water	2	The action reduces runoff and erosion. Also, the borders may attract beneficial insects or trap insect pests, reducing the need for pesticide applications.
Pesticides in Groundwater	2	The action may attract beneficial insects or trap insect pests, reducing the need for pesticide applications.
Nutrients in Surface water	2	Permanent vegetation will take up available nutrients and increase organic matter. The increased organic matter will increase cation exchange capacity which will hold nutrients.
Nutrients in Groundwater	2	Permanent vegetation will take up available nutrients and increase organic matter. The increased organic matter will increase cation exchange capacity which will hold nutrients.
Salts in Surface Water	0	Not Applicable
Salts in Groundwater	1	The action will result in increased uptake by plants.
Excess Pathogens and Chemicals from Manure, Bio-solic	1	Less erosion and runoff reduces delivery of pathogens. More moist environment in permanent vegetation may slow pathogen mortality, however.
Excess Pathogens and Chemicals from Manure, Bio-solic	0	Permanent vegetation increases soil organic matter and microbial activity, which competes with pathogens. However, permanent vegetation may delay mortality of some pathogens by slowing desiccation.

Excessive Sediment in Surface Water	2	Vegetation protects soil surface and traps sediment.
Elevated Water Temperature	0	Not Applicable
Petroleum, Heavy Metals and Other Pollutants Transporte	0	Not Applicable
Petroleum, Heavy Metals and Other Pollutants Transporte	0	Not Applicable
Air Quality Impacts		
Emissions of Particulate Matter (PM) and PM Precursors	1	Permanent vegetation around the field edge reduces particulate emissions from vehicle traffic and tillage in the border area.
Emissions of Ozone Precursors	0	Not Applicable
Emissions of Greenhouse Gases (GHGs)	1	Vegetation removes CO2 from the air and stores it in the form of carbon in the plants and soil.
Objectionable Odors	0	Not Applicable
Degraded Plant Condition		
Undesirable Plant Productivity and Health	5	Plants are selected and managed to maintain optimal productivity and health.
Inadequate Structure and Composition	5	Plants selected are adapted and suited.
Excessive Plant Pest Pressure	4	Vegetation is installed and managed to control undesired species.
Wildfire Hazard, Excessive Biomass Accumulation	0	Not Applicable
Fish and Wildlife - Inadequate Habitat		
Inadequate Habitat - Food	2	Increased quality and quantity of vegetation provides more food for wildlife.
Inadequate Habitat - Cover/Shelter	2	Plants may be chosen and managed to enhance value as cover/shelter.
Inadequate Habitat - Water	4	Not Applicable
Inadequate Habitat - Habitat Continuity (Space)	2	Permanent vegetation may provide added habitat and connectivity for selected wildlife species.
Livestock Production Limitation		
Inadequate Feed and Forage	0	There may be some use of the planting for feed and forage by livestock.
Inadequate Shelter	0	Not Applicable
Inadequate Water	0	Not Applicable
Inefficient Energy Use		
Equipment and Facilities	0	Not Applicable
Farming/Ranching Practices and Field Operations	0	Not Applicable

CPPE Practice Effects:	*0 No Effect*
5 Substantial Improvement	*-1 Slight Worsening*
4 Moderate to Substantial Improvement	*-2 Slight to Moderate Worsening*
3 Moderate Improvement	*-3 Moderate Worsening*
2 Slight to Moderate Improvement	*-4 Moderate to Substantial Worsening*
1 Slight Improvement	*-5 Substantial Worsening*

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

ACCESS CONTROL

CODE 472

(ac)

DEFINITION

The temporary or permanent exclusion of animals, people, vehicles, and equipment from an area.

PURPOSE

This practice is used to accomplish the following purpose:

- Achieve and maintain desired resource conditions by monitoring and managing the intensity of use by animals, people, vehicles, and equipment in coordination with the application schedule of practices, measures, and activities specified in the conservation plan

CONDITIONS WHERE PRACTICE APPLIES

This practice applies on all land uses.

CRITERIA

General Criteria Applicable to All Purposes

Use-regulating activities (e.g., posting of signs, patrolling, gates, fences and other barriers, permits) must achieve the intended purpose and include mitigating associated resource concerns to acceptable levels during their installation, operation, and maintenance. Activities will complement the application schedule and life-span of other practices specified in the conservation plan.

Each activity or measure will identify the entity to be monitored and regulated (animals, people, vehicles, and equipment) and specify the intent, intensity, amounts, and timing of exclusion by that entity. Activities may involve temporary to permanent exclusion of one to all entities.

Placement, location, dimensions, and materials (e.g., signs, gates), and frequency of use (e.g., continuous, specific season, or specific dates) must be described for each activity including monitoring frequency.

CONSIDERATIONS

Even though usage of the area is monitored and controlled, the land manager and/or tenant should be advised about emergency preparedness agencies and related information (e.g., the local fire/wildfire control agency and pumper truck water sources) on or near the area. Information should be designated initially and redesignated annually.

PLANS AND SPECIFICATIONS

Specifications for applying this practice must be prepared for each area and recorded using approved specification sheets, job sheets, and narrative statements in the conservation plan, or other acceptable documentation.

OPERATION AND MAINTENANCE

Monitoring of the effectiveness of use-regulating activities will be performed routinely and at least annually with changes made to specifications and operation and maintenance requirements as necessary.

Modifications to activities and use of measures are allowed temporarily to accommodate emergency-level contingencies such as wildfire, hurricane, drought, or flood if resource conditions are maintained

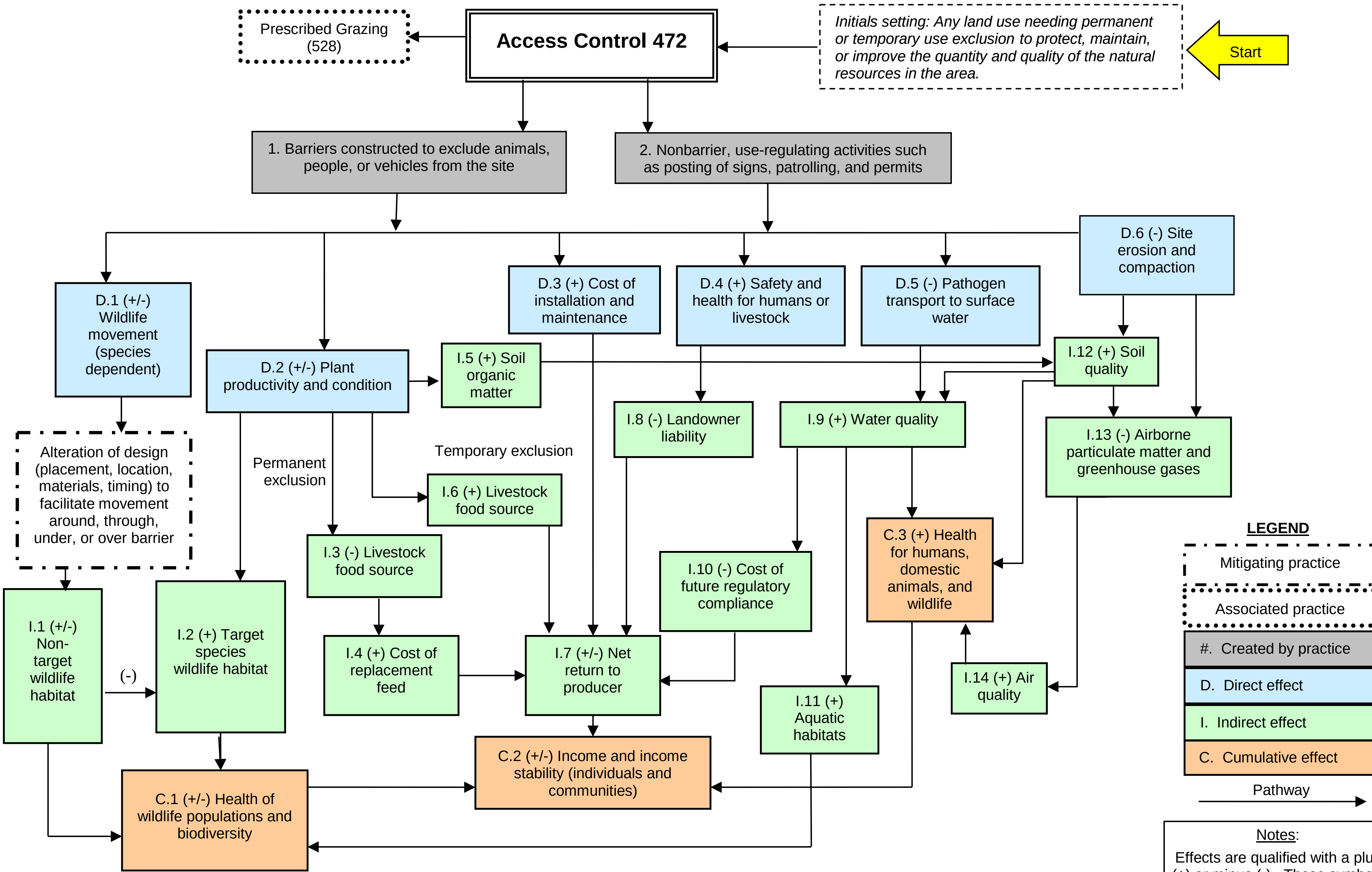
REFERENCES

Gucinski, H., M.J. Furniss, R.R. Ziemer, M.H. Brookes. 2001. Forest roads: A Synthesis of Scientific Information. Gen. Tech. Rep. PNWGTR-509. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. Portland, OR.

U.S. Department of Transportation, Federal Highway Administration. 2009. Manual on Uniform Traffic Control Devices for Streets and Highways - Part 5, Traffic Control Devices for Low-Volume Roads. Washington, DC. https://mutcd.fhwa.dot.gov/pdfs/2009r1r2/pdf_index.htm.

NRCS CONSERVATION PRACTICE EFFECTS - NETWORK DIAGRAM

October 2017



Notes:

Effects are qualified with a plus (+) or minus (-). These symbols indicate only an increase (+) or a decrease (-) in the effect upon the resource, not whether the effect is beneficial or adverse.

Effects of NRCS Conservation Practices - National

Access Control

The temporary or permanent exclusion of animals, people, vehicles, and/or equipment from an area.

Code: 472
Units: ac

C-Crop	F-Forest	R-Range	P-Pasture	Pr-Protected	FS-Farmstead	D-Developed	W-Water	O-Other	AL-Aso Land

Typical Landuse: C F R P Pr FS D W O AL

Soil Erosion	Effect	Rationale
Soil Erosion - Sheet and Rill Erosion	3	Control of animals, people and vehicles reduces disturbance of soil and vegetation.
Soil Erosion - Wind Erosion	1	Control of animals, people and vehicles reduces disturbance of soil and vegetation.
Soil Erosion - Ephemeral Gully Erosion	4	Control of animals, people and vehicles reduces disturbance of soil and vegetation.
Soil Erosion - Classic Gully Erosion	4	Control of animals, people and vehicles reduces disturbance of soil and vegetation.
Soil Erosion - Streambank, Shoreline, Water Conveyance (	4	Control of animals, people and vehicles reduces disturbance of soil and vegetation.
Soil Quality Degradation		
Organic Matter Depletion	1	Control of animals, people and vehicles help maintain conditions of soil and vegetation.
Compaction	4	Control of animals, people and vehicles lessens compactive forces on soil.
Subsidence	0	Not Applicable
Concentration of Salts or Other Chemicals	0	Control of animals, people and vehicles will influence plant growth and alter infiltration and leaching to a limited degree.
Excess Water		
Excess Water - Seeps	1	Control of animals, people and vehicles influences vigor and health of vegetation which in turn can influence water uptake and infiltration.
Excess Water - Runoff, Flooding, or Ponding	0	Control of animals, people and vehicles can improve vigor and health of vegetation which can increase retardance of water flows. Also, exclusion structures can trap debris further retarding flows.
Excess Water - Seasonal High Water Table	2	Control of animals, people and vehicles influences vigor and health of vegetation which in turn can influence water uptake.
Excess Water - Drifted Snow	0	Not Applicable
Insufficient Water		
Insufficient Water - Inefficient Use of Irrigation Water	0	Not Applicable
Insufficient Water - Inefficient Moisture Management	3	Control of animals, people and vehicles influences vegetation vigor and soil structure which can help optimize water use.
Water Quality Degradation		
Pesticides in Surface Water	1	Control of animals, people and vehicles influences vigor and health of vegetation and soil condition which retain pesticides when applied with other management practices.
Pesticides in Groundwater	0	Not Applicable
Nutrients in Surface water	1	Control of animals, people and vehicles influences vigor and health of vegetation and soil condition reducing runoff when applied with other management practices.
Nutrients in Groundwater	1	Control of animals, people, and vehicles influences vegetation vigor and soil structure which can accelerate use and breakdown of nutrients/organics.
Salts in Surface Water	0	Not Applicable
Salts in Groundwater	0	Not Applicable
Excess Pathogens and Chemicals from Manure, Bio-soli	1	Control of animals, people and vehicles influences vigor and health of vegetation and soil condition which in turn can influence water uptake and infiltration to reduce runoff and increase mortality of pathogens.
Excess Pathogens and Chemicals from Manure, Bio-soli	1	Control of animals and people lessens pathogen production in sensitive areas.
Excessive Sediment in Surface Water	3	Control of animals, people and vehicles influences vigor and health of vegetation and soil condition reducing sediment supply to surface waters when applied with other management practices.

Elevated Water Temperature	3	Control of animals, people and vehicles influences vigor, health, and availability of riparian vegetation which can shade associated surface waters.
Petroleum, Heavy Metals and Other Pollutants Transport	1	Control of animals, people and vehicles improves vigor and health of vegetation and soil condition, which in turn can influence water uptake and infiltration to reduce runoff. Reducing vehicles eliminates heavy metals from brakes and fuel.
Petroleum, Heavy Metals and Other Pollutants Transport	1	Control of animals, people, and vehicles influences vegetation vigor and soil structure which can accelerate attenuation of heavy metals.
Air Quality Impacts		
Emissions of Particulate Matter (PM) and PM Precursors	2	Restricting traffic on an area can reduce crushing action of tires on the surface and result in an improved stand of vegetation, which can reduce the generation of particulates.
Emissions of Ozone Precursors	1	Restricting traffic will reduce engine emissions from that area.
Emissions of Greenhouse Gases (GHGs)	1	Vegetation removes CO2 from the air and stores it in the form of carbon in the plants and soil. Restricting traffic will reduce engine emissions from that area.
Objectionable Odors	0	Not Applicable
Degraded Plant Condition		
Undesirable Plant Productivity and Health	3	Control of animals, people, and vehicles facilitates when used with other practices maintains and enhances health and vigor of desired plant communities.
Inadequate Structure and Composition	3	Control of access encourages plants that are adapted and suited for the site.
Excessive Plant Pest Pressure	5	Control of animals, people and vehicles influences vigor and health of desirable vegetation thereby reducing threat of noxious and invasive plants when applied with other conservation practices.
Wildfire Hazard, Excessive Biomass Accumulation	3	Access by people and vehicles to high hazard areas can be restricted.
Fish and Wildlife - Inadequate Habitat		
Inadequate Habitat - Food	3	Control of animals, people and vehicles influences vigor, health, and availability of vegetation for food.
Inadequate Habitat - Cover/Shelter	3	Control of animals, people and vehicles influences vigor, health, and availability of vegetation cover/shelter.
Inadequate Habitat - Water	3	Control of access protects available water sources.
Inadequate Habitat - Habitat Continuity (Space)	1	Excluded use protects wildlife space requirements.
Livestock Production Limitation		
Inadequate Feed and Forage	3	Control of animals influences vigor and health of vegetation.
Inadequate Shelter	0	Not Applicable
Inadequate Water	0	Not Applicable
Inefficient Energy Use		
Equipment and Facilities	0	Not Applicable
Farming/Ranching Practices and Field Operations	0	Not Applicable

CPPE Practice Effects:	*0 No Effect*
5 Substantial Improvement	*-1 Slight Worsening*
4 Moderate to Substantial Improvement	*-2 Slight to Moderate Worsening*
3 Moderate Improvement	*-3 Moderate Worsening*
2 Slight to Moderate Improvement	*-4 Moderate to Substantial Worsening*
1 Slight Improvement	*-5 Substantial Worsening*

United States Department of Agriculture

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

NUTRIENT MANAGEMENT

CODE 590

(ac)

DEFINITION

Manage rate, source, placement, and timing of plant nutrients and soil amendments while reducing environmental impacts.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Improve plant health and productivity
- Reduce excess nutrients in surface and ground water
- Reduce emissions of objectionable odors
- Reduce emissions of particulate matter (PM) and PM precursors
- Reduce emissions of greenhouse gases (GHG)
- Reduce emissions of ozone precursors
- Reduce the risk of potential pathogens from manure, biosolids, or compost application from reaching surface and ground water
- Improve or maintain soil organic matter

CONDITIONS WHERE PRACTICE APPLIES

All fields where plant nutrients and soil amendments are applied. Does not apply to one-time nutrient applications at establishment of permanent vegetation.

CRITERIA

General Criteria Applicable to All Purposes

Develop a nutrient management plan for nitrogen (N), phosphorus (P), and potassium (K), which accounts for all known measurable sources and removal of these nutrients.

Sources of nutrients include, but are not limited to, commercial fertilizers (including starter and in-furrow starter/pop-up fertilizer), animal manures, legume fixation credits, green manures, plant or crop residues, compost, organic by-products, municipal and industrial biosolids, wastewater, organic materials, estimated plant available soil nutrients, and irrigation water.

When irrigating, apply irrigation water in a manner that reduces the risk of nutrient loss to surface and ground water.

Follow all applicable State requirements and regulations when applying nutrients near areas prone to contamination, such as designated water quality sensitive areas, (e.g., lakes, ponds, rivers and streams, sinkholes, wellheads, classic gullies, ditches, or surface inlets) that run unmitigated to surface or groundwater.

Soil and tissue testing and analysis
Base the nutrient management plan on current soil test results in accordance with land grant university (LGU) guidance, or industry practice when recognized by the Mississippi State Extension Service (MSU-ES). Use soil tests no older than 2 years when developing new nutrient management plans. Use tissue testing, when applicable, for monitoring or adjusting the nutrient management plan in accordance with Mississippi State University Extension Service guidance, or industry practice when recognized by the Mississippi State University Extension (See publication 2647 Nutrient Management Guidelines for Agronomic Crops Grown in Mississippi).

For nutrient management plan revisions and maintenance, take soil tests on an interval recommended by the LGU (MSU-ES) or as required by local rules and regulations.

Collect, prepare, store, and ship all soil and tissue samples following LGU (MSU-ES) guidance or industry practice. The test analyses must include pertinent information for monitoring or amending the annual nutrient plan. Follow LGU (MSU-ES) guidelines regarding required analyses and test interpretations.

For soil test analyses, use laboratories successfully meeting the requirements and performance standards of the North American Proficiency Testing Program under the auspices of the Soil Science Society of America and NRCS or use an alternative NRCS- or State-approved certification program that considers laboratory performance and proficiency to assure accuracy of soil test results. Alternative certification programs must have solid stakeholder support (e.g., Mississippi Department of Environmental Quality, growers, and others) and be State or regional in scope.

Maintain soil pH within ranges which enhance the adequate level for plant or crop nutrient availability and utilization. Refer to State LGU (MSU-ES) documentation for guidance (See publication 2647 Nutrient Management Guidelines for Agronomic Crops Grown in Mississippi).

Manure, organic by-product, and biosolids testing and analysis
Collect, prepare, store, and ship all manure, organic by-products, and biosolids following LGU (MSU-ES) guidance or industry practice when recognized by the LGU (MSU-ES). In the absence of such guidance, test at least annually, or more frequently if needed to account for operational changes (e.g., feed management, animal type, manure handling strategy, etc.) impacting manure nutrient concentrations. If no operational changes occur and operations can document a stable level of nutrient concentrations for the preceding 3 consecutive years, manure may be tested less frequently, unless Federal, State, or local regulations require more frequent testing. Follow LGU (MSU-ES) guidelines regarding required analyses and test interpretations. Analyze, as a minimum, total N, total P or P_2O_5, total K or K_2O, and percent solids.

When planning for new or modified livestock operations, and manure tests are not available yet, use the output and analyses from similar operations in the geographical area if they accurately estimate nutrient output from the proposed operation or use “book values” recognized by the NRCS (e.g., NRCS Agricultural Waste Management Field Handbook) and the LGU (MSU-ES).

For manure analyses, use laboratories successfully meeting the requirements and performance standards of the Manure Testing Laboratory Certification program under the auspices of the Minnesota Department of Agriculture or other NRCS-approved program that considers laboratory performance and proficiency to assure accurate manure test results (See MSU publicated 2897 Forage and Manure Analysis Laboratories).

For nutrient management plans developed as a component of a comprehensive nutrient management plan for an animal feeding operation (AFO) follow policy in NRCS directive General Manual (GM) 190, Part 405, “Comprehensive Nutrient Management Plans.” These plans must include documentation of all nutrient imports, exports, and on-farm transfers.

Nutrient loss risk assessments
Use current NRCS-approved nitrogen, phosphorus, and soil erosion risk assessment tools to assess the site-specific risk of nutrient and soil loss.

Complete an NRCS-approved nutrient risk assessment for N on all fields where nutrient management is planned unless the Mississippi NRCS, in cooperation with Mississippi Department of Environmental Quality authorities, has determined specific conditions where N leaching is not a risk to water quality, including drinking water.

The Mississippi Phosphorous Index (PI) Phosphorus Index for Mississippi MS-ESC-TN05, NRCS-approved nutrient management risk assessment for phosphorous) must be completed when —

- P application rate exceeds LGU (MSU-ES) fertility rate guidelines for the planned crop(s).
- The planned area is within a P-impaired watershed.
- The site-specific conditions equating to low risk of P loss have not been determined by the NRCS in cooperation with the LGU (MSU-ES).

Any fields excluded from a P risk assessment must have a documented agronomic need for P, based on soil test P and MSU-ES nutrient recommendations.

For fields receiving manure, where P risk assessment results equate to—

- LOW risk.—Manure can be applied at rates to supply P at greater than crop requirement not to exceed the N requirement for the succeeding crop.
- MODERATE risk.—Manure can be applied at rates not to exceed crop P removal rate or the soil test P recommended rate for the planned crops in rotation.
- HIGH risk.—Manure can be applied at rates not to exceed crop P removal rate if the following requirements are met:
  - A soil P drawdown strategy has been developed, documented, and implemented for the crop rotation.
  - Implementation of all mitigation practices determined to be needed by site-specific assessments for nutrients and soil loss to protect water quality.
  - Any deviation from these high-risk requirements that would increase the risk of P runoff requires the approval of the Chief of the NRCS.

A phosphorous index will not be required when the risk of phosphorous loss is low, individual fields have a documented agronomic need for phosphorous; based on soil test phosphorous (STP) and MSU-ES nutrient recommendations, and all four of the following conditions are met:

Low or medium soil test phosphorous (0-72 lbs/ac. STP) levels based on current soil test(s)

- Slope is less than 5%
- Soil loss is less than or equal to soil loss tolerance
- Nutrient application shall not exceed Mississippi State University Extension Service fertility rate guidelines for the planned crop(s).

The 4Rs of nutrient stewardship
Manage nutrients based on the 4Rs of nutrient stewardship—apply the right nutrient source at the right rate at the right time in the right place—to improve nutrient use efficiency by the crop and to reduce nutrient losses to surface and groundwater and to the atmosphere.

Nutrient source

Choose nutrient sources compatible with application timing, tillage and planting system, soil properties, crop, crop rotation, soil organic content, and local climate to minimize risk to the environment.

Determine nutrient values of all nutrient sources (e.g. commercial fertilizers, manure, organic by-products, biosolids) prior to land application.

Determine nutrient contribution of cover crops, previous crop residues, and soil organic matter.

For operations following USDA's National Organic Program, apply and manage nutrient sources according to program regulations.

For enhanced efficiency fertilizer (EEF) products, use products defined by the Association of American Plant Food Control Officials as EEF and be accepted for use by the Mississippi Bureau of Plant Industries, a division of the Mississippi Department of Agriculture and Commerce.

In areas where salinity is a concern, select nutrient sources that limit the buildup of soil salts. When manures are applied, and soil salinity is a concern, monitor salt concentrations to prevent potential plant or crop damage and reduced soil quality.

Apply manure or organic by-products on legumes at rates no greater than the LGU (MSU-ES) estimated N removal rates in harvested plant biomass, not to exceed P risk assessment limitations.

For any single application of nutrients applied as liquid (e.g., liquid manure, nutrients in irrigation water, fertigation)—

- Do not exceed the soil's infiltration rate or water holding capacity.
- Apply so that nutrients move no deeper than the current crop rooting depth.
- Avoid runoff or loss to subsurface tile drains.

Nutrient rate

Plan nutrient application rates for N, P, and K using LGU (MSU-ES) recommendations or industry practices when recognized by the LGU (MSU-ES). Lower-than-recommended nutrient application rates are permissible if the client's objectives are met.

At a minimum, determine the rate based on crop/cropping sequence, current soil test results, and NRCS-approved nutrient risk assessments. Where applicable, use realistic yield goals.

For new crops or varieties where LGU (MSU-ES) guidance is unavailable, industry-demonstrated yield and nutrient uptake information may be used.

Estimate realistic yield potentials or realistic yield goals using LGU (MSU-ES) procedures or based on historical yield or growth data, soil productivity information, climatic conditions, nutrient test results, level of management, and/or local research results considering comparable management and production conditions.

Nutrient application timing and placement

Consider the nutrient source, management and production system limitations, soil properties, weather conditions, drainage system, soil biology, and nutrient risk assessment to develop optimal timing of nutrients. For N, time the application as closely as practical with plant and crop uptake. For P, time planned surface application when runoff potential is low. Time the application of all nutrients to minimize potential for soil compaction.

For crop rotations or multiple crops grown in one year, do not apply additional P if it was already added in an amount sufficient to supply all crop nutrient needs.

To avoid salt damage, follow LGU (MSU-ES) recommendations for the timing, placement, and rate of applied N and K in starter fertilizer and must be consistent with guidelines (see publication 2647 Nutrient Management Guidelines for Agronomic Crops grown in Mississippi) or industry practice recognized by MSU-ES.

Do not surface apply nutrients when there is a risk of runoff, including when—

- Soils are frozen.
- Soils are snow-covered.
- The top 2 inches of soil are saturated.

Exceptions for the above criteria related to surface-applied nutrients when there is a risk of runoff can be made when specified conditions are met and adequate conservation measures are installed to prevent the offsite delivery of nutrients. NRCS, in cooperation with Mississippi Department of Environmental Quality authority, will define adequate treatment levels and specified conditions for applications of manure if soils are frozen and/or snow covered or the top 2 inches of soil are saturated. The adequate treatment level and specified conditions for winter applications of manure are defined by NRCS in concurrence with the Mississippi Department of Environmental Quality as follows:

- When filed slope is less than 5%
- When crops are actively growing,
- When a minimum forage height of 4 inches is maintained,
- When specifically addressed in the nutrient management plan and the amount and form of nutrients to be applied does not exceed agronomic recommendations, and
- When the buffer widths for intermittent streams and surface water bodies are increased from 50 feet to 100 feet Weather (short term)
- Areas of concentrated flow
- Organic residue and living covers
- Amount and source of nutrients to be applied
- Setback distances to protect local water quality

Additional Criteria to Minimize Agricultural Nonpoint Source Pollution of Surface and Groundwater

Apply conservation practices to avoid nutrient loss and control and trap nutrients before they can leave the field(s) by surface, leaching, or subsurface drainage (e.g., tile, karst) when there is a significant risk of transport of nutrients.

Additional Criteria to Reduce the Risk of Potential Pathogens From Manure, Biosolids, or Compost Application From Reaching Surface and Groundwater

When applicable, follow proper biosecurity measures as provided in NRCS directives GM-130, Part 403, Subpart H, “Biosecurity Preparedness and Response.”

Follow all applicable Federal, Tribal, State, and local laws and policies concerning the application of manure, biosolids, or compost in the production of fresh, edible crops.

Apply manure, biosolids, or compost with minimal soil disturbance or by injection into the soil unless it is being applied to an actively growing crop, a minimum of 30 percent residue exists, or there is a living cover that has a fibrous root system with 75 percent or more cover. Do not surface apply manure if a storm event is forecast within 24 hours.

Additional Criteria to Reduce Emissions of Objectionable Odors, PM and PM Precursors, and GHG and Ozone Precursors

To address air quality concerns caused by odor, N, sulfur, and particulate emissions; adjust the source, timing, amount, and placement of nutrients to reduce the negative impact of these emissions on the environment and human health.

Do not surface apply solid nutrient sources, including commercial fertilizers, manure, or organic by-products of similar dryness/density when there is a high probability that wind will blow the material and emissions offsite. Do not surface apply liquid nutrient sources when there is a high probability that wind will blow the liquid droplets applied from sprinklers or other applicable methods offsite.

Reduce the potential for volatilization by applying sources subject to volatilization during cooler, higher humidity conditions or by placement that minimizes vulnerability to volatilization.

Additional Criteria to Improve or Maintain Organic Matter

Design the plant or crop management systems so the soil conditioning index (SCI) organic matter subfactor is positive.

Apply manure, compost, or other organic nutrient sources at a rate and with minimal disturbance that will improve soil organic matter without exceeding acceptable risk of N or P loss.

For low residue plant or cropping systems, apply adequate nutrients to optimize plant or crop residue production to maintain or increase soil organic matter.

CONSIDERATIONS

General Considerations

Consider development of nutrient management plans by conservation management unit (CMU). A CMU is a field, group of fields, or other land units of the same land use and having similar treatment needs and planned management. A CMU is a grouping by the planner to simplify planning activities and facilitate development of conservation management systems. A CMU has definitive boundaries such as fencing, drainage, vegetation, topography, or soil lines.

Develop site-specific yield maps using a yield monitoring system, multispectral imagery or other methods. Use the data to further delineate low- and high-yield areas, or zones, and make the necessary management changes. Use variable rate nutrient application based on site-specific factor variability. See NRCS directive Agronomy Technical Note (TN) 190, AGR.3, “Precision Nutrient Management Planning.”

Use the adaptive nutrient management learning process to improve nutrient use efficiency on farms as outlined in NRCS’ national nutrient policy in GM-190, Part 402, “Nutrient Management.” Consider using an adaptive approach to adjust nutrient rate, timing, form, and placement as soil biologic functions and soil organic matter changes over time. See NRCS directive Agronomy Technical Note (TN) 190, AGR.7, “Adaptive Nutrient Management Process.”

When developing new nutrient management plans, consider using soil test information no older than 1 year rather than 2 years.

Develop a whole farm nutrient budget (nutrient mass balance), including all imported and exported nutrients. Imports may include feed, fertilizer, animals and bedding, while exports may include crop removal, animal products, animal sales, manure, and compost.

Modify animal feed diets to reduce the nutrient content of manure following guidance contained in Conservation Practice Standard (CPS) Feed Management (Code 592).

Provide a nutrient analysis of all nutrient source exports (manure or other materials).

Excessive levels of some nutrients can cause induced deficiencies of other nutrients, (e.g., high soil test P levels can result in zinc deficiency in corn).

Use soil tests, plant tissue analyses, and field observations to check for secondary plant nutrient deficiencies or toxicity that may impact plant growth or availability of the primary nutrients.

Do not apply K in situations where an excess (greater than soil test K recommendation) causes nutrient imbalances in crops or forages.

Use bioreactors and multistage drainage strategies to mitigate nutrient loss pathways, as applicable.

Use legume crops and cover crops to provide N through biological fixation. Cover crops with a carbon to nitrogen ratio below 20:1 can release a large amount of soluble N after being plowed or tilled into the soil when an actively growing crop is not present to take up nutrients, leading to increased risks of nitrate movement and nitrous oxide emissions. The nitrous oxide emissions often occur in high soil moisture conditions, such as when a legume cover crop is plowed down in fall or early spring. To avoid these losses, use grass-legume or grass-legume-forbs mixtures with a more balanced carbon to nitrogen ratio.

Use winter hardy grass cover crops to take up excess N after the cash crop growing season and promote contribution of the nitrogen to next plant or crop.

Use conservation practices that slow runoff, reduce erosion, and increase infiltration (e.g., filter strip, contour farming, or contour buffer strips).

Use application methods, timing, technologies or strategies to reduce the risk of nutrient movement or loss, such as—

- Split nutrient applications.
- Banded applications.
- Injection of nutrients below the soil surface.
- Incorporate surface-applied nutrient sources when precipitation capable of producing runoff or erosion is forecast within the time of a planned application.
- High-efficiency irrigation systems and technology.
- Enhanced efficiency fertilizers
    - Slow or controlled release fertilizers
    - Nitrification inhibitors
    - Urease inhibitors.
- Drainage water management.
- Tissue testing, chlorophyll meters, or real-time sensors.
- Pathogen management considerations.

When a recycled product (e.g., compost) is to be used as a nutrient source on food crops or as food for humans or animals, make sure that pathogen levels have been reduced to acceptable levels (reference the Food and Drug Administration's Food Safety Modernization Act). www.fda.gov/FSMA. When the recycled product has come from another farming operation, implement biosecurity measures and evaluate the risk of pathogen transfer that could cause plant or animal diseases.

Use manure treatment systems that reduce pathogen content from manure.

Implementing a soil health management system that reduces tillage or other soil disturbance, includes a diverse rotation of crops and cover crops, keeps roots growing throughout the year, and keeps the soils covered to reduce nutrient losses, and improves—

- Nutrient use efficiency, rooting depth, and availability of nutrients.

- Soil organic matter levels.
- Availability of nutrients from organic sources.
- Aggregate stability and soil structure.
- Infiltration, drainage, and aeration of the soil profile.
- Soil biological activity.
- Water use efficiency and available moisture.

Use targeted or prescribed livestock grazing to enhance nutrient cycling and improve soil nutrient cycling functions.

Elevated soil test P levels may lead to reduced mycorrhizal fungal associations and immobilize some micronutrients, such as iron, zinc, and copper.

Apply manure, compost, or other nutrient sources with minimal soil disturbance and at a rate that will improve soil organic matter without exceeding acceptable risk of N or P loss.

PLANS AND SPECIFICATIONS

In the nutrient management plan, document—

- Aerial site photograph(s), imagery, topography, or site map(s).
- Soil survey map of the site.
- Soil information including: soil type, surface texture, drainage class, permeability, available water capacity, depth to water table, restrictive features, and flooding and ponding frequency.
- Location of designated sensitive areas and the associated nutrient application restrictions and setbacks.
- Location of nearby residences, or other locations where humans may be present on a regular basis, that may be impacted if odors or PM are transported to those locations.
- Results of approved risk assessment tools for N, P, and erosion losses.
- Documentation establishing the application site presents a low risk for P transport to local water if P is applied in excess of crop requirement.
- Current and planned plant production sequence or crop rotation.
- All available test results (e.g. soil, water, compost, manure, organic by-product, and plant tissue sample analyses) upon which the nutrient budget and management plan are based.
- When soil P levels are increasing above an agronomic level, include a discussion of the risk associated with P accumulation and a proposed P draw-down strategy.
- Realistic yield goals for the crops (where applicable for developing the nutrient management plan).
- Nutrient recommendations for N, P, and K for the entire plant production sequence or crop rotation.
- Listing, quantification, application method and timing for all nutrient sources (including all enhanced efficiency fertilizer products) that are planned for use and documentation of all nutrient imports, exports, and onsite transfers.
- Guidance for implementation, operation and maintenance, and recordkeeping.

For variable rate nutrient management plans, also include—

- Geo-referenced field boundary and data collected that was processed and analyzed as a GIS layer or layers to generate nutrient or soil amendment recommendations per management zone. Must include site-specific yield maps using soils data, current soil test results, and a yield monitoring system with GPS receiver to correlate field location with yield.
- Nutrient recommendation guidance and recommendation equations used to convert the GIS base data layer or layers to a nutrient source material recommendation GIS layer or layers.

- After implementation, provide application records per management zone or as applied map within individual field boundaries (or electronic records) documenting source, timing, method, and rate of all nutrient or soil amendment applications.

If increases in soil P levels are expected above an agronomic level (i.e., when N-based rates are used), document—

- Soil P levels at which it is desirable to convert to P-based planning.
- A long-term strategy and proposed implementation timeline for soil test P drawdown from the production and harvesting of crops.
- Management activities or techniques used to reduce the potential for P transport and loss.
- For AFOs, a quantification of manure produced in excess of crop nutrient requirements.

OPERATION AND MAINTENANCE

Review or revise plans periodically to determine if adjustments or modifications are needed. At a minimum, review and revise plans as needed with each soil test cycle, changes in manure management, volume or analysis, plants and crops, or plant and crop management.

Monitor fields receiving animal manures and biosolids for the accumulation of heavy metals and P in accordance with LGU guidance and State law.

For animal feeding operation, significant changes in animal numbers, management, and feed management will necessitate additional manure analyses to establish a revised average nutrient content.

Calibrate application equipment to ensure accurate distribution of material at planned rates. For products too dangerous to calibrate, follow LGU or equipment manufacturer guidance on proper equipment design, plumbing, and maintenance.

Document the nutrient application rate. When the applied rate differs from the planned rate, provide appropriate documentation to explain the difference.

