US Army Corps of Engineers®
Walla Walla District

BARBER POOL SECTION 1135 ECOSYSTEM RESTORATION ADA COUNTY, IDAHO

DRAFT INTEGRATED FEASIBLITY REPORT AND ENVIRONMENTAL ASSESSMENT

APPENDIX G, MONITORING AND ADAPTIVE MANAGEMENT PLAN

This page intentionally left blank.

BARBER POOL SECTION 1135 ECOSTYEM RESTORATION
ADA COUNTY, IDAHO
DRAFT INTEGRATED FEASIBILITY REPORT
AND ENVIRONMENTAL ASSESSMENT

APPENDIX G, MONITORING AND ADAPTIVE MANAGEMENT PLAN

CONTENTS

ACRONYMS AND ABBREVIATIONS

BDA	Beaver Dam Analog
BPCA	Barber Pool Conservation Area
BSU	Boise State University
Bureau	Bureau of Reclamation
CAP	Continuing Authorities Resolution
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
cfs	cubic feet per second
ER	Engineering Regulation
ESA	Endangered Species Act
FONSI	Finding of No Significant Impact
FR/EA	Feasibility Report and Environmental Assessment
IDFG	Idaho Department of Fish and Game
NEPA	National Environmental Policy Act
NSF	Non-Federal Sponsor
PALS	Post Assisted Log Structures
PL	Public Law
USACE	U.S. Army Corps of Engineers
USC	United States Code
USFWS	U.S. Fish and Wildlife Service
WMA	Wildlife Management Area
WRDA	Water Resources Development Act
BPCA	Barber Pool Conservation Area
BSU	Boise State University
Bureau	Bureau of Reclamation
CAP	Continuing Authorities Resolution
CEQ	Council on Environmental Quality

SECTION 1 - INTRODUCTION

This document provides a feasibility-level monitoring and adaptive management plan for the Barber Pool Conservation Area (BPCA) Ecosystem Restoration Feasibility Study. The study reviewed opportunities for ecosystem restoration (ER) in Ada County, which could contribute to larger ongoing efforts to improve, preserve, and sustain ecological resources along the Boise River. The study recommends a project that would restore riparian area, wetlands, and instream habitat of the Boise River within the BPCA.

This plan identifies potential monitoring activities, outlines how results from the monitoring would be used to assess project success and, if needed, adaptively manage the project to achieve the desired ecosystem restoration objectives. The plan specifies who would be responsible for monitoring and adaptive management activities and provides estimated costs.

This Monitoring and Adaptive Management Plan (MAMP) was prepared by the USACE, and the final plan will include input from members of the project delivery team (PDT) and resource agencies, including US Fish and Wildlife Service, Idaho Fish and Game, and Boise State University. The level of detail in this plan is based on currently available data and information developed during plan formulation as part of the feasibility study. Uncertainties remain concerning the exact project features, monitoring elements, and adaptive management opportunities. Components of the MAMP, including costs, were similarly estimated using available information. Uncertainties will be addressed in the preconstruction, engineering and design (PED) phase; this plan will be revised to incorporate more detailed monitoring and adaptive management plans and cost breakdowns.

1.1 AUTHORIZATION FOR MONITORING AND ADAPTIVE MANAGEMENT

In accordance with the Water Resources Development Act of 2007 Section 2036, Section 2039 and subsequent implementation guidance (CECW-PB Memorandum dated August 31, 2009), MAMPs are required for both National Ecosystem Restoration (NER) project components and for any Mitigation Plan required for the National Economic Development (NED) component.

Section 2039 specifically directs the Secretary of the Army to ensure that when conducting a feasibility study for a project (or component of a project) for ER that the recommended project includes a plan for monitoring the success of the ER. The implementation guidance for Section 2039 specifies that ER projects include plans to track and improve restoration success through monitoring and adaptive management. Guidance stipulates that the monitoring plan includes a description of the monitoring activities, the criteria for success, and the estimated cost and duration of the monitoring. It also specifies that monitoring will be performed until restoration success is achieved.

This MAMP includes all elements required by the WRDA 2007 implementation guidance for section 2039.