Protect workers from and avoid unnecessary contact with nutrient sources. Take extra caution when handling anhydrous ammonia or when managing organic wastes stored in unventilated tanks, impoundments, or other enclosures.

Use material generated from cleaning nutrient application equipment in an environmentally safe manner. Collect, store, or field apply excess material in an appropriate manner.

Recycle or dispose of nutrient containers in compliance with State and local guidelines or regulations.

Maintain records for at least 5 years to document plan implementation and maintenance. Records must include—

- All test results (soil, water, compost, manure, organic by-product, and plant tissue sample analyses) upon which the nutrient management plan is based.
- Listing and quantification of all nutrient sources (including all enhanced efficiency fertilizer products) that are planned for use and documentation of all nutrient imports, exports and onsite transfers.
- Date(s), method(s), and location(s) of all nutrient applications.
- Weather conditions and soil moisture at the time of application, elapsed time from manure application to rainfall or irrigation event(s).
- Plants and crops planted, planting and harvest dates, yields, nutrient analyses of harvested biomass, and plant or crop residues removed.
- Dates of plan review, name of reviewer, and recommended adjustments resulting from the review.

For variable rate nutrient management plans, also include—

- Maps identifying the variable application location, source, timing, amount, and placement of all plant and crop nutrients applied.
- GPS-based yield maps for crops where yields can be digitally collected.

REFERENCES

APEX Model to Determine Water Quality Assessments in Agricultural Fields in the Mississippi Delta. Mississippi State University GRI.

Association of American Plant Food Control Officials (AAPFCO). 2017. AAPFCO Official Publication no. 70. AAPFCO Inc., Little Rock, AR.

Follett, R.F. 2001. Nitrogen transformation and transport processes. In Nitrogen in the environment; sources, problems, and solutions, (eds.) R.F. Follett and J. Hatfield, pp. 17–44. Elsevier Science Publishers. The Netherlands. 520 pp.

Oldham, L. 2012, Nutrient Management Guidelines for Agronomic Crops Grown in Mississippi. pub. 2647, Mississippi State University, Mississippi State, MS.

Schepers, J.S., and W.R. Ruan, (eds.) 2008. Nitrogen in agricultural systems. Agron. Monogr. no. 49, American Society of Agronomy (ASA), Crop Science Society of America (CSSA), Soil Science Society of America (SSSA). Madison, WI.

Sims, J.T. (ed.) 2005. Phosphorus: Agriculture and the environment. Agron. Monogr. no. 46. ASA, CSSA, and SSSA, Madison, WI.

Stevenson, F.J. (ed.) 1982. Nitrogen in agricultural soils. Agron. Series 22. ASA, CSSA, and SSSA, Madison, WI.

USDA, NRCS. Agronomy Technical Note 3, Precision Nutrient Management Planning. 2010. Washington, DC. NRCS eDirectives under Technical Notes, Title 190 https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1043477.pdf?msclkid=2dd25accd14911eca69212f9a9092013.

USDA, NRCS. Agronomy Technical Note 7, Adaptive Nutrient Management Process. 2013. Washington, DC. NRCS eDirectives under Technical Notes, Title 190 https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=34196.wba.

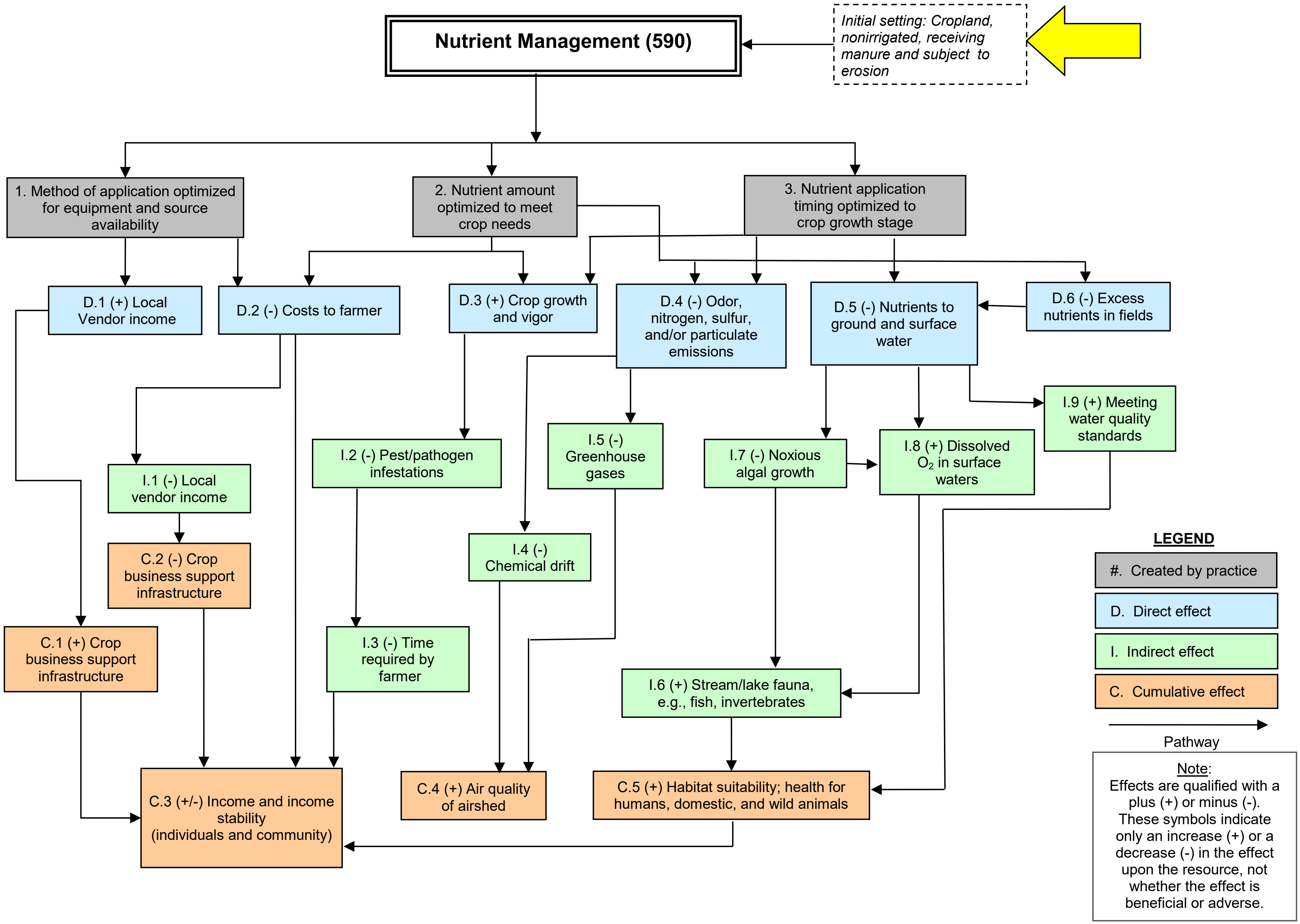
USDA, NRCS. Nutrient Management Technical Note 7, Reducing Risk of E. coli O157:H7. 2007. Washington, DC. NRCS eDirectives under Technical Notes, Title 190 https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1044367.pdf#:~:text=Nutrient%20Management%20Technical%20Note%20No.%207%20September%2C%202007,the%20contamination%20of%20foodstuffs%20with%20E.%20coli%20O157%3AH7.?msclkid=7d8a3214d14911eca58033b733b91ce5 .

USDA, NRCS. Title 190, General Manual, (GM), Part 402, Nutrient Management. 2011. Washington, DC. NRCS eDirectives under General Manual, Title 190 https://directives.sc.egov.usda.gov/viewerFS.aspx?hid=27119&msclkid=d2591b54d14911ec8a8cc5e2edca70d5.

USDA, NRCS. Title 190, National Instruction (NI), Part 313, Nutrient Management Policy Implementation. 2017. Washington, DC. NRCS eDirectives under National Instruction, Title 190 https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=40478.wba .

NRCS CONSERVATION PRACTICE EFFECTS - NETWORK DIAGRAM

May 2019



Effects of NRCS Conservation Practices - National

Nutrient Management

Managing the amount (rate), source, placement (method of application), and timing of plant nutrients and soil amendments.

Code: 590
Units: ac.

C-Crop	F-Forest	R-Range	P-Pasture	Pr-Protected	FS-Farmstead	D-Developed	W-Water	O-Other	AL-Aso Land

Typical Landuse: C F R P Pr FS D O AL

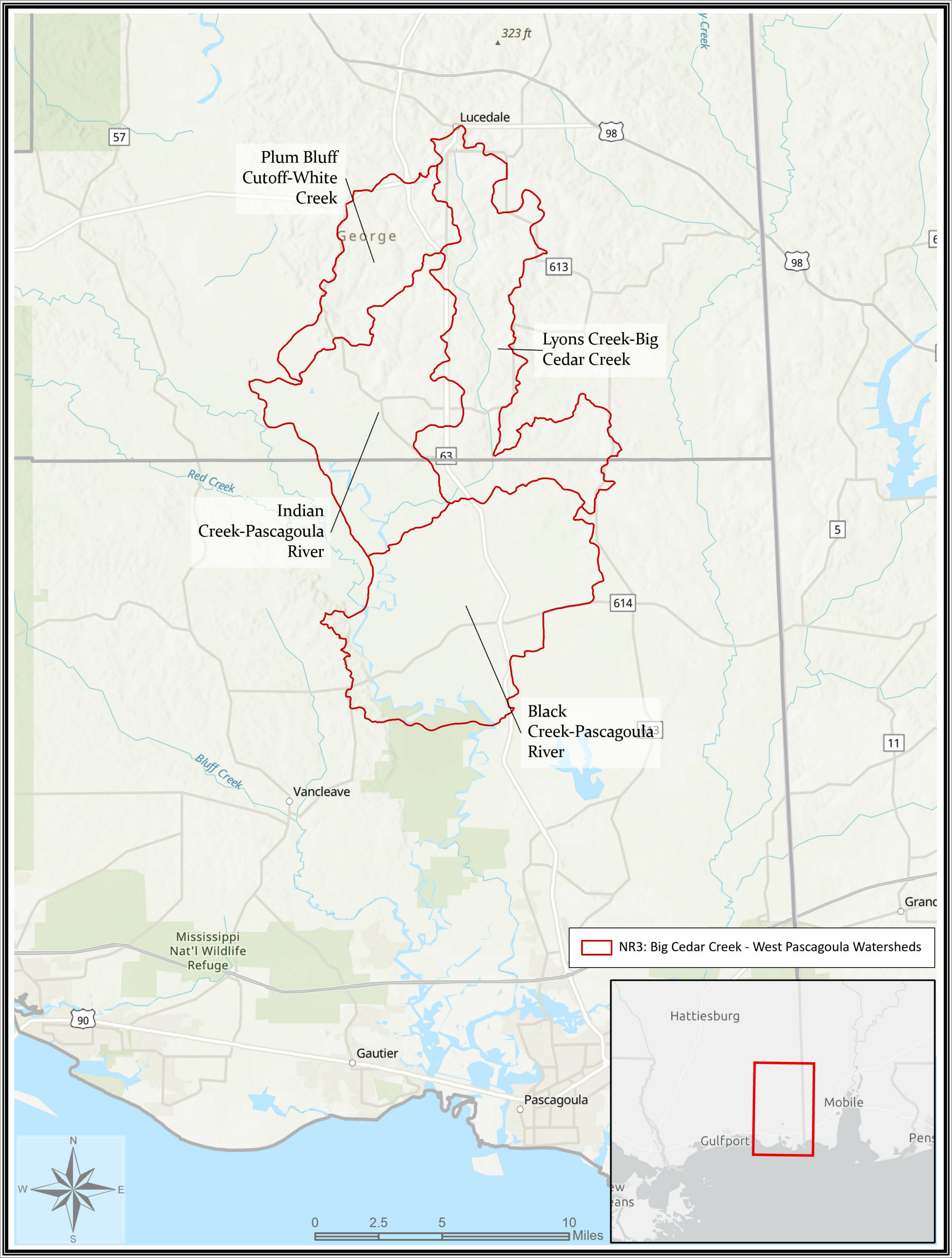
Soil Erosion	Effect	Rationale
Soil Erosion - Sheet and Rill Erosion	0	Soil disturbance to incorporate fertilizer loosens the soil and buries surface residue which can increase erosion. Other application methods do not contribute to erosion.
Soil Erosion - Wind Erosion	0	Soil disturbance to incorporate fertilizer loosens the soil and buries surface residue which can increase erosion. Other application methods do not contribute to erosion.
Soil Erosion - Ephemeral Gully Erosion	0	Soil disturbance to incorporate fertilizer loosens the soil and buries surface residue which can increase erosion. Other application methods do not contribute to erosion.
Soil Erosion - Classic Gully Erosion	0	Not Applicable
Soil Erosion - Streambank, Shoreline, Water Conveyance C	0	Not Applicable
Soil Quality Degradation		
Organic Matter Depletion	2	Management of pH and applying sufficient nutrients will maintain or enhance biomass production
Compaction	-2	Field operations on moist soils cause soil compaction.
Subsidence	0	Not Applicable
Concentration of Salts or Other Chemicals	2	Matching plant requirements with nutrient applications decreases excess nutrient conditions and reduces salts and other contaminants
Excess Water		
Excess Water - Seeps	0	Not Applicable
Excess Water - Runoff, Flooding, or Ponding	0	Not Applicable
Excess Water - Seasonal High Water Table	0	Not Applicable
Excess Water - Drifted Snow	0	Not Applicable
Insufficient Water		
Insufficient Water - Inefficient Use of Irrigation Water	0	Excess nitrogen promotes shoot growth in relation to root growth.
Insufficient Water - Inefficient Moisture Management	0	Excess nitrogen promotes shoot growth in relation to root growth.
Water Quality Degradation		
Pesticides in Surface Water	0	Not Applicable
Pesticides in Groundwater	0	Not Applicable
Nutrients in Surface water	5	Right: Amount, source, placement, and timing (4R) provides nutrients when plants need them most.
Nutrients in Groundwater	5	The amount and timing of nutrient application are balanced with plant needs.
Salts in Surface Water	1	Proper nutrient application should reduce salinity if nutrient source contains salts.
Salts in Groundwater	1	Proper nutrient application should reduce salinity if nutrient source contains salts.
Excess Pathogens and Chemicals from Manure, Bio-solic	1	Decrease application of pathogens if nutrient source contains pathogens.
Excess Pathogens and Chemicals from Manure, Bio-solic	1	The action limits the amount of manure that can be applied thus preventing harmful levels of pathogens.

Excessive Sediment in Surface Water	0	Proper nutrient application will minimize losses due to runoff.
Elevated Water Temperature	0	Not Applicable
Petroleum, Heavy Metals and Other Pollutants Transporte	2	Changing pH will alter the solubility of metals. The action will reduce the application rate of heavy metals if required.
Petroleum, Heavy Metals and Other Pollutants Transporte	2	Management of pH will alter the solubility of metals. The action will reduce the application rate of heavy metals, if required
Air Quality Impacts		
Emissions of Particulate Matter (PM) and PM Precursors	3	The proper application of nitrogen can greatly reduce ammonia emissions. Proper application techniques can also reduce particulate emissions from solid manure and fertilizers.
Emissions of Ozone Precursors	2	The proper application of nitrogen can reduce NOx emissions. Proper application techniques can also reduce VOC emissions from manure.
Emissions of Greenhouse Gases (GHGs)	4	Management of nutrients optimizes the storage of soil carbon. The propoer application of nitrogen can reduce emissions of nitrous oxide.
Objectionable Odors	4	The proper application of nitrogen can reduce ammonia emissions. Proper application techniques can also reduce emissions of VOCs and other odorous compounds from manure.
Degraded Plant Condition		
Undesirable Plant Productivity and Health	2	Nutrients and soil amendments are optimized to enhance health and vigor of desired species.
Inadequate Structure and Composition	2	Nutrients and soil amendments are optimized to enhance suited and desired species.
Excessive Plant Pest Pressure	0	Not Applicable
Wildfire Hazard, Excessive Biomass Accumulation	0	Not Applicable
Fish and Wildlife - Inadequate Habitat		
Inadequate Habitat - Food	1	Management enhances production of any food species planted.
Inadequate Habitat - Cover/Shelter	1	Management enhances cover/shelter conditions.
Inadequate Habitat - Water	0	Not Applicable
Inadequate Habitat - Habitat Continuity (Space)	0	Not Applicable
Livestock Production Limitation		
Inadequate Feed and Forage	4	Nutrients are managed to ensure optimal production and nutritive value of the forage used by livestock.
Inadequate Shelter	0	Not Applicable
Inadequate Water	2	Management improves livestock water quality.
Inefficient Energy Use		
Equipment and Facilities	0	Not Applicable
Farming/Ranching Practices and Field Operations	0	Not Applicable

CPPE Practice Effects:	*0 No Effect*
5 Substantial Improvement	*-1 Slight Worsening*
4 Moderate to Substantial Improvement	*-2 Slight to Moderate Worsening*
3 Moderate Improvement	*-3 Moderate Worsening*
2 Slight to Moderate Improvement	*-4 Moderate to Substantial Worsening*
1 Slight Improvement	*-5 Substantial Worsening*

Nutrient Reduction Alternative 3: Big Cedar Creek-West Pascagoula River

Project Area Map
List of USDA NRCS Conservation Practices
USDA NRCS Exemplar Conservation Practice Standards
Effects of Exemplar NRCS Conservation Practices
Conservation Practice Network Diagrams for Exemplar Conservation Practices



323 ft
Lucedale
98
57
Plum Bluff
Cutoff-White
Creek
George
613
98
Lyons Creek-Big
Cedar Creek
63
Red Creek
Indian
Creek-Pascagoula
River
5
614
Black
Creek-Pascagoula
River
11
Bluff Creek
Vancleave
Grand
NR3: Big Cedar Creek - West Pascagoula Watersheds
Mississippi
Nat'l Wildlife
Refuge
90
Hattiesburg
Mobile
Gulfport
Gautier
Pascagoula
N
W
E
S
0
2.5
5
10
Miles

Code	Practice
201	Edge of Field Water Quality Monitoring Data Collection
202	Edge of Field Water Quality Monitoring System Implementation
313	Waste Storage Facility
314	Brush Management (Heavy Equipment)
315	Herbaceous Weed Control
317	Composting Facility
327	Conservation Cover
328	Conservation Crop Rotation
329	Residue Management, No-Till
338	Prescribed Burning
340	Cover Crops
342	Critical Area Planting
345	Residue and Tillage Management, Reduced Till
350	Sediment Basin
356	Dike
362	Diversion
378	Pond
381	Silvopasture Establishment
382	Fence
386	Field Border
390	Riparian Herbaceous Cover
391	Riparian Forest Buffer
393	Filter Strip
394	Firebreak (New construction)
410	Grade Stabilization Structure
412	Grassed Waterways
422	Hedgerow Planting
430	Irrigation Pipeline
441	Irrigation System, Microirrigation
442	Irrigation System, Sprinkler
443	Irrigation System, Surface and Subsurface
449	Irrigation Water Management
460	Land Clearing
464	Irrigation Land Leveling
468	Lined Waterway Or Outlet
484	Mulching
490	Forest Site Preparation (Chemical or Burning)
490	Forest Site Preparation (Mechanical)
511	Forage Harvest Management
512	Pasture and Hay Planting
516	Pipeline
528A	Prescribed Grazing
554	Drainage Water Management
561	Heavy Use Area Protection
576	Livestock Shelter Structure

578	Stream Crossing
580	Streambank and Shoreline Protection
587	Structure For Water Control
590	Nutrient Management
595	Pest Management
600	Terrace
612	Tree/Shrub Establishment (Hand Planting)
612	Tree/Shrub Establishment (Mechanical Planting)
614	Watering Facility
642	Water Well
644	Wetland Wildlife Habitat Management
666	Forest Stand Improvement (Chemical/Hand Tools)
666	Forest Stand Improvement (Cutting/removal with heavy equipment)

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

RESIDUE AND TILLAGE MANAGEMENT, NO TILL

CODE 329

(ac)

DEFINITION

Limiting soil disturbance to manage the amount, orientation and distribution of crop and plant residue on the soil surface year around.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Reduce sheet, rill and wind erosion and excessive sediment in surface waters
- Reduce tillage-induced particulate emissions
- Maintain or increase soil health and organic matter content
- Increase plant-available moisture
- Reduce energy use
- Provide food and escape cover for wildlife

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all cropland.

CRITERIA

General Criteria Applicable to All Purposes

Residue shall not be burned.

Distribute all residues uniformly over the entire field. Removing residue from directly within the seeding or transplanting area prior to or as part of the planting operation is acceptable.

This practice only involves an in-row soil disturbance operation during strip tillage, the planting operation, and a seed row/furrow closing device. There is no full-width soil disturbance performed from the time immediately following harvest or termination of one cash crop through harvest or termination of the next cash crop in the rotation regardless of the depth of the tillage operation. The soil tillage intensity rating (STIR) value shall include all field operations that are performed during the crop interval between harvest and termination of the previous cash crop and harvest or termination of the current cash crop (includes fallow periods). The crop interval STIR value shall be no greater than 20.

Additional Criteria to Reduce Sheet, Rill and Wind Erosion, Reduce Excessive Sediment in Surface Waters, and Reduce Tillage-Induced Particulate Emissions

Use the current approved water and wind erosion prediction technology to determine the if field operations planned provide the amount of randomly distributed surface residue needed, time of year residue needs to be present in the field, and amount of surface soil disturbance allowed to reduce erosion to the desired level. Calculations shall account for the effects of other practices in the management system.

Additional Criteria to Maintain or Increase Soil Health and Organic Matter Content

Ensure the soil condition index (SCI) for the cropping system results in a positive rating.

Additional Criteria to Increase Plant-Available Moisture

Maintain a minimum of 60 percent residue cover on the soil surface throughout the year.

Trapping snow

Minimum crop stubble height during the time significant snowfall is expected to occur shall be—

- At least 10 inches for crops with a row spacing of less than 15 inches.
- At least 15 inches for crops with a row spacing of 15 inches or greater.

Additional Criteria to Reduce Energy Use

Reduce the total energy consumption associated with field operations by at least 25 percent compared to the benchmark condition. Use the current approved NRCS tool for determining energy use to document energy use reductions.

Additional Criteria to Provide Food and Escape Cover for Wildlife

Use an approved habitat evaluation procedure to determine when residue needs to be present, and the amount, orientation, and stubble height needed to provide adequate food and cover for target species.

CONSIDERATIONS

General Considerations

Removal of crop residue, such as by baling or grazing, can have a negative impact on resources. These activities should not be performed without full evaluation of impacts on soil, water, animal, plant, and air resources.

Production of adequate crop residues to achieve the purpose(s) of this practice can be enhanced through the use of high residue crops and crop varieties, use of cover crops, double cropping, and adjustment of plant populations through seeding rates and row spacing.

When providing technical assistance to organic producers, ensure residue and tillage management, activities are consistent with the USDA Agricultural Marketing Service National Organic Program regulations.

Residue should not be shredded after harvest. Shredding residue makes it more susceptible to movement by wind or water, and areas where residue accumulates may interfere with planting the next crop.

Using residue management - no till for all crops in the rotation or cropping system can enhance the positive effects of this practice by—

- Increasing the rate of soil organic matter accumulation.
- Keeping soil in a consolidated condition and improved aggregate stability.
- Sequestering additional carbon in the soil.
- Further reducing the amount of particulate matter generated by field operations.
- Reduce energy inputs to establish crops.
- Forming root channels and other near-surface voids that increase infiltration.

Considerations to Increase Soil Health and Organic Matter Content

Carbon loss is directly related to the volume of soil disturbed, intensity of the disturbance and soil moisture content and soil temperature at the time the disturbance occurs. To make this practice more effective—

- When deep soil disturbance is performed, such as by subsoiling or fertilizer injection, make sure the vertical slot created by these implements is closed at the surface.

- Planting with a single disk or slot opener no-till drill will release less CO_2 and oxidize less organic matter than planting with a wide-point hoe/chisel opener seeder drill.
- Soil disturbance that occurs when soil temperatures are below 50° F will oxidize less organic matter and release less CO_2 than operations done when the soil is warmer.
- Maximizing year-round coverage of the soil with living vegetation (e.g., cover crops) and/or crop residues builds organic matter and reduces soil temperature, thereby slowing organic matter oxidation.
- Use a diverse crop rotation, incorporating multiple crop types (cool-season grass, cool-season legume/forb, warm-season grass, warm-season legume/forb) into the crop rotation.
- Plant a cover crop after every cash crop in the rotation. Multispecies cover crop mixes provide greater benefits than single-specie cover crops.

Considerations to Increase Plant-Available Moisture

Leaving stubble taller than the 10-inch minimum will trap more snow.

Variable-height stubble patterns may be created to further increase snow storage.

Performing all field operations on the contour will slow overland flow and allow more opportunity for infiltration.

Considerations for Wildlife Food and Cover

Leaving rows of unharvested crop standing at intervals across the field or adjacent to permanent cover will enhance the value of residues for wildlife food and cover. Leaving unharvested crop rows for two growing seasons will further enhance the value of these areas for wildlife.

Leave crop residues undisturbed after harvest (e.g., no shredding or baling) to maximize the cover and food source benefits for wildlife.

PLANS AND SPECIFICATIONS

Specifications for establishment and operation of this practice shall be prepared for each field or treatment unit. Record the specifications using the practice implementation requirements document. The specifications shall identify, as appropriate—

- Purpose for applying the practice.
- Planned crop(s).
- Amount of residue produced by each crop.
- All field operations or activities that affect—
    - Residue orientation including height (where applicable).
    - Surface disturbance.
    - The amount of residue (pounds/acre or percent surface cover) required to accomplish the purpose, and the time of year it must be present.
- Planned soil tillage intensity rating STIR value, soil condition index value, and erosion rate.
- Target species of wildlife, if applicable.
- Benchmark and planned fuel consumption, if applicable.

OPERATION AND MAINTENANCE

Evaluate/measure the crop residues cover and orientation after each crop to ensure the planned amounts and orientation are being achieved. Adjust management as needed to either plan a new residue amount and orientation or adjust the planting and/or harvesting equipment.

Limited tillage is allowed to close or level ruts from harvesting equipment. No more than 10 percent of the field may be tilled for this purpose.

If there are areas of heavy residue accumulation (because of movement by water or wind) in the field, spread the residue prior to planting so it does not interfere with planter operation.

REFERENCES

Bolton, Ryan. 2003. Impact of the surface residue layer on decomposition, soil water properties and nitrogen dynamics. M.S. thesis. Univ. of Saskatchewan, Saskatoon, Saskatchewan, CA.

Reicosky, D.C., M.J. Lindstrom, T.E. Schumacher, D.E. Lobb and D.D. Malo. 2005. Tillage-induced CO2 loss across an eroded landscape. Soil Tillage Res. 81:183-194.

Reicosky, D.C. 2004. Tillage-induced soil properties and chamber mixing effects on gas exchange. Proc. 16th Triennial Conf., Int. Soil Till. Org. (ISTRO).

Renard, K.G., G.R. Foster, G.A. Weesies, D.K. McCool, and D.C. Yoder, coordinators. 1997. Predicting soil erosion by water: A guide to conservation planning with the Revised Universal Soil Loss Equation (RUSLE). U.S. Department of Agriculture, Agriculture Handbook No. 703.

Shaffer, M.J., and W.E. Larson (ed.). 1987. Tillage and surface-residue sensitive potential evaporation submodel. In NTRM, a soil-crop simulation model for nitrogen, tillage and crop residue management. USDA Conserv. Res. Rep. 34-1. USDA-ARS.

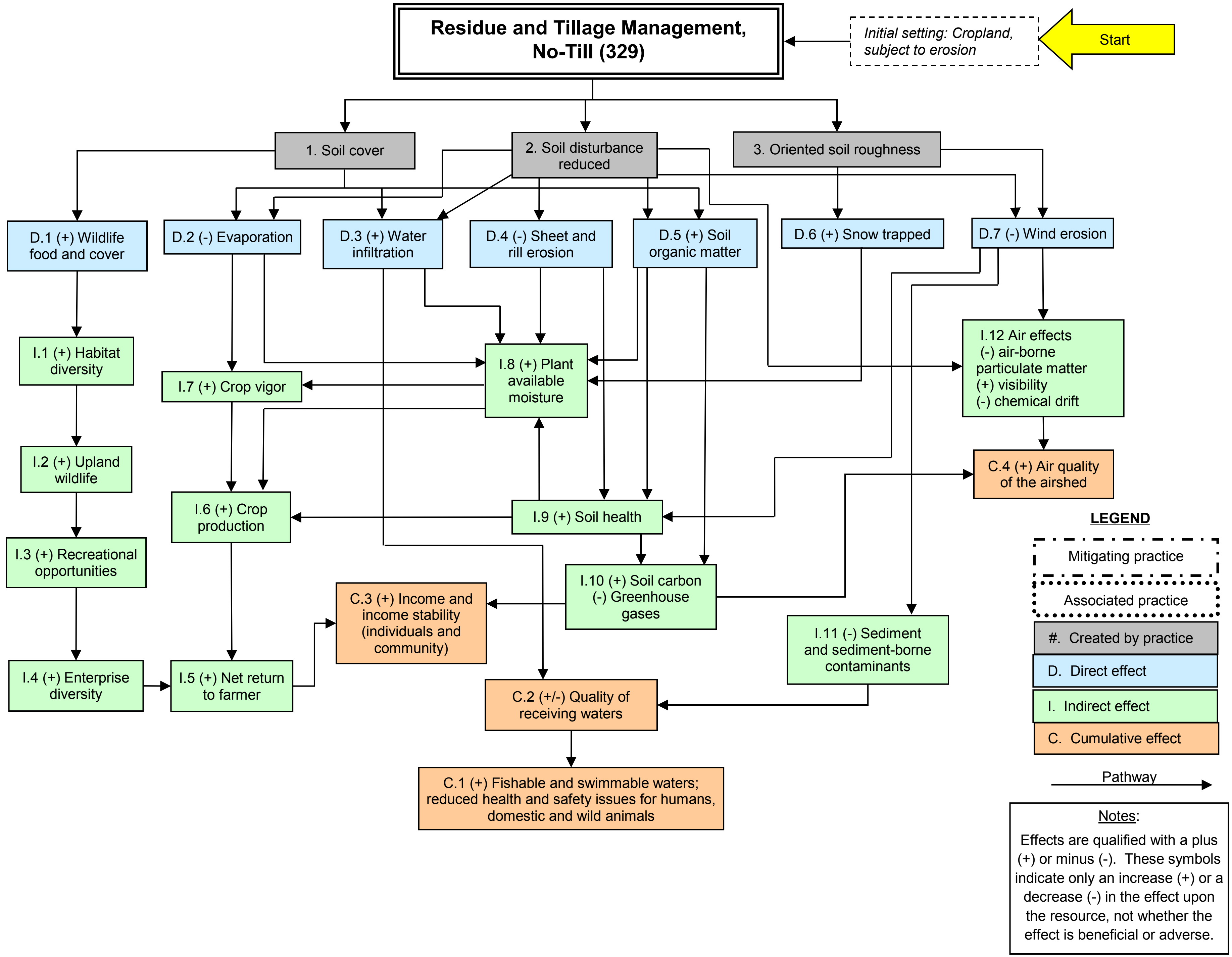
Skidmore, E.L. and N.P. Woodruff. 1968. Wind erosion forces in the United States and their use in predicting soil loss. U.S. Department of Agriculture. Agriculture Handbook No. 346.

USDA Natural Resources Conservation Service. 2011. National Agronomy Manual. 190-V. 4th Ed.

S.J. van Donk, D. L. Martin, S. Irmak, S. R. Melvin, J. L. Petersen, D. R. Davison, 2010. Crop Residue Cover Effects on Evaporation, Soil Water Content, and Yield of Deficit-Irrigated Corn in West-Central Nebraska. http://watercenter.unl.edu/ResearchDB/publications/Crop_Residue_Cover_Effects.pdf.

NRCS CONSERVATION PRACTICE EFFECTS - NETWORK DIAGRAM

September 2016



Effects of NRCS Conservation Practices - National

Residue and Tillage Management, No Till/Strip Till/Direct Seed

Managing the amount, orientation and distribution of crop and other plant residue on the soil surface year round, limiting soil-disturbing activities to those necessary to place nutrients, condition residue and plant crops.

Code: 329
Units: ac.

	C-Crop	F-Forest	R-Range	P-Pasture	Pr-Protected	FS-Farmstead	D-Developed	W-Water	O-Other	AL-Aso Land
Typical Landuse:	C			P					O	

Soil Erosion	Effect	Rationale
Soil Erosion - Sheet and Rill Erosion	4	Managing residue to reduce soil disturbance and increase residue cover reduces erosion by water.
Soil Erosion - Wind Erosion	4	Managing residue to reduce soil disturbance and increase residue cover reduces erosion by wind.
Soil Erosion - Ephemeral Gully Erosion	4	Managing residue to reduce soil disturbance and increase residue cover reduces erosion by water.
Soil Erosion - Classic Gully Erosion	0	Not Applicable
Soil Erosion - Streambank, Shoreline, Water Conveyance C	0	Not Applicable
Soil Quality Degradation		
Organic Matter Depletion	2	Decreased erosion and less oxidation from lack of soil disturbance will increase or maintain organic matter.
Compaction	2	Fewer field operations and less tillage reduce the potential for soil compaction.
Subsidence	0	Not Applicable
Concentration of Salts or Other Chemicals	1	Low disturbance and high residue cropping systems increase organic matter which will buffer salts.
Excess Water		
Excess Water - Seeps	-1	No-till increases infiltration resulting in more water moving through the profile.
Excess Water - Runoff, Flooding, or Ponding	2	No-till increases infiltration, reducing runoff and ponding.
Excess Water - Seasonal High Water Table	-1	Can reduce evaporation and increase infiltration of water
Excess Water - Drifted Snow	0	Not Applicable
Insufficient Water		
Insufficient Water - Inefficient Use of Irrigation Water	2	No-till increases infiltration and decreases evaporation resulting in more available water. However, increased infiltration reduces the efficiency of flood and furrow irrigation.
Insufficient Water - Inefficient Moisture Management	2	No-till increases infiltration and decreases evaporation resulting in more available water.
Water Quality Degradation		
Pesticides in Surface Water	4	The action decreases runoff and erosion.
Pesticides in Groundwater	0	Not Applicable
Nutrients in Surface water	2	Less erosion and runoff reduces transport of nutrients.
Nutrients in Groundwater	-1	The action increases infiltration that contributes to nutrient leaching. Also, high organic carbon will cause microbes to immobilize nutrients.
Salts in Surface Water	1	Less runoff reduces transport of soluble salts. However increased infiltration results in more seepage which can carry soluble salts to the surface.
Salts in Groundwater	-1	Better infiltration may increase leaching potential.
Excess Pathogens and Chemicals from Manure, Bio-solic	1	Less erosion and runoff reduces delivery of pathogens.
Excess Pathogens and Chemicals from Manure, Bio-solic	0	Not Applicable

Excessive Sediment in Surface Water	4	Less erosion and runoff reduces transport of sediment.
Elevated Water Temperature	0	Not Applicable
Petroleum, Heavy Metals and Other Pollutants Transporte	0	Not Applicable
Petroleum, Heavy Metals and Other Pollutants Transporte	0	Not Applicable
Air Quality Impacts		
Emissions of Particulate Matter (PM) and PM Precursors	4	Less soil disturbance, increased residue on the surface and fewer field operations reduce the generation of particulate matter.
Emissions of Ozone Precursors	2	Reduced use of machinery reduces ozone precursor emissions.
Emissions of Greenhouse Gases (GHGs)	4	Reduced use of machinery reduces CO2 emissions and increases soil carbon storage.
Objectionable Odors	0	Not Applicable
Degraded Plant Condition		
Undesirable Plant Productivity and Health	2	Conserving moisture and improving soil conditions contribute to enhanced plant productivity and health. However, on cold and wet soils there may be a delay in emergence and early growth.
Inadequate Structure and Composition	0	Not Applicable
Excessive Plant Pest Pressure	0	Not Applicable
Wildfire Hazard, Excessive Biomass Accumulation	0	Not Applicable
Fish and Wildlife - Inadequate Habitat		
Inadequate Habitat - Food	2	Crop residue provides some food for wildlife.
Inadequate Habitat - Cover/Shelter	2	Crop residue provides some cover/shelter.
Inadequate Habitat - Water	4	Not Applicable
Inadequate Habitat - Habitat Continuity (Space)	1	Residue restores some habitat/space.
Livestock Production Limitation		
Inadequate Feed and Forage	0	Not Applicable
Inadequate Shelter	0	Not Applicable
Inadequate Water	0	Not Applicable
Inefficient Energy Use		
Equipment and Facilities	4	No tillage equipment needed
Farming/Ranching Practices and Field Operations	4	No tillage operations

CPPE Practice Effects:	*0 No Effect*
5 Substantial Improvement	*-1 Slight Worsening*
4 Moderate to Substantial Improvement	*-2 Slight to Moderate Worsening*
3 Moderate Improvement	*-3 Moderate Worsening*
2 Slight to Moderate Improvement	*-4 Moderate to Substantial Worsening*
1 Slight Improvement	*-5 Substantial Worsening*

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

COVER CROP

CODE 340

(ac)

DEFINITION

Grasses, legumes, and forbs planted for seasonal vegetative cover.