1.2 INTRODUCTION TO MONITORING AND ADAPTIVE MANAGEMENT

Monitoring and adaptive management provides a directed iterative approach to achieving restoration project goals and objectives by focusing on strategies promoting flexible decision making that can be adjusted in the face of uncertainties as outcomes from restoration management actions and other events become better understood. Initiating a formal MAMP early in the study process enables the study team to identify and resolve key uncertainties and other potential issues that can positively or negatively influence project outcomes during every stage of the planning and project implementation process. Hence, early implementation of monitoring and adaptive management will result in a project that can better succeed under a wide range of uncertain conditions and can be adjusted as necessary. Furthermore, careful monitoring of project outcomes both advances scientific understanding and helps adjust policies and/or operations as part of an iterative learning process.

Learning from the management experience is not a new idea; but the purposeful and systematic pursuit of knowledge to address identified uncertainties has rarely been practiced. Adaptive management acknowledges the uncertainty about how ecological systems function and how they may respond to management actions. Nevertheless, adaptive management is not a random trial-and-error process; it is not ad-hoc or simply reactionary. An essential element of adaptive management is the development and execution of a monitoring and assessment program to analyze and understand responses of the system to implementation of the project as restoration progresses. The MAMP was developed and will be used to:

- Allow scientists and managers to collaboratively design plans for managing complex and incompletely understood ecological systems.
- Reduce uncertainty over time.
- Implement systematic monitoring of outcomes and impacts.
- Incorporate an iterative approach to decision-making.
- Provide a basis for identifying options for improvements in the design, construction and operation of restoration through adaptive management.
- Ensure interagency collaboration and productive stakeholder participation as they are key elements to success.

1.2.1 Monitoring and Adaptive Management Process

The developed monitoring and adaptive management program and process is complimentary to the USACE Project Life Cycle (planning, design, construction, and operation and maintenance). The process is not elaborate or duplicative and enhances activities that already take place. The basic process was adapted from a technical note published by the Engineering Research and Development Center (ERDC). Elements of the program include an iterative process involving planning a program or project; designing the project; building the project; operating and maintaining the project; monitoring and assessing project performance; and continuing, adjusting, or terminating a project if the goals and objectives are not being achieved.

1.2.2 Adaptive Management Team

As part of the monitoring and adaptive management process, a team is set up to implement the process. The MAMP provides the framework and guidance for an Adaptive Management Team (AMT) to review and assess monitoring results and consider and recommend adaptive management actions when ecological success is not achieved and decision criteria are triggered. The AMT members shall work together to make recommendations relevant to implementing the MAMP. The AMT is composed of USACE staff, the non-Federal sponsor (NFS), and interested resource agencies and/or other stakeholders. Although the USACE has coordinated with the entities that will comprise the AMT in development of the Integrated Feasibility Report and Environmental Assessment (IFR-EA), the AMT will be officially established during PED.

The AMT focuses on the ecological function of the habitats through related management actions to maintain and provide functional coastal marsh habitat within the project area. The AMT shall review the monitoring results and advise on and recommend actions that are consistent with the project goals and reflect the current and future needs of the habitat and the species they support within the project area. The USACE shall have final determination on all adaptive management actions recommended.

The USACE is responsible for ensuring that monitoring data and assessments are properly used in the adaptive management decision-making process. If the USACE determines that adaptive management actions are needed, it will coordinate with the AMT on implementation of those actions. The USACE is also responsible for project documentation, reporting, and external communication.

The AMT shall meet at a minimum of once per year, as scheduled by the USACE during the monitoring period, to review the results of monitoring and assess whether project objectives are being met. If objectives are not met, the AMT may recommend that adaptive management actions be taken in response to monitoring results as compared to decision-making triggers.

The AMT may also consider other related projects in the hydrologic basin in determining the appropriate adaptive management actions and may consult with other recognized experts or stakeholders as appropriate, to achieve project goals.

Recommendations for adaptive management should be based on:

- Monitoring data from previous years,
- Consideration of current habitat conditions,

- Consideration of current and potential threats to habitat establishment success, and
- Past and predicted response by target species and habitats.

1.2.2.1 Team Structure

The AMT shall include representatives from USACE, Walla Walla District and the Regional Planning and Environmental Center (RPEC), and the NFS responsible for cost-sharing construction and future operations and maintenance.