PURPOSE

This practice is applied to support one or more of the following purposes:

- Reduce erosion from wind and water
- Maintain or increase soil health and organic matter content
- Reduce water quality degradation by utilizing excessive soil nutrients
- Suppress excessive weed pressures and break pest cycles
- Improve soil moisture use efficiency
- Minimize soil compaction

CONDITIONS WHERE PRACTICE APPLIES

All lands requiring seasonal vegetative cover for natural resource protection or improvement.

CRITERIA

General Criteria Applicable to All Purposes

Plant species, seedbed preparation, seeding rates, seeding dates, seeding depths, fertility requirements, and planting methods will be consistent with applicable local criteria and soil/site conditions.

Select species that are compatible with other components of the cropping system.

Ensure herbicides used with crops are compatible with cover crop selections and purpose(s).

Cover crops may be established between successive production crops, or companion- planted or relay-planted into production crops. Select species and planting dates that will not compete with the production crop yield or harvest.

Do not burn cover crop residue.

Determine the method and timing of termination to meet the grower’s objective and the current NRCS Cover Crop Termination Guidelines.

When a cover crop will be grazed or hayed ensure that crop selection(s) comply with pesticide label rotational crop restrictions and that the planned management will not compromise the selected conservation purpose(s).

Do not harvest cover crops for seed.

If the specific rhizobium bacteria for the selected legume are not present in the soil, treat the seed with the appropriate inoculum at the time of planting.

Additional Criteria to Reduce Erosion from Wind and Water

Time the cover crop establishment in conjunction with other practices to adequately protect the soil during the critical erosion period(s).

Select cover crops that will have the physical characteristics necessary to provide adequate erosion protection.

Use the current erosion prediction technology to determine the amount of surface and/or canopy cover needed from the cover crop to achieve the erosion objective.

Additional Criteria to Maintain or Increase Soil Health and Organic Matter Content

Cover crop species will be selected on the basis of producing higher volumes of organic material and root mass to maintain or increase soil organic matter.

The planned crop rotation including the cover crop and associated management activities will score a Soil Conditioning Index (SCI) value > 0, as determined using the current approved NRCS Soil Conditioning Index (SCI) procedure, with appropriate adjustments for additions to and or subtractions from plant biomass.

The cover crop shall be planted as early as possible and be terminated as late as practical for the producer’s cropping system to maximize plant biomass production, considering crop insurance criteria, the time needed to prepare the field for planting the next crop, and soil moisture depletion.

Additional Criteria Reduce Water Quality Degradation by Utilizing Excessive Soil Nutrients

Establish cover crops as soon as practical prior to or after harvest of the production crop. (i.e. before or after harvest)

Select cover crop species for their ability to effectively utilize nutrients.

Terminate the cover crop as late as practical to maximize plant biomass production and nutrient uptake. Practical considerations for termination date may include crop insurance criteria, the amount of time needed to prepare the field for planting the next crop, weather conditions, and cover crop effects on soil moisture and nutrient availability to the following crop.

If the cover crop will be harvested for feed (hay/balage/etc.), choose species that are suitable for the planned livestock, and capable of removing the excess nutrients present.

Additional Criteria to Suppress Excessive Weed Pressures and Break Pest Cycles

Select cover crop species for their life cycles, growth habits, and other biological, chemical

and or physical characteristics to provide one or more of the following:

- To suppress weeds, or compete with weeds.
- Break pest life cycles or suppress of plant pests or pathogens.
- Provide food or habitat for natural enemies of pests.
- Release compounds such as glucosinolates that suppress soil borne pathogens or pests.

Select cover crop species that do not harbor pests or diseases of subsequent crops in the rotation.

Additional Criteria to Improve Soil Moisture Use Efficiency

In areas of limited soil moisture, terminate growth of the cover crop sufficiently early to conserve soil moisture for the subsequent crop. Cover crops established for moisture conservation shall be left on the soil surface.

In areas of potential excess soil moisture, allow the cover crop to grow as long as possible to maximize soil moisture removal.

Additional Criteria to Minimize Soil Compaction

Select cover crop species that have the ability to root deeply and the capacity to penetrate or prevent compacted layers.

CONSIDERATIONS

Plant cover crops in a timely matter and when there is adequate moisture to establish a good stand.

To ensure cover crops are managed and compatible with the client's crop insurance criteria, terminate cover crops at or within 5 days after planting but before crop emergence.

Maintain an actively growing cover crop as late as feasible to maximize plant growth, allowing time to prepare the field for the next crop and to optimize soil moisture.

Select cover crops that are compatible with the production system, well adapted to the region's climate and soils, and resistant to prevalent pests, weeds, and diseases. Avoid cover crop species that harbor or carry over potentially damaging diseases or insects.

Cover crops may be used to improve site conditions for establishment of perennial species.

When cover crops are used for grazing, select species that will have desired forage traits, be palatable to livestock, and not interfere with the production of the subsequent crop.

Use plant species that enhance forage opportunities for pollinators by using diverse legumes and other forbs.

Cover crops may be selected to provide food or habitat for natural enemies of production crop pests.

Cover crops residues should be left on the soil surface to maximize allelopathic (chemical) and mulching (physical) effects.

Seed a higher density cover crop stand to promote rapid canopy closure and greater weed suppression. Increased seeding rates (1.5 to 2 times normal) can improve weed- competitiveness.

Cover crops may be selected that release biofumigation compounds that inhibit soil-borne plant pests and pathogens.

Species can be selected to serve as trap crops to divert pests from production crops.

Select a mixture of two or more cover crop species from different plant families to achieve one or more of the following: (1) species mix with different maturity dates, (2) attract beneficial insects, (3) attract pollinators, (4) increase soil biological diversity, (5) serve as a trap crop for insect pests, or (6) provide food and cover for wildlife habitat management.

Plant legumes or mixtures of legumes with grasses, crucifers, and/or other forbs to achieve biological nitrogen fixation. Select cover crop species or mixture, and timing and method of termination that will maximize efficiency of nitrogen utilization by the following crop, considering soil type and conditions, season and weather conditions, cropping system, C:N ratio of the cover crop at termination, and anticipated nitrogen needs of the subsequent crop. Use LGU- recommended nitrogen credits from the legume and reduce nitrogen applications to the subsequent crop accordingly. “If the specific rhizobium bacteria for the selected legume are not present in the soil, treat the seed with the appropriate inoculum at the time of planting.

Time the termination of cover crops to meet nutrient release goals. Termination at early vegetative stages may cause a more rapid release compared to termination at a more mature stage.

Both residue decomposition rates and soil fertility can affect nutrient availability following termination of cover crops

Allelopathic effects to the subsequent crop should be evaluated when selecting the appropriate cover crop.

Legumes add the most plant-available N if terminated when about 30% of the crop is in bloom.

Additional Considerations to Reduce Erosion by Wind or Water

To reduce erosion, best results are achieved when the combined canopy and surface residue cover attains 90 percent or greater during the period of potentially erosive wind or rainfall.

Additional Considerations to Reduce Water Quality Degradation by Utilizing Excessive Soil Nutrients

Use deep-rooted species to maximize nutrient recovery.

When appropriate for the crop production system, mowing certain grass cover crops (e.g., sorghum-sudangrass, pearl millet) prior to heading and allowing the cover crop to regrow can enhance rooting depth and density, thereby increasing their subsoiling and nutrient-recycling efficacy.

Additional Considerations to Increase Soil Health and Organic Matter Content

Increase the diversity of cover crops (e.g., mixtures of several plant species) to promote a wider diversity of soil organisms, and thereby promote increased soil organic matter.

Plant legumes or mixtures of legumes with grasses, crucifers, and/or other forbs to provide nitrogen through biological nitrogen fixation.

Legumes add the most plant-available N if terminated when about 30% of the crop is in bloom.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for each field or treatment unit according to the planning criteria and operation and maintenance requirements of this standard. Specifications shall describe the requirements to apply the practice to achieve the intended purpose for the practice site. Plans for the establishment of cover crops shall, as a minimum, include the following specification components in an approved Cover Crop, 340, Implementation Requirements document:

- Field number and acres
- Species of plant(s) to be established.
- Seeding rates.
- Seeding dates.
- Establishment procedure.
- Rates, timing, and forms of nutrient application (if needed).
- Dates and method to terminate the cover crop.
- Other information pertinent to establishing and managing the cover crop e.g., if haying or grazing is planned specify the planned management for haying or grazing.

OPERATION AND MAINTENANCE

Evaluate the cover crop to determine if the cover crop is meeting the planned purpose(s). If the cover crop is not meeting the purpose(s) adjust the management, change the species of cover crop, or choose a different technology.

REFERENCES

A. Clark (ed.). 2007. Managing cover crops profitably. 3rd ed. Sustainable Agriculture Network Handbook Series; bk 9.

Hargrove, W.L., ed. Cover crops for clean water. SWCS, 1991.

Magdoff, F. and H. van Es. Cover Crops. 2000. p. 87-96 *In* Building soils for better crops. 2nd ed. Sustainable Agriculture Network Handbook Series; bk 4. National Agriculture Library. Beltsville, MD.

Reeves, D.W. 1994. Cover crops and erosion. p. 125-172 *In* J.L. Hatfield and B.A. Stewart (eds.) Crops Residue Management. CRC Press, Boca Raton, FL.

NRCS Cover Crop Termination Guidelines:
http://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/climatechange/?cid=stelprdb1077238

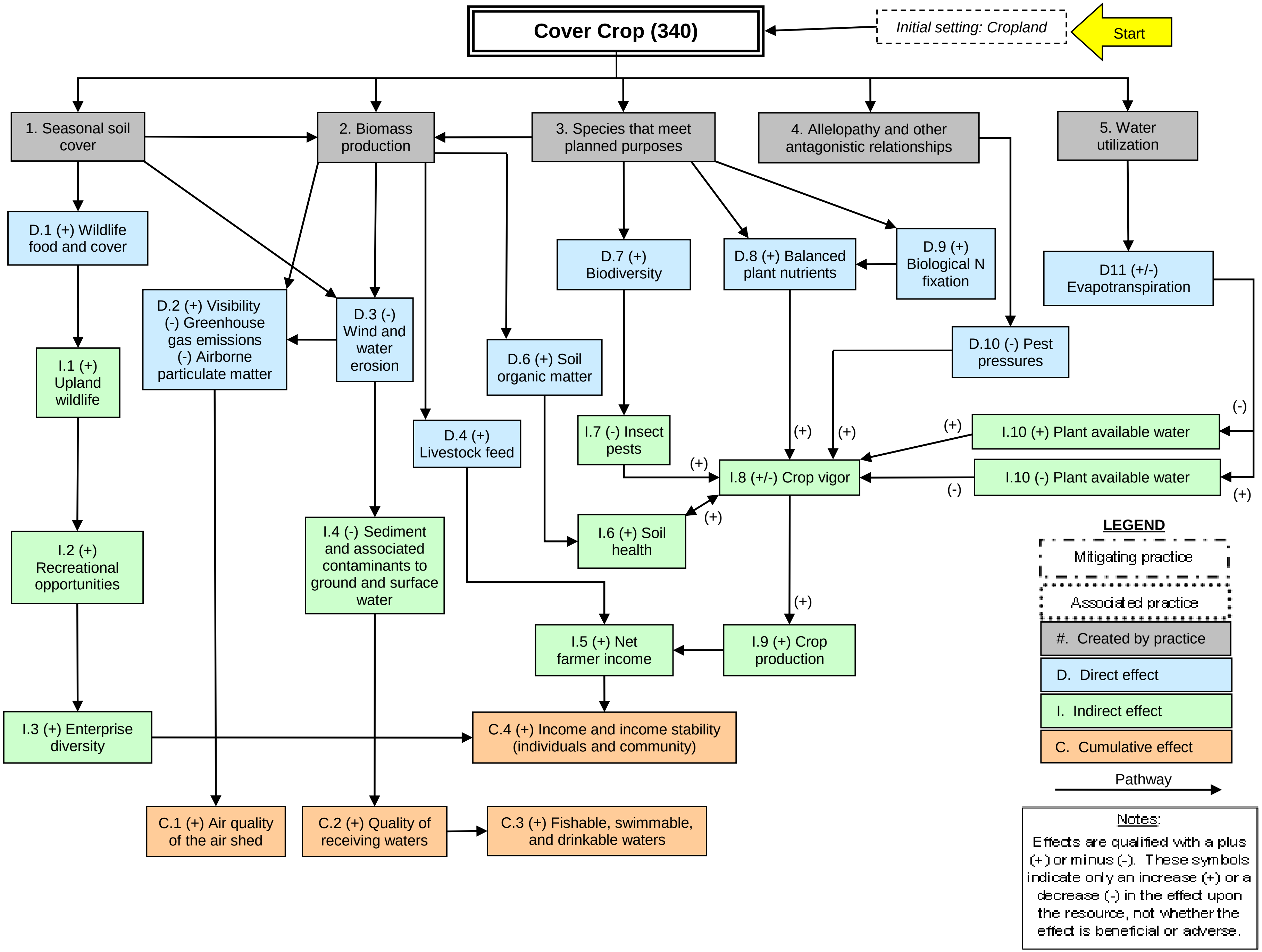
Revised Universal Soil Loss Equation Version 2 (RUSLE2) website:
http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/tools/rusle2/

Wind Erosion Prediction System (WEPS) website:
http://www.nrcs.usda.gov/wps/portal/nrcs/main/national/technical/tools/weps/

USDA, Natural Resources Conservation Service, National Agronomy Manual, 4th Edition, Feb. 2011. Website: http://directives.sc.egov.usda.gov/ Under Manuals and Title 190.

NRCS CONSERVATION PRACTICE EFFECTS - NETWORK DIAGRAM

September 2014



Effects of NRCS Conservation Practices - National

Cover Crop

Crops including grasses, legumes, and forbs for seasonal cover and other conservation purposes.

Code: 340
Units: ac.

C-Crop	F-Forest	R-Range	P-Pasture	Pr-Protected	FS-Farmstead	D-Developed	W-Water	O-Other	AL-Aso Land
C	F	R	P	Pr				O	AL

Typical Landuse: C F R P Pr O AL

Soil Erosion	Effect	Rationale
Soil Erosion - Sheet and Rill Erosion	4	Increased cover during erosive periods will reduce soil detachment by water.
Soil Erosion - Wind Erosion	4	Increased cover during erosive periods will reduce soil detachment by wind.
Soil Erosion - Ephemeral Gully Erosion	3	Increased cover during erosive periods will reduce concentrated flow and associated soil detachment.
Soil Erosion - Classic Gully Erosion	0	Not Applicable
Soil Erosion - Streambank, Shoreline, Water Conveyance C	0	Not Applicable
Soil Quality Degradation		
Organic Matter Depletion	2	More biomass produced will increase organic matter.
Compaction	2	Increased biomass and roots improve aggregation, which gives better resistance to compaction.
Subsidence	0	If it affects drainage the practice can have an impact on subsidence.
Concentration of Salts or Other Chemicals	1	Increased organic matter will buffer salts.
Excess Water		
Excess Water - Seeps	1	Growing plants will take up excess water. However, infiltration will increase, which may offset some of the benefits.
Excess Water - Runoff, Flooding, or Ponding	2	Growing plants will reduce runoff and increase infiltration.
Excess Water - Seasonal High Water Table	1	Growing plants will take up excess water. However, infiltration will increase, which may offset some of the benefits.
Excess Water - Drifted Snow	0	Not Applicable
Insufficient Water		
Insufficient Water - Inefficient Use of Irrigation Water	1	Improves infiltration
Insufficient Water - Inefficient Moisture Management	2	Improves infiltration, soil structure, and winter water use that may otherwise be lost. For dry climates (<20 inches/year); cover crops will compete for main crop's moisture.
Water Quality Degradation		
Pesticides in Surface Water	2	The action reduces runoff and erosion.
Pesticides in Groundwater	2	The action increases soil organic matter, biological activity, and pesticide uptake.
Nutrients in Surface water	2	The action reduces erosion and runoff and transport of nutrients. Cover crops can uptake excess nutrients.
Nutrients in Groundwater	2	The action utilizes excess nutrients and increases organic matter. The additional organic matter will increase cation exchange capacity which will hold nutrients.
Salts in Surface Water	0	Less runoff reduces transport of soluble salts. Growing vegetation can use excess water which reduces seepage.
Salts in Groundwater	1	Cover crops can take up salts and water reducing the leaching potential of salts.
Excess Pathogens and Chemicals from Manure, Bio-solic	1	Less erosion and runoff reduces delivery of pathogens.
Excess Pathogens and Chemicals from Manure, Bio-solic	2	The action increases organic matter promoting microbial activity which competes with pathogens.

Excessive Sediment in Surface Water	2	Vegetation will reduce erosion and transport of sediment.
Elevated Water Temperature	0	Not Applicable
Petroleum, Heavy Metals and Other Pollutants Transporte	0	Not Applicable
Petroleum, Heavy Metals and Other Pollutants Transporte	0	Not Applicable
Air Quality Impacts		
Emissions of Particulate Matter (PM) and PM Precursors	3	Ground cover helps reduce wind erosion and generation of fugitive dust.
Emissions of Ozone Precursors	0	Not Applicable
Emissions of Greenhouse Gases (GHGs)	2	Vegetation removes CO2 from the air and stores it in the form of carbon in the plants and soil.
Objectionable Odors	0	Not Applicable
Degraded Plant Condition		
Undesirable Plant Productivity and Health	2	Plants are selected and managed to maintain optimal productivity and health and can contribute to subsequent crop health and productivity.
Inadequate Structure and Composition	5	Plants selected are adapted and suited.
Excessive Plant Pest Pressure	4	Vegetation is installed and managed to control undesired species.
Wildfire Hazard, Excessive Biomass Accumulation	0	Not Applicable
Fish and Wildlife - Inadequate Habitat		
Inadequate Habitat - Food	2	Increased quality and quantity of vegetation provides more food for wildlife.
Inadequate Habitat - Cover/Shelter	2	Increased quality and quantity of vegetation provides more cover for wildlife.
Inadequate Habitat - Water	4	Not Applicable
Inadequate Habitat - Habitat Continuity (Space)	2	Increased cover will increase space for wildlife. May be used to connect other cover areas.
Livestock Production Limitation		
Inadequate Feed and Forage	2	Cover crops will add supplemental forage.
Inadequate Shelter	0	Not Applicable
Inadequate Water	0	Not Applicable
Inefficient Energy Use		
Equipment and Facilities	0	Not Applicable
Farming/Ranching Practices and Field Operations	2	Cover crops can reduce nitrogen inputs.

CPPE Practice Effects:	*0 No Effect*
5 Substantial Improvement	*-1 Slight Worsening*
4 Moderate to Substantial Improvement	*-2 Slight to Moderate Worsening*
3 Moderate Improvement	*-3 Moderate Worsening*
2 Slight to Moderate Improvement	*-4 Moderate to Substantial Worsening*
1 Slight Improvement	*-5 Substantial Worsening*

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

FENCE

CODE 382

(ft)

DEFINITION

A constructed barrier to animals or people.

PURPOSE

This practice is used to accomplish one or more of the following purposes–

- This practice facilitates the accomplishment of conservation objectives by providing a means to control movement of animals and people, including vehicles

CONDITIONS WHERE PRACTICE APPLIES

This practice may be applied on any area where management of animal or human movement is needed.

CRITERIA

General Criteria Applicable to All Purposes

Fencing materials, type and design of fence installed shall be of a high quality and durability. The type and design of fence installed will meet the management objectives and site challenges. Based on objectives, fences may be permanent, portable, or temporary.

Fences shall be positioned to facilitate management requirements. Ingress/egress features such as gates and cattle guards shall be planned. The fence design and installation should have the life expectancy appropriate for management objectives and shall follow all federal, state and local laws and regulations.

Height, size, spacing and type of materials used will provide the desired control, life expectancy, and management of animals and people of concern.

Fences shall be designed, located, and installed to meet appropriate local wildlife and land management needs and requirements.

CONSIDERATIONS

The fence design and location should consider: topography, soil properties, livestock management, animal safety, livestock trailing, access to water facilities, development of potential grazing systems, human access and safety, landscape aesthetics, erosion problems, soil moisture conditions, flooding potential, stream crossings, and durability of materials.

When appropriate, natural barriers should be utilized instead of fencing.

Where applicable, cleared rights-of-way may be established which would facilitate fence construction and maintenance. Avoid clearing of vegetation during the nesting season for migratory birds.

Where applicable, fences should be marked to enhance visibility as a safety measure for animals or people.

Fences across gullies, canyons or streams may require special bracing, designs or approaches.

Fence design and location should consider ease of access for construction, repair and maintenance.

Fence construction requiring the removal of existing fencing materials should provide for proper disposal to prevent harm to animals, people and equipment.

PLANS AND SPECIFICATIONS

Plans and specifications are to be prepared for all fence types, installations and specific sites. Requirements for applying the practice to achieve all of its intended purposes shall be described.

OPERATION AND MAINTENANCE

Regular inspection of fences should be part of an ongoing maintenance program to ensure continuing proper function of the fence. Operation and Maintenance (O&M) includes the following:

A schedule for regular inspections and after storms and other disturbance events.

Maintenance activities:

- Repair or replacement of loose or broken material, gates and other forms of ingress/egress
- Removal of trees/limbs
- Replacement of water gaps as necessary
- Repair of eroded areas as necessary
- Repair or replacement of markers or other safety and control features as required.

REFERENCES

Bell, H.M. 1973. Rangeland management for livestock production. University of Oklahoma Press.

Heady, H.F. and R.D. Child. 1994. Rangeland ecology and management. Western Press.

Holechek, J.L., R.D. Pieper, and C.H. Herbel. 2001. Range management: principles and practices. Prentice Hall.

Paige, C. 2012. A Landowner's Guide to Fences and Wildlife: Practical Tips to Make Your Fences Wildlife Friendly. Wyoming Land Trust, Pinedale, WY.

Stoddard, L.A., A.D. Smith, and T.W. Box. 1975. Range management. McGraw-Hill Book Company.

United States Department of Interior, Bureau of Land Management and United States Department of Agriculture, Forest Service. 1988. Fences. Missoula Technology and Development Center.

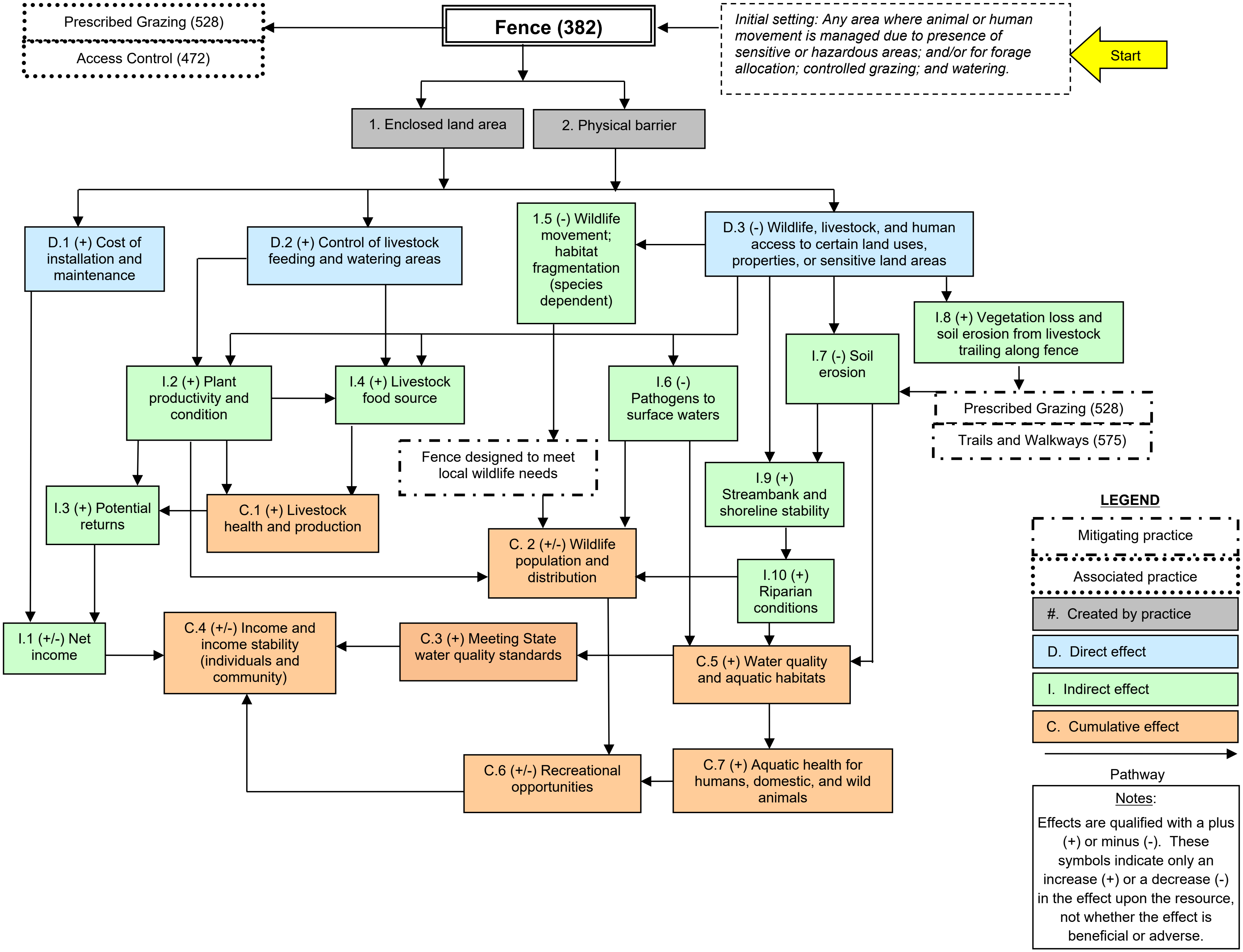
United States Department of Agriculture, Natural Resources Conservation Service. 2005. Electric fencing for serious graziers. Columbia, Mo.

United States Department of Agriculture, Natural Resources Conservation Service. 2003. National range and pasture handbook, revision 1. Washington, DC.

Vallentine, J.F. 1971. Range development and improvement. Brigham Young University Press.

NRCS CONSERVATION PRACTICE EFFECTS - NETWORK DIAGRAM

July 2021



Fence

Effects of NRCS Conservation Practices - National

Fence

A constructed barrier to animals or people.

Code: 382
Units: ft.

C-Crop
F-Forest
R-Range
P-Pasture
Pr-Protected
FS-Farmstead
D-Developed
W-Water
O-Other
AL-Aso Land

Typical Landuse: C F R P Pr FS D W O AL

Soil Erosion	Effect	Rationale
Soil Erosion - Sheet and Rill Erosion	1	Barriers reduce the excessive disturbance of soil and vegetation by facilitating the effective control of timing, frequency, duration and intensity of use of an area by animals or people.
Soil Erosion - Wind Erosion	0	Barriers reduce the excessive disturbance of soil and vegetation by facilitating the effective control of timing, frequency, duration and intensity of use of an area by animals or people.
Soil Erosion - Ephemeral Gully Erosion	0	Barriers reduce the excessive disturbance of soil and vegetation by facilitating the effective control of timing, frequency, duration and intensity of use of an area by animals or people.
Soil Erosion - Classic Gully Erosion	0	Barriers reduce the excessive disturbance of soil and vegetation by facilitating the effective control of timing, frequency, duration and intensity of use of an area by animals or people.
Soil Erosion - Streambank, Shoreline, Water Conveyance	0	Barriers reduce the excessive disturbance of soil and vegetation by facilitating the effective control of timing, frequency, duration and intensity of use of an area by animals or people. This promotes vegetative growth and streambank stabilization.
Soil Quality Degradation		
Organic Matter Depletion	0	Not applicable.
Compaction	1	Not applicable.
Subsidence	0	Not applicable.
Concentration of Salts or Other Chemicals	0	Not applicable.
Excess Water		
Excess Water - Seeps	0	Not Applicable
Excess Water - Runoff, Flooding, or Ponding	0	Not applicable.
Excess Water - Seasonal High Water Table	0	Not Applicable
Excess Water - Drifted Snow	0	Not applicable.
Insufficient Water		
Insufficient Water - Inefficient Use of Irrigation Water	0	Not Applicable
Insufficient Water - Inefficient Moisture Management	0	Not applicable.
Water Quality Degradation		
Pesticides in Surface Water	0	Not Applicable
Pesticides in Groundwater	0	Not Applicable
Nutrients in Surface water	0	Not applicable.
Nutrients in Groundwater	0	Not applicable.
Salts in Surface Water	0	Not Applicable
Salts in Groundwater	0	Not applicable.
Excess Pathogens and Chemicals from Manure, Bio-so	2	Control access of animals and/or people to stream areas.
Excess Pathogens and Chemicals from Manure, Bio-so	0	Not Applicable
Excessive Sediment in Surface Water	0	Not applicable.
Elevated Water Temperature	0	Not Applicable
Petroleum, Heavy Metals and Other Pollutants Transpo	0	Not applicable.
Petroleum, Heavy Metals and Other Pollutants Transpo	0	Not Applicable
Air Quality Impacts		
Emissions of Particulate Matter (PM) and PM Precursors	0	Not Applicable
Emissions of Ozone Precursors	0	Not Applicable
Emissions of Greenhouse Gases (GHGs)	1	Fencing can be used to protect and/or improve vegetation.
Objectionable Odors	0	Not Applicable
Degraded Plant Condition		
Undesirable Plant Productivity and Health	2	Control of animals facilitates grazing management enhancing health and vigor of desired plant communities.
Inadequate Structure and Composition	0	Control of animals facilitates grazing management which encourages growth of plants that are adapted and suitable for the site.
Excessive Plant Pest Pressure	0	Not applicable.
Wildfire Hazard, Excessive Biomass Accumulation	0	Not Applicable
Fish and Wildlife - Inadequate Habitat		
Inadequate Habitat - Food	0	Not Applicable
Inadequate Habitat - Cover/Shelter	0	Not Applicable
Inadequate Habitat - Water	1	Not Applicable
Inadequate Habitat - Habitat Continuity (Space)	0	Species dependent.
Livestock Production Limitation		
Inadequate Feed and Forage	3	Control of animals influences vigor and health of vegetation.
Inadequate Shelter	0	Not applicable.
Inadequate Water	0	Not Applicable
Inefficient Energy Use		
Equipment and Facilities	0	Not Applicable
Farming/Ranching Practices and Field Operations	0	Not Applicable

CPPE Practice Effects: *0 No Effect*

	5 Substantial Improvement	*-1 Slight Worsening*
	4 Moderate to Substantial Improvement	*-2 Slight to Moderate Worsening*
	3 Moderate Improvement	*-3 Moderate Worsening*
	2 Slight to Moderate Improvement	*-4 Moderate to Substantial Worsening*
	1 Slight Improvement	*-5 Substantial Worsening*

Source: National Conservation Practices Physical Effects
Hal Gordon, WNTSC Economist, Portland, Oregon
May-13

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

FIELD BORDER

CODE 386

(ac)

DEFINITION

A strip of permanent vegetation established at the edge or around the perimeter of a field.

PURPOSE

This practice is used to accomplish one or more of the following purposes–

- Reduce erosion from wind and water and reduce excessive sediment to surface waters (soil erosion)
- Reduce sedimentation offsite and protect water quality and nutrients in surface and ground waters (water quality degradation)
- Provide food and cover for wildlife and pollinators or other beneficial organisms (inadequate habitat for fish and wildlife)
- Reduce greenhouse gases and increase carbon storage (air quality impact)
- Reduce emissions of particulate matter (air quality impact)

CONDITIONS WHERE PRACTICE APPLIES

This practice is applied around the inside perimeter of fields. Its use can support or connect other buffer practices within and between fields. This practice applies to cropland and pasture fields.

CRITERIA

General Criteria Applicable to All Purposes

Establish field borders at field edges to the extent needed to meet the resource needs and producer objectives. Minimum field border widths shall be based on local design criteria specific to the purpose or purposes for installing the practice.

Establish field borders to adapted species of permanent grass, forbs and/or shrubs that accomplish the design objective.

Plants selected for field borders will have the physical characteristics necessary to control wind and water erosion to tolerable levels on the field border area. For portions of the border that will be subject to equipment traffic, establish species tolerant to equipment such traffic.

Seedbed preparation, seeding rates, seeding dates, seeding depths, fertility requirements, and planting methods will be consistent with approved local criteria and site conditions.

Ephemeral gullies and rills present in the planned border area will be eliminated as part of seedbed preparation. If present, ephemeral gullies and rills located immediately upslope from the planned border area need to be treated to ensure more sheet flow and less concentrated flow enters the field border area.

Break up or redirect concentrated water flow within the field borders to prevent gully erosion.

Additional Criteria to Reduce Erosion from Wind and Water and Reduce Excessive Sediment to Surface Waters

Field border establishment will be timed so that the soil will be adequately protected during the critical erosion period(s).

Establish permanent species that create a dense cover.

Establish stiff-stemmed, upright grasses, grass/legumes or forbs to trap wind or waterborne soil particles.

The amount of surface and/or canopy cover needed from the field border shall be determined using current approved water and wind erosion prediction technology. Soil erosion estimates shall account for the effects of other practices in the management system.

Wind erosion reduction

Locate borders to provide a stable area on the windward edge of the field as determined by prevailing wind direction data during the critical erosion period(s).

Minimum height of grass or forbs shall be one foot during the critical wind erosion period.

Water erosion reduction

Locate borders to eliminate sloping end rows, headlands, and other areas where concentrated water flows will enter or exit the field.

Orient plant rows as closely as possible to be perpendicular to sheet flow direction.

Additional Criteria for to Reduce Sedimentation Offsite and Protect Water Quality and Excess Nutrients in Surface and Ground Waters

Do not burn the field border.

As a minimum, locate field borders along the edge(s) of the field where runoff enters or leaves the field. The minimum width for this purpose shall be 30 feet and have a dense vegetative stand (similar to a dense sod).

Design border widths to comply with all applicable State and local regulations regarding manure and chemical application setbacks.

Establish stiff-stemmed, upright grasses, grass/legumes or forbs to trap wind or waterborne soil particles.

Additional Criteria to Provide Wildlife Food and Cover and Pollinator or Other Beneficial Organisms

Use an approved habitat evaluation procedure to determine the appropriate amount, arrangement and composition of habitat resources needed to provide adequate food and cover for target wildlife species.

Select species that provide adequate habitat, food source and/or cover for the wildlife species of interest.

The minimum width for this purpose shall be 30 feet.

Schedule mowing, harvest, weed control, and other management activities within the field border to accommodate reproduction and other life-cycle requirements of target wildlife species.

When possible, disturb no more than 1/3 of the field border at any given time. Avoid vehicle traffic in the field border area.

For beneficial organisms (e.g., predatory and parasitic insects, spiders, insectivorous birds and bats, raptors, and terrestrial rodent predators) that prey on target pests, select diverse plant species that meet dietary, nesting and cover requirements for the intended species, at least during the critical period for control of target pests, and ideally year-round. Avoid exposure of the field border to pesticides and other chemicals that are potentially harmful to wildlife, pollinators, and other beneficial organisms.

When wildlife and/or pollinators are a concern, a lower percent groundcover than would be needed if protecting soil and water quality is acceptable as long as the soil resource concern is also adequately addressed (i.e., no excessive soil loss). This may be achieved by simply increasing the field border width.

Additional Criteria to Reduce Greenhouse Gases and Increase Carbon Storage

Establish plant species that will produce adequate above- and below-ground biomass for the site (i.e., a positive soil conditioning index will be achieved).

Maximize the width and length of the field border to fit the site and increase total biomass production.

Do not burn the field border.

Do not disturb the roots of the established vegetation with tillage.

Additional Criteria to Reduce Emissions of Particulate Matter

Establish plant species with morphological characteristics that optimize interception and adhesion of airborne particulates. Select plants with persistent roots and residue that stabilize soil aggregates and mitigate the generation of airborne particulates.

Do not burn the field border.

Establish species resistant to damage from equipment traffic.

CONSIDERATIONS

Applicable to All Purposes

Design border widths to comply with all applicable State and local regulations regarding manure and chemical application setbacks.

Plant field borders around the entire field, not just on the field edges where water enters or leaves the field, to maximize resource conservation benefits.

Establishing a narrow strip of stiff-stemmed upright grass at the crop/field border interface can increase soil particle and other airborne particulate trapping efficiency of the field border.

Native plants are best suited for wildlife and pollinator habitat enhancement, and provide other ecological benefits where adapted to site conditions and when consistent with producer objectives.

When enhancement of wildlife habitat is a purpose, plant species diversity should be encouraged. Plantings that result in multiple structural levels of vegetation will maximize wildlife use.

Include native plants that provide diverse pollen and nectar sources to encourage local pollinator populations. Where possible, re-establish the native plant community for the site.

Overseed the field border with forbs for increased plant diversity, soil quality, pollinators, and wildlife benefits.

In selecting plant species consider the plant’s tolerance to—

- Sediment deposition and chemicals planned for application.
- Drought in arid areas or where evapotranspiration can potentially exceed precipitation during the field border’s active growing period(s).

- Equipment traffic.

Establish plant species that will have the desired visual effects and that will not interfere with field operations or field border maintenance.

Establish plant species taking into account shading from adjacent vegetation.

The use of native perennial plant species as opposed to introduced species provides a longer period of resource protection.