The USACE may be represented by the Project Biologist(s), as well as the Project Hydrology and Hydraulics (H&H) representative and the Project Geotechnical representative as needed. Other USACE attendees may include the Project Manager, Project Real Estate Specialists, and/or Operations and Maintenance designees, as needed.

For the feasibility study, the NFS is Boise State University. A construction NFS would be identified prior to PED. The NFS would ultimately be responsible for all Operations, Maintenance, Repair, Replacement, and Rehabilitation (OMRRR) activities once the USACE notifies the NFS of project completion. Prior to final project completion, the USACE would transfer responsibility of functional elements of the project to the NFS as they are completed. The NFS may be represented by its designees which may include Project Managers, Planners, Design Engineers, Environmental Specialists, or other designees.

The AMT should also include representatives from resource agencies who would serve in an advisory capacity, to assist in evaluation of monitoring data and assessment of adaptive management needs. The agencies may include, but is not limited to, and upon their acceptance:

- U.S. Fish and Wildlife Service, Boise Office
- Idaho Fish and Game Department
- Boise State University

1.3 RECOMMENDED PLAN

Given the unique opportunity to restore the Barber Pool reach comprehensively and the Sponsor’s preference to maximize functional lift, the Alternative 4, which includes actions within Main Channel 1, Main Channel 2, and Main Channel 3 represents the most effective and justified selection as the TSP. It captures the greatest cumulative habitat gain, achieves broad ecosystem restoration objectives, and remains within acceptable cost-effectiveness thresholds for federal participation.

1.3.1 Project Goals and Objectives

During the initial stages of project development, the study team, with stakeholder and resource agency input, developed restoration goals and objectives to be achieved by the BPCA project. The overarching goal of the project is to enhance the ecological health, function, and resilience of the Barber Pool Conservation Area ecosystem through self-regulating actions. This includes improving in-channel aquatic habitat, reconnecting historic floodplain hydrology, and rehabilitating riparian and wetland habitats to support biodiversity across the Boise River corridor.

Planning objectives represent desired positive changes to the without-project condition. All the planning objectives focus on activity within the study area and within the 50-year period of analysis of year 2027 to 2077. The planning objectives for this study are as follows:

1. Restore ***in-channel aquatic habitat*** diversity within the Boise River Channel.
2. Restore ***floodplain*** connectivity within the BPCA.
3. Restore ***riparian and wetland*** habitat within the BPCA.

1.3.2 Sources of Uncertainty and Associated Risks

A fundamental tenet underlying the adaptive management process is achieving desired project outcomes in the face of uncertainties. Scientific uncertainties and technological challenges are inherent with any large-scale restoration project with the principal source of uncertainty typically including:

1. Incomplete description and understanding of relevant ecosystem structure and function,

2. Imprecise relationships between project management actions and corresponding outcomes,

3. Engineering challenges in implementing project alternatives, and

4. Ambiguous management and decision-making processes.

It is important to determine the type of risk each uncertainty comprises and to discern what constitutes sufficient knowledge to proceed considering those risks. There is significant institutional knowledge regarding the construction of the restoration measures; therefore, there is minimal uncertainty from a construction standpoint. Uncertainties relating to measure design and performance are mainly centered on site specific, design-level details (e.g. exact sediment quantities, invasive species removal needs, extent of erosion control needs, construction staging area locations, pipeline pathways, timing and duration of construction, engineering challenges, etc.), which would be addressed during the pre-engineering and design phase (PED). Identified uncertainties with the plan include:

- Climate variability, such as drought conditions and the variability of significant storm frequency, intensity, and timing.
- Natural Variability in ecological and physical processes.
- Sediment Dynamics, including subsidence and accretion rates.
- Wetland Restoration Requirements such as water, sediment, and nutrient requirements including magnitude and duration of inundation, annual sediment needs, and type and quantity of nutrients to achieve desired productivity.
- Invasive and Nuisance Species, including invasive Spartina hybrids; and
- Project Feature Implementation Timing, including schedule and timeline, availability of construction funds.

SECTION 2 - MONITORING

An effective monitoring program will be required to determine if the project outcomes are consistent with original project goals and objectives. The power of a monitoring program developed to support adaptive management lies in the establishment of feedback between continued project monitoring and corresponding project management. A carefully designed monitoring program is the central component of the project adaptive management program as it supplies the information to assess whether the project is functioning as planned.

Monitoring must be closely integrated with the adaptive management components because it is the key to the evaluation of adaptive management needs. Objectives must be considered to determine appropriate indicators to monitor. In order to be effective, monitoring must be able to distinguish between ecosystem responses that result from project implement (i.e. management actions) and natural ecosystem variability.

2.1 MONITORING PLAN

According to the USACE implementation guidance memo for WRDA Section 2039, "Monitoring includes the systematic collection and analysis of data that provides information useful for assessing project performance, determining whether ecological success have been achieved, or whether adaptive management may be needed to attain project benefits."

The following discussion outlines a monitoring plan that will support the BPCA Restoration Project. The plan identifies performance measures along with desired outcomes and monitoring design in relation to specific objectives. A performance measure includes specific feature(s) to be monitored to determine project performance. Additional monitoring is identified as supporting information needs that will help further understand interrelationships of restoration features and external environmental variability and to corroborate project effects.

Such criteria, or decision-making triggers, are related to each performance measure and desired outcome and identify the need to discuss potential implementation of adaptive management actions with the AMT. These criteria/triggers are identified in Section 3.3.

Overall, monitoring results will be used to evaluate the progress of habitat restoration toward meeting project objectives and to inform the need for adaptive management actions to ensure successful restoration is achieved.

2.1.1 Monitoring Period

Pre-construction/baseline data, during construction, and post-construction monitoring will be utilized to determine restoration success. Baseline monitoring will begin during PED prior to project construction and continue during construction when possible. Monitoring will continue until the trajectory of ecological change and/or other measures of project success are determined as defined by project-specific objectives. Section 2039 of WRDA 2007 allows ecological success monitoring to be cost-shared for up to ten years post-construction. Once ecological success has been achieved, which may occur in less than ten years post-construction, no further monitoring would be performed. If ecological success cannot be determined within the ten-year post construction period of monitoring, any additional required monitoring would be the responsibility of the NFS.

There may be issues related to sustainability of the project that would require some monitoring and adaptive management beyond achieving the project objectives. Consequently, it may be appropriate to consider resuming project-specific monitoring and adaptive management after project success has been achieved or beyond the 10 years particularly if there are sudden or long-term changed conditions that would contribute to the long-term success of the project.

Per USACE policy, cost-shared monitoring would cease if additional monitoring would result in monitoring costs exceeding 1 percent of the total project cost minus the costs of adaptive monitoring and adaptive management of the restoration features.

For purposes of this document, Year 0 is the period prior to construction and up to the last day of construction (even if that period of time is over multiple years) plus 12 months. In most instances, year 0 monitoring would occur during PED, except where noted it would occur just prior to construction. This would serve as the baseline condition for which to compare all future data collections. Year 1 is the first year post-construction and starts 12 months after all construction is complete. Year 1 data collection would occur between 12 and 24 months after the last placement. During this period, there is significant sediment movement from settlement, drainage, and potential erosion, so this year is critical in capturing areas where significant change has occurred as these areas would be at risk for failure.

2.1.2 Monitoring Elements

Defining and assessing progress towards project objectives are crucial components of the MAMP. The following section outlines the proposed performance measure metrics, desired outcomes and monitoring design needed to measure restoration progress, determine ecological success and support the adaptive management program should changes need to be made to improve project performance. The elements described in this section are based on the available project information and will be updated and refined during PED. Elements of monitoring are measures within the TSP that are separate and each require monitoring procedures during inspections.

Each measure may vary in design, scale, and implementation method depending on the specific alternative and the site location within the BPCA, reflecting differences in habitat type, hydrology, access, and restoration goals. The nine measures are:

<u>Measure 1 - Vegetation plantings</u>

This measure involves planting native riparian, wetland, and upland species to restore degraded vegetation communities within the BPCA. Target species would be selected based on soil type, moisture regime, and historical occurrence, ensuring they are well-suited to local conditions. Establishing native vegetation can stabilize eroding banks, improve water quality through nutrient uptake, and provide essential habitat for fish, birds, and other wildlife. The measure may use a mix of live stakes, container plants, bare-root seedlings, and broadcast seeding. This measure would support meeting all three study objectives.