Conservation Practice Standards Prescribed Burning (Code 338), Prescribed Grazing (Code 528), and Early Successional Habitat Development and Management (Code 647) are management practices that can be used to maintain suitable habitat for specifically desired wildlife species, provided those practices are applied following specifications that do not compromise the purpose(s) of the practice.

To minimize wildlife mortality and habitat degradation, turn or drive machinery on field borders only when necessary, at low speed, and with implements fully raised. If extensive turning/traffic will be necessary on the field border during the nesting season, mortality may be reduced by mowing it early to reduce its attractiveness as a nesting site, if alternative nesting cover is available.

Design border widths to match the required field application setback widths for easier management (i.e., land-use and management changes occur in the same location).

Consider installing a contour buffer system, no till practice, or other conservation practices on adjacent upland areas to reduce surface runoff and excessive sedimentation of field borders.

Organic producers may have to submit plans and specifications to their certifying agent for approval prior to installation, as part of the organic producer’s organic system plan.

Where genetic drift is a concern, use buffer vegetation to create a barrier between the pollen-producing crop and the crop that must be protected, or increase the distance between them so that cross-pollination is less likely.

Border widths can be designed to accommodate equipment turning, parking, loading/unloading equipment, grain harvest operations, etc. to minimize soil compaction on the high-traffic field edges.

Water bars or berms may be needed to breakup or redirect concentrated water flow within the field borders.

PLANS AND SPECIFICATIONS

Specifications shall be prepared for each site and purpose and recorded in the approved implementation requirements document.

- Practice purpose(s).
- Field border widths and lengths based on local design criteria.
- Field border location(s) within the field(s) or farm boundary.
- Species to be used and the location and planting density of the species used.
- Site preparation requirements.
- Timing of planting and planting method.
- Liming or fertilizer requirements.
- Operation and maintenance requirements.

OPERATION AND MAINTENANCE

Field borders require careful management and maintenance for performance and longevity. The following O&M activities will be planned and applied as needed:

- Repair storm damage.
- Remove sediment from above, within, and along the leading edge of the field border when accumulated sediment either alters the function of the field border or threatens the degradation of the planted species.
- Shut off pesticide sprayers and raise tillage equipment to avoid damage to field borders.
- Shape and reseed border areas damaged by animals, chemicals, tillage, or equipment traffic.
- Do not use the field border as a hay yard or machinery parking lot for any extended period of time, especially if doing so will damage or impair the function of the field border.
- Maintain desired vegetative communities and plant vigor by liming, fertilizing, mowing, disking, or burning and controlling noxious and invasive weeds to sustain effectiveness of the border.
- Repair and reseed ephemeral gullies and rills that develop in the border.
- Minimally invasive vertical tillage (e.g., paraplowing) may be performed in rare cases where compaction and vehicle traffic have degraded the field border function. The purpose of the tillage is strictly to relieve soil compaction and increase infiltration rates so as to provide a better media for reestablishment of vegetation and field border function.
- When managing for wildlife, maintenance activities that result in disturbance of vegetation should not be conducted during the primary nesting, fawning and calving seasons. In addition, when managing for wildlife, pollinator, and beneficial habitat, conduct any pesticide spray operations in the production area in a manner that prevents exposure of the field border to the pesticides, taking into account toxicity of the materials used to non-pest organisms, and weather conditions. Activities should be timed to allow for regrowth before the growing season ends whenever possible. The optimal vegetative successional state shall be maintained to accommodate target wildlife species' requirements.
- Periodic removal of some products such as medicinal herbs, nuts, and fruits is permitted provided the conservation purpose is not compromised by the loss of vegetation or harvesting disturbance.
- Avoid vehicle traffic when soil moisture conditions are saturated.
- Maintain records of the field border maintenance as needed by the land user.

REFERENCES

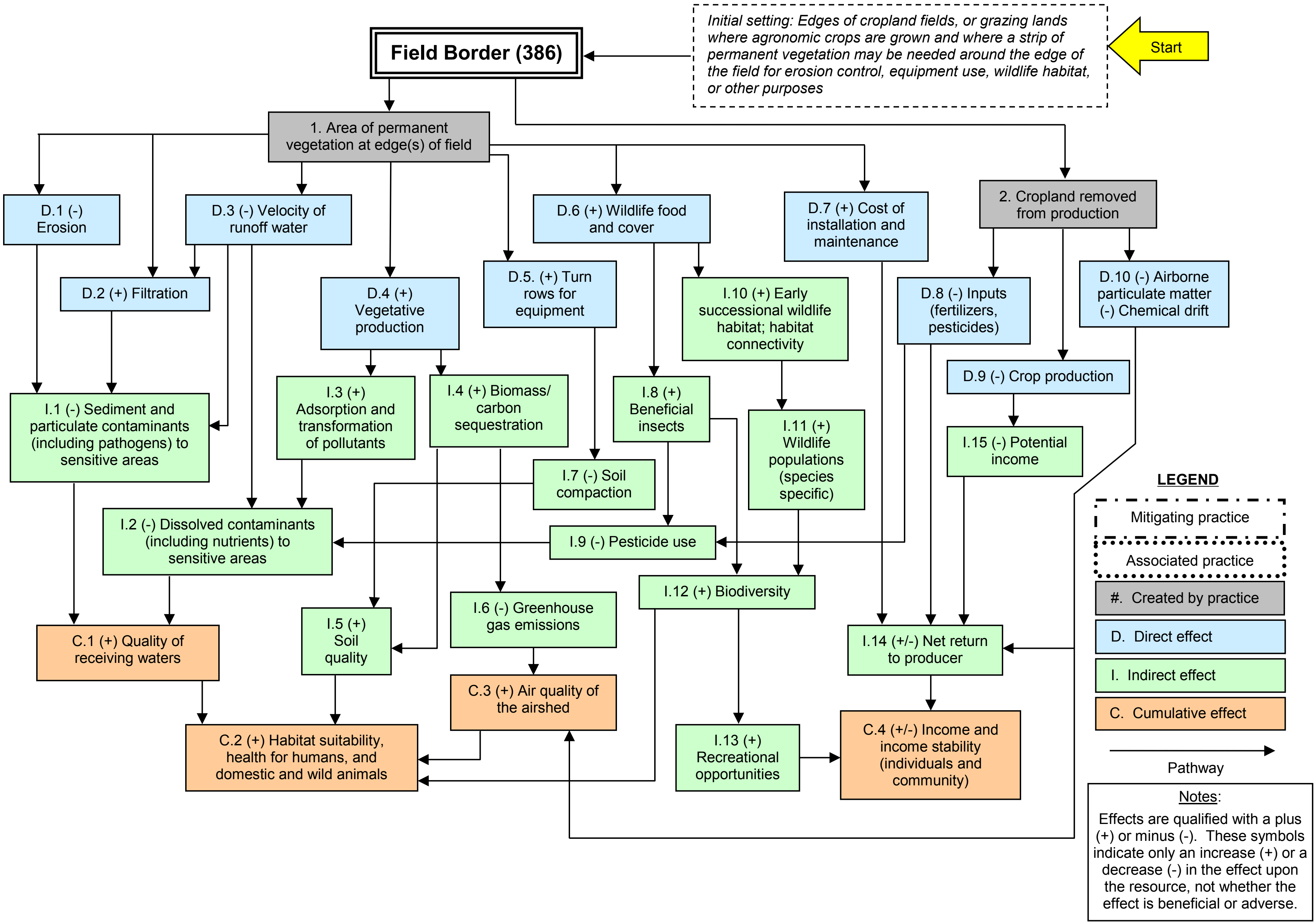
Baumgartner, J. et al. Biodiversity Conservation – An Organic Farmer's Guide. 2005. Wild Farm Alliance. http://www.wildfarmalliance.org.

K. G. Renard, G.R. Foster, G.A. Weesies, K.D.K. McCool and D.C. Yoder. 1997. Predicting Soil Erosion by Water: A Guide to Conservation Planning with the Revised Universal Soil Loss Equation (RUSLE), Agricultural Handbook Number 703.

Revised Universal Soil Loss Equation Version 2 (RUSLE2) Web site (checked May 2007): http://fargo.nserl.purdue.edu/rusle2_dataweb/RUSLE2_Index.htm.

NRCS CONSERVATION PRACTICE EFFECTS - NETWORK DIAGRAM

September 2016



Effects of NRCS Conservation Practices - National

Field Border

A stripe of permanent vegetation established at the edge or around the perimeter or a field.

Code: 386
Units: ft.

Typical Landuse:	C-Crop	F-Forest	R-Range	P-Pasture	Pr-Protected	FS-Farmstead	D-Developed	W-Water	O-Other	AL-Aso Land
	C			P					O	

Soil Erosion	Effect	Rationale
Soil Erosion - Sheet and Rill Erosion	4	Permanent vegetation planted across the slope reduces erosive water energy.
Soil Erosion - Wind Erosion	4	Stiff-stemmed, permanent vegetation traps saltating particles. More roughened surface slows wind velocities.
Soil Erosion - Ephemeral Gully Erosion	1	Vegetation across the slope reduces erosive energy of concentrated flows where they exit the field.
Soil Erosion - Classic Gully Erosion	0	Not Applicable
Soil Erosion - Streambank, Shoreline, Water Conveyance C	1	Increased vegetation can reduce concentrated runoff flowing over streambanks.
Soil Quality Degradation		
Organic Matter Depletion	4	Permanent cover and lack of soil disturbance reduces decomposition of soil organic materials such as roots and allows accumulation.
Compaction	2	Root penetration and organic matter helps restore soil structure.
Subsidence	0	Drainage has the predominant impact on subsidence.
Concentration of Salts or Other Chemicals	0	Not Applicable
Excess Water		
Excess Water - Seeps	0	Not Applicable
Excess Water - Runoff, Flooding, or Ponding	1	Permanent vegetation will reduce runoff and increase infiltration.
Excess Water - Seasonal High Water Table	0	Not Applicable
Excess Water - Drifted Snow	0	Not Applicable
Insufficient Water		
Insufficient Water - Inefficient Use of Irrigation Water	0	Not Applicable
Insufficient Water - Inefficient Moisture Management	0	Not Applicable
Water Quality Degradation		
Pesticides in Surface Water	2	The action reduces runoff and erosion. Also, the borders may attract beneficial insects or trap insect pests, reducing the need for pesticide applications.
Pesticides in Groundwater	2	The action may attract beneficial insects or trap insect pests, reducing the need for pesticide applications.
Nutrients in Surface water	2	Permanent vegetation will take up available nutrients and increase organic matter. The increased organic matter will increase cation exchange capacity which will hold nutrients.
Nutrients in Groundwater	2	Permanent vegetation will take up available nutrients and increase organic matter. The increased organic matter will increase cation exchange capacity which will hold nutrients.
Salts in Surface Water	0	Not Applicable
Salts in Groundwater	1	The action will result in increased uptake by plants.
Excess Pathogens and Chemicals from Manure, Bio-solic	1	Less erosion and runoff reduces delivery of pathogens. More moist environment in permanent vegetation may slow pathogen mortality, however.
Excess Pathogens and Chemicals from Manure, Bio-solic	0	Permanent vegetation increases soil organic matter and microbial activity, which competes with pathogens. However, permanent vegetation may delay mortality of some pathogens by slowing desiccation.

Excessive Sediment in Surface Water	2	Vegetation protects soil surface and traps sediment.
Elevated Water Temperature	0	Not Applicable
Petroleum, Heavy Metals and Other Pollutants Transporte	0	Not Applicable
Petroleum, Heavy Metals and Other Pollutants Transporte	0	Not Applicable
Air Quality Impacts		
Emissions of Particulate Matter (PM) and PM Precursors	1	Permanent vegetation around the field edge reduces particulate emissions from vehicle traffic and tillage in the border area.
Emissions of Ozone Precursors	0	Not Applicable
Emissions of Greenhouse Gases (GHGs)	1	Vegetation removes CO2 from the air and stores it in the form of carbon in the plants and soil.
Objectionable Odors	0	Not Applicable
Degraded Plant Condition		
Undesirable Plant Productivity and Health	5	Plants are selected and managed to maintain optimal productivity and health.
Inadequate Structure and Composition	5	Plants selected are adapted and suited.
Excessive Plant Pest Pressure	4	Vegetation is installed and managed to control undesired species.
Wildfire Hazard, Excessive Biomass Accumulation	0	Not Applicable
Fish and Wildlife - Inadequate Habitat		
Inadequate Habitat - Food	2	Increased quality and quantity of vegetation provides more food for wildlife.
Inadequate Habitat - Cover/Shelter	2	Plants may be chosen and managed to enhance value as cover/shelter.
Inadequate Habitat - Water	4	Not Applicable
Inadequate Habitat - Habitat Continuity (Space)	2	Permanent vegetation may provide added habitat and connectivity for selected wildlife species.
Livestock Production Limitation		
Inadequate Feed and Forage	0	There may be some use of the planting for feed and forage by livestock.
Inadequate Shelter	0	Not Applicable
Inadequate Water	0	Not Applicable
Inefficient Energy Use		
Equipment and Facilities	0	Not Applicable
Farming/Ranching Practices and Field Operations	0	Not Applicable

CPPE Practice Effects:	*0 No Effect*
5 Substantial Improvement	*-1 Slight Worsening*
4 Moderate to Substantial Improvement	*-2 Slight to Moderate Worsening*
3 Moderate Improvement	*-3 Moderate Worsening*
2 Slight to Moderate Improvement	*-4 Moderate to Substantial Worsening*
1 Slight Improvement	*-5 Substantial Worsening*

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

ACCESS CONTROL

CODE 472

(ac)

DEFINITION

The temporary or permanent exclusion of animals, people, vehicles, and equipment from an area.

PURPOSE

This practice is used to accomplish the following purpose:

- Achieve and maintain desired resource conditions by monitoring and managing the intensity of use by animals, people, vehicles, and equipment in coordination with the application schedule of practices, measures, and activities specified in the conservation plan

CONDITIONS WHERE PRACTICE APPLIES

This practice applies on all land uses.

CRITERIA

General Criteria Applicable to All Purposes

Use-regulating activities (e.g., posting of signs, patrolling, gates, fences and other barriers, permits) must achieve the intended purpose and include mitigating associated resource concerns to acceptable levels during their installation, operation, and maintenance. Activities will complement the application schedule and life-span of other practices specified in the conservation plan.

Each activity or measure will identify the entity to be monitored and regulated (animals, people, vehicles, and equipment) and specify the intent, intensity, amounts, and timing of exclusion by that entity. Activities may involve temporary to permanent exclusion of one to all entities.

Placement, location, dimensions, and materials (e.g., signs, gates), and frequency of use (e.g., continuous, specific season, or specific dates) must be described for each activity including monitoring frequency.

CONSIDERATIONS

Even though usage of the area is monitored and controlled, the land manager and/or tenant should be advised about emergency preparedness agencies and related information (e.g., the local fire/wildfire control agency and pumper truck water sources) on or near the area. Information should be designated initially and redesignated annually.

PLANS AND SPECIFICATIONS

Specifications for applying this practice must be prepared for each area and recorded using approved specification sheets, job sheets, and narrative statements in the conservation plan, or other acceptable documentation.

OPERATION AND MAINTENANCE

Monitoring of the effectiveness of use-regulating activities will be performed routinely and at least annually with changes made to specifications and operation and maintenance requirements as necessary.

Modifications to activities and use of measures are allowed temporarily to accommodate emergency-level contingencies such as wildfire, hurricane, drought, or flood if resource conditions are maintained

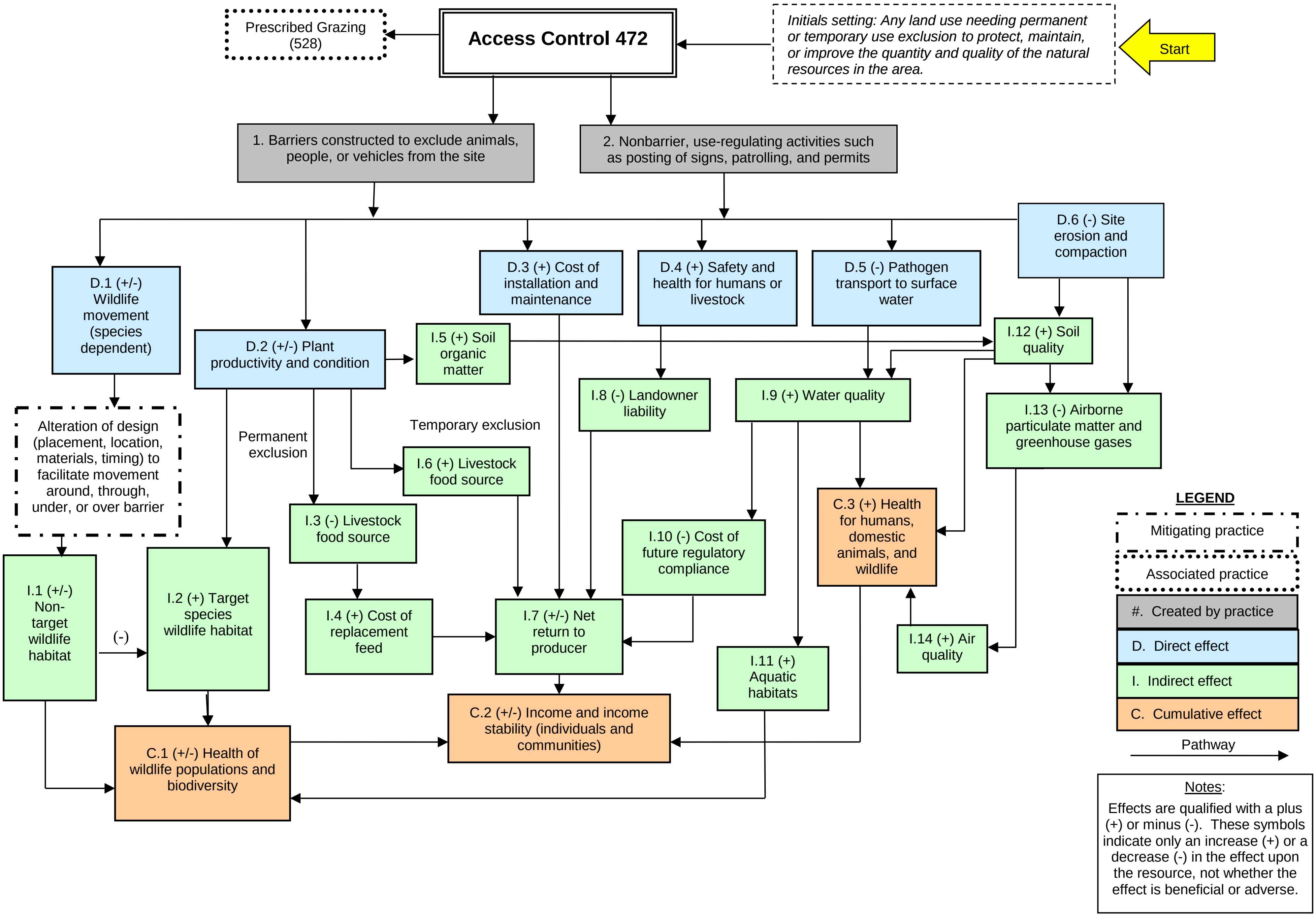
REFERENCES

Gucinski, H., M.J. Furniss, R.R. Ziemer, M.H. Brookes. 2001. Forest roads: A Synthesis of Scientific Information. Gen. Tech. Rep. PNWGTR-509. U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. Portland, OR.

U.S. Department of Transportation, Federal Highway Administration. 2009. Manual on Uniform Traffic Control Devices for Streets and Highways - Part 5, Traffic Control Devices for Low-Volume Roads. Washington, DC. https://mutcd.fhwa.dot.gov/pdfs/2009r1r2/pdf_index.htm.

NRCS CONSERVATION PRACTICE EFFECTS - NETWORK DIAGRAM

October 2017



Effects of NRCS Conservation Practices - National

Access Control

The temporary or permanent exclusion of animals, people, vehicles, and/or equipment from an area.

Code: 472
Units: ac

Typical Landuse: C F R P Pr FS D W O AL

C-Crop	F-Forest	R-Range	P-Pasture	Pr-Protected	FS-Farmstead	D-Developed	W-Water	O-Other	AL-Aso Land
C	F	R	P	Pr	FS	D	W	O	AL

Soil Erosion	Effect	Rationale
Soil Erosion - Sheet and Rill Erosion	3	Control of animals, people and vehicles reduces disturbance of soil and vegetation.
Soil Erosion - Wind Erosion	1	Control of animals, people and vehicles reduces disturbance of soil and vegetation.
Soil Erosion - Ephemeral Gully Erosion	4	Control of animals, people and vehicles reduces disturbance of soil and vegetation.
Soil Erosion - Classic Gully Erosion	4	Control of animals, people and vehicles reduces disturbance of soil and vegetation.
Soil Erosion - Streambank, Shoreline, Water Conveyance (	4	Control of animals, people and vehicles reduces disturbance of soil and vegetation.
Soil Quality Degradation		
Organic Matter Depletion	1	Control of animals, people and vehicles help maintain conditions of soil and vegetation.
Compaction	4	Control of animals, people and vehicles lessens compactive forces on soil.
Subsidence	0	Not Applicable
Concentration of Salts or Other Chemicals	0	Control of animals, people and vehicles will influence plant growth and alter infiltration and leaching to a limited degree.
Excess Water		
Excess Water - Seeps	1	Control of animals, people and vehicles influences vigor and health of vegetation which in turn can influence water uptake and infiltration.
Excess Water - Runoff, Flooding, or Ponding	0	Control of animals, people and vehicles can improve vigor and health of vegetation which can increase retardance of water flows. Also, exclusion structures can trap debris further retarding flows.
Excess Water - Seasonal High Water Table	2	Control of animals, people and vehicles influences vigor and health of vegetation which in turn can influence water uptake.
Excess Water - Drifted Snow	0	Not Applicable
Insufficient Water		
Insufficient Water - Inefficient Use of Irrigation Water	0	Not Applicable
Insufficient Water - Inefficient Moisture Management	3	Control of animals, people and vehicles influences vegetation vigor and soil structure which can help optimize water use.
Water Quality Degradation		
Pesticides in Surface Water	1	Control of animals, people and vehicles influences vigor and health of vegetation and soil condition which retain pesticides when applied with other management practices.
Pesticides in Groundwater	0	Not Applicable
Nutrients in Surface water	1	Control of animals, people and vehicles influences vigor and health of vegetation and soil condition reducing runoff when applied with other management practices.
Nutrients in Groundwater	1	Control of animals, people, and vehicles influences vegetation vigor and soil structure which can accelerate use and breakdown of nutrients/organics.
Salts in Surface Water	0	Not Applicable
Salts in Groundwater	0	Not Applicable
Excess Pathogens and Chemicals from Manure, Bio-soli	1	Control of animals, people and vehicles influences vigor and health of vegetation and soil condition which in turn can influence water uptake and infiltration to reduce runoff and increase mortality of pathogens.
Excess Pathogens and Chemicals from Manure, Bio-soli	1	Control of animals and people lessens pathogen production in sensitive areas.
Excessive Sediment in Surface Water	3	Control of animals, people and vehicles influences vigor and health of vegetation and soil condition reducing sediment supply to surface waters when applied with other management practices.

Elevated Water Temperature	3	Control of animals, people and vehicles influences vigor, health, and availability of riparian vegetation which can shade associated surface waters.
Petroleum, Heavy Metals and Other Pollutants Transport	1	Control of animals, people and vehicles improves vigor and health of vegetation and soil condition, which in turn can influence water uptake and infiltration to reduce runoff. Reducing vehicles eliminates heavy metals from brakes and fuel.
Petroleum, Heavy Metals and Other Pollutants Transport	1	Control of animals, people, and vehicles influences vegetation vigor and soil structure which can accelerate attenuation of heavy metals.
Air Quality Impacts		
Emissions of Particulate Matter (PM) and PM Precursors	2	Restricting traffic on an area can reduce crushing action of tires on the surface and result in an improved stand of vegetation, which can reduce the generation of particulates.
Emissions of Ozone Precursors	1	Restricting traffic will reduce engine emissions from that area.
Emissions of Greenhouse Gases (GHGs)	1	Vegetation removes CO2 from the air and stores it in the form of carbon in the plants and soil. Restricting traffic will reduce engine emissions from that area.
Objectionable Odors	0	Not Applicable
Degraded Plant Condition		
Undesirable Plant Productivity and Health	3	Control of animals, people, and vehicles facilitates when used with other practices maintains and enhances health and vigor of desired plant communities.
Inadequate Structure and Composition	3	Control of access encourages plants that are adapted and suited for the site.
Excessive Plant Pest Pressure	5	Control of animals, people and vehicles influences vigor and health of desirable vegetation thereby reducing threat of noxious and invasive plants when applied with other conservation practices.
Wildfire Hazard, Excessive Biomass Accumulation	3	Access by people and vehicles to high hazard areas can be restricted.
Fish and Wildlife - Inadequate Habitat		
Inadequate Habitat - Food	3	Control of animals, people and vehicles influences vigor, health, and availability of vegetation for food.
Inadequate Habitat - Cover/Shelter	3	Control of animals, people and vehicles influences vigor, health, and availability of vegetation cover/shelter.
Inadequate Habitat - Water	3	Control of access protects available water sources.
Inadequate Habitat - Habitat Continuity (Space)	1	Excluded use protects wildlife space requirements.
Livestock Production Limitation		
Inadequate Feed and Forage	3	Control of animals influences vigor and health of vegetation.
Inadequate Shelter	0	Not Applicable
Inadequate Water	0	Not Applicable
Inefficient Energy Use		
Equipment and Facilities	0	Not Applicable
Farming/Ranching Practices and Field Operations	0	Not Applicable

CPPE Practice Effects:	*0 No Effect*
5 Substantial Improvement	*-1 Slight Worsening*
4 Moderate to Substantial Improvement	*-2 Slight to Moderate Worsening*
3 Moderate Improvement	*-3 Moderate Worsening*
2 Slight to Moderate Improvement	*-4 Moderate to Substantial Worsening*
1 Slight Improvement	*-5 Substantial Worsening*

United States Department of Agriculture

Natural Resources Conservation Service

CONSERVATION PRACTICE STANDARD

NUTRIENT MANAGEMENT

CODE 590

(ac)

DEFINITION

Manage rate, source, placement, and timing of plant nutrients and soil amendments while reducing environmental impacts.

PURPOSE

This practice is used to accomplish one or more of the following purposes:

- Improve plant health and productivity
- Reduce excess nutrients in surface and ground water
- Reduce emissions of objectionable odors
- Reduce emissions of particulate matter (PM) and PM precursors
- Reduce emissions of greenhouse gases (GHG)
- Reduce emissions of ozone precursors
- Reduce the risk of potential pathogens from manure, biosolids, or compost application from reaching surface and ground water
- Improve or maintain soil organic matter

CONDITIONS WHERE PRACTICE APPLIES

All fields where plant nutrients and soil amendments are applied. Does not apply to one-time nutrient applications at establishment of permanent vegetation.

CRITERIA

General Criteria Applicable to All Purposes

Develop a nutrient management plan for nitrogen (N), phosphorus (P), and potassium (K), which accounts for all known measurable sources and removal of these nutrients.

Sources of nutrients include, but are not limited to, commercial fertilizers (including starter and in-furrow starter/pop-up fertilizer), animal manures, legume fixation credits, green manures, plant or crop residues, compost, organic by-products, municipal and industrial biosolids, wastewater, organic materials, estimated plant available soil nutrients, and irrigation water.

When irrigating, apply irrigation water in a manner that reduces the risk of nutrient loss to surface and ground water.

Follow all applicable State requirements and regulations when applying nutrients near areas prone to contamination, such as designated water quality sensitive areas, (e.g., lakes, ponds, rivers and streams, sinkholes, wellheads, classic gullies, ditches, or surface inlets) that run unmitigated to surface or groundwater.

Soil and tissue testing and analysis
Base the nutrient management plan on current soil test results in accordance with land grant university (LGU) guidance, or industry practice when recognized by the Mississippi State Extension Service (MSU-ES). Use soil tests no older than 2 years when developing new nutrient management plans. Use tissue testing, when applicable, for monitoring or adjusting the nutrient management plan in accordance with Mississippi State University Extension Service guidance, or industry practice when recognized by the Mississippi State University Extension (See publication 2647 Nutrient Management Guidelines for Agronomic Crops Grown in Mississippi).

For nutrient management plan revisions and maintenance, take soil tests on an interval recommended by the LGU (MSU-ES) or as required by local rules and regulations.

Collect, prepare, store, and ship all soil and tissue samples following LGU (MSU-ES) guidance or industry practice. The test analyses must include pertinent information for monitoring or amending the annual nutrient plan. Follow LGU (MSU-ES) guidelines regarding required analyses and test interpretations.

For soil test analyses, use laboratories successfully meeting the requirements and performance standards of the North American Proficiency Testing Program under the auspices of the Soil Science Society of America and NRCS or use an alternative NRCS- or State-approved certification program that considers laboratory performance and proficiency to assure accuracy of soil test results. Alternative certification programs must have solid stakeholder support (e.g., Mississippi Department of Environmental Quality, growers, and others) and be State or regional in scope.

Maintain soil pH within ranges which enhance the adequate level for plant or crop nutrient availability and utilization. Refer to State LGU (MSU-ES) documentation for guidance (See publication 2647 Nutrient Management Guidelines for Agronomic Crops Grown in Mississippi).

Manure, organic by-product, and biosolids testing and analysis
Collect, prepare, store, and ship all manure, organic by-products, and biosolids following LGU (MSU-ES) guidance or industry practice when recognized by the LGU (MSU-ES). In the absence of such guidance, test at least annually, or more frequently if needed to account for operational changes (e.g., feed management, animal type, manure handling strategy, etc.) impacting manure nutrient concentrations. If no operational changes occur and operations can document a stable level of nutrient concentrations for the preceding 3 consecutive years, manure may be tested less frequently, unless Federal, State, or local regulations require more frequent testing. Follow LGU (MSU-ES) guidelines regarding required analyses and test interpretations. Analyze, as a minimum, total N, total P or P_2O_5, total K or K_2O, and percent solids.

When planning for new or modified livestock operations, and manure tests are not available yet, use the output and analyses from similar operations in the geographical area if they accurately estimate nutrient output from the proposed operation or use “book values” recognized by the NRCS (e.g., NRCS Agricultural Waste Management Field Handbook) and the LGU (MSU-ES).

For manure analyses, use laboratories successfully meeting the requirements and performance standards of the Manure Testing Laboratory Certification program under the auspices of the Minnesota Department of Agriculture or other NRCS-approved program that considers laboratory performance and proficiency to assure accurate manure test results (See MSU publicated 2897 Forage and Manure Analysis Laboratories).

For nutrient management plans developed as a component of a comprehensive nutrient management plan for an animal feeding operation (AFO) follow policy in NRCS directive General Manual (GM) 190, Part 405, “Comprehensive Nutrient Management Plans.” These plans must include documentation of all nutrient imports, exports, and on-farm transfers.

Nutrient loss risk assessments
Use current NRCS-approved nitrogen, phosphorus, and soil erosion risk assessment tools to assess the site-specific risk of nutrient and soil loss.

Complete an NRCS-approved nutrient risk assessment for N on all fields where nutrient management is planned unless the Mississippi NRCS, in cooperation with Mississippi Department of Environmental Quality authorities, has determined specific conditions where N leaching is not a risk to water quality, including drinking water.

The Mississippi Phosphorous Index (PI) Phosphorus Index for Mississippi MS-ESC-TN05, NRCS-approved nutrient management risk assessment for phosphorous) must be completed when —

- P application rate exceeds LGU (MSU-ES) fertility rate guidelines for the planned crop(s).
- The planned area is within a P-impaired watershed.
- The site-specific conditions equating to low risk of P loss have not been determined by the NRCS in cooperation with the LGU (MSU-ES).

Any fields excluded from a P risk assessment must have a documented agronomic need for P, based on soil test P and MSU-ES nutrient recommendations.

For fields receiving manure, where P risk assessment results equate to—

- LOW risk.—Manure can be applied at rates to supply P at greater than crop requirement not to exceed the N requirement for the succeeding crop.
- MODERATE risk.—Manure can be applied at rates not to exceed crop P removal rate or the soil test P recommended rate for the planned crops in rotation.
- HIGH risk.—Manure can be applied at rates not to exceed crop P removal rate if the following requirements are met:
  - A soil P drawdown strategy has been developed, documented, and implemented for the crop rotation.
  - Implementation of all mitigation practices determined to be needed by site-specific assessments for nutrients and soil loss to protect water quality.
  - Any deviation from these high-risk requirements that would increase the risk of P runoff requires the approval of the Chief of the NRCS.

A phosphorous index will not be required when the risk of phosphorous loss is low, individual fields have a documented agronomic need for phosphorous; based on soil test phosphorous (STP) and MSU-ES nutrient recommendations, and all four of the following conditions are met:

Low or medium soil test phosphorous (0-72 lbs/ac. STP) levels based on current soil test(s)

- Slope is less than 5%
- Soil loss is less than or equal to soil loss tolerance
- Nutrient application shall not exceed Mississippi State University Extension Service fertility rate guidelines for the planned crop(s).

The 4Rs of nutrient stewardship
Manage nutrients based on the 4Rs of nutrient stewardship—apply the right nutrient source at the right rate at the right time in the right place—to improve nutrient use efficiency by the crop and to reduce nutrient losses to surface and groundwater and to the atmosphere.

Nutrient source

Choose nutrient sources compatible with application timing, tillage and planting system, soil properties, crop, crop rotation, soil organic content, and local climate to minimize risk to the environment.

Determine nutrient values of all nutrient sources (e.g. commercial fertilizers, manure, organic by-products, biosolids) prior to land application.

Determine nutrient contribution of cover crops, previous crop residues, and soil organic matter.

For operations following USDA's National Organic Program, apply and manage nutrient sources according to program regulations.

For enhanced efficiency fertilizer (EEF) products, use products defined by the Association of American Plant Food Control Officials as EEF and be accepted for use by the Mississippi Bureau of Plant Industries, a division of the Mississippi Department of Agriculture and Commerce.

In areas where salinity is a concern, select nutrient sources that limit the buildup of soil salts. When manures are applied, and soil salinity is a concern, monitor salt concentrations to prevent potential plant or crop damage and reduced soil quality.

Apply manure or organic by-products on legumes at rates no greater than the LGU (MSU-ES) estimated N removal rates in harvested plant biomass, not to exceed P risk assessment limitations.

For any single application of nutrients applied as liquid (e.g., liquid manure, nutrients in irrigation water, fertigation)—

- Do not exceed the soil's infiltration rate or water holding capacity.
- Apply so that nutrients move no deeper than the current crop rooting depth.
- Avoid runoff or loss to subsurface tile drains.

Nutrient rate

Plan nutrient application rates for N, P, and K using LGU (MSU-ES) recommendations or industry practices when recognized by the LGU (MSU-ES). Lower-than-recommended nutrient application rates are permissible if the client's objectives are met.

At a minimum, determine the rate based on crop/cropping sequence, current soil test results, and NRCS-approved nutrient risk assessments. Where applicable, use realistic yield goals.

For new crops or varieties where LGU (MSU-ES) guidance is unavailable, industry-demonstrated yield and nutrient uptake information may be used.

Estimate realistic yield potentials or realistic yield goals using LGU (MSU-ES) procedures or based on historical yield or growth data, soil productivity information, climatic conditions, nutrient test results, level of management, and/or local research results considering comparable management and production conditions.

Nutrient application timing and placement

Consider the nutrient source, management and production system limitations, soil properties, weather conditions, drainage system, soil biology, and nutrient risk assessment to develop optimal timing of nutrients. For N, time the application as closely as practical with plant and crop uptake. For P, time planned surface application when runoff potential is low. Time the application of all nutrients to minimize potential for soil compaction.

For crop rotations or multiple crops grown in one year, do not apply additional P if it was already added in an amount sufficient to supply all crop nutrient needs.

To avoid salt damage, follow LGU (MSU-ES) recommendations for the timing, placement, and rate of applied N and K in starter fertilizer and must be consistent with guidelines (see publication 2647 Nutrient Management Guidelines for Agronomic Crops grown in Mississippi) or industry practice recognized by MSU-ES.

Do not surface apply nutrients when there is a risk of runoff, including when—

- Soils are frozen.
- Soils are snow-covered.
- The top 2 inches of soil are saturated.

Exceptions for the above criteria related to surface-applied nutrients when there is a risk of runoff can be made when specified conditions are met and adequate conservation measures are installed to prevent the offsite delivery of nutrients. NRCS, in cooperation with Mississippi Department of Environmental Quality authority, will define adequate treatment levels and specified conditions for applications of manure if soils are frozen and/or snow covered or the top 2 inches of soil are saturated. The adequate treatment level and specified conditions for winter applications of manure are defined by NRCS in concurrence with the Mississippi Department of Environmental Quality as follows:

- When filed slope is less than 5%
- When crops are actively growing,
- When a minimum forage height of 4 inches is maintained,
- When specifically addressed in the nutrient management plan and the amount and form of nutrients to be applied does not exceed agronomic recommendations, and
- When the buffer widths for intermittent streams and surface water bodies are increased from 50 feet to 100 feet Weather (short term)
- Areas of concentrated flow
- Organic residue and living covers
- Amount and source of nutrients to be applied
- Setback distances to protect local water quality

Additional Criteria to Minimize Agricultural Nonpoint Source Pollution of Surface and Groundwater

Apply conservation practices to avoid nutrient loss and control and trap nutrients before they can leave the field(s) by surface, leaching, or subsurface drainage (e.g., tile, karst) when there is a significant risk of transport of nutrients.