<u>Measure 2 - Placement of in-stream structures</u>

Instream structures, such as large woody debris, engineered log jams, and strategically placed boulders, would be installed to increase channel complexity. These structures can create pools, riffles, and undercut banks, which improve habitat for native fish and aquatic invertebrates. In the BPCA context, instream structures can also help redirect flows away from eroding banks, trap sediment, and promote localized floodplain connectivity. Materials would be sourced to mimic natural features and minimize visual intrusion. Placement would be designed to avoid obstructing navigation and to withstand seasonal high-flow events. This measure would support meeting Objective 1: Restore in-channel Habitat, and Objective 3: Restore Riparian and Wetland Habitat.

<u>Measure 3 - Installation of BDA's and PALS</u>

Beaver dam analogs (BDAs) and post-assisted log structures (PALS) mimic natural beaver dams by slowing water velocities, spreading flows across the floodplain, and promoting sediment deposition. In the BPCA, this could enhance wetland function, increase backwater habitat, and help retain late-season moisture in riparian soils. BDAs and PALS can also improve aquatic habitat for juvenile fish by providing low-velocity refuge areas. Installation would involve driving untreated wooden posts within conveyance channels and weaving them with woody material to create semi-permeable barriers. These structures are designed to degrade naturally over time, allowing for adaptive management. This measure would support meeting Objective 2: Reconnect and Restore Floodplain Use, and Objective 3 Restore Riparian and Wetland Habitat.

<u>Measure 4 - Excavation of recently filled-in side channels to flow perennially</u>

This measure targets side channels that historically carried perennial flow but have been blocked or filled by sediment deposition or vegetation encroachment. Excavation would restore hydraulic connection between the mainstem Boise River and these channels, allowing them to support aquatic species year-round. In the BPCA, perennial side channels can provide critical habitat diversity, reduce main channel velocities, and offer rearing habitat for fish during high-flow events. Work would involve careful grading to maintain natural channel morphology and prevent future rapid sedimentation. This measure would support meeting all three study objectives.

Measure 5 - Excavation of inactive floodplain channels

Floodplain channels that no longer or only carry water during extreme events would be reconnected through excavation and grading. The goal is to improve seasonal inundation patterns, support diverse riparian vegetation, and enhance habitat for amphibians, waterfowl, and other floodplain-dependent species. In the BPCA, reactivated floodplain channels could also increase groundwater recharge and moderate flood peaks. Excavation would be designed to maintain natural meander patterns and integrate with existing vegetation. This measure would support meeting Study Objective 2: Reconnect and Restore Floodplain Use, and Objective 3 Restore Riparian and Wetland Habitat

Measure 6 - Excavation of uplands to wetlands

Upland areas could be excavated to allow establishment of wetlands. These wetlands can provide valuable habitat for amphibians, waterfowl, and pollinators while improving water quality through sediment and nutrient filtration. In the BPCA, wetland restoration would also enhance flood storage capacity and create visually diverse landscapes. Excavation depth and contouring would be designed to ensure targeted hydrology, whether from groundwater inputs, overbank flooding, or precipitation. This measure would support meeting Study Objective 2: Reconnect and Restore Floodplain Use, and Objective 3: Restore Riparian and Wetland Habitat.

Measure 7 - Filling of open channel segments

Some channel segments may be filled to redirect flows, reduce bank erosion, or restore floodplain hydrology. In the BPCA, this could involve placing clean sediment, gravel, and large wood in channels that are causing habitat fragmentation or excessive erosion. Careful design would be needed to avoid upstream flooding or unintended habitat loss. Fill material would be placed to blend with the surrounding environment and support revegetation. This measure would support meeting all three study objectives

Measure 8 - Build controlled access points

This measure establishes designated, stabilized access points to manage human use of sensitive riparian and aquatic areas. Controlled access points can reduce bank trampling, limit vegetation loss, and prevent sedimentation from foot or boat traffic. In the BPCA, this might include installing gravel landings or trails in high-use areas. These facilities would be designed to blend aesthetically with the natural environment and withstand seasonal water level changes. Signage and educational elements could be included to encourage responsible recreation. This measure would support meeting Objective 3: Restore Riparian and Wetland Habitat.