Additional Criteria to Reduce the Risk of Potential Pathogens From Manure, Biosolids, or Compost Application From Reaching Surface and Groundwater

When applicable, follow proper biosecurity measures as provided in NRCS directives GM-130, Part 403, Subpart H, “Biosecurity Preparedness and Response.”

Follow all applicable Federal, Tribal, State, and local laws and policies concerning the application of manure, biosolids, or compost in the production of fresh, edible crops.

Apply manure, biosolids, or compost with minimal soil disturbance or by injection into the soil unless it is being applied to an actively growing crop, a minimum of 30 percent residue exists, or there is a living cover that has a fibrous root system with 75 percent or more cover. Do not surface apply manure if a storm event is forecast within 24 hours.

Additional Criteria to Reduce Emissions of Objectionable Odors, PM and PM Precursors, and GHG and Ozone Precursors

To address air quality concerns caused by odor, N, sulfur, and particulate emissions; adjust the source, timing, amount, and placement of nutrients to reduce the negative impact of these emissions on the environment and human health.

Do not surface apply solid nutrient sources, including commercial fertilizers, manure, or organic by-products of similar dryness/density when there is a high probability that wind will blow the material and emissions offsite. Do not surface apply liquid nutrient sources when there is a high probability that wind will blow the liquid droplets applied from sprinklers or other applicable methods offsite.

Reduce the potential for volatilization by applying sources subject to volatilization during cooler, higher humidity conditions or by placement that minimizes vulnerability to volatilization.

Additional Criteria to Improve or Maintain Organic Matter

Design the plant or crop management systems so the soil conditioning index (SCI) organic matter subfactor is positive.

Apply manure, compost, or other organic nutrient sources at a rate and with minimal disturbance that will improve soil organic matter without exceeding acceptable risk of N or P loss.

For low residue plant or cropping systems, apply adequate nutrients to optimize plant or crop residue production to maintain or increase soil organic matter.

CONSIDERATIONS

General Considerations

Consider development of nutrient management plans by conservation management unit (CMU). A CMU is a field, group of fields, or other land units of the same land use and having similar treatment needs and planned management. A CMU is a grouping by the planner to simplify planning activities and facilitate development of conservation management systems. A CMU has definitive boundaries such as fencing, drainage, vegetation, topography, or soil lines.

Develop site-specific yield maps using a yield monitoring system, multispectral imagery or other methods. Use the data to further delineate low- and high-yield areas, or zones, and make the necessary management changes. Use variable rate nutrient application based on site-specific factor variability. See NRCS directive Agronomy Technical Note (TN) 190, AGR.3, “Precision Nutrient Management Planning.”

Use the adaptive nutrient management learning process to improve nutrient use efficiency on farms as outlined in NRCS’ national nutrient policy in GM-190, Part 402, “Nutrient Management.” Consider using an adaptive approach to adjust nutrient rate, timing, form, and placement as soil biologic functions and soil organic matter changes over time. See NRCS directive Agronomy Technical Note (TN) 190, AGR.7, “Adaptive Nutrient Management Process.”

When developing new nutrient management plans, consider using soil test information no older than 1 year rather than 2 years.

Develop a whole farm nutrient budget (nutrient mass balance), including all imported and exported nutrients. Imports may include feed, fertilizer, animals and bedding, while exports may include crop removal, animal products, animal sales, manure, and compost.

Modify animal feed diets to reduce the nutrient content of manure following guidance contained in Conservation Practice Standard (CPS) Feed Management (Code 592).

Provide a nutrient analysis of all nutrient source exports (manure or other materials).

Excessive levels of some nutrients can cause induced deficiencies of other nutrients, (e.g., high soil test P levels can result in zinc deficiency in corn).

Use soil tests, plant tissue analyses, and field observations to check for secondary plant nutrient deficiencies or toxicity that may impact plant growth or availability of the primary nutrients.

Do not apply K in situations where an excess (greater than soil test K recommendation) causes nutrient imbalances in crops or forages.

Use bioreactors and multistage drainage strategies to mitigate nutrient loss pathways, as applicable.

Use legume crops and cover crops to provide N through biological fixation. Cover crops with a carbon to nitrogen ratio below 20:1 can release a large amount of soluble N after being plowed or tilled into the soil when an actively growing crop is not present to take up nutrients, leading to increased risks of nitrate movement and nitrous oxide emissions. The nitrous oxide emissions often occur in high soil moisture conditions, such as when a legume cover crop is plowed down in fall or early spring. To avoid these losses, use grass-legume or grass-legume-forbs mixtures with a more balanced carbon to nitrogen ratio.

Use winter hardy grass cover crops to take up excess N after the cash crop growing season and promote contribution of the nitrogen to next plant or crop.

Use conservation practices that slow runoff, reduce erosion, and increase infiltration (e.g., filter strip, contour farming, or contour buffer strips).

Use application methods, timing, technologies or strategies to reduce the risk of nutrient movement or loss, such as—

- Split nutrient applications.
- Banded applications.
- Injection of nutrients below the soil surface.
- Incorporate surface-applied nutrient sources when precipitation capable of producing runoff or erosion is forecast within the time of a planned application.
- High-efficiency irrigation systems and technology.
- Enhanced efficiency fertilizers
  - Slow or controlled release fertilizers
  - Nitrification inhibitors
  - Urease inhibitors.
- Drainage water management.
- Tissue testing, chlorophyll meters, or real-time sensors.
- Pathogen management considerations.

When a recycled product (e.g., compost) is to be used as a nutrient source on food crops or as food for humans or animals, make sure that pathogen levels have been reduced to acceptable levels (reference the Food and Drug Administration’s Food Safety Modernization Act). www.fda.gov/FSMA. When the recycled product has come from another farming operation, implement biosecurity measures and evaluate the risk of pathogen transfer that could cause plant or animal diseases.

Use manure treatment systems that reduce pathogen content from manure.

Implementing a soil health management system that reduces tillage or other soil disturbance, includes a diverse rotation of crops and cover crops, keeps roots growing throughout the year, and keeps the soils covered to reduce nutrient losses, and improves—

- Nutrient use efficiency, rooting depth, and availability of nutrients.

- Soil organic matter levels.
- Availability of nutrients from organic sources.
- Aggregate stability and soil structure.
- Infiltration, drainage, and aeration of the soil profile.
- Soil biological activity.
- Water use efficiency and available moisture.

Use targeted or prescribed livestock grazing to enhance nutrient cycling and improve soil nutrient cycling functions.

Elevated soil test P levels may lead to reduced mycorrhizal fungal associations and immobilize some micronutrients, such as iron, zinc, and copper.

Apply manure, compost, or other nutrient sources with minimal soil disturbance and at a rate that will improve soil organic matter without exceeding acceptable risk of N or P loss.

PLANS AND SPECIFICATIONS

In the nutrient management plan, document—

- Aerial site photograph(s), imagery, topography, or site map(s).
- Soil survey map of the site.
- Soil information including: soil type, surface texture, drainage class, permeability, available water capacity, depth to water table, restrictive features, and flooding and ponding frequency.
- Location of designated sensitive areas and the associated nutrient application restrictions and setbacks.
- Location of nearby residences, or other locations where humans may be present on a regular basis, that may be impacted if odors or PM are transported to those locations.
- Results of approved risk assessment tools for N, P, and erosion losses.
- Documentation establishing the application site presents a low risk for P transport to local water if P is applied in excess of crop requirement.
- Current and planned plant production sequence or crop rotation.
- All available test results (e.g. soil, water, compost, manure, organic by-product, and plant tissue sample analyses) upon which the nutrient budget and management plan are based.
- When soil P levels are increasing above an agronomic level, include a discussion of the risk associated with P accumulation and a proposed P draw-down strategy.
- Realistic yield goals for the crops (where applicable for developing the nutrient management plan).
- Nutrient recommendations for N, P, and K for the entire plant production sequence or crop rotation.
- Listing, quantification, application method and timing for all nutrient sources (including all enhanced efficiency fertilizer products) that are planned for use and documentation of all nutrient imports, exports, and onsite transfers.
- Guidance for implementation, operation and maintenance, and recordkeeping.

For variable rate nutrient management plans, also include—

- Geo-referenced field boundary and data collected that was processed and analyzed as a GIS layer or layers to generate nutrient or soil amendment recommendations per management zone. Must include site-specific yield maps using soils data, current soil test results, and a yield monitoring system with GPS receiver to correlate field location with yield.
- Nutrient recommendation guidance and recommendation equations used to convert the GIS base data layer or layers to a nutrient source material recommendation GIS layer or layers.

- After implementation, provide application records per management zone or as applied map within individual field boundaries (or electronic records) documenting source, timing, method, and rate of all nutrient or soil amendment applications.

If increases in soil P levels are expected above an agronomic level (i.e., when N-based rates are used), document—

- Soil P levels at which it is desirable to convert to P-based planning.
- A long-term strategy and proposed implementation timeline for soil test P drawdown from the production and harvesting of crops.
- Management activities or techniques used to reduce the potential for P transport and loss.
- For AFOs, a quantification of manure produced in excess of crop nutrient requirements.

OPERATION AND MAINTENANCE

Review or revise plans periodically to determine if adjustments or modifications are needed. At a minimum, review and revise plans as needed with each soil test cycle, changes in manure management, volume or analysis, plants and crops, or plant and crop management.

Monitor fields receiving animal manures and biosolids for the accumulation of heavy metals and P in accordance with LGU guidance and State law.

For animal feeding operation, significant changes in animal numbers, management, and feed management will necessitate additional manure analyses to establish a revised average nutrient content.

Calibrate application equipment to ensure accurate distribution of material at planned rates. For products too dangerous to calibrate, follow LGU or equipment manufacturer guidance on proper equipment design, plumbing, and maintenance.

Document the nutrient application rate. When the applied rate differs from the planned rate, provide appropriate documentation to explain the difference.

Protect workers from and avoid unnecessary contact with nutrient sources. Take extra caution when handling anhydrous ammonia or when managing organic wastes stored in unventilated tanks, impoundments, or other enclosures.

Use material generated from cleaning nutrient application equipment in an environmentally safe manner. Collect, store, or field apply excess material in an appropriate manner.

Recycle or dispose of nutrient containers in compliance with State and local guidelines or regulations.

Maintain records for at least 5 years to document plan implementation and maintenance. Records must include—

- All test results (soil, water, compost, manure, organic by-product, and plant tissue sample analyses) upon which the nutrient management plan is based.
- Listing and quantification of all nutrient sources (including all enhanced efficiency fertilizer products) that are planned for use and documentation of all nutrient imports, exports and onsite transfers.
- Date(s), method(s), and location(s) of all nutrient applications.
- Weather conditions and soil moisture at the time of application, elapsed time from manure application to rainfall or irrigation event(s).
- Plants and crops planted, planting and harvest dates, yields, nutrient analyses of harvested biomass, and plant or crop residues removed.
- Dates of plan review, name of reviewer, and recommended adjustments resulting from the review.

For variable rate nutrient management plans, also include—

- Maps identifying the variable application location, source, timing, amount, and placement of all plant and crop nutrients applied.
- GPS-based yield maps for crops where yields can be digitally collected.

REFERENCES

APEX Model to Determine Water Quality Assessments in Agricultural Fields in the Mississippi Delta. Mississippi State University GRI.

Association of American Plant Food Control Officials (AAPFCO). 2017. AAPFCO Official Publication no. 70. AAPFCO Inc., Little Rock, AR.

Follett, R.F. 2001. Nitrogen transformation and transport processes. In Nitrogen in the environment; sources, problems, and solutions, (eds.) R.F. Follett and J. Hatfield, pp. 17–44. Elsevier Science Publishers. The Netherlands. 520 pp.

Oldham, L. 2012, Nutrient Management Guidelines for Agronomic Crops Grown in Mississippi. pub. 2647, Mississippi State University, Mississippi State, MS.

Schepers, J.S., and W.R. Ruan, (eds.) 2008. Nitrogen in agricultural systems. Agron. Monogr. no. 49, American Society of Agronomy (ASA), Crop Science Society of America (CSSA), Soil Science Society of America (SSSA). Madison, WI.

Sims, J.T. (ed.) 2005. Phosphorus: Agriculture and the environment. Agron. Monogr. no. 46. ASA, CSSA, and SSSA, Madison, WI.

Stevenson, F.J. (ed.) 1982. Nitrogen in agricultural soils. Agron. Series 22. ASA, CSSA, and SSSA, Madison, WI.

USDA, NRCS. Agronomy Technical Note 3, Precision Nutrient Management Planning. 2010. Washington, DC. NRCS eDirectives under Technical Notes, Title 190 https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1043477.pdf?msclkid=2dd25accd14911eca69212f9a9092013.

USDA, NRCS. Agronomy Technical Note 7, Adaptive Nutrient Management Process. 2013. Washington, DC. NRCS eDirectives under Technical Notes, Title 190 https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=34196.wba.

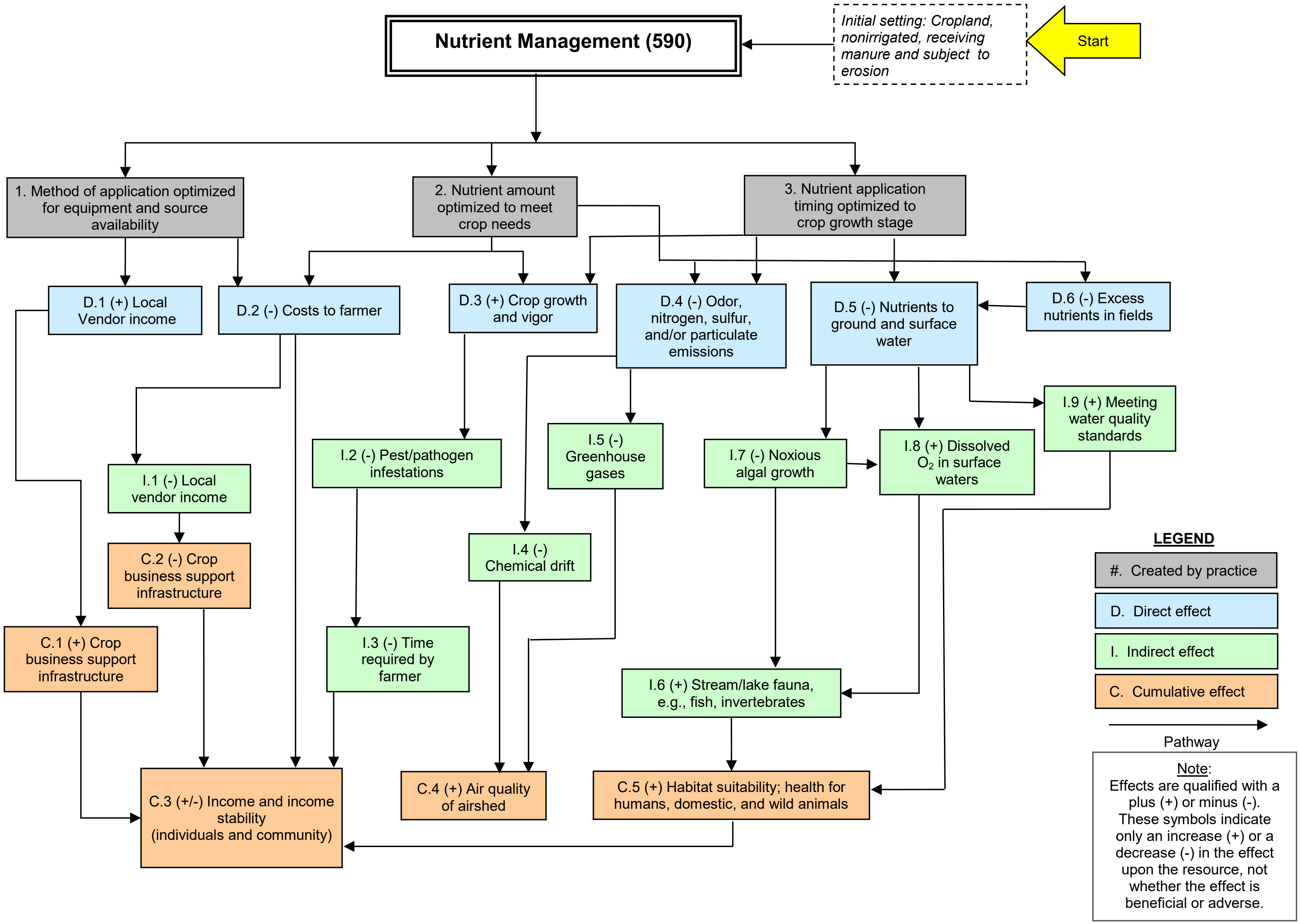
USDA, NRCS. Nutrient Management Technical Note 7, Reducing Risk of E. coli O157:H7. 2007. Washington, DC. NRCS eDirectives under Technical Notes, Title 190 https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1044367.pdf#:~:text=Nutrient%20Management%20Technical%20Note%20No.%207%20September%2C%202007,the%20contamination%20of%20foodstuffs%20with%20E.%20coli%20O157%3AH7.?msclkid=7d8a3214d14911eca58033b733b91ce5 .

USDA, NRCS. Title 190, General Manual, (GM), Part 402, Nutrient Management. 2011. Washington, DC. NRCS eDirectives under General Manual, Title 190 https://directives.sc.egov.usda.gov/viewerFS.aspx?hid=27119&msclkid=d2591b54d14911ec8a8cc5e2edca70d5.

USDA, NRCS. Title 190, National Instruction (NI), Part 313, Nutrient Management Policy Implementation. 2017. Washington, DC. NRCS eDirectives under National Instruction, Title 190 https://directives.sc.egov.usda.gov/OpenNonWebContent.aspx?content=40478.wba .

NRCS CONSERVATION PRACTICE EFFECTS - NETWORK DIAGRAM

May 2019



Effects of NRCS Conservation Practices - National

Nutrient Management

Managing the amount (rate), source, placement (method of application), and timing of plant nutrients and soil amendments.

Code: 590
Units: ac.

C-Crop	F-Forest	R-Range	P-Pasture	Pr-Protected	FS-Farmstead	D-Developed	W-Water	O-Other	AL-Aso Land
C	F	R	P	Pr	FS	D		O	AL

Typical Landuse: C F R P Pr FS D O AL

Soil Erosion	Effect	Rationale
Soil Erosion - Sheet and Rill Erosion	0	Soil disturbance to incorporate fertilizer loosens the soil and buries surface residue which can increase erosion. Other application methods do not contribute to erosion.
Soil Erosion - Wind Erosion	0	Soil disturbance to incorporate fertilizer loosens the soil and buries surface residue which can increase erosion. Other application methods do not contribute to erosion.
Soil Erosion - Ephemeral Gully Erosion	0	Soil disturbance to incorporate fertilizer loosens the soil and buries surface residue which can increase erosion. Other application methods do not contribute to erosion.
Soil Erosion - Classic Gully Erosion	0	Not Applicable
Soil Erosion - Streambank, Shoreline, Water Conveyance C	0	Not Applicable
Soil Quality Degradation		
Organic Matter Depletion	2	Management of pH and applying sufficient nutrients will maintain or enhance biomass production
Compaction	-2	Field operations on moist soils cause soil compaction.
Subsidence	0	Not Applicable
Concentration of Salts or Other Chemicals	2	Matching plant requirements with nutrient applications decreases excess nutrient conditions and reduces salts and other contaminants
Excess Water		
Excess Water - Seeps	0	Not Applicable
Excess Water - Runoff, Flooding, or Ponding	0	Not Applicable
Excess Water - Seasonal High Water Table	0	Not Applicable
Excess Water - Drifted Snow	0	Not Applicable
Insufficient Water		
Insufficient Water - Inefficient Use of Irrigation Water	0	Excess nitrogen promotes shoot growth in relation to root growth.
Insufficient Water - Inefficient Moisture Management	0	Excess nitrogen promotes shoot growth in relation to root growth.
Water Quality Degradation		
Pesticides in Surface Water	0	Not Applicable
Pesticides in Groundwater	0	Not Applicable
Nutrients in Surface water	5	Right: Amount, source, placement, and timing (4R) provides nutrients when plants need them most.
Nutrients in Groundwater	5	The amount and timing of nutrient application are balanced with plant needs.
Salts in Surface Water	1	Proper nutrient application should reduce salinity if nutrient source contains salts.
Salts in Groundwater	1	Proper nutrient application should reduce salinity if nutrient source contains salts.
Excess Pathogens and Chemicals from Manure, Bio-solic	1	Decrease application of pathogens if nutrient source contains pathogens.
Excess Pathogens and Chemicals from Manure, Bio-solic	1	The action limits the amount of manure that can be applied thus preventing harmful levels of pathogens.

Excessive Sediment in Surface Water	0	Proper nutrient application will minimize losses due to runoff.
Elevated Water Temperature	0	Not Applicable
Petroleum, Heavy Metals and Other Pollutants Transporte	2	Changing pH will alter the solubility of metals. The action will reduce the application rate of heavy metals if required.
Petroleum, Heavy Metals and Other Pollutants Transporte	2	Management of pH will alter the solubility of metals. The action will reduce the application rate of heavy metals, if required
Air Quality Impacts		
Emissions of Particulate Matter (PM) and PM Precursors	3	The proper application of nitrogen can greatly reduce ammonia emissions. Proper application techniques can also reduce particulate emissions from solid manure and fertilizers.
Emissions of Ozone Precursors	2	The proper application of nitrogen can reduce NOx emissions. Proper application techniques can also reduce VOC emissions from manure.
Emissions of Greenhouse Gases (GHGs)	4	Management of nutrients optimizes the storage of soil carbon. The propoer application of nitrogen can reduce emissions of nitrous oxide.
Objectionable Odors	4	The proper application of nitrogen can reduce ammonia emissions. Proper application techniques can also reduce emissions of VOCs and other odorous compounds from manure.
Degraded Plant Condition		
Undesirable Plant Productivity and Health	2	Nutrients and soil amendments are optimized to enhance health and vigor of desired species.
Inadequate Structure and Composition	2	Nutrients and soil amendments are optimized to enhance suited and desired species.
Excessive Plant Pest Pressure	0	Not Applicable
Wildfire Hazard, Excessive Biomass Accumulation	0	Not Applicable
Fish and Wildlife - Inadequate Habitat		
Inadequate Habitat - Food	1	Management enhances production of any food species planted.
Inadequate Habitat - Cover/Shelter	1	Management enhances cover/shelter conditions.
Inadequate Habitat - Water	0	Not Applicable
Inadequate Habitat - Habitat Continuity (Space)	0	Not Applicable
Livestock Production Limitation		
Inadequate Feed and Forage	4	Nutrients are managed to ensure optimal production and nutritive value of the forage used by livestock.
Inadequate Shelter	0	Not Applicable
Inadequate Water	2	Management improves livestock water quality.
Inefficient Energy Use		
Equipment and Facilities	0	Not Applicable
Farming/Ranching Practices and Field Operations	0	Not Applicable

CPPE Practice Effects:	*0 No Effect*
5 Substantial Improvement	*-1 Slight Worsening*
4 Moderate to Substantial Improvement	*-2 Slight to Moderate Worsening*
3 Moderate Improvement	*-3 Moderate Worsening*
2 Slight to Moderate Improvement	*-4 Moderate to Substantial Worsening*
1 Slight Improvement	*-5 Substantial Worsening*

Appendix B
Nutrient Reduction Environmental Evaluation Worksheets

MS TIG RP4/EA Environmental Evaluation Worksheet for Back Bay-Biloxi Davis Bayou Nutrient Reduction[1]

A. Proposed Actions and Affected Habitat Types (Describe restoration measures and management activities proposed on the project site.)

Describe the Need for Action for the project area:

Click here to enter text.

Discuss alternatives considered (No Action, Alternative 1, Alternative 2):

Click here to enter text.

Describe restoration measures, management activities, and USDA Conservation Practices proposed on the project site:

Click here to enter text.

1. Resource Concerns

Analyze and record the existing conditions for each identified concern, and describe the effects/impacts of identified alternatives:

Resource Concerns	**No Action** (*Describe both short- and long-term impacts*)	**Alternative 1** (*Describe both short- and long-term impacts*)	**Alternative 2** (*Describe both short- and long-term impacts*)
Soil: Erosion Click here to enter text.	Click here to enter text.	Click here to enter text.	Click here to enter text.
Water: Excess / Insufficient Water Click here to enter text.	Click here to enter text.	Click here to enter text.	Click here to enter text.
Water: Water Quality Degradation Click here to enter text.	Click here to enter text.	Click here to enter text.	Click here to enter text.

[1] The MS TIG has developed the Environmental Evaluation Worksheet in order to facilitate NEPA review of site-specific restoration measures and management activities as they are identified in the future. The Trustees may improve/revise the Environmental Evaluation Worksheet with future usage.

Resource Concerns	**No Action** (*Describe both short- and long-term impacts*)	**Alternative 1** (*Describe both short- and long-term impacts*)	**Alternative 2** (*Describe both short- and long-term impacts*)
Plants: Degraded Plant Conditions Click here to enter text.	Click here to enter text.	Click here to enter text.	Click here to enter text.
Animals: Inadequate Habitat for Fish and Wildlife Click here to enter text.	Click here to enter text.	Click here to enter text.	Click here to enter text.
Human: Economic and Social Considerations Click here to enter text.	Click here to enter text.	Click here to enter text.	Click here to enter text.

2. Best Practices

   a. Which of the applicable Best Practices listed in the Final MS TIG RP4/EA will be followed? List them here and provide detailed analysis in Attachment A.
   Click here to enter text.

   b. Identify any Best Practices or other mitigation measures not included in the Final RP4/EA that will be implemented, including those associated with consultations and required permits:
   Click here to enter text.

B. Permits and Consultations

Authorization	Authorization Name/Number	Date Issued/Anticipated	Notes
CWA Section 404	Click here to enter text.	Click here to enter text.	Click here to enter text.
RHA Section 10	Click here to enter text.	Click here to enter text.	Click here to enter text.
Mississippi Department of Marine Resources	Click here to enter text.	Click here to enter text.	Click here to enter text.

Authorization	Authorization Name/Number	Date Issued/Anticipated	Notes
Coastal Wetlands Authorization			
CWA Section 401-Water Quality Certification	Click here to enter text.	Click here to enter text.	Click here to enter text.

1. ESA

   a. Identify ESA-protected species and/or designated critical habitat on the parcel where work will be performed:
      Click here to enter text.

   b. Were all ESA-protected species and/or designated critical habitat, as well as the actions being proposed and their potential effects to protected species and/or critical habitat included in the Final RP4/EA and consultation(s) or a subsequent consultation(s)? (Check one)
      i. ☐Yes. Insert date consultation completed: Click here to enter text.
      ii. ☐No. Consult with the MS TIG to determine if additional consultations are needed prior to approval to proceed.

   c. Will the applicable best practices and/or conservation measures be followed for all protected species and designated critical habitat that would be affected by the proposed action (Attachment A and Section A.2)?
      i. ☐Yes. Go to the next question.
      ii. ☐No. Consult with the MS TIG to determine if additional consultation(s) are needed prior to approval to proceed.

2. NHPA

   Is the proposed action an undertaking with potential for adverse effects on resources protected by NHPA as determined by a qualified cultural resource specialist? (Check one)

   a. ☐No. Go to the next question.
   b. ☐Yes. Consult with the MS TIG to determine if additional consultation(s) will be needed prior to approval to proceed.

C. Environmental Impacts

Will the proposed restoration measures and management activities, when implemented with appropriate Best Practices, result in adverse effects to the ***physical, biological, or socioeconomic environment*** that are less than or equal to the adverse effects identified in the Final RP4/EA?

(Check one)

1. ☐Yes.
2. ☐No. Notify the TIG of the before taking further action.

D. Finding (select one)

1. ☐ The proposed actions and anticipated effects fall within scope of the Final MS TIG RP4/EA and no further analysis is required.
2. ☐ The proposed actions and anticipated effects may not fall within the scope of the Final MS TIG RP4/EA and additional analysis may be required.

To the best of my knowledge, the information above is accurate and complete:

Click here to enter text.	Click here to enter text.
Name (Planner(s) Name/Signature)	Date

Submitted to Federal representative of MS TIG for review and concurrence on (Date:) Click here to enter text.

☐MS TIG Federal representative finds no further NEPA analysis is necessary.

☐MS TIG Federal representative finds additional NEPA analysis is necessary.

Click here to enter text.	Click here to enter text.
Signature (Federal representative(s) of the MS TIG)	Date

Attachment A

BEST PRACTICES

Physical Resources

Geology and Substrates

- Click here to enter text.

Hydrology and Water Quality

- Click here to enter text.

Biological Resources

Habitats, Wildlife, and Marine and Estuarine Resources

- Prior to bringing any equipment (including personal gear, machinery, vehicles, or vessels) to the work site, inspect each item for mud or soil, seeds, and vegetation. If present, clean the equipment, vehicles, or personal gear until they are free from mud, soil, seeds, and vegetation.
- Inspect the equipment, vehicles, and personal gear each time they are being prepared to go to a site or prior to transferring between sites to avoid spreading exotic, nuisance species.
- Click here to enter text.

Rare and Protected Species

- Click here to enter text.

Federally Managed Fisheries

- Click here to enter text.

Socioeconomic Resources

Cultural Resources

- Click here to enter text.

Tourism and Recreation

- Click here to enter text.

Aesthetics and Visual Resources

- Click here to enter text.

U.S. Department of Agriculture Natural Resources Conservation Service	NRCS-CPA-52 4/2013	A. Client Name:
ENVIRONMENTAL EVALUATION WORKSHEET		**B. Conservation Plan ID #** (as applicable): **Program Authority** (optional):
D. Client's Objective(s) (purpose):		**C. Identification #** (farm, tract, field #, etc. as required):

E. Need for Action:	**H. Alternatives**		
	No Action √ if RMS ☐	***Alternative 1*** √ if RMS ☐	***Alternative 2*** √ if RMS ☐

Resource Concerns

In Section "F" below, analyze, record, and address concerns identified through the Resources Inventory process.
(See FOTG Section III - Resource Planning Criteria for guidance).

F. Resource Concerns and Existing/ Benchmark Conditions (Analyze and record the existing/benchmark conditions for each identified concern)	**I. Effects of Alternatives**					
	No Action		***Alternative 1***		***Alternative 2***	
	Amount, Status, Description *(Document both short and long term impacts)*	**√ if does NOT meet PC**	**Amount, Status, Description** *(Document both short and long term impacts)*	**√ if does NOT meet PC**	**Amount, Status, Description** *(Document both short and long term impacts)*	**√ if does NOT meet PC**
SOIL: *EROSION*						
		☐ NOT meet PC		☐ NOT meet PC		☐ NOT meet PC
		☐ NOT meet PC		☐ NOT meet PC		☐ NOT meet PC
SOIL: *SOIL QUALITY DEGRADATION*						
		☐ NOT meet PC		☐ NOT meet PC		☐ NOT meet PC
		☐ NOT meet PC		☐ NOT meet PC		☐ NOT meet PC
WATER: *EXCESS / INSUFFICIENT WATER*						
		☐ NOT meet PC		☐ NOT meet PC		☐ NOT meet PC
WATER: *WATER QUALITY DEGRADATION*						
		☐ NOT meet PC		☐ NOT meet PC		☐ NOT meet PC
		☐ NOT meet PC		☐ NOT meet PC		☐ NOT meet PC

F. Resource Concerns and Existing/ Benchmark Conditions (Analyze and record the existing/benchmark conditions for each identified concern)	I. (continued)					
	No Action		*Alternative 1*		*Alternative 2*	
	Amount, Status, Description *(Document both short and long term impacts)*	**√ if does NOT meet PC**	**Amount, Status, Description** *(Document both short and long term impacts)*	**√ if does NOT meet PC**	**Amount, Status, Description** *(Document both short and long term impacts)*	**√ if does NOT meet PC**
AIR: *AIR QUALITY IMPACTS*						
		☐ NOT meet PC		☐ NOT meet PC		☐ NOT meet PC
		☐ NOT meet PC		☐ NOT meet PC		☐ NOT meet PC
PLANTS: *DEGRADED PLANT CONDITION*						
		☐ NOT meet PC		☐ NOT meet PC		☐ NOT meet PC
		☐ NOT meet PC		☐ NOT meet PC		☐ NOT meet PC
ANIMALS: *INADEQUATE HABITAT FOR FISH AND WILDLIFE*						
		☐ NOT meet PC		☐ NOT meet PC		☐ NOT meet PC
ANIMALS: *LIVESTOCK PRODUCTION LIMITATION*						
		☐ NOT meet PC		☐ NOT meet PC		☐ NOT meet PC
		☐ NOT meet PC		☐ NOT meet PC		☐ NOT meet PC
ENERGY: *INEFFICIENT ENERGY USE*						
		☐ NOT meet PC		☐ NOT meet PC		☐ NOT meet PC
		☐ NOT meet PC		☐ NOT meet PC		☐ NOT meet PC
HUMAN: *ECONOMIC AND SOCIAL CONSIDERATIONS*						

Special Environmental Concerns: Environmental Laws, Executive Orders, policies, etc.

In Section "G" complete and attach Environmental Procedures Guide Sheets for documentation as applicable. Items with a "●" may require a federal permit or consultation/coordination between the lead agency and another government agency. In these cases, effects may need to be determined in consultation with another agency. Planning and practice implementation may proceed for practices not involved in consultation.

G. Special Environmental Concerns (Document existing/ benchmark conditions)	**J. Impacts to Special Environmental Concerns**					
	No Action		***Alternative 1***		***Alternative 2***	
	Document all impacts (Attach Guide Sheets as applicable)	√ if needs further action	Document all impacts (Attach Guide Sheets as applicable)	√ if needs further action	Document all impacts (Attach Guide Sheets as applicable)	√ if needs further action
●Clean Air Act *Guide Sheet* *FS1* *FS-2*		☐		☐		☐
●Clean Water Act / Waters of the U.S. *Guide Sheet* *Fact Sheet*		☐		☐		☐
●Coastal Zone Management *Guide Sheet* *Fact Sheet*		☐		☐		☐
Coral Reefs *Guide Sheet* *Fact Sheet*		☐		☐		☐
●Cultural Resources / Historic Properties *Guide Sheet* *Fact Sheet*		☐		☐		☐
●Endangered and Threatened Species *Guide Sheet* *Fact Sheet*		☐		☐		☐
Environmental Justice *Guide Sheet* *Fact Sheet*		☐		☐		☐
●Essential Fish Habitat *Guide Sheet* *Fact Sheet*		☐		☐		☐
Floodplain Management *Guide Sheet* *Fact Sheet*		☐		☐		☐
Invasive Species *Guide Sheet* *Fact Sheet*		☐		☐		☐
●Migratory Birds/Bald and Golden Eagle Protection Act *Guide Sheet* *Fact Sheet*		☐		☐		☐
Natural Areas *Guide Sheet* *Fact Sheet*		☐		☐		☐
Prime and Unique Farmlands *Guide Sheet* *Fact Sheet*		☐		☐		☐
Riparian Area *Guide Sheet* *Fact Sheet*		☐		☐		☐
Scenic Beauty *Guide Sheet* *Fact Sheet*		☐		☐		☐

•Wetlands *Guide Sheet* *Fact Sheet*		☐		☐		☐
•Wild and Scenic Rivers *Guide Sheet* *Fact Sheet*		☐		☐		☐

K. Other Agencies and Broad Public Concerns		***No Action***	***Alternative 1***	***Alternative 2***
Easements, Permissions, Public Review, or Permits Required and Agencies Consulted.				
Cumulative Effects Narrative (Describe the cumulative impacts considered, including past, present and known future actions regardless of who performed the actions)				
L. Mitigation (Record actions to avoid, minimize, and compensate)				
M. Preferred Alternative	√ preferred alternative	☐	☐	☐
	Supporting reason			

N. Context (Record context of alternatives analysis)

The significance of an action must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality.

O. Determination of Significance or Extraordinary Circumstances

Intensity: Refers to the severity of impact. Impacts may be both beneficial and adverse. A significant effect may exist even if the Federal agency believes that on balance the effect will be beneficial. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts.

If you answer ANY of the below questions "yes" then contact the State Environmental Liaison as there may be extraordinary circumstances and significance issues to consider and a site specific NEPA analysis may be required.

Yes	No	
☐	☐	• Is the preferred alternative expected to cause significant effects on public health or safety?
☐	☐	• Is the preferred alternative expected to significantly affect unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas?
☐	☐	• Are the effects of the preferred alternative on the quality of the human environment likely to be highly controversial?
☐	☐	• Does the preferred alternative have highly uncertain effects or involve unique or unknown risks on the human environment?
☐	☐	• Does the preferred alternative establish a precedent for future actions with significant impacts or represent a decision in principle about a future consideration?
☐	☐	• Is the preferred alternative known or reasonably expected to have potentially significant environment impacts to the quality of the human environment either individually or cumulatively over time?
☐	☐	• Will the preferred alternative likely have a significant adverse effect on ANY of the special environmental concerns? Use the Evaluation Procedure Guide Sheets to assist in this determination. This includes, but is not limited to, concerns such as cultural or historical resources, endangered and threatened species, environmental justice, wetlands, floodplains, coastal zones, coral reefs, essential fish habitat, wild and scenic rivers, clean air, riparian areas, natural areas, and invasive species.
☐	☐	• Will the preferred alternative threaten a violation of Federal, State, or local law or requirements for the protection of the environment?

P. To the best of my knowledge, the data shown on this form is accurate and complete:

In the case where a non-NRCS person (e.g. another MS TIG Trustee) assists with planning they are to sign the first signature block and then NRCS is to sign the second block to verify the information's accuracy.

Signature (TSP if applicable)	**Title**	**Date**
Signature (NRCS)	**Title**	**Date**

If preferred alternative is not a federal action where NRCS has control or responsibility and this NRCS-CPA-52 is shared with someone other than the client then indicate to whom this is being provided.

The following sections are to be completed by the Responsible Federal Official (RFO)

NRCS is the RFO if the action is lead federal agency for NRDA-funded actions planned by NRCS.

Q. NEPA Compliance Finding (check one)

The preferred alternative:		**Action required**
☐	1) is a federal action that has been sufficiently analyzed in an existing NEPA document to which this environmental evaluation is tiered because the expected effects are within the range of those described in the applicable NEPA document and there are no predicted significant adverse environmental effects or extraordinary circumstances.	Document in "R.1" below. No additional analysis is required.
☐	2) is a federal action that has **NOT** been sufficiently analyzed or may involve predicted significant adverse environmental effects or extraordinary circumstances and may require an EA or EIS.	Contact the State Environmental Liaison. Further NEPA analysis required.

R. Rationale Supporting the Finding

R.1 Findings Documentation	

I have considered the effects of the alternatives on the Resource Concerns, Economic and Social Considerations, Special Environmental Concerns, and Extraordinary Circumstances as defined by Agency regulation and policy and based on that made the finding indicated above.

S. Signature of Responsible Federal Official:

Signature	**Title**	**Date**

Additional notes

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Appendix C
Monitoring and Adaptive Management Plans

WCNH1 Coastwide Habitat Acquisition Project: Monitoring and Adaptive Management Plan

Table of Contents

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring needed to evaluate progress toward meeting project objectives and to support adaptive management of the restoration project, as needed. Where applicable, it identifies key sources of uncertainty and incorporates monitoring data and decision points that address these uncertainties. As not all projects would have the same sources and degree of uncertainty, this project-specific MAM plan is scaled according to level of uncertainty, scope, scale, and Restoration Type associated with this project.

This MAM plan is a living document and may be updated as needed to reflect changing conditions and/or new information. Any future revisions to this document would be made publicly available through the DIVER Portal (https://www.diver.orr.noaa.gov/web/guest/home) and accessible through the Trustee Council's website (https://www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

The project is being implemented to restore Wetland, Coastal, and Nearshore Habitats injured by the Deepwater Horizon (DWH) oil spill, consistent with the Programmatic Damage Assessment and Restoration Plan and Programmatic Environmental Impact Statement (PDARP/PEIS).

- Programmatic Goal: Restore and Conserve Habitat

- Restoration Type: Wetlands, Coastal, and Nearshore Habitats
- Restoration Approach: Protect and Conserve Marine, Coastal, Estuarine, and Riparian Habitats
- Restoration Technique: Acquire Land for Conservation
- TIG: Mississippi Trustee Implementation Group (MS TIG)
- Restoration Plan: Mississippi Trustee Implementation Group Restoration Plan 4

The project would acquire land in coastal areas (Hancock, Harrison and Jackson counties) for conservation that has high ecological value and/or 2) where wetlands, coastal, and nearshore habitat creation, restoration, and preservation projects could be implemented in future restoration actions (for example, lands adjacent to coastal bays and estuaries). Conserving and protecting land parcels via acquisition can protect wetlands and other significant coastal, estuarine, riverine and riparian habitats; create connections between protected areas and remove direct threats of development. Once acquired, parcels would be conserved, complementing and advancing the goals of coastal management, habitat conservation, and applicable plans. In addition, parcels may be sites for future restoration activities not currently a part of this project budget (e.g., habitat management, installation of living shorelines, intertidal and subtidal oyster reef restoration, hydrologic connectivity projects, and/or expansion/enhancement of marsh habitat using beneficial use materials).

1.2 Restoration Type Goals and Project Restoration Objectives

The overall goal for this Restoration Type relevant to this project, as identified in the PDARP/PEIS, is:

- **Goal 1**: Restore and conserve coastal habitat in Mississippi through the purchase of lands for conservation.

The project restoration objective is:

- **Objective 1:** Acquisition and conservation of up to 3,000 acres of coastal habitat to complement and advance the goals of coastal management, habitat conservation, and other applicable plans.

Performance criteria would be used to determine restoration success or the need for corrective action in accordance with 15 Code of Federal Records 990.55(b)(1)(vii)). Specific, measurable performance criteria are defined, as applicable, for monitoring parameters associated with each of the restoration objectives in Section 3.0.

2.0 Adaptive Management

To increase the likelihood of achieving the project objective, the Mississippi Department of Environmental Quality (MDEQ) will conduct targeted monitoring and use the monitoring data to refine, as necessary, future management actions. During the due diligence period, MDEQ will attempt to cure any defects which may arise in order to complete the acquisition.

3.0 Project Monitoring, Performance Criteria, and Potential Corrective Actions

The monitoring plan for this restoration project was developed to evaluate project performance, key uncertainties, and potential corrective actions, if needed.

Information on each monitoring parameter is provided below and is organized by objective. The list of corrective actions provided below is not exhaustive; rather, it includes a list of potential actions to be considered if the project is not performing as expected once implemented. Other corrective actions may be identified post-implementation, as appropriate.

- **Objective 1**: Acquisition and conservation of up to 3,000 acres of coastal habitat to complement and advance the goals of coastal management, habitat conservation, and other applicable plans.

Table 3-1 Monitoring Parameters

Monitoring Parameter	Purpose	Method	Timing, Frequency, Duration	Sample Size and Sites	Performance Criteria	Potential Corrective Action(s)
Area	Performance criterion	Acreage listed in acquisition documents	Deeds will be recorded at the time of closing.	N/A	Up to 3,000 acres depending on habitat type and project budget	N/A

4.0 Monitoring Schedule

The schedule for project performance monitoring is shown in Table 4-1 by monitoring parameter.

Table 4-1 Monitoring Schedule

Monitoring Parameters	Years 1-10
Area	x

5.0 Evaluation

The MS TIG anticipates conducting an evaluation of the monitoring data collected (as described above) to help answer the following questions:

- Were the project restoration objectives achieved? If not, is there a reason why they were not met?
- Were there unanticipated events unrelated to the restoration project that potentially affected the monitoring results (e.g., hurricanes)?

6.0 Data Management

6.1 Data Description

Data will be compiled within 12 months after collection. To the extent practicable, data generated during monitoring activities would be documented using standardized field datasheets. If standardized datasheets are unavailable, then project-specific datasheets would be drafted prior to conducting any project monitoring activities. Original datasheets, notebooks and photographs will be retained by MDEQ in accordance with MDEQ record retention policy.

Relevant project data that are handwritten on hardcopy datasheets or notebooks would be transcribed (entered) into standard digital format as appropriate per protocols developed by MDEQ. Electronic data files should be named with the date on which the file was created and should include a ReadMe file that describes when the file was created and by whom and any explanatory notes on the file contents. If a data file is revised, a new copy should be made and the original preserved.

As appropriate, all data will have properly documented Federal Geographic Data Committee/International Organization for Standardization (FGDC/ISO) metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data was collected, Quality Assurance/Quality Control (QA/QC) procedures, other information about data such as meaning, relationships to other data, origin, usage, and format).

6.2 Data Review and Clearance

6.3 N/A

6.4 Data Storage and Accessibility

Once all data has been QA/QC'ed it will be stored on MDEQ servers. MDEQ will provide DWH NRDA MAM data and information to DIVER as soon as possible and no more than 1 year from when data are collected.

6.5 Data Sharing

Data will be made publicly available, in accordance with the Open, Public, Electronic and Necessary Government Data Act of 2019, through the DIVER Explorer Interface within 1 year of when the data collection occurred.

7.0 Reporting

All reporting will occur after field surveys are completed annually. This report will summarize the findings for the sampling period including all worksheets transferred into digital format and presented in tabular and graphical formats. The data should be summarized in such a way that it is meaningful to the reader. Additionally, an annual report would be completed that includes:

- Summary data –synthesized data for all efforts during the year.
- Graphics, if applicable, and associated interpretations of the data.
- Comparisons of pre- and post-project conditions, as applicable.
- Any uncertainties with management actions.
- Potential data collection issues.
- Reporting on general MAM activities in the DIVER Restoration Portal on an annual basis.
- Developing a Final MAM Report before a project is closed out.

8.0 Roles and Responsibilities

The MS TIG is responsible for addressing MAM objectives that pertain to their restoration activities and for communicating information to the public through DIVER. The Implementing Trustee for the project is MDEQ. MDEQ's roles include coordination with the MS TIG to track project progress, program management and oversight, monitoring oversight, data management, and reporting.

WCNH2 Living Shoreline Bulkhead Alternative Project: Monitoring and Adaptive Management Plan

Table of Contents

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring needed to evaluate progress toward meeting project objectives and to support adaptive management of the restoration project, as needed. Where applicable, it identifies key sources of uncertainty and incorporates monitoring data and decision points that address these uncertainties. As not all projects would have the same sources and degree of uncertainty, this project-specific MAM plan is scaled according to level of uncertainty, scope, scale, and Restoration Type associated with this project.

This MAM plan is a living document and may be updated as needed to reflect changing conditions and/or new information. Any future revisions to this document would be made publicly available through the DIVER Portal (https://www.diver.orr.noaa.gov/web/guest/home) and accessible through the Trustee Council's website (https://www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

The project is being implemented to restore Wetland, Coastal, and Nearshore Habitats injured by the Deepwater Horizon (DWH) oil spill, consistent with the Programmatic Damage Assessment and Restoration Plan and Programmatic Environmental Impact Statement (PDARP/PEIS).

- Programmatic Goal: Restore and Conserve Habitat
- Restoration Type: Wetlands, Coastal, and Nearshore Habitats
- Restoration Approach: Create, Restore, and Enhance Coastal Wetlands

- Restoration Technique: Construct Breakwaters
- TIG: Mississippi Trustee Implementation Group (MS TIG)
- Restoration Plan: Mississippi Trustee Implementation Group Restoration Plan 4

The project would construct small-scale living shorelines that would reduce shoreline erosion and incorporate vegetation or other living, natural "soft" elements alone or in combination with some type of harder shoreline structure (e.g., oyster or mussel reefs or rock sills) for added protection and stability. Projects would be located adjacent to properties with public access to view as demonstration projects.

1.2 Restoration Type Goals and Project Restoration Objectives

The overall goal for this Restoration Type relevant to this project, as identified in the PDARP/PEIS, is:

- **Goal 1**: Reduce rate of shoreline erosion

The project restoration objective is:

- **Objective 1**: Construct up to three living shorelines to reduce shoreline erosion, in locations adjacent to properties with public shoreline access to view as demonstration project.

Performance criteria would be used to determine restoration success or the need for corrective action in accordance with 15 Code of Federal Records 990.55(b)(1)(vii)). Specific, measurable performance criteria are defined, as applicable, for monitoring parameters associated with each of the restoration objectives in Section 3.0.

2.0 Adaptive Management

To increase the likelihood of achieving the project objective, the Mississippi Department of Environmental Quality (MDEQ) will conduct targeted monitoring and use the monitoring data to refine, as necessary, future management actions.

3.0 Project Monitoring, Performance Criteria, and Potential Corrective Actions

The monitoring plan for this restoration project was developed to evaluate project performance, key uncertainties, and potential corrective actions, if needed. Information on each monitoring parameter is provided below and is organized by objective. The list of corrective actions provided below is not exhaustive; rather, it includes a list of potential actions to be considered if the project is not performing as expected once implemented. Other corrective actions maybe identified post-implementation, as appropriate. Project monitoring, performance criteria, and potential corrective actions are summarized in Tables 1 and 2 below.

- **Objective 1**: Reduce rate of shoreline erosion

Table 3-1 Monitoring Parameters

Monitoring Parameter	Purpose	Method	Timing, Frequency, Duration	Sample Size and Sites	Performance Criteria	Potential Corrective Action(s)
Structural integrity - Constructed as designed	Performance Criterion	Acceptance of project by engineer of record	Year 0 (completion of construction)	One	Project was constructed as designed	Resolution with contractor such that the terms of the contract are met
Structural integrity observations	Additional Monitoring	Conduct visual observations and take pictures of the project site from a boat or shoreline, or during an aerial survey.	Post-construction (Opportunely, for example if the project site is directly impacted by a major storm.)	Qualitative observations along entire length of reef structure, done at least annually during shoreline position surveys	N/A Additional Monitoring	N/A Additional Monitoring
Area- Project Footprint	Performance Criterion	*Any or all of these methods could be used in addition, other methodologies, not included here, could be identified as monitoring protocols are finalized. Method 1: Shoreline Vectors; Method 2: Pedestrian/ GPS Surveys; Method 3: Permanent Base Locations; See descriptions below	Post-construction (Year 5)	One	Over the 5-year monitoring period, the total living shoreline footprint is project area footprint is ≥ 80% of year 0 (as-built).	Add material to existing living shoreline as budget allows
Shoreline Position	Performance Criterion	See Area- Project Footprint Methodologies	Pre-construction (once); Post-construction (Year 5); or if the project site is impacted by a major storm.	To be determined with development of projects	Over the 5-year monitoring period, the median loss is less than pre-construction erosion rates.	Add material to living shorelines as budget allows.

*Method #1-Shoreline Vectors: Shoreline vectors would be derived from acquired topographic/aerial imagery data utilizing a drone or similar technology and would be referenced to vertical and horizontal datums so that accurate measurements can be made using spatial software. Shoreline data between years will be analyzed by calculating linear distance between derived position data.
Method #2-Pedestrian/GPS surveys: Walk the marsh edge and take continuous readings with a differential GPS. Marsh edge is defined as the lower/seaward extent of the emergent marsh vegetation. Import and analyze data using spatial analysis software. Determine shoreline loss/gain in meters per year. Potential method described by Steyer et al. (1995 revised 2000) and Baggett et al. (2013).
Method #3-Permanent Base Locations: Establish permanent base locations along the length of the shoreline at least 10 m landward of the marsh edge. Measure the linear distance from the base location to the marsh edge along an established compass direction. Marsh edge is defined as the lower/seaward extent of the emergent marsh vegetation. Import and analyze data using spatial analysis software. Determine shoreline loss/gain in meters per year. Potential method described by Steyer et al. (1995 revised 2000), Meyer et al. (1997), Piazza et al. (2005), and Baggett et al. (2013).

4.0 Monitoring Schedule

The schedule for project performance monitoring is shown in Table 4-1 by monitoring parameter.

Table 4-1 Monitoring Schedule

Monitoring Parameter/Data	Pre-Construction Monitoring	Construction monitoring (initial)	Post-Construction Monitoring (ongoing)					
		As-built (Year 0)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Structural integrity observations*		X	X	X	X	X	X	X
Area, Project Footprint		X			X			X
Shoreline position	X				X			X

*Structural integrity observations will be made opportunely as needed from Year 1 to Year 6

5.0 Evaluation

The MS TIG anticipates conducting an evaluation of the monitoring data collected (as described above) to help answer the following questions:

- Were the project restoration objectives achieved? If not, is there a reason why they were not met?
- Were there unanticipated events unrelated to the restoration project that potentially affected the monitoring results (e.g., hurricanes)?

6.0 Data Management

6.1 Data Description

Data will be compiled within 12 months after collection. To the extent practicable, data generated during monitoring activities would be documented using standardized field datasheets. If standardized datasheets are unavailable, then project-specific datasheets would be drafted prior to conducting any project monitoring activities. Original hardcopy datasheets, notebooks and photographs will be retained by MDEQ in accordance with MDEQ record retention policy.

Relevant project data that are handwritten on hardcopy datasheets or notebooks would be transcribed (entered) into standard digital format as appropriate per protocols developed by MDEQ. Electronic data files should be named with the date on which the file was created and should include a ReadMe file that describes when the file was created and by whom and any explanatory notes on the file contents. If a data file is revised, a new copy should be made and the original preserved.

All data will have properly documented Federal Geographic Data Committee/International Organization for Standardization (FGDC/ISO) metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data was collected, Quality Assurance/Quality Control (QA/QC) procedures, other information about data such as meaning, relationships to other data, origin, usage, and format).

6.2 Data Review and Clearance

After transcription of the data, the electronic data sheets will be verified against the original hardcopy datasheets and/or notebooks. Any corrections needed will be made to transcription errors before data are used for any analyses or distributed outside of theagency. MDEQ will verify and validate MAM data and information and would ensure that all data are: i) entered or converted into agreed upon/commonly used digital format; ii) labeled with metadata following FGDC/ISO standards to the extent practicable and in accordance with MDEQ requirements.

After identified errors are addressed, data are QA/QC'ed. MDEQ will give the other MS TIG members time to review the data before making such information publicly available (as described below).

6.3 Data Storage and Accessibility

Once all data has been QA/QC'ed in accordance with the MDEQ 2019 Quality Management Plan (QMP-004-R2) and will be stored on MDEQ servers. MDEQ will provide DWH NRDA MAM data and information to DIVER as soon as possible and no more than 1 year from when data are collected.

6.4 Data Sharing

Data will be made publicly available, in accordance with the Open, Public, Electronic and Necessary Government Data Act of 2019, through the DIVER Explorer Interface within 1 year of when the data collection occurred.

7.0 Reporting

All reporting will occur after field surveys are completed annually. This report will summarize the findings for the sampling period including all worksheets transferred into digital format and presented in tabular and graphical formats. The data should be summarized in such a way that it is meaningful to the reader. Additionally, an annual report would be completed that includes:

- Summary data –synthesized data for all efforts during the year.
- Graphics, if applicable, and associated interpretations of the data.
- Comparisons of pre- and post-project conditions, as applicable.
- Any uncertainties with management actions.
- Potential data collection issues.
- Reporting on general MAM activities in the DIVER Restoration Portal on an annual basis.
- Developing a Final MAM Report before a project is closed out.

8.0 Roles and Responsibilities

The MS TIG is responsible for addressing MAM objectives that pertain to their restoration activities and for communicating information to the public through DIVER. The Implementing Trustee for the project is MDEQ. MDEQ's roles include coordination with the MS TIG to track project progress, program management and oversight, monitoring oversight, and construction and monitoring, data management, and reporting.

WCNH3 Hancock County Marsh Living Shoreline Phase 6 Project: Monitoring and Adaptive Management Plan

Table of Contents

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring needed to evaluate progress toward meeting project objectives and to support adaptive management of the restoration project, as needed. Where applicable, it identifies key sources of uncertainty and incorporates monitoring data and decision points that address these uncertainties. As not all projects would have the same sources and degree of uncertainty, this project-specific MAM plan is scaled according to level of uncertainty, scope, scale, and Restoration Type associated with this project.

This MAM plan is a living document and may be updated as needed to reflect changing conditions and/or new information. Any future revisions to this document would be made publicly available through the DIVER Portal (https://www.diver.orr.noaa.gov/web/guest/home) and accessible through the Trustee Council's website (https://www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

The project is being implemented to restore Wetland, Coastal, and Nearshore Habitats injured by the Deepwater Horizon (DWH) oil spill, consistent with the Programmatic Damage Assessment and Restoration Plan and Programmatic Environmental Impact Statement (PDARP/PEIS).

- Programmatic Goal: Restore and Conserve Habitat
- Restoration Type: Wetlands, Coastal, and Nearshore Habitats

- Restoration Approach: Create, Restore, and Enhance Coastal Wetlands
- Restoration Technique: Construct Breakwaters
- TIG: Mississippi Trustee Implementation Group (MS TIG)
- Restoration Plan: Mississippi Trustee Implementation Group Restoration Plan 4

The project would construct an approximately 1.7-mile long segmented riprap breakwater in the Mississippi Sound between Bayou Bolan and Bayou Caddy. It would be Phase 6 of the existing Hancock County Marsh Living Shoreline Project (HCMLS), an ongoing Early Restoration Phase III DWH NRDA Project which included 5.9 miles of breakwater (construction complete, monitoring ongoing), a 46-acre subtidal reef (construction complete, monitoring ongoing) and a 46-acre created marsh (under construction). Historic erosion rates from 1850 to 2001 along Hancock County Marsh from Pearl River to Bayou Bolan range from 6 to 10 feet per year (Schmid 2002) and shoreline position monitoring data have shown the existing breakwaters' success in decreasing shoreline erosion. The purpose of the project is to protect the Hancock County Marsh Preserve shoreline and salt marsh habitat from erosion and to create habitat for secondary benthic productivity. The project would extend the shoreline protection and enhanced benthic secondary productivity benefits already provided by the Hancock County Marsh Living Shoreline breakwaters (which originate at the Louisiana/Mississippi state line and extend northward to Bayou Bolan).

1.2 Restoration Type Goals and Project Restoration Objectives

The overall goal for this Restoration Type relevant to this project, as identified in the PDARP/PEIS, is:

- **Goal 1**: Construct living shoreline breakwater to protect shoreline from erosion and support secondary productivity

The project restoration objective is:

- **Objective 1**: Reduce rate of shoreline erosion
- **Objective 2**: Provide benthic habitat to support secondary productivity

Performance criteria would be used to determine restoration success or the need for corrective action in accordance with 15 Code of Federal Records 990.55(b)(1)(vii)). Specific, measurable performance criteria are defined, as applicable, for monitoring parameters associated with each of the restoration objectives in Section 3.0.

2.0 Adaptive Management

To increase the likelihood of achieving the project objective, NOAA will conduct targeted monitoring and MDEQ and NOAA will use the monitoring data to refine, as necessary, future management actions. For example, sediment buildup around the constructed breakwater can potentially cause sampling baskets to be buried, so they may need to be moved if monitoring results indicate there is too much sediment buildup. Data from the elevation surveys will indicate whether additional breakwater material may be needed. Data collected from the bivalve counts can be used to determine if the breakwater structure could benefit from any spat placement activities. Data collected before and after tropical system events can help determine how the structure is performing through these events and whether adjustments need to be made, such as misplaced rocks that need to be relocated.

3.0 Project Monitoring, Performance Criteria, and Potential Corrective Actions

The monitoring plan for this restoration project was developed to evaluate project performance, key uncertainties, and potential corrective actions, if needed. Information on each monitoring parameter is provided below and is organized by objective. The list of corrective actions provided below is not exhaustive; rather, it includes a list of potential actions to be considered if the project is not performing as expected once implemented. Other corrective actions maybe identified post-implementation, as appropriate. Project monitoring, performance criteria, and potential corrective actions are summarized in Tables 3-1 below.

Table 3-1 Monitoring Parameters

Monitoring Parameter	Purpose	Method	Timing, Frequency, Duration	Sample Size and Sites	Performance Criteria	Potential Corrective Action(s)
Structural integrity (Constructed as designed)	Performance Criterion	Acceptance of project by engineer of record	Year 0 (completion of construction)	One	Project was constructed as designed	Resolution with contractor such that the terms of the contract are met
Structural integrity	Additional Monitoring	Conduct visual observations and take pictures of the project site from a boat or shoreline, or during an aerial survey.	Post-construction (Opportunely, for example if the project site is directly impacted by a major storm.)	Qualitative observations along entire length of reef structure	N/A Additional Monitoring	N/A Additional Monitoring
Area – Habitat by type (acres)	Performance Criterion	*Any or all of these methods could be used in addition, other methodologies, not included here, could be identified as monitoring protocols are finalized. Method 1: Shoreline Vectors; Method 2: Pedestrian/ GPS Surveys; Method 3: Permanent Base Locations; **See descriptions below**	Post-construction (Year 2 and 5)	One	Over the 5-year monitoring period, the breakwater area is $\geq$ 80% of year 0 (as-built).	Add material to existing living shoreline as budget allows
Elevation-Habitat	Additional Monitoring	Bathymetric/topographic surveying (i.e., RTK, GPS)	Post-construction (Years 2 and 5)	TBD with development of final monitoring protocols	N/A	Add material to existing breakwater structure as budget allows

Monitoring Parameter	Purpose	Method	Timing, Frequency, Duration	Sample Size and Sites	Performance Criteria	Potential Corrective Action(s)
Shoreline Position	Performance Criterion	See Area- Project Footprint Methodologies	Pre-construction (once); Post-construction (Year 5); or if the project site is impacted by a major storm.	To be determined with development of projects	Over the 5-year monitoring period, there is less than median loss is less than the pre-construction erosion rates.	Add material to living shorelines as budget allows.
Bivalve density (bivalves/m^2)	Performance criterion	Sample quadrats	Post construction annually		At least 10 bivalves per m^2	Add living material to breakwaters as budget allows.
Biomass, Epibenthic or Infaunal Organisms	Performance criterion	Substrate baskets	Post construction annually	TBD	Over five-year monitoring period, the average infauna and epifauna invertebrate biomass is at least 84 g wet weight/m^2	Add material to living shorelines as budget allows.
*Method #1-Shoreline Vectors: Shoreline vectors would be derived from acquired topographic/aerial imagery data utilizing a drone or similar technology and would be referenced to vertical and horizontal datums so that accurate measurements can be made using spatial software. Shoreline data between years will be analyzed by calculating linear distance between derived position data. Method #2-Pedestrian/GPS surveys: Walk the marsh edge and take continuous readings with a differential GPS. Marsh edge is defined as the lower/seaward extent of the emergent marsh vegetation. Import and analyze data using spatial analysis software. Determine shoreline loss/gain in meters per year. Potential method described by Steyer et al. (1995 revised 2000) and Baggett et al. (2013). Method #3-Permanent Base Locations: Establish permanent base locations along the length of the shoreline at least 10 m landward of the marsh edge. Measure the linear distance from the base location to the marsh edge along an established compass direction. Marsh edge is defined as the lower/seaward extent of the emergent marsh vegetation. Import and analyze data using spatial analysis software. Determine shoreline loss/gain in meters per year. Potential method described by Steyer et al. (1995 revised 2000), Meyer et al. (1997), Piazza et al. (2005), and Baggett et al. (2013).						

4.0 Monitoring Schedule

The schedule for project performance monitoring is shown in Table 4-1 by monitoring parameter.

Table 4-1 Monitoring Schedule

Monitoring Parameter/Data	Pre-Construction Monitoring	Construction monitoring (initial)	Post-Construction Monitoring (ongoing)				
		As-built (Year 0)	Year 1	Year 2	Year 3	Year 4	Year 5
Structural Integrity (Constructed as designed)		X					
Structural integrity		X	X	X	X	X	X

Area – Habitat by type (acres)				X			X
Elevation-Habitat				X			X
Shoreline position	X			X			X
Bivalve density (bivalves/m2)			X	X	X	X	X
Biomass, Epibenthic or Infaunal Organisms			X	X	X	X	X

5.0 Evaluation

The MS TIG anticipates conducting an evaluation of the monitoring data collected (as described above) to help answer the following questions:

- Were the project restoration objectives achieved? If not, is there a reason why they were not met?
- Were there unanticipated events unrelated to the restoration project that potentially affected the monitoring results (e.g., hurricanes)?

6.0 Data Management

6.1 Data Description

Data will be compiled within 12 months after collection. To the extent practicable, data generated during monitoring activities would be documented using standardized field datasheets. If standardized datasheets are unavailable, then project-specific datasheets would be drafted prior to conducting any project monitoring activities. Original hardcopy datasheets, notebooks and photographs will be retained by MDEQ in accordance with MDEQ record retention policy.

Relevant project data that are handwritten on hardcopy datasheets or notebooks would be transcribed (entered) into standard digital format as appropriate per protocols developed by MDEQ. Electronic data files should be named with the date on which the file was created and should include a ReadMe file that describes when the file was created and by whom and any explanatory notes on the file contents. If a data file is revised, a new copy should be made and the original preserved.

All data will have properly documented Federal Geographic Data Committee/International Organization for Standardization (FGDC/ISO) metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data was collected, Quality Assurance/Quality Control (QA/QC) procedures, other information about data such as meaning, relationships to other data, origin, usage, and format).

6.2 Data Review and Clearance

After transcription of the data, the electronic data sheets will be verified against the original hardcopy datasheets and/or notebooks. Any corrections needed will be made to transcription errors before data are used for any analyses or distributed outside of the agency. MDEQ and NOAA will verify and validate MAM data and information and would ensure that all data are: i) entered or converted into agreed upon/commonly used digital format; ii) labeled with metadata following FGDC/ISO standards to the extent practicable and in accordance with MDEQ and NOAA requirements.

After identified errors are addressed, data are QA/QC'ed in accordance with the contractor's QAPP. MDEQ and NOAA will give the other MS TIG members time to review the data before making such information publicly available (as described below).

6.3 Data Storage and Accessibility

Once all data has been QA/QC'ed it will be stored on MDEQ and NOAA servers. NOAA will provide DWH NRDA MAM data and information to DIVER as soon as possible and no more than 1 year from when data are collected.

6.4 Data Sharing

Data will be made publicly available, in accordance with the Open, Public, Electronic and Necessary Government Data Act of 2019, through the DIVER Explorer Interface within 1 year of when the data collection occurred.

7.0 Reporting

All reporting will occur after field surveys are completed annually. This report will summarize the findings for the sampling period including all worksheets transferred into digital format and presented in tabular and graphical formats. The data should be summarized in such a way that it is meaningful to the reader. Additionally, an annual report would be completed that includes:

- Summary data –synthesized data for all efforts during the year.
- Graphics, if applicable, and associated interpretations of the data.
- Comparisons of pre- and post-project conditions, as applicable.
- Any uncertainties with management actions.
- Potential data collection issues.
- Reporting on general MAM activities in the DIVER Restoration Portal on an annual basis.
- Developing a Final MAM Report before a project is closed out.

8.0 Roles and Responsibilities

The MS TIG is responsible for addressing MAM objectives that pertain to their restoration activities and for communicating information to the public through DIVER. The Implementing Trustees for the project are MDEQ and NOAA. MDEQ's roles include coordination with the MS TIG to track project progress, program management and oversight, monitoring oversight, construction and monitoring, data management, and reporting. NOAA's role is to conduct the monitoring and report monitoring results in DIVER. NOAA and MDEQ would work collaboratively on any potential corrective actions or adaptive management.

NR1 Back Bay – Davis Bayou Nutrient Reduction: Monitoring and Adaptive Management Plan

Table of Contents

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring needed to evaluate progress toward meeting project objectives and to support adaptive management of the restoration project, as needed. Where applicable, it identifies key sources of uncertainty and incorporates monitoring data and decision points that address these uncertainties. As not all projects would have the same sources and degree of uncertainty, this project-specific MAM plan is scaled according to level of uncertainty, scope, scale, and Restoration Type associated with this project.

This MAM plan is a living document and may be updated as needed to reflect changing conditions and/or new information. Any future revisions to this document would be made publicly available through the DIVER Portal (https://www.diver.orr.noaa.gov/web/guest/home) and accessible through the Trustee Council's website (https://www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

The project is being implemented to improve water quality of the Back Bay of Biloxi, Davis Bayou and the Mississippi Sound through nutrient reduction. This watershed-scale project restores injury caused by the Deepwater Horizon (DWH) oil spill, consistent with the Programmatic Damage Assessment and Restoration Plan and Programmatic Environmental Impact Statement (PDARP/PEIS).

- Programmatic Goal: Restore Water Quality
- Restoration Type: Nutrient Reduction (Nonpoint Source)
- Restoration Approach: Reduce Nutrient Loads to Coastal Watershed
- Restoration Techniques: Implement low-impact development (LID) practices; Implement traditional stormwater control measures (SCM); Implement erosion and sediment control (ESC) practices
- TIG: Mississippi Trustee Implementation Group (MS TIG)
- Restoration Plan: Mississippi Trustee Implementation Group Restoration Plan 4

The project would improve water quality by implementing conservation practices to reduce nutrients and sediment runoff in coastal watersheds. The Mississippi Department of Environmental Quality (MDEQ) Non-Point Source Program identified two priority HUC 12 watersheds for this project: Back Bay of Biloxi (031700090605) and Davis Bayou - Biloxi Bay (0317000906060). MDEQ and its watershed stakeholders would develop conservation plans to identify conservation practices that reduce nutrient runoff and sediment and then implement those practices. Practices could include stormwater runoff control, heavy use protection area, streambank and shoreline protection, stream habitat improvement and management, constructed wetland, wetland enhancement, brush management, herbaceous weed treatment, restoration of rare or declining natural communities, construction of dike and levees, water and sediment control basin, and other conservation practices.

1.2 Restoration Type Goals and Project Restoration Objectives

The overall goal for this Restoration Type relevant to this project, as identified in the PDARP/PEIS, are:

- **Goal 1**: Reduce nutrient loadings to Gulf Coast estuaries, habitats, and resources that are threatened by chronic eutrophication, hypoxia, or harmful algal blooms or that suffer habitat losses associated with water quality degradation.
- **Goal 2**: Where appropriate, co-locate nutrient load reduction projects with other restoration projects to enhance ecological services provided by other restoration approaches and cluster projects at the watershed level with the goal of making a discernible difference in water quality.

The project restoration objective is:

- **Objective 1**: Reduce phosphorus, nitrogen, and sediment loads during storm events leaving project areas in prioritized watersheds.

Performance criteria would be used to determine restoration success or the need for corrective action in accordance with 15 Code of Federal Records 990.55(b)(1)(vii)). Specific, measurable performance criteria are defined, as applicable, for monitoring parameters associated with each of the restoration objectives in Section 3.0.

2.0 Adaptive Management

To increase the likelihood of achieving the project objective, MDEQ would conduct targeted monitoring and use the monitoring data to refine, as necessary, future management actions.

3.0 Project Monitoring, Performance Criteria, and Potential Corrective Actions

The monitoring plan for this restoration project was developed to evaluate project performance, key uncertainties, and potential corrective actions, if needed.

Information on each monitoring parameter is provided below and is organized by objective. The list of corrective actions provided below is not exhaustive; rather, it includes a list of potential actions to be considered if the project is not performing as expected once implemented. Other corrective actions may be identified post-implementation, as appropriate.

- **Objective 1:** Reduce sediment, phosphorus, and nitrogen loads during storm events leaving project areas in prioritized watersheds.

Table 3-1 Monitoring Parameters

Monitoring Parameter	Purpose	Method	Timing, Frequency, Duration	Sample Size and Sites	Performance Criteria	Potential Corrective Action(s)
Water Quality: Total suspended solids (mg/L) Total phosphorus (mg/L); Total Nitrogen (mg/L)	Performance Criterion	Instream sample collection using EPA Standard Methods will occur at appropriately located upstream and downstream stations that bracket portions of project areas with conservation treatments. Samples will be taken at baseflow conditions.	Four sampling events (quarterly) per year for 5 years per project	TBD	Reduction in parameter concentrations over project period	Actions will vary depending on the type of conservation measure that is implemented.
Total dissolved solids; Ammonia; Nitrate + Nitrite; and field measurements including specific conductance, pH; dissolved oxygen; turbidity; and salinity.	Additional information	Instream sample collection using standard monitoring protocols will occur at appropriately located upstream and downstream stations that bracket portions of project areas with conservation treatments. Samples will be taken at baseflow conditions.	Four sampling events (quarterly) per year for 5 years per project	TBD	N/A	N/A
Conservation Practices Water Quality (Number Implemented by Activity)	Performance Criterion	Document the number of conservation practices implemented.	As needed for 5 years	N/A	TBD: *x* conservation practices implemented	Additional planning to determine appropriate government lands to implement conservation practices.

4.0 Monitoring Schedule

The schedule for project performance monitoring is shown in Table 4-1 by monitoring parameter.

Table 4-1 Monitoring Schedule

Monitoring Parameter/Data	Pre-Construction Monitoring	Year 0	Year 1	Year 2	Year 3
Water Quality: Total Suspended Solids (mg/L) and Turbidity (NTU); Total Phosphorus (mg/L); Total Nitrogen (mg/L)	X		X	X	X
Conservation Improvements, Water Quality (Number Implemented by Activity)			X	X	X

5.0 Evaluation

The MS TIG anticipates conducting an evaluation of the monitoring data collected (as described above) to help answer the following questions:

- Were the project restoration objectives achieved? If not, is there a reason why they were not met?
- Were there unanticipated events unrelated to the restoration project that potentially affected the monitoring results (e.g., hurricanes)?

6.0 Data Management

6.1 Data Description

Data will be compiled within 12 months after collection. To the extent practicable, data generated during monitoring activities would be documented using standardized field datasheets. If standardized datasheets are unavailable, then project-specific datasheets would be drafted prior to conducting any project monitoring activities. Original datasheets, notebooks and photographs will be retained by MDEQ in accordance with MDEQ record retention policy.

Relevant project data that are handwritten on hardcopy datasheets or notebooks would be transcribed (entered) into standard digital format as appropriate per protocols developed by MDEQ. Electronic data files should be named with the date on which the file was created and should include a ReadMe file that describes when the file was created and by whom and any explanatory notes on the file contents. If a data file is revised, a new copy should be made and the original preserved.

As applicable, all data will have properly documented Federal Geographic Data Committee/International Organization for Standardization (FGDC/ISO) metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data was collected, Quality Assurance/Quality Control (QA/QC) procedures, other information about data such as meaning, relationships to other data, origin, usage, and format).