Measure 9 - Excavate bankline to expand floodplain and riparian

Bankline excavation would widen the active floodplain by removing material from confined riverbanks. This would allow the river to spread during high flows, improving channel stability and sediment deposition patterns. Design would ensure bank stability over the long term and minimize downstream impacts. This measure would support meeting all three study objectives.

2.1.3 Monitoring Procedures

The following monitoring procedures will provide the information necessary to evaluate the previously identified project objectives for the BPCA project. The monitoring procedures are described in enough detail to make the approach clear, but do not fully describe the monitoring regime. A monitoring plan with detailed methods, protocols, timing, and responsible parties will be developed in coordination with resource agencies prior to the start of monitoring. During development of the detailed MAMP, it is expected that if new, cost-effective methodologies exist they will be employed. Likewise, it is expected that at that time monitoring specifications, such as timing of the surveys (i.e. flood releases, growing season, etc.), specific equipment needs, monitoring locations, etc. will be identified.

Inspection: Inspection of restored areas will occur after completion of construction. Follow-up inspections will then occur annually after flood flows occur (i.e. flows that deposit substantial sand on the flood plain) or within every 2 years. Each inspection is estimated to require a team of two one 8-hour day to conduct for each of the elements monitored below.

Vegetation Plantings Monitoring: Monitoring for vegetation plantings will begin with baseline surveys during PED to document existing vegetation composition, percent cover, invasive species presence, soil moisture, and site-specific constraints. During construction, planting locations will be mapped and planting densities verified. Post-construction monitoring will occur annually for the first five years, then in Years 7 and 10, unless ecological success is reached earlier. Data collection will include percent survival of installed species, percent cover of native versus invasive vegetation, stem density, and evidence of herbivory or drought stress. Photo points and vegetation transects will be used to ensure consistent long-term comparisons.

Hydrology, soil moisture, and sediment deposition will also be monitored because they influence plant establishment. If survival or native dominance falls below performance expectations, adaptive management may include replanting, temporary irrigation, invasive species treatments, or herbivore protection. Monitoring will also evaluate whether vegetation provides functional benefits such as bank stability, shade, and organic inputs. By Year 5, trends should indicate whether the site is on a trajectory toward a stable, self-sustaining community. If objectives are met before Year 10, monitoring may conclude early. However, significant disturbances such as flooding, wildfire, or drought may require monitoring to resume to evaluate long-term sustainability.

Instream Structures Monitoring: Baseline conditions will be documented prior to construction and include channel cross sections, bed material composition, erosion patterns, and existing hydraulic structures. During construction, each instream structure will be surveyed for proper placement, embedment, and orientation. Post-construction monitoring will occur after the first high-flow event, at Year 1, and then every two years through Year 10 unless ecological success is documented earlier.

Monitoring will assess structural stability, evidence of scour or deposition, formation of pools or riffles, cover availability for fish, and hydraulic diversity. GPS mapping and cross-sectional surveys will track geomorphic adjustments. If more than expected movement or degradation occurs, adaptive actions may include adding ballast, augmenting structures, or adjusting placement designs. Biological monitoring will document fish and macroinvertebrate use of created habitat areas.

Successful performance is indicated by structures remaining stable and providing increased habitat complexity without causing unintended erosion. If objectives are reached early, monitoring may conclude; however, large flood events may trigger additional inspections. Long-term sustainability will be assessed by evaluating natural recruitment of large wood and whether hydraulic diversity persists without intervention.

BDAs and PALS Monitoring: Monitoring will begin with baseline assessments of channel geometry, current velocities, sediment deposition, riparian vegetation, and groundwater elevation. During construction, each BDA and PALS installation will be mapped, photographed, and inspected for structural integrity and alignment with design elevations. Post-construction monitoring will occur after the first high-flow season, at Year 1, and biennially through Year 10 unless goals are met sooner.

Key metrics include structure stability, water-surface elevations upstream and downstream, floodplain inundation frequency, sediment deposition rates, and plant colonization in newly wetted areas. Installation success is also evaluated by presence of backwater habitats, groundwater retention, and increased slow-water refuges for fish. If structures fail prematurely or do not impound water as intended, corrective actions may include replacing woven material, adjusting post spacing, or enhancing wood packing. If unintended flooding or bank erosion develops, modifications may be required.