6.2 Data Review and Clearance

After transcription of the data, the electronic data sheets will be verified against the original hardcopy datasheets and/or notebooks. Any corrections needed will be made to transcription errors before data are used for any analyses or distributed outside of the agency. MDEQ will verify and validate MAM data and information and would ensure that all data are: i) entered or converted into agreed upon/commonly used digital format; ii) labeled with metadata following FGDC/ISO standards to the extent practicable and in accordance with MDEQ requirements.

After identified errors are addressed, data are QA/QC'ed in accordance with the MDEQ 2019 Quality Management Plan (QMP-004-R2). MDEQ will give the other MS TIG members time to review the data before making such information publicly available (as described below).

6.3 Data Storage and Accessibility

Once all data has been QA/QC'ed it will be stored on MDEQ servers. MDEQ will provide DWH NRDA MAM data and information to DIVER as soon as possible and no more than 1 year from when data are collected.

6.4 Data Sharing

Data will be made publicly available, in accordance with the Open, Public, Electronic and Necessary Government Data Act of 2019, through the DIVER Explorer Interface within 1 year of when the data collection occurred.

7.0 Reporting

All reporting will occur after field surveys are completed annually. This report will summarize the findings for the sampling period including all worksheets transferred into digital format and presented in tabular and graphical formats. The data should be summarized in such a way that it is meaningful to the reader. Additionally, an annual report would be completed that includes:

- Summary data –synthesized data for all efforts during the year.
- Graphics, if applicable, and associated interpretations of the data.
- Comparisons of pre- and post-project conditions, as applicable.
- Any uncertainties with management actions.
- Potential data collection issues.
- Reporting on general MAM activities in the DIVER Restoration Portal on an annual basis.
- Developing a Final MAM Report before a project is closed out.

8.0 Roles and Responsibilities

The MS TIG is responsible for addressing MAM objectives that pertain to their restoration activities and for communicating information to the public through DIVER. The Implementing Trustee for the project is MDEQ. MDEQ's roles include coordination with the MS TIG to track project progress, program management and oversight, monitoring oversight, data management, and reporting.

Monitoring and Adaptive Management Plan: Big Cedar – Rocky Creek Nutrient Reduction Project

1.0 Introduction

The Deepwater Horizon (DWH) Mississippi Trustee Implementation Group (MS TIG) developed this Monitoring and Adaptive Management Plan (MAM Plan) for Big Cedar – Rocky Creek Nutrient Reduction Project. The Project will be constructed using funds associated with the Natural Resource Damage Assessment (NRDA). The purpose of this MAM Plan is to identify monitoring activities that will be conducted to evaluate and document restoration effectiveness, including performance criteria for determining restoration success or need for interim corrective action (15 CFR 990.55(b)(1)(vii)). Where applicable, the MAM Plan identifies key sources of project uncertainty and incorporates monitoring data and decision points that address these uncertainties to ensure that restoration objectives are met, and project benefits are maximized. It also establishes a decision-making process for making adjustments where needed.

This plan was developed in accordance with the MAM Plan template provided in the MAM Manual Version 2.0 (Updated December, 2021), and was adapted to fit the needs of this project (DWH NRDA Trustees 2019). This MAM Plan is a living document and may be updatedas needed to reflect changing conditions. Future revisions to this document will be made publicly available as part of project implementation through the Data Integration, Visualization, Exploration, and Reporting (DIVER) website (www.diver.orr.noaa.gov/web/guest/home) and accessible through the Trustee Council's website (www.habitat.noaa.gov/storymap/dwh/).

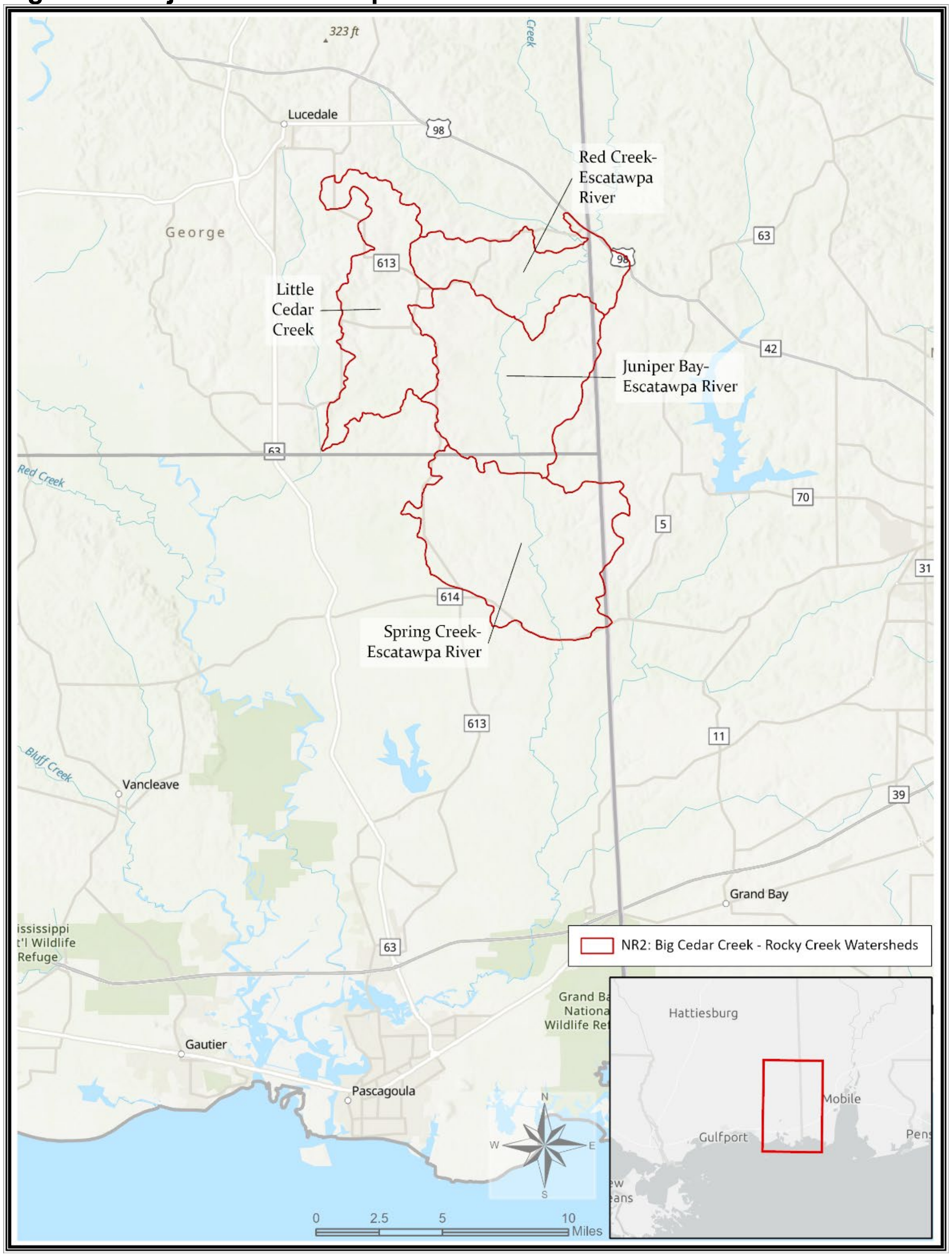
1.1 Project Overview

The Big Cedar – Rocky Creek Nutrient Reduction Project is located within four high priority watersheds of the Pascagoula River system: 1. Red Creek-Escatawpa River, 2. Juniper Bay-Escatawpa River, 3. Spring Creek-Escatawpa River, 4. Little Cedar Creek (Figure 1). The Project proposes to implement conservation practices on agricultural lands within these four 12-digit hydrologic unit codes (HUCs) to improve water quality conditions at the watershed level. Outreach and financial and technical assistance would be provided to voluntary participants to develop and implement conservation practices on agricultural land that is vulnerable to nutrient and sediment runoff. CPs are technical methods designed to help conserve soil, water, air, energy, and related plant and animal resources. Conservation practices are included in Appendix A of MS TIG RP4/EA.

The watershed is composed of approximated 71,031 acres with four dominate land use types: 1.) forestland (48,647 ac; 68.5%), 2.) pastureland (10,962 ac; 15.4%), 3.) cropland (8,138 ac (11.5), 4.) developed (3,285 ac; 4.6%). Nutrient runoff from agricultural lands can adversely affect the health of coastal waters. Excessive nutrient enrichment, or eutrophication, of Gulf Coast estuaries and their watersheds is a chronic threat that can lead to hypoxia (low oxygen levels), harmful algal blooms, habitat loss, and fish kills (DWH Trustees 2016). The Project would restore and enhance the ecological and hydrological integrity of water resources within immediate tributaries and receiving waterbodies. The Project would implement conservation practices to reduce nutrient and sediment runoff from agricultural lands within the Big Cedar – Rocky Creek watershed. Although agricultural lands are not the sole contributors of nutrients to coastal waters, they are a major contributor. Reducing nutrient and sediment loads to the system would improve the functionality of in-stream habitats and downstream estuarine/Gulf habitats used by aquatic organisms to fulfill critical life history cycles.

Given the success of USDA-NRCS Farm Bill programs and their strong acceptance by private landowners, there is a significant opportunity to implement conservation practices on private lands. This project would include four phases: 1) landowner outreach and education, 2) conservation planning, 3) E&D and environmental compliance, and 4) conservation practice implementation. USDA will be the Implementing Trustee with Mississippi Department of Environmental Quality (MDEQ) and the U.S. Environmental Protection Agency (EPA) as MS TIG Trustees assisting in the project. USDA will work with NRCS (a project partner) and will perform landowner outreach activities and implementation of conservation practices in targeted watersheds. The USDA will work with NRCS (a project partner) and will provide outreach and technical assistance to voluntary participants (landowners), especially on the most vulnerable acres in the watersheds, to develop and implement site-specific conservation plans. Implementation of conservation practices would include implementation of structural practices (e.g., earth moving) and non-structural practices (e.g., nutrient management). The landowners would be responsible for maintenance and operation of structural measures and application of non-structural measures. Engineering plans and designs for structural practices included in the conservation plans and funding would help landowners acquire all local, state, and federal permits required to implement the conservation practice(s). Landowners would receive financial and technical assistance to implement the conservation practices.

Figure 1. Project location map



The project proposes to implement clusters of projects in hydrologic unit code 12 (HUC 12 level) with the goal of making a discernable difference in local water quality. While this targeted and concentrated approach is desired, the project proponents understand the voluntary nature of conservation implementation and will strive to reach the critical sources within the watershed. Contracts with landowners would serve as an agreement to implement the conservation practices on their properties as outlined in a conservation plan developed according to appropriate standards and specifications (including any required property access agreement and activities related to project monitoring). Although the landowner would typically implement the conservation practices, if the landowner is not capable of carrying out the work, a third party could be hired to implement them. Operation and maintenance (O&M) would be evaluated as specified in the conservation plan and may include, but would not be limited to, addressing soil erosion or vegetation establishment issues due to weather-related events. O&M activities would be identified in the conservation plan based on site evaluations and performance monitoring data and reports.

This project is being implemented as restoration for the Deepwater Horizon oil spill (DWH oil spill) Natural Resource Damage Assessment (NRDA), consistent with the Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement (Final PDARP/PEIS) (DWH Trustees 2016). Per the PDARP/PEIS, the project falls into the following restoration categories:

- **Programmatic Goal:** Restore Water Quality
- **Restoration Type:** Nutrient Reduction (Nonpoint Source)
- **Restoration Approach:** Reduce Nutrient Loads to Coastal Wetlands
- **Restoration Technique**: Agricultural Conservation Practices
- **Trustee Implementation Group:** Mississippi TIG
- **Restoration Plan:** Mississippi Trustee Implementation Group Draft Restoration Plan and Environmental Assessment #4: Restoration of Wetlands, Coastal, and Nearshore Habitats; Nutrient Reduction (Nonpoint Source); and Provide and Enhance Recreational Opportunities

1.2 Restoration Type Goals and Project Restoration Objectives

To help meet the restoration goals for injuries to coastal habitats, the Project’s restoration objective is to reduce nitrogen, phosphorus, and sediment loads during storm events leaving private agricultural lands in the Big Cedar – Rocky Creek watershed. Focusing on croplands and pasturelands, the Project will implement conservation practices to reduce nutrient losses from the landscape; reduce nutrient loads to streams and downstream receiving waters; and reduce water quality degradation in watersheds that provide benefits to marine resources and coastal watersheds. In reducing nonpoint source nutrient and sediment loading, the Trustees envision that the Project will compensate, in part, for water quality impacts associated with the DWH oil spill.

As summarized in Chapter 5 of the PDARP/PEIS, the restoration goals for injuries to water quality are as follows:

- Reduce nutrient loadings to Gulf Coast estuaries, habitats, and resources that are threatened by chronic eutrophication, hypoxia, or harmful algal blooms or that suffer habitat losses associated with water quality degradation.
- Where appropriate, co-locate nutrient load reduction projects with other restoration projects to enhance ecological services provided by other restoration approaches.
- Enhance ecosystem services of existing and restored Gulf Coast habitats.

1.3 Conceptual Setting

The conceptual setting identifies factors and interactions that may influence the project outcomes. This may include factors affecting whether the project is implemented as planned (e.g., the expected number of samples were obtained), cofactors that may have a significant effect on variance in the data, and factors that may alter the expected outcome of the restoration effort. Understanding the conceptual setting would aid in adaptive management of the project, as well as future projects of a similar type by identifying some of these factors and providing the opportunity to anticipate their effects and plan for contingencies.

Aspects of the ecological system within and outside of the Big Cedar – Rocky Creek watershed that may be affected by implementation of the Project will depend on the type of BMPs and/or CPs implemented on the cropland and grazing lands. For example, construction of CPs could result in the spread of invasive species near each project site, which would result in a minor, long-term impact to the surrounding environment. Another example includes the effects of grassed waterways on terrestrial species. Installation of grassed waterways could potentially cause short-term minor impacts to terrestrial habitats due to potential vegetation clearing. However, there may be long-term beneficial effects, as the grassed waterways may provide additional habitat for certain species, as well as improve downstream aquatic habitats with the improvement of localized water quality. At the time of the drafting of this Plan, specific Project locations and BMPs/CPs have not yet been identified, and this MAM Plan will need to be updated to include a more robust analysis of the conceptual setting.

In addition, subsequent environmental review will need to occur to determine whether a planned site-specific action is below the maximum impacts described in RP/EA#4 (MS TIG 2023). If the site-specific action is below the maximum impacts described in this RP/EA, the analysis of the effects will be documented and reviewed by the Implementing Trustee, and the action will proceed. Any associated documentation will be routed through the Mississippi TIG to the administrative record, where it will be publicly available. If the evaluation of the planned site-specific action indicates the effects are likely to exceed the maximum impacts described in this RP/EA, the MS TIG will undertake additional site-specific environmental review consistent with the National Environmental Policy Act (NEPA) requirements and other requirements for protection of the environment. The MS TIG does not propose to take actions that would result in any significant adverse impacts on the environment.

1.4 Potential Sources of Uncertainty

Although the likelihood of project success is evaluated under the OPA regulations (15 CFR § 990.54(a)(3)), uncertainties may exist regarding how to best implement projects to achieve the greatest benefits for the injured resources. These uncertainties may arise from an incomplete understanding of the current conceptual setting; from unknown conditions in the future; or from project elements that do not perform as anticipated (e.g., sediment compaction or vegetation success). For the Big Cedar-Rocky Creek Nutrient Reduction Project, the uncertainties (summarized in Table 1) could affect project success and could therefore be key drivers of corrective actions or adaptive management decisions. The below sections summarize project monitoring protocols and describe how this information will be used to inform adaptive management to address these uncertainties.

Potential uncertainties are defined as those that may affect the ability to achieve stated project restoration objective(s). To aid in the identification of uncertainties, Trustees utilized a variety of sources, including but not limited to PDARP/PEIS Restoration Type MAM sections (DWH Trustees 2016), Monitoring and Adaptive Management Procedures and Guidelines Manual Version 2.0, Updated December 2021 (DWH Trustees 2021), and other documents. Select monitoring activities can then be implemented to inform these uncertainties and to select appropriate corrective actions in the event the Project is not meeting its performance criteria (Table 1).

Table 1. Key Uncertainties

Reference Number	Key Uncertainty	Description on How the Uncertainty Could Impact Project Success and/or Decision-Making
1	Willingness of landowners to participate	Based upon early engagement, it is assumed that the USDA would be able to attract farmers and landowners to participate in the development and implementation of BMPs/CPs. However, there is always a level of uncertainty in eventual participation. A lack of participation by landowners would impact the overall goals of nutrient and sediment loading reduction in the watershed.
2	Linkages between water quality improvements and ecosystem benefits	Linkages in this specific watershed to water quality and ecosystem health are not fully understood. It may be possible that specific projects do not result in immediate or significant improvements to ecosystem health.
3	Pollutant transport and freshwater flow through Gulf coastal watersheds	With increased flooding events, freshwater flow regimes through the watershed may change, which may alter the effectiveness of specific projects. Changes in flow patterns could result in additional nonpoint source water quality impacts to occur.
4	Degree to which local improvements in water quality contribute to water quality improvements downstream	The degree to which local improvements in water quality at the cropland and grazing land to water quality improvements downstream is not fully known at this time. If the linkages are not strong, then Project implementation may not be able to significantly reduce sediment and nutrient loading in the watershed.

As the projects are implemented and ongoing success monitoring is conducted, project uncertainties may become apparent. Additional discussion and specific details regarding how uncertainties may affect the Project should be added to this MAM plan.

2.0 Project Monitoring

The MAM Plan was developed to evaluate project performance, key uncertainties, and potential corrective actions, if needed, after the Project's execution. The monitoring data collected will also be used to predict the Project's performance during the project's design life. The implementation of conservation practices in agricultural and forestry landscapes are well-known management actions that reduce nonpoint source pollutant loads of nutrients and sediment impacting downstream receiving waters (Baker et al., 2018). Conservation practices would follow the USDA paradigm of avoid, control, and trap. Thus, practices are designed to reduce erosion, slow runoff velocities, and increase hydraulic residence time within the field or tract, and/or edge of field, all which are imperative to the physical, chemical, and biological processes that decrease nutrient and sediment loadings (Barlow and Kröger, 2014). Utilizing model outputs as well as observational data, conservation practices can be targeted into small watershed areas to produce measurable decreases in nutrients and sediments from the field itself, as well as within the downstream receiving water body. Reducing nutrient and sediment loads to the system is imperative for the functionality of in-stream habitats that are used by aquatic organisms to fulfill critical life history cycles.

Though additional measures may be implemented to more fully characterize the Project's effectiveness, the MS TIG proposes the continued implementation of proven and established monitoring methodologies to monitor project success:

- Parameter #1: Number of installed CPs and BMPs on cropland and grazing land
- Parameter #2: Number of Contracts (if different from number of installed CPs
- Parameter #3: Reduction in TN and TP from cropland and grazing land
- Parameter #4: Reduction in TSS and turbidity from cropland and grazing land

For each of the identified monitoring parameters, information is provided as to their intended purpose (e.g., monitor progress toward meeting one or more of the restoration objectives, support adaptive management of the project, etc.), monitoring methods, timing and frequency, duration, sample size, and sites (Table 2). Further, these parameters will be monitored to demonstrate how the restoration project is trending toward the performance criteria and to inform the need for corrective actions (see Table 2, and Section 5, Project-Level Decisions). In addition to monitoring the overall Project, as well as specific projects implemented with landowners, the Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0, Updated (DWH Natural Resource Damage Assessment Trustees 2019) recommends project-level monitoring be conducted at reference or control sites. Throughout project implementation, project team members, and USDA partners, will have the opportunity to refine design parameters as additional information becomes available. Performance criteria will be identified/implemented to determine restoration success or the need for corrective action in accordance with 15 CFR 990.55(b)(1)(vii)).

Table 2. Project objectives, parameters, data collection activities, performance criteria and potential corrective actions.

Project Objective	Parameter(s)	Method	Timing and frequency of data collection	Sample size/sites	Performance Criteria	Potential Corrective Actions
Reduce sediment, phosphorus, and nitrogen loads during storm events leaving private lands in the Big Cedar – Rocky Creek watershed	Number of installed conservation practices (CPs) and best management practices (BMPs) on cropland and grazing land.	The recommended methodology for monitoring this parameter is to count the number of improvements implemented at each cropland and grazing as part of the Project. Monitoring of this parameter should occur on-site through direct observation of the implemented CPs and BMPs. One observation is sufficient to record this parameter; follow-up visits to the participating cropland and pastureland for data collection would not be necessary, unless changes to the CPs and BMPs are made after initial implementation.	Throughout the implementation period of specific projects, and after construction of CPs/BMPs on the landowner(s) property.	To be determined	Increased number of installed CPs and BMPs on cropland and grazing land	Adding additional CPs and BMPs to participating agricultural operations, as necessary, to reduce nutrient loading to the Gulf Coast. Increase outreach or approach previously unwilling partners a second time.
	Reduction in total nitrogen (TN) and total phosphorus (TP) in receiving waters cropland and grazing land.	The recommended methodology for monitoring this parameter is direct sampling and detection to measure the sum of all forms of phosphorus and nitrogen, including organic and inorganic forms. Guidance for specific water sampling methodology to measure TN can be found in the American Society for Testing and Materials (ASTM) D5176 Volumes 11.01 and 11.02 and the USGS National Field Manual for the Collection of Water-Quality Data (ASTM 2013a, 2013b; USGS variously dated). For guidance on potential methodologies to	To be determined	Sample Size: To be determined Sites: To be determined	Identifiable reduction in TN and TP from cropland and grazing land Need baseline data and/or modeling to compare final vs. initial	Improving project infrastructure (e.g., installing additional wastewater treatment CPs and BMPs). Conducting routine maintenance activities (e.g., cleaning and maintaining waste separators and associated filters)

Project Objective	Parameter(s)	Method	Timing and frequency of data collection	Sample size/sites	Performance Criteria	Potential Corrective Actions
		measure TP, see the US EPA Methodologies 300.0, 365.2, 365.3, and 300.1 (EPA 1997, 1993a, 1971a, 1978). Also, for additional guidance see the Standard Methodologies 4110C and 4110B, and the United States Geological Society (USGS) Methodology for Evaluation of Alkaline Persulfate Digestion as an Alternative to Kjeldal Digestion for Determination of Total and Dissolved Nitrogen and Phosphorus in Water (National Environmental Methods Index 2011a, 2011b; USGS 2003). Additional information would also be collected when sampling for TN and total phosphorus TP, such as loads (i.e., water level and flow), depth of the sample, and collection method. Further, ammonium nitrogen (NH4-N), nitrite plus nitrate nitrogen (NO2-N + NO3-N), and total Kjeldahl nitrogen (TKN) could be analyzed from the samples. Data collection and calibration procedures of detection instruments would be determined by the respective instrument's quality assurance and quality control (QA/QC) procedures. At this time, the exact locations, types, and amounts of CPs and BMPs are unknown; therefore, it is impossible to				

Project Objective	Parameter(s)	Method	Timing and frequency of data collection	Sample size/sites	Performance Criteria	Potential Corrective Actions
		establish exact sampling methodologies and guidance in the first version of this MAM plan. However, the project specific planning, engineering, and design documents would outline the specifics necessary to update this MAM plan to include the locations, frequencies, sample size, and durations of sampling for this monitoring parameter.				

Project Objective	Parameter(s)	Method	Timing and frequency of data collection	Sample size/sites	Performance Criteria	Potential Corrective Actions
	Reduction in TSS and turbidity from cropland and grazing land	The recommended methodology for monitoring this parameter is direct sampling and detection to measure the TSS and turbidity. TSS is defined as the dry weight of sediment from the known volume of a sub-sample of the original water sample and is measured as milligrams per liter (mg/L) or parts-per-million (ppm). Turbidity is defined as a measure of intensity of light scatter by a sample, or the cloudiness/haziness of a sample. For methods on collection of TSS, see EPA 160.2, and for methods on assessing water turbidity see EPA 180.1 (EPA 1971b; EPA 1993b) and Wagner et al. (2006). Data collection and calibration procedures of detection instruments would be determined by the respective instrument manual(s) and QA/QC of the Trustee over monitoring.	To be determined	To be determined	Identifiable reduction in TSS and turbidity from cropland and grazing land Need baseline data and/or modeling to compare final vs initial	Improving project infrastructure (e.g., installing additional wastewater treatment CPs and BMPs). Conducting routine maintenance activities (e.g., cleaning and maintaining diversion channels to increase the effectiveness of TSS reduction)
	Number of Contracts (if different from number of installed CPs/BMPs)	The recommended methodology for monitoring this parameter is to count the number of contracts (landowners signed onto the program).	Throughout the implementation period of specific projects.	To be determined	Number of contracts continue to grow on a yearly basis.	Additional outreach to landowners, continued education and communication with communities within the four 12-digit HUCs.

3.0 Adaptive Management

Monitoring information collected at the project-level can also inform adaptive management (a form of structured decision-making applied to the management of natural resources in the face of uncertainty of that individual project) (Pastorok et al. 1997; Williams 2011). Adaptive Management was identified as one of the Trustee programmatic restoration goals in the Final PDARP/PEIS. As described in Chapter 5, Appendix E of the Final PDARP/PEIS, the Trustee Council, including the MS TIG, has committed to a MAM Framework to support restoration activities, including determining the need for corrective actions through supported compliance and success monitoring.

Adaptive management will occur for the Project throughout the entire project lifecycle. If negative impacts from the projects occur, or if the projects are unable to attract landowners, adaptive management may be necessary to ensure the projects' goals and objectives are achieved. The focus for adaptive management is on identifying and, where possible, reducing those uncertainties that affect the decisions within the scope of the projects. If not addressed, uncertainties may delay the time it takes to achieve the restoration objectives or hinder the projects' ability to fully achieve their objectives.

The projects activities proposed under the Big Cedar – Rocky Creek Nutrient Reduction Project would use previously established types of CPs and BMPs. USDA has demonstrated success in developing and implementing the same types of CPs within similar watersheds across the Gulf Coast. Examples of past successful water quality restoration projects include regional watershed management plans, state Clean Water Act (CWA) 319 programs, and USDA conservation programs (i.e., EQIP, Conservation Reserve Program, Wetlands Reserve Program, Wildlife Habitat Incentives Program). Additionally, the USDA conservation programs and the US EPA have funded the successful implementation of agriculture CPs throughout the nation, resulting in significant reductions in nutrient loadings to water bodies nationwide.

4.0 Evaluation

Project MAM includes planned evaluations of the selected parameters (see Table 2) throughout the project's lifetime. Evaluation of monitoring data is needed to assess the project implementation and performance in meeting restoration objectives, resolving uncertainties to increase understanding, and determining whether corrective actions are needed. The monitoring data would be used to answer the following questions:

- Were the project restoration objectives achieved? If not, is there a reason why they were not met?
- Did the restoration project produce unanticipated effects?
- Were there unanticipated events unrelated to the restoration project that potentially affected the monitoring results (e.g., hurricanes)?
- Were any new uncertainties identified?

By thoughtfully designing evaluation methods for the design and implementation of project restoration activities, the project team can assess if the project is meeting its restoration objectives and could determine the need for adaptive management or corrective actions. Project performance would be assessed against the following performance criteria, all of which are quantitative and based on the projects' goals and objectives:

- Increase in the number of nutrient reduction CPs and BMPs on cropland and grazing land.
- Targeted reduction (percent nutrient reduction over time) of instream TN and TP on cropland and grazing land.
- Targeted reduction (percent nutrient reduction over time) of instream of TSS and turbidity on cropland and grazing land.
- Increased number of contracts over time (if different from number of installed CPs/BMPs).

To properly establish if the BMPs/CPs are achieving nutrient reduction, pre-construction evaluations would need to occur. Pre-construction water quality monitoring would provide baseline information on the project-specific nutrient loads entering the ecosystem from the cropland and grazing land. Using the baseline data, USDA will be able to gauge whether targeted reduction of TN, TP, and TSS is occurring as a result of project implementation. Because the details of the proposed monitoring regimes are unknown, the following methods for analyzing, evaluating, and interpreting the monitoring data collected for the Project could include the following:

- <u>Data summarization and characterization:</u> This analysis would include calculation of the basic statistics of the monitoring data (e.g., linear regression of TN) within the proposed sampling location(s). This information would form the basis for a more comprehensive analysis (if needed). Data from this analysis can be presented in both graphical and tabular formats.
- <u>Status determination:</u> This evaluation would help determine if the projects are meeting their performance criteria. Observed values from the monitoring efforts would be compared to the performance criteria and perhaps to observed historical values. For example, if the monitoring results indicate that there is an increase in TSS and turbidity entering the nearest waterway, there may be an issue with the CPs and BMPs, or increased agricultural use on the site. This evaluation methodology would involve both expert interpretation and statistical analysis.
- <u>Trends evaluation:</u> This evaluation methodology can be used to address whether there is a change in nutrient loading and water quality over time. This analysis can inform how trends form, and if those trends are randomly occurring.

Specific analysis methods would be applied to all of the monitoring parameters once the specific projects are designed and implemented. At that time, this MAM plan would also be updated to include project-specific information.

5.0 Project-Level Decisions: Performance Criteria and Potential Corrective Actions

The MS TIG describes how updated knowledge gained from the evaluation of monitoring data will be used at the project-level to determine whether the Project is considered successful or whether corrective actions are needed. A project may not be achieving its intended objectives because of previously identified key uncertainties, unanticipated consequences, previously unknown conditions, or unanticipated environmental drivers. The decision to implement (or not implement) corrective actions is one type of decision within the larger adaptive management decision-making framework.

Learning through monitoring allows for corrective actions to be made to achieve desired outcomes. Table 2 identifies performance criteria, monitoring parameters, and potential corrective actions that could be taken if the performance criteria are not met (as defined in NRDA regulations (15 CFR 990.55(b)(1)(vii)). This table should not be considered all encompassing; rather, it represents a listing of potential actions for each individual parameter to be considered if the Project is not performing as expected once implemented. Other corrective actions may be identified post-implementation and included in an operations and maintenance (O&M) plan. The decision of whether or not a corrective action should be implemented for the Project should consider the overall outcomes of the restoration project (i.e., looking at the combined evaluation of multiple performance criteria) in order to understand why project performance deviates from the predicted or anticipated outcome. Corrective action may not be taken in all cases based on such considerations. The knowledge gained from this process could also inform future restoration decisions such as the selection, design, and implementation of similar projects.

6.0 Monitoring Schedule

The schedule for the project monitoring is in Table 3, separated by monitoring activity. The duration of monitoring activities will be determined upon completion of the individual landowner projects and prior to implementation of this MAM plan. This information will be added and revised as needed whenever monitoring methods are refined or revised. However, monitoring the effectiveness of BMPs/CPs on agricultural lands on water quality can take many years. It is possible that future iterations of this MAM plan would include long-term monitoring requirements, estimated to be 5 years.

Table 3. Monitoring Schedule

Monitoring Parameters	Monitoring Time Frame		
	Pre-Construction and Planning	Construction	Post-Construction
Number of installed CPs and BMPs on cropland and grazing land			X
Reduction in TN and TP from cropland and grazing land	X		X
Reduction in TSS and turbidity from cropland and grazing land	X		X
Number of Contracts	X		X

7.0 Data Management

To the extent practicable, all environmental and biological data generated during monitoring activities will be documented using standardized field datasheets. If standardized datasheets are unavailable or not readily amendable to record project-specific data, then project-specific datasheets will be drafted prior to conducting any project monitoring activities. Original hard copy datasheets and notebooks and photographs will be retained by the implementing Trustee.

Relevant project data that are handwritten on hard copy datasheets or notebooks will be transcribed (entered) into standard digital format. If digital files are recorded (via ipad or tablet), the data will be downloaded into the standard format. All field datasheets and notebook entries will be scanned to PDF files. Electronic data files should be named with the date on which the file was created and should include a ReadMe file that describes when the file was created and by whom and any explanatory notes on the file contents. If a data file is revised, a new copy should be made, including explanation of the need for the revision, and the original preserved.

All data will have properly documented FGDC/ISO metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data were collected, quality assurance/quality control [QA/QC] procedures, and other information about data such as meaning, relationships to other data, origin, usage, and format—can reference different documents).

7.1 Data Review and Clearance

Data will be reviewed for QA/QC in accordance with the *Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0, Updated 2021* (DWH Natural Resource Damage Assessment Trustees. 2021), and any errors in transcription will be corrected. Implementing Trustees will verify and validate data and information and will ensure that all data are entered or converted into agreed upon/commonly used digital format and labeled with metadata following FGDC/ISO standards to the extent practicable and in accordance with implementing Trustee agency requirements.

After all identified errors are addressed, the implementing Trustee will give the other MS TIG members time to review the data before making such information publicly available (as described below). Before submitting the monitoring data and information package, co-implementing Trustees shall confirm with one another that the package is approved for submission and will then be considered cleared.

7.2 Data Storage and Accessibility

After data have been cleared, they will be submitted to the DIVER Restoration Portal. Trustees will provide DWH NRDA MAM data and information to the Restoration Portal as soon as possible, and no more than 1 year from when data are collected.

7.3 Data Sharing

Data will be made publicly available in accordance with the Federal Open Data Policy through the DIVER Restoration Portal and the Deepwater Horizon NRDA Trustees website.

8.0 Reporting

Reporting should follow the guidelines set forth in Section 2.6.3 and Attachment D of the MAM Manual (DWH Trustees 2021). Information to be reported includes the following:

1. An introduction that provides an overview of the project, location, and restoration activities, as well as restoration objectives and performance criteria applicable to the project
    a. This information can be taken from this MAM plan and repeated in all reports.
2. A detailed description of the methods used for implementation of the MAM
    a. This information can be taken from this MAM plan and repeated in all reports.
3. Results from the reporting period, or, in the case of the final report, a comprehensive summary of results from the entire MAM plan implementation period.

   a. Results should be presented clearly and show progress that has been made toward performance criteria and/or restoration objectives. Information that can be used to present results includes tables or graphs, site visit summaries, and other datasets that support analysis of the project's progress toward meeting performance standard.
4. A discussion of the results (optional for interim reports, required for final report).
5. Conclusions that summarize the findings, progress toward meeting performance criteria and restoration objectives, and recommendations for corrective actions (optional for interim reports, required for final report).
6. Project highlights showcasing lessons learned to inform future project planning and implementation.
7. Transmission of data and meta-data used in the report, as well as a description of all data collected during the reporting period, even if they were not used in the report
8. A complete list of references

The first report would be submitted after the completion of pre-construction monitoring of a proposed project. Subsequent reports would be submitted after the completion of post-construction monitoring. The number of reports would be dependent on the CPs and BMPs installed, and other project-specific details (such as location) that are not known at this time. This MAM plan would be updated once the project-specific information is understood.

9.0 Roles and Responsibilities

The MS TIG is responsible for addressing MAM objectives that pertain to their restoration activities and for communicating information to the Trustee Council or Cross-TIG MAM work group. The USDA will be the Implementing Trustee with Mississippi Department of Environmental Quality (MDEQ) and the U.S. Environmental Protection Agency (EPA) as MS TIG Trustees assisting in the project. The implementing Trustees' roles include:

- Data collection
- Data analysis
- Report composition
- Ensuring corrective action activities are performed, if necessary
- Providing project progress information to the MS TIG

10.0 References

American Society for Testing and Materials (ASTM). 2013a. Annual Book of ASTM Standards, Section 11, Water and Environmental Technology, Volume 11.01, Water (I). Conshohocken, Pennsylvania: American Society for Testing and Materials.

______. 2013b. Annual Book of ASTM Standards, Section 11, Water and Environmental Technology, Volume 11.02, Water (I). Conshohocken, Pennsylvania: American Society for Testing and Materials.

Baker, B.H.; Prince Czarnecki, J.M.; Omer, A.R.; Aldridge, C.A.; Kröger, R.; and, J.D. Prevost. 2018. Journal of Soil and Water Conservation January 2018, 73 (1) 75-85; DOI: https://doi.org/10.2489/jswc.73.1.75

Baird, E.W., A.D. Eaton, and E.W. Rice. 2017. Standard Methods for the Examination of Water and Wastewater, 23rd Edition. American Public Health Association, American

Water Works Association, and Water Environmental Federation.

Barlow, Jeannie & Robert Kroger. 2014. Nitrogen transport within an agricultural landscape: Insights on how hydrology, biogeochemistry, and the landscape intersect to control the fate and transport of nitrogen in the Mississippi Delta. Journal of Soil and Water Conservation. 69. 11A-16A. 10.2489/jswc.69.1.11A.

Deepwater Horizon Oil Spill Trustees (DWH Trustees). 2016. Deepwater Horizon Oil Spill: Final Programmatic Damage Assessment and Restoration Plan and Final Programmatic Environmental Impact Statement (Final PDARP/PEIS). Available at: http://www.gulfspillrestoration.noaa.gov/restoration-planning/gulf-plan. Accessed November 10, 2021.

_____. 2021. Monitoring and Adaptive Management Procedures and Guidelines Manual Version 2.0, Updated. Appendix to the Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the DWH Oil Spill. December 2019. Available: http://www.gulfspillrestoration.noaa.gov/. Accessed November 1, 2021.