Long-term success is indicated by natural beaver colonization or sustained function of structures without intervention. If objectives are reached before Year 10, monitoring may conclude. Major flow changes or channel avulsions may require renewed monitoring.

Excavation of Side Channels to Perennial Flow Monitoring: Baseline monitoring will document existing disconnected or intermittent side channels, including channel geometry, substrate conditions, groundwater elevation, riparian vegetation, and current connectivity to the main river. During construction, as-built channel elevations and dimensions will be surveyed. Post-construction monitoring will occur at Year 1 and biennially through Year 10, focused on hydraulic connectivity and habitat development.

Metrics include flow permanence, wetted width, water depth, velocity distribution, shading, substrate stability, and fish use. Groundwater and main channel flow conditions will also be monitored to confirm the design elevations are performing as intended. If sediment deposition blocks entrances or flow becomes intermittent, adaptive measures may include targeted excavation, grade control installation, or vegetation removal.

Success is defined by sustained perennial flow and establishment of functional rearing habitat. Monitoring may conclude early if objectives are met before Year 10, but renewed monitoring may be triggered by major floods that alter channel morphology.

Excavation of Inactive Floodplain Channels Monitoring: Monitoring begins with baseline documentation of channel remnants, soil moisture, inundation patterns, vegetation composition, and groundwater interactions. During construction, channel grading and elevations will be surveyed to confirm design accuracy. Post-construction monitoring will occur at Year 1 and every two years through Year 10.

Monitoring will focus on inundation frequency and duration, development of riparian vegetation, changes in groundwater levels, sediment deposition, wildlife use, and channel stability. Remote sensing and field surveys will document seasonal flooding. If channels dry out prematurely or become overly incised, adaptive measures could include additional excavation, installation of grade controls, or planting water-tolerant vegetation.

Success is achieved when floodplain channels exhibit predictable inundation and support diverse wetland and riparian vegetation. Unexpected hydrologic changes or major climate-driven shifts may require additional monitoring beyond Year 10.

Excavation of Uplands to Wetlands Monitoring: Baseline monitoring will document topography, hydrology, groundwater conditions, soil composition, and vegetation communities. During construction, surveys will verify excavation depths and contours. Post-construction monitoring at Years 1, 3, 5, 7, and 10 will evaluate water retention, vegetation establishment, and soil saturation.

Metrics include hydroperiod characteristics, percent cover of emergent vegetation, invasive species presence, water quality parameters such as turbidity and nutrients, and wildlife usage. If wetlands fail to retain water or vegetation establishment is poor, adaptive measures may include microtopographic adjustments, supplemental plantings, or installation of water control features.

Early success is indicated by consistent seasonal inundation and colonization by wetland vegetation. If objectives are reached before Year 10, monitoring may end, although drought or hydrologic shifts may trigger renewed monitoring.

Filling of Open Channel Segments Monitoring: Monitoring begins with baseline assessments of channel geometry, erosion patterns, and hydrology. During construction, fill placement and compaction will be inspected, and as-built elevations surveyed. Post-construction monitoring at Year 1 and biennially through Year 10 will evaluate structural stability and ecological function.

Metrics include bank stability, sediment movement, vegetation establishment on filled areas, flow redirection success, and whether unintended erosion develops upstream or downstream. If fill material erodes or shifts, corrective actions may include regrading, adding rock or wood reinforcement, or planting deep-rooted vegetation.

Success is achieved when flow is redirected as intended and the filled segments remain stable. Monitoring may conclude early if all performance standards are met. Major hydrologic events may require additional post-event inspections.

Construction of Controlled Access Points Monitoring: Baseline monitoring will document existing access patterns, erosion hotspots, and vegetation loss. During construction, placement of gravel surfacing, signage, and stabilization features will be inspected. Post-construction monitoring at Years 1, 3, 5, 7, and 10 will evaluate durability, user compliance, and erosion control performance.

Metrics include surface stability, sedimentation levels near access points, vegetation conditions adjacent to trails, and evidence of unauthorized access. If erosion occurs or compliance is low, adaptive measures may include resurfacing, installing barriers, adjusting signage, or enhancing public education.

Success is indicated by stable, well-defined access routes with minimal environmental impact. Recreational use patterns or unexpected site disturbances may require continued monitoring after Year 10.

Bankline Excavation to Expand Floodplain Monitoring: Baseline data will be collected on existing bank geometry, floodplain width, vegetation, and erosion patterns. Construction monitoring will verify excavation depths, slopes, and stabilization work. Post-construction monitoring at Years 1, 3, 5, 7, and 10 will focus on hydrologic connectivity, vegetation colonization, and bank stability.

Metrics include floodplain inundation frequency, bank erosion rates, development of riparian vegetation, sediment deposition, and hydraulic performance during high flows. If instability occurs, adaptive measures may include additional grading, installation of bioengineered bank treatments, or supplemental planting.

Success is defined by expanded floodplain connectivity and stable banks supporting native vegetation. Large flow events or geomorphic shifts may require additional monitoring after Year 10.

2.1.4 Use of Monitoring Results and Analysis

Results of monitoring will be assessed in comparison to project objectives and decision-making triggers to evaluate whether the project is functioning as planned and whether adaptive management actions are needed to achieve project objectives. The results of the monitoring will be provided to the AMT who will evaluate and compare data to project objectives and decision-making triggers. The AMT will use the monitoring results to assess habitat responses to management, evaluate overall project performance, and make recommendations for adaptive management actions as appropriate. If monitoring results, as compared to desired outcomes and decision-making triggers show that project objectives are not being met, the AMT will evaluate causes of failure and recommend adaptive management actions to remedy the underlying problems.

As data is gathered through monitoring, more information will also be available to address uncertainties and fill information gap. Uncertainties such as effective operational regimes, restoration design needs, benefits generated by restored features, and accuracy of models can be evaluated to inform adaptive management actions and future restoration needs.

2.2 COST OF MONITORING

Section 2039 of the WRDA 2007 allows monitoring to be cost-shared for up to ten years post-construction. Therefore, for cost estimating purposes the maximum cost-shared monitoring period (10 years) was assumed for all features. Each monitoring metric will be detailed in terms of monitoring methods, locations, frequency and duration in the main report.

SECTION 3 - ADAPTIVE MANAGMENT

Scientific, technological, socio-economic, engineering, and institutional uncertainties are challenges inherent with any large-scale ecosystem restoration project. A structured monitoring plan will be implemented to provide the feedback necessary to inform decisions about future project adjustments.

Adaptive management is distinguished from more traditional monitoring in part through implementation of an organized, coherent, and documented decision process. For this project, the adaptive management program decision process will include

- Anticipation of the kinds of management decisions that are possible within the original project design.
- Specification of values of performance measures that will be used as decision-criteria.
- Establishment of a consensus approach to decision making; and
- A mechanism to document, report, and archive decisions made during the timeframe of the adaptive management program.

3.1 RATIONALE FOR ADAPTIVE MANAGMENT

The primary incentive for implementing an adaptive management program is to increase the likelihood of achieving desired project outcomes given project uncertainties. All ecosystem restoration projects face uncertainty due to incomplete understanding of relevant ecosystem structure and function, resulting in imprecise relationships between project actions and corresponding outcomes. Given these uncertainties, adaptive management provides an organized and coherent process that suggests management actions in relation to measured project performance compared to desired project outcomes. Adaptive management establishes critical feedback among project monitoring, and informed project management, and learning through reduced uncertainty.

Many factors such as ecosystem dynamics, engineering applications, institutional requirements, and many other key uncertainties can change and/or evolve over a project's life. The MAMP will be regularly updated to reflect monitoring-acquired and other new information as well as resolution and progress on resolving existing key uncertainties or identification of any new uncertainties that may emerge. Specifically, the MAMP will be revised and updated and project measure specific plans developed during the feasibility level of design phase and further in pre-construction engineering and design (PED) phase as more detailed project designs are developed and uncertainties are better understood. The MAMP would then be used during and after project construction to adjust the project, as necessary to better achieve goals, objectives, and restoration/management outputs/results.

3.2 ASSESSMENT

The assessment phase of the adaptive management framework describes the process by which the results of the monitoring efforts will be compared to the project performance