DWH NRDA Trustees. 2017a. "Monitoring and Adaptive Management Procedures and Guidelines Manual Version 1.0." Appendix in *Trustee Council Standard Operating Procedures for Implementation of the Natural Resource Restoration for the DWH Oil Spill*. December. www.gulfspillrestoration.noaa.gov/

National Environmental Methods Index. 2011a. Standard Method 4110C: Anions in Water by Ion Chromatography. Available at: https://www.nemi.gov/methods/method_summary/5705/. Accessed January 25, 2018.

______. 2011b. Standard Method 4110B: Anions in Water by Ion Chromatography with Chemical Suppression of Eluent conductivity. Available at: https://www.nemi.gov/methods/method_ summary/7428/. Accessed January 25, 2018.

National Oceanic and Atmospheric Administration Deepwater Horizon (DWH) Data Management Team. n.d. DIVER Portal-DWH Restoration User Manual.

Pastorok, R.A.; MacDonald, A.; Sampson, J.R.; Wilber, P.; Yozzo, D.J.; Titre, J.P. (1997) An ecological decision framework for environmental restoration projects. Ecological Engineering. 9(1-2):89-107.

U.S. Environmental Protection Agency (EPA). 1971a. Method 365.2, Phosphorous, All forms (Colorimetric, Ascorbic, Acid, Single Reagent). Available at: http://monitoringprotocols.pbworks.com/f/EPA365_2.pdf. Accessed January 25, 2018.

______. 1971b. Method 160.2: Residue, Non-Filterable (Gravimetric, Dried at 103-105℃). Available at: http://www.caslab.com/EPA-Methods/PDF/EPA-Method-160-2.pdf. Accessed January 25, 2018.

______. 1978. Method 365.3, Phosphorous, All forms (Colorimetric, Ascorbic, Acid, Single Reagent). Available at: http://www.caslab.com/EPA-Methods/PDF/EPA-Method-3653.pdf. Accessed January 25, 2018.

______. 1993a. Method 300.0, Determination of Inorganic Anions by Ion Chromatography. Revision 2.1. Available at: https://www.epa.gov/sites/production/files/2015-08/documents/method_300-0_rev_2-1_1993.pdf. Accessed January 25, 2018.

______. 1993b. Method 180.1: Determination of Turbidity by Nephelometry. Available at: https://www.epa.gov/sites/production/files/2015-08/documents/method_180-

1_1993.pdf. Accessed January 25, 2018.

_______. 1997. Method 300.1, Determination of Inorganic Anions in Drinking Water by Ion Chromatography. Revision 1.0. Available at: https://www.epa.gov/sites/production/files/2015-06/documents/epa-300.1.pdf. Accessed January 25, 2018.

_______. 2002. Method 1604: Total Coliforms and Escherichia Coli in Water by Membrane Filtration Using a Simultaneous Detection Technique (MI Medium). EPA-821-R-02-024. Washington, DC.: U.S. Environmental Protection Agency, Office of Water.

_______. 2004. Standard Method 9223B: Enzyme Substrate Coliform Test. Available at: https://www.standardmethods.org/store/ProductView.cfm?ProductID=313. Accessed January 25, 2018.

_______. 2017. Clean Water Act Methods Update Rule – Final Rule. Table 1H – List of Approved Microbiological Methods for Ambient Water. August 28, 2017. Federal Register 82(165):40867–408768.

U.S. Geological Survey (USGS). Variously dated. National Field Manual for the Collection of Water-Quality Data. U.S. Geological Survey, Techniques and Methods, Book 9, Handbooks for Water-Resources Investigations. Available at: http://pubs.water.usgs.gov/twri9A. Accessed January 25, 2018.

———. 2003. Methods of Analysis by the U.S. Geological Survey National Water Quality Laboratory—Evaluation of Alkaline Persulfate Digestion as an Alternative to Kjeldahl Digestion for Determination of Total and Dissolved Nitrogen and Phosphorus in Water. Available at: https://nwql.usgs.gov/Public/pubs/WRIR03-4174/WRIR03-4174.pdf. Accessed January 25, 2018.

Wagner, R.J., R.W. Boulger Jr., C.J. Oblinger, and B.A. Smith. 2006. Guidelines and Standard Procedures for Continuous Water-Quality Monitors: Station Operation, Record Computation, and Data Reporting. U.S. Geological Survey. Available at: http://pubs.water.usgs.gov/tm1d3. Accessed January 29, 2018.

Williams, B.K. (2011) Adaptive management of natural resources – framework and issues. Journal of Environmental Management. 92(5): 1346-1353.

12.0 MAM Plan Revision History

Old Version #	Revision Date	Reason for Change	New Version #

REC1, Jourdan River Boardwalk: Monitoring and Adaptive Management Plan

Table of Contents

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring needed to evaluate progress toward meeting project objectives and to support adaptive management of the restoration project, as needed. Where applicable, it identifies key sources of uncertainty and incorporates monitoring data and decision points that address these uncertainties. As not all projects would have the same sources and degree of uncertainty, this project-specific MAM plan is scaled according to level of uncertainty, scope, scale, and Restoration Type associated with this project.

This MAM plan is a living document and may be updated as needed to reflect changing conditions and/or new information. Any future revisions to this document would be made publicly available through the DIVER Portal (https://www.diver.orr.noaa.gov/web/guest/home) and accessible through the Trustee Council's website (https://www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

This project is being implemented to restore for recreational use losses resulting from the Deepwater Horizon (DWH) oil spill, consistent with the ProgrammaticDamage Assessment and Restoration Plan and Programmatic Environmental Impact Statement (PDARP/PEIS).

- Programmatic Goal: Provide and Enhance Recreational Opportunities
- Restoration Type: Provide and Enhance Recreational Opportunities
- Restoration Approach: Enhance Public Access to Natural Resources for Recreational Use;

Promote Environmental Stewardship, Education, and Outreach
- Restoration Technique: Enhance public access to natural resources for recreational use; Create or enhance natural resource-related education facilities
- TIG: Mississippi Trustee Implementation Group (MS TIG)
- Restoration Plan: Mississippi Trustee Implementation Group Restoration Plan 4

This project would fund construction of a public boardwalk along the Jourdan River to provide access to and information about this tidal estuarine ecosystem in coastal Mississippi. The project includes a boardwalk, nature observatory, seating areas, and educational signage about the wetlands, coastal, and nearshore habitats including the tidal Jourdan River, adjacent estuarine marsh, and resources (e.g., birds) that use these habitats.

1.2 Restoration Type Goals and Project Restoration Objectives

The overall goal for this Restoration Type relevant to this project, as identified in the PDARP/PEIS, are:

- **Goal 1**: Enhance public access to natural resources for recreational use
- **Goal 2**: Promote environmental stewardship, education, and outreach

The project restoration objective is:

- **Objective 1**: Provide and enhance recreational opportunities and promote environmental stewardship, education, and outreach by funding the construction of a public boardwalk with an elevated nature observatory and several seating areas, including educational signage to describe the ecosystem and species of the Jourdan River/St. Louis Bay estuarine habitat.

Performance criteria would be used to determine restoration success or the need for corrective action in accordance with 15 Code of Federal Records 990.55(b)(1)(vii)). Specific, measurable performance criteria are defined, as applicable, for monitoring parameters associated with each of the restoration objectives in Section 3.0.

2.0 Adaptive Management

To increase the likelihood of achieving the project objective, MDEQ will conduct targeted monitoring and use the monitoring data to refine, as necessary, future management actions.

3.0 Project Monitoring, Performance Criteria, and Potential Corrective Actions

The monitoring plan for this restoration project was developed to evaluate project performance, key uncertainties, and potential corrective actions, if needed.

Information on each monitoring parameter is provided below and is organized by objective. The list of corrective actions provided below is not exhaustive; rather, it includes a list of potential actions to be considered if the project is not performing as expected once implemented. Other corrective actions may be identified post-implementation, as appropriate.

- **Objective 1**: Provide and enhance recreational opportunities and promote environmental stewardship, education, and outreach by: funding the construction of a public boardwalk with an elevated Nature Observatory and several seating areas, with educational signage to describe the ecosystem and species of the Jourdan River/St. Louis Bay estuarine habitat.

Table 3-1 Monitoring Parameters

Monitoring Parameter	Purpose	Method	Timing, Frequency, Duration	Sample Size and Sites	Performance Criteria	Potential Corrective Action(s)
Structural integrity Completed as designed	Performance Criterion	Acceptance of the project by the engineer of record	Year 0 (completion of construction)	One	Project was constructed as designed	Require contractor correction
Visitor use	Performance Criterion	Visitor counts at facility entrance	Twice per year for three years following completion of project features	One	Public use of the facilities following completion of improvements	N/A

4.0 Monitoring Schedule

The schedule for project performance monitoring is shown in Table 4-1 by monitoring parameter.

Table 4-1 Monitoring Schedule

Monitoring Parameters	Year 0	Year 1	Year 2	Year 3
Construction of project features	x			
Visitor use/access		x	x	x

5.0 Evaluation

The MS TIG anticipates conducting an evaluation of the monitoring data collected (as described above) to help answer the following questions:

- Were the project restoration objectives achieved? If not, is there a reason why they were not met?
- Were there unanticipated events unrelated to the restoration project that potentially affected the monitoring results (e.g., hurricanes)?

6.0 Data Management

6.1 Data Description

Data will be compiled within 12 months after collection. To the extent practicable, data generated during monitoring activities would be documented using standardized field datasheets. If standardized datasheets are unavailable, then project-specific datasheets would be drafted prior to conducting any project monitoring activities. Original datasheets, notebooks and photographs will be retained by MDEQ in accordance with MDEQ record retention policy.

Relevant project data that are handwritten on hardcopy datasheets or notebooks would be transcribed (entered) into standard digital format as appropriate per protocols developed by MDEQ. Electronic data files should be named with the date on which the file was created and should include a ReadMe file that describes when the file was created and by whom and any explanatory notes on the file contents. If a data file is revised, a new copy should be made and the original preserved.

As appropriate, all data will have properly documented Federal Geographic Data Committee/International Organization for Standardization (FGDC/ISO) metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data was collected, Quality Assurance/Quality Control (QA/QC) procedures, other information about data such as meaning, relationships to other data, origin, usage, and format).

6.2 Data Review and Clearance

After transcription of the data, the electronic data sheets will be verified against the original hardcopy datasheets and/or notebooks. Any corrections needed will be made to transcription errors before data are used for any analyses or distributed outside of theagency. MDEQ will verify and validate MAM data and information and would ensure that all data are: i) entered or converted into agreed upon/commonly used digital format; ii) labeled with metadata following FGDC/ISO standards to the extent practicable and in accordance with MDEQ requirements.

After identified errors are addressed, data are QA/QC'ed. MDEQ will give the other MS TIG members time to review the data before making such information publicly available (as described below).

6.3 Data Storage and Accessibility

Once all data has been QA/QC'ed in accordance with the MDEQ 2019 Quality Management Plan (QMP-004-R2) it will be stored on MDEQ servers. MDEQ will provide DWH NRDA MAM data and information to DIVER as soon as possible and no more than 1 year from when data are collected.

6.4 Data Sharing

Data will be made publicly available, in accordance with the Open, Public, Electronic and Necessary Government Data Act of 2019, through the DIVER Explorer Interface within 1 year of when the data collection occurred.

7.0 Reporting

All reporting will occur after field surveys are completed annually. This report will summarize the findings for the sampling period including all worksheets transferred into digital format and presented in tabular and graphical formats. The data should be summarized in such a way that it is meaningful to the reader. Additionally, an annual report would be completed that includes:

- Summary data –synthesized data for all efforts during the year.
- Graphics, if applicable, and associated interpretations of the data.
- Comparisons of pre- and post-project conditions, as applicable.
- Any uncertainties with management actions.
- Potential data collection issues.
- Reporting on general MAM activities in the DIVER Restoration Portal on an annual basis.
- Developing a Final MAM Report before a project is closed out.

8.0 Roles and Responsibilities

The MS TIG is responsible for addressing MAM objectives that pertain to its restoration activities and for communicating information to the public through DIVER. The Implementing Trustee for the project is MDEQ. MDEQ's roles include coordination with the MS TIG to track project progress, program management and oversight, monitoring oversight, data management, and reporting.

REC2, Shepard State Park Recreational Enhancements: Monitoring and Adaptive Management Plan

Table of Contents

1.0 Introduction

This project Monitoring and Adaptive Management (MAM) Plan identifies the monitoring needed to evaluate progress toward meeting project objectives and to support adaptive management of the restoration project, as needed. Where applicable, it identifies key sources of uncertainty and incorporates monitoring data and decision points that address these uncertainties. As not all projects would have the same sources and degree of uncertainty, this project-specific MAM plan is scaled according to level of uncertainty, scope, scale, and Restoration Type associated with this project.

This MAM plan is a living document and may be updated as needed to reflect changing conditions and/or new information. Any future revisions to this document would be made publicly available through the DIVER Portal (https://www.diver.orr.noaa.gov/web/guest/home) and accessible through the Trustee Council's website (https://www.habitat.noaa.gov/storymap/dwh/).

1.1 Project Overview

This project is being implemented to restore for recreational use losses resulting from the Deepwater Horizon (DWH) oil spill, consistent with the ProgrammaticDamage Assessment and Restoration Plan and Programmatic Environmental Impact Statement (PDARP/PEIS).

- Programmatic Goal: Provide and Enhance Recreational Opportunities
- Restoration Type: Provide and Enhance Recreational Opportunities
- Restoration Approach: Enhance Public Access to Natural Resources for Recreational Use;

Promote Environmental Stewardship, Education, and Outreach

- Restoration Technique: Enhance public access to natural resources for recreational use; Create or enhance natural resource-related education facilities; Create or enhance natural resource-related education programs
- TIG: Mississippi Trustee Implementation Group (MS TIG)
- Restoration Plan: Mississippi Trustee Implementation Group Restoration Plan 4

This restoration project would be implemented at the Shepard State Park in Gautier, Mississippi. The project would fund interior and exterior renovation of the existing Gray House to create an Environmental Education Center for hosting nature-based classes and events and where students could come for field trips. Also included is the development of educational programs, installation of educational signage, and trail enhancement and maintenance.

1.2 Restoration Type Goals and Project Restoration Objectives

The overall goals for this Restoration Type relevant to this project, as identified in the PDARP/PEIS, are:

- **Goal 1**: Enhance public access to natural resources for recreational use
- **Goal 2**: Promote Environmental Stewardship, Education, and Outreach

The project restoration objective is:

- **Objective 1**: Enhance recreational opportunities and promote environmental stewardship, education, and outreach through renovation of the existing Gray House to create an Environmental Education Center for hosting nature-based classes and events; development of educational programs; installation of educational signage, and trail enhancement and maintenance.

Performance criteria would be used to determine restoration success or the need for corrective action in accordance with 15 Code of Federal Records 990.55(b)(1)(vii)). Specific, measurable performance criteria are defined, as applicable, for monitoring parameters associated with each of the restoration objectives in Section 3.0.

2.0 Adaptive Management

To increase the likelihood of achieving the project objective, MDEQ will conduct targeted monitoring and use the monitoring data to refine, as necessary, future management actions.

3.0 Project Monitoring, Performance Criteria, and Potential Corrective Actions

The monitoring plan for this restoration project was developed to evaluate project performance, key uncertainties, and potential corrective actions, if needed.

Information on each monitoring parameter is provided below and is organized by objective. The list of corrective actions provided below is not exhaustive; rather, it includes a list of potential actions to be considered if the project is not performing as expected once implemented. Other corrective actions may be identified post-implementation, as appropriate.

- **Objective 1**: Enhance recreational opportunities and promote environmental stewardship, education, and outreach through renovation of the existing Gray House to create an Environmental Education Center for hosting nature-based classes and events; development of educational programs; installation of educational signage, and trail enhancement and maintenance.

Table 3-1 Monitoring Parameters

Monitoring Parameter	Purpose	Method	Timing, Frequency, Duration	Sample Size and Sites	Performance Criteria	Potential Corrective Action(s)
Structural Integrity (completed as designed)	Performance Criterion	Acceptance of the project by the engineer of record	Completion of construction	One	Constructed as designed	Require contractor correction
Visitor Use	Performance Criterion	Visitor count at facility entrance	Twice per year for three years following completion of project features	One	Public use of the facilities and programs following completion of improvements	N/A
Visitors (visitor use by activity)- educational programs	Additional Information	Information to be provided by Shepard State Park	Ongoing	One	N/A	N/A

4.0 Monitoring Schedule

The schedule for project performance monitoring is shown in Table 4-1 by monitoring parameter.

Table 4-1 Monitoring Schedule

Monitoring Parameters	Year 0	Year 1	Year 2	Year 3
Construction of project features	x			
Visitor use/access		x	x	x

5.0 Evaluation

The MS TIG anticipates conducting an evaluation of the monitoring data collected (as described above) to help answer the following questions:

- Were the project restoration objectives achieved? If not, is there a reason why they were not met?
- Were there unanticipated events unrelated to the restoration project that potentially affect the monitoring results (e.g., hurricanes)?

6.0 Data Management

6.1 Data Description

Data will be compiled within 12 months after collection. To the extent practicable, data generated during monitoring activities would be documented using standardized field datasheets. If standardized datasheets are unavailable, then project-specific datasheets would be drafted prior to conducting any project monitoring activities. Original datasheets, notebooks and photographs will be retained by MDEQ in accordance with MDEQ record retention policy.

Relevant project data that are handwritten on hardcopy datasheets or notebooks would be transcribed (entered) into standard digital format as appropriate per protocols developed by MDEQ. Electronic data files should be named with the date on which the file was created and should include a ReadMe file that describes when the file was created and by whom and any explanatory notes on the file contents. If a data file is revised, a new copy should be made and the original preserved.

As appropriate, all data will have properly documented Federal Geographic Data Committee/International Organization for Standardization (FGDC/ISO) metadata, a data dictionary (defines codes and fields used in the dataset), and/or a Readme file as appropriate (e.g., how data was collected, Quality Assurance/Quality Control (QA/QC) procedures, other information about data such as meaning, relationships to other data, origin, usage, and format).

6.2 Data Review and Clearance

After transcription of the data, the electronic data sheets will be verified against the original hardcopy datasheets and/or notebooks. Any corrections needed will be made to transcription errors before data are used for any analyses or distributed outside of theagency. MDEQ will verify and validate MAM data and information and would ensure that all data are: i) entered or converted into agreed upon/commonly used digital format; ii) labeled with metadata following FGDC/ISO standards to the extent practicable and in accordance with MDEQ requirements.

After identified errors are addressed, data are QA/QC'ed. MDEQ will give the other MS TIG members time to review the data before making such information publicly available (as described below).

6.3 Data Storage and Accessibility

Once all data has been QA/QC'ed in accordance with the MDEQ 2019 Quality Management Plan (QMP-004-R2), it will be stored on MDEQ servers. MDEQ will provide DWH NRDA MAM data and information to DIVER as soon as possible and no more than 1 year from when data are collected.

6.4 Data Sharing

Data will be made publicly available, in accordance with the Open, Public, Electronic and Necessary Government Data Act of 2019, through the DIVER Explorer Interface within 1 year of when the data collection occurred.

7.0 Reporting

All reporting will occur after field surveys are completed annually. This report will summarize the findings for the sampling period including all worksheets transferred into digital format and presented in tabular and graphical formats. The data should be summarized in such a way that it is meaningful to the reader. Additionally, an annual report would be completed that includes:

- Summary data –synthesized data for all efforts during the year.
- Graphics, if applicable, and associated interpretations of the data.
- Comparisons of pre- and post-project conditions, as applicable.
- Any uncertainties with management actions.
- Potential data collection issues.
- Reporting on general MAM activities in the DIVER Restoration Portal on an annual basis.
- Developing a Final MAM Report before a project is closed out.

8.0 Roles and Responsibilities

The MS TIG is responsible for addressing MAM objectives that pertain to its restoration activities and for communicating information to the public through DIVER. The Implementing Trustee for the project is MDEQ. MDEQ's roles include coordination with the MS TIG to track project progress, program management and oversight, monitoring oversight, data management, and reporting.

Appendix D
Table 6.3-2 Guidelines for NEPA impact determinations in the Final PDARP/PEIS

Table 6.3-2. Guidelines for NEPA impact determinations in the Final PDARP/PEIS.

Resource	Impact Duration	Impact Intensity Definitions		
		Minor	Moderate	Major
Physical Resources				
Geology and Substrates	Short-term: During construction period. Long-term: Over the life of the project or longer.	Disturbance to geologic features or soils could be detectable, but could be small and localized. There could be no changes to local geologic features or soil characteristics. Erosion and/or compaction could occur in localized areas.	Disturbance could occur over local and immediately adjacent areas. Impacts to geology or soils could be readily apparent and result in changes to the soil character or local geologic characteristics. Erosion and compaction impacts could occur over local and immediately adjacent areas.	Disturbance could occur over a widespread area. Impacts to geology or soils could be readily apparent and could result in changes to the character of the geology or soils over a widespread area. Erosion and compaction could occur over a widespread area. Disruptions to substrates or soils may be permanent.
Hydrology and Water Quality	Short-term: During construction period. Long-term: Over the life of the project or longer.	Hydrology: The effect on hydrology could be measurable, but it could be small and localized. The effect could only temporarily alter the area's hydrology, including surface and ground water flows. Water quality: Impacts could result in a detectable change to water quality, but the change could be expected to be small and localized. Impacts could quickly become undetectable. State water quality standards as required by the Clean Water Act could not be exceeded. Floodplains: Impacts may result in a detectable change to natural and beneficial floodplain values, but the change could be expected to be small, and localized. There could be no appreciable increased risk of flood loss including impacts on human safety, health, and welfare. Wetlands: The effect on wetlands could be measurable but small in terms of area and the nature of the impact. A small impact on the size, integrity, or	Hydrology: The effect on hydrology could be measurable, but small and limited to local and adjacent areas. The effect could permanently alter the area's hydrology, including surface and ground water flows. Water quality: Effects to water quality could be observable over a relatively large area. Impacts could result in a change to water quality that could be readily detectable and limited to local and adjacent areas. Change in water quality could persist; however, it could likely not exceed state water quality standards as required by the Clean Water Act. Floodplains: Impacts could result in a change to natural and beneficial floodplain values and could be readily detectable, but limited to local and adjacent areas. Location of operations in floodplains could increase risk of flood loss, including impacts on human safety, health, and welfare.	Hydrology: The effect on hydrology could be measurable and widespread. The effect could permanently alter hydrologic patterns including surface and ground water flows. Water quality: Impacts could likely result in a change to water quality that could be readily detectable and widespread. Impacts could likely result in exceedance of state water quality standards and/or could impair designated uses of a water body. Floodplains: Impacts could result in a change to natural and beneficial floodplain values that could have substantial consequences over a widespread area. Location of operations could increase risk of flood loss, including impacts on human safety, health, and welfare. Wetlands: The action could cause a permanent loss of wetlands across a widespread area. The character of the wetlands could be changed so that the functions typically provided by the wetland could be permanently lost.

Resource	Impact Duration	Impact Intensity Definitions: Minor	Moderate	Major
		wetland function could not be affected, and natural restoration could occur if left alone.	Wetlands: The action could cause a measurable effect on wetlands indicators (size, integrity, or connectivity) or could result in a permanent loss of wetland acreage across local and adjacent areas. However, wetland functions could only be permanently altered in limited areas.	
Air Quality	Short-term: During construction period. Long-term: Over the life of the project or longer.	The impact on air quality may be measurable, but could be localized and temporary, such that the emissions do not exceed the Environmental Protection Agency's (EPA's) *de minimis* criteria for a general conformity determination under the Clean Air Act (40 CFR § 93.153).	The impact on air quality could be measurable and limited to local and adjacent areas. Emissions of criteria pollutants could be at EPA's *de minimis* criteria levels for general conformity determination.	The impact on air quality could be measurable over a widespread area. Emissions are high, such that they could exceed EPA's *de minimis* criteria for a general conformity determination.
Noise	Short-term: During construction period. Long-term: Over the life of the project.	Increased noise could attract attention, but its contribution to the soundscape would be localized and unlikely to affect current user activities.	Increased noise could attract attention and contribute to the soundscape including in local areas and those adjacent to the action, but could not dominate. User activities could be affected.	Increased noise could attract attention and dominate the soundscape over widespread areas. Noise levels could eliminate or discourage user activities.
Biological Resources				
Habitats	Short-term: Lasting less than two growing seasons. Long-term: Lasting longer than two growing seasons.	Impacts on native vegetation may be detectable, but could not alter natural conditions and could be limited to localized areas. Infrequent disturbance to individual plants could be expected, but would not affect local or range-wide population stability. Infrequent or insignificant one-time disturbance to locally suitable habitat could occur, but sufficient habitat could remain functional at both the local and regional scales to maintain the viability of the species. Opportunity for increased spread of non-native species could be detectable but	Impacts on native vegetation could be measurable but limited to local and adjacent areas. Occasional disturbance to individual plants could be expected. These disturbances could affect local populations negatively but could not be expected to affect regional population stability. Some impacts might occur in key habitats, but sufficient local habitat could retain function to maintain the viability of the species both locally and throughout its range. Opportunity for increased spread of non-native species could be detectable and	Impacts on native vegetation could be measurable and widespread. Frequent disturbances of individual plants could be expected, with negative impacts to both local and regional population levels. These disturbances could negatively affect range-wide population stability. Some impacts might occur in key habitats, and habitat impacts could negatively affect the viability of the species both locally and throughout its range. Actions could result in the widespread increase of non-native species, resulting in broad and permanent changes to native

Resource	Impact Duration	Impact Intensity Definitions: Minor	Moderate	Major
		temporary and localized and could not displace native species populations and distributions.	limited to local and adjacent areas, but could only result in temporary changes to native species population and distributions.	species populations and distributions.
Wildlife Species (including birds)	Short-term: Lasting up to two breeding seasons, depending on length of breeding season. Long-term: Lasting more than two breeding seasons.	Impacts to native species, their habitats, or the natural processes sustaining them could be detectable, but localized, and could not measurably alter natural conditions. Infrequent responses to disturbance by some individuals could be expected, but without interference to feeding, reproduction, resting, migrating, or other factors affecting population levels. Small changes to local population numbers, population structure, and other demographic factors could occur. Sufficient habitat could remain functional at both the local and range-wide scales to maintain the viability of the species. Opportunity for increased spread of non-native species could be detectable but temporary and localized, and these species could not displace native species populations and distributions.	Impacts on native species, their habitats, or the natural processes sustaining them could be measurable but limited to local and adjacent areas. Occasional responses to disturbance by some individuals could be expected, with some negative impacts to feeding, reproduction, resting, migrating, or other factors affecting local population levels. Some impacts might occur in key habitats. However, sufficient population numbers or habitat could retain function to maintain the viability of the species both locally and throughout its range. Opportunity for increased spread of non-native species could be detectable and limited to local and adjacent areas, but could only result in temporary changes to native species population and distributions.	Impacts on native species, their habitats, or the natural processes sustaining them could be detectable and widespread. Frequent responses to disturbance by some individuals could be expected, with negative impacts to feeding, reproduction, migrating, or other factors resulting in a decrease in both local and range-wide population levels and habitat type. Impacts could occur during critical periods of reproduction or in key habitats and could result in direct mortality or loss of habitat that might affect the viability of a species. Local population numbers, population structure, and other demographic factors might experience large changes or declines. Actions could result in the widespread increase of non-native species resulting in broad and permanent changes to native species populations and distributions.
Marine and Estuarine Fauna, (fish, shellfish benthic organisms)	Short-term: Lasting up to two spawning seasons, depending on length of season. Long-term: Lasting more than two spawning seasons.	Impacts could be detectable and localized but small. Disturbance of individual species could occur; however, there could be no change in the diversity or local populations of marine and estuarine species. Any disturbance could not interfere with key behaviors such as feeding and spawning. There could be no restriction of movements daily or seasonally. Opportunity for increased spread of non-native species could be detectable but	Impacts could be readily apparent and result in a change in marine and estuarine species populations in local and adjacent areas. Areas being disturbed may display a change in species diversity; however, overall populations could not be altered. Some key behaviors could be affected but not to the extent that species viability is affected. Some movements could be restricted seasonally. Opportunity for increased spread of non-	Impacts could be readily apparent and could substantially change marine and estuarine species populations over a widescale area, possibly river-basin wide. Disturbances could result in a decrease in fish species diversity and populations. The viability of some species could be affected. Species movements could be seasonally constrained or eliminated. Actions could result in the widespread increase of non-native species resulting in broad and permanent changes to native

Resource	Impact Duration	Impact Intensity Definitions: Minor	Moderate	Major
		temporary and localized and these species could not displace native species populations and distributions.	native species could be detectable and limited to local and adjacent areas, but could only result in temporary changes to native species population and distributions.	species populations and distributions.
Protected Species	Short-term: Lasting up to one breeding/growing season. Long-term: Lasting more than one breeding/growing season.	Impacts on protected species, their habitats, or the natural processes sustaining them could be detectable, but small and localized, and could not measurably alter natural conditions. Impacts could likely result in a "may affect, not likely to adversely affect" determination for at least one listed species.	Impacts on protected species, their habitats, or the natural processes sustaining them could be detectable and some alteration in the numbers of protected species or occasional responses to disturbance by some individuals could be expected, with some negative impacts to feeding, reproduction, resting, migrating, or other factors affecting local and adjacent population levels. Impacts could occur in key habitats, but sufficient population numbers or habitat could remain functional to maintain the viability of the species both locally and throughout their range. Some disturbance to individuals or impacts to potential or designated critical habitat could occur. Impacts could likely result in a "may affect, likely to adversely affect" determination for at least one listed species. No adverse modification of critical habitat could be expected.	Impacts on protected species, their habitats, or the natural processes sustaining them could be detectable, widespread, and permanent. Substantial impacts to the population numbers of protected species, or interference with their survival, growth, or reproduction could be expected. There could be impacts to key habitat, resulting in substantial reductions in species numbers. Results in an "is likely to jeopardize proposed or listed species/adversely modify proposed or designated critical habitat (impairment)" determination for at least one listed species.

Resource	Impact Duration	Impact Intensity Definitions Minor	Moderate	Major
Socioeconomic Resources				
Socioeconomics and Environmental Justice[a]	Short-term: During construction period. Long-term: Over the life of the project or longer.	A few individuals, groups, businesses, properties, or institutions could be affected. Impacts could be small and localized. These impacts are not expected to substantively alter social and/or economic conditions. Actions could not disproportionately affect minority and low-income populations.	Many individuals, groups, businesses, properties, or institutions could be affected. Impacts could be readily apparent and detectable in local and adjacent areas and could have a noticeable effect on social and/or economic conditions. Actions could disproportionately affect minority and low-income populations. However, the impact could be temporary and localized.	A large number of individuals, groups, businesses, properties, or institutions could be affected. Impacts could be readily detectable and observed, extend over a widespread area, and have a substantial influence on social and/or economic conditions. Actions could disproportionately affect minority and low-income populations, and this impact could be permanent and widespread.
Cultural Resources	Short-term: During construction period. Long-term: Over the life of the project or longer.	The disturbance of a site(s), building, structure, or object could be confined to a small area with little, if any, loss of important cultural information potential.	Disturbance of a site(s), building, structure, or object not expected to result in a substantial loss of important cultural information.	Disturbance of a site(s), building, structure, or object could be substantial and may result in the loss of most or all its potential to yield important cultural information.
Infrastructure	Short-term: During construction period. Long-term: Over the life of the project or longer.	The action could affect public services or utilities but the impact could be localized and within operational capacities. There could be negligible increases in local daily traffic volumes resulting in perceived inconvenience to drivers but no actual disruptions to traffic.	The action could affect public services or utilities in local and adjacent areas and the impact could require the acquisition of additional service providers or capacity. Detectable increase in daily traffic volumes (with slightly reduced speed of travel), resulting in slowed traffic and delays, but no change in level of service (LOS). Short service interruptions (temporary closure for a few hours) to roadway and railroad traffic could occur.	The action could affect public services or utilities over a widespread area resulting in the loss of certain services or necessary utilities. Extensive increase in daily traffic volumes (with reduced speed of travel) resulting in an adverse change in LOS to worsened conditions. Extensive service disruptions (temporary closure of one day or more) to roadways or railroad traffic could occur.
Land and Marine Management	Short-term: During construction period. Long-term: Over the life of the project or longer.	The action could require a variance or zoning change or an amendment to a land use, area comprehensive, or management plan, but could not affect overall use and management beyond the local area.	The action could require a variance or zoning change or an amendment to a land use, area comprehensive, or management plan, and could affect overall land use and management in local and adjacent areas.	The action could cause permanent changes to and conflict with land uses or management plans over a widespread area.
Tourism and	Short-term: During	There could be partial developed	There could be complete site closures to	All developed site capacity could be

Resource	Impact Duration	Impact Intensity Definitions: Minor	Moderate	Major
Recreational Use	construction period. Long-term: Over the life of the project or longer.	recreational site closures to protect public safety. The same site capacity and visitor experience could remain unchanged after construction. The impact could be detectable and/or could only affect some recreationalists. Users could likely be aware of the action but changes in use could be slight. There could be partial closures to protect public safety. Impacts could be local. There could be a change in local recreational opportunities; however it could affect relatively few visitors or could not affect any related recreational activities.	protect public safety. However, the sites could be reopened after activities occur. There could be slightly reduced site capacity. The visitor experience could be slightly changed but still available. The impact could be readily apparent and/or could affect many recreationalists locally and in adjacent areas. Users could be aware of the action. There could be complete closures to protect public safety. However, the areas could be reopened after activities occur. Some users could choose to pursue activities in other available local or regional areas.	eliminated because developed facilities could be closed and removed. Visitors could be displaced to facilities over a widespread area and visitor experiences could no longer be available in many locations. The impact could affect most recreationalists over a widespread area. Users could be highly aware of the action. Users could choose to pursue activities in other available regional areas.
Fisheries and Aquaculture	Short-term: During construction period. Long-term: Over the life of the project or longer.	A few individuals, groups, businesses, properties, or institutions could be affected. Impacts could be small and localized. These impacts are not expected to substantively alter social and/or economic conditions.	Many individuals, groups, businesses, properties, or institutions could be affected. Impacts could be readily apparent and detectable in local and adjacent areas and could have a noticeable effect on social and/or economic conditions.	A large number of individuals, groups, businesses, properties, or institutions could be affected. Impacts could be readily detectable and observed, extend over a widespread area, and could have a substantial influence on social and/or economic conditions.
Marine Transporta-tion	Short-term: During construction period. Long-term: Over the life of the project or longer.	The action could affect public services or utilities, but the impact could be localized and within operational capacities. There could be negligible increases in local daily marine traffic volumes resulting in perceived inconvenience to operators but no actual disruptions to transportation.	The action could affect public services or utilities in local and adjacent areas, and the impact could require the acquisition of additional service providers or capacity. Detectable increase in daily marine traffic volumes could occur (with slightly reduced speed of travel), resulting in slowed traffic and delays. Short service interruptions could occur (temporary delays for a few hours).	The action could affect public services utilities over a widespread area resulting in the loss of certain services or necessary utilities. Extensive increase in daily marine traffic volumes could occur (with reduced speed of travel), resulting in extensive service disruptions (temporary closure of one day or more).
Aesthetics and Visual Resources	Short-term: During construction period.	There could be a change in the view shed that was readily apparent but could not attract attention, dominate the view, or	There could be a change in the view shed that was readily apparent and attracts attention. Changes could not	Changes to the characteristic views could dominate and detract from current user activities or experiences.

Resource	Impact Duration	Impact Intensity Definitions Minor	Moderate	Major
	Long-term: Over the life of the project or longer.	detract from current user activities or experiences.	dominate the viewscape, although they could detract from the current user activities or experiences.	
Public Health and Safety, Including Flood and Shoreline Protection	Short-term: During construction period. Long-term: Over the life of the project or longer.	Actions could not result in 1) soil, groundwater, and/or surface water contamination; 2) exposure of contaminated media to construction workers or transmission line operations personnel; and/or 3) mobilization and migration of contaminants currently in the soil, groundwater, or surface water at levels that could harm the workers or general public. Increased risk of potential hazards (e.g., increased likelihood of storm surge) to visitors, residents, and workers from decreased shoreline integrity could be temporary and localized.	Project construction and operation could result in 1) exposure, mobilization and/or migration of existing contaminated soil, groundwater, or surface water to an extent that requires mitigation; and/or 2) could introduce detectable levels of contaminants to soil, groundwater, and/or surface water in localized areas within the project boundaries such that mitigation/remediation is required to restore the affected area to the preconstruction conditions. Increased risk of potential hazards to visitors, residents, and workers from decreased shoreline integrity could be sufficient to cause a permanent change in use patterns and area avoidance in local and adjacent areas.	Actions could result in 1) soil, groundwater, and/or surface water contamination at levels exceeding federal, state, or local hazardous waste criteria, including those established by 40 CFR § 261; 2) mobilization of contaminants currently in the soil, groundwater, or surface water, resulting in exposure of humans or other sensitive receptors such as plants and wildlife to contaminant levels that could result in health effects; and 3) the presence of contaminated soil, groundwater, or surface water within the project area, exposing workers and/or the public to contaminated or hazardous materials at levels exceeding those permitted by federal Occupational Safety and Health Administration (OSHA) in 29 CFR § 1910. Increased risk of potential hazards to visitors, residents, and workers from decreased shoreline integrity could be substantial and could cause permanent changes in use patterns and area avoidance over a widespread area.

[a] Evaluation of potential environmental justice issues will be fully address in future tiered documents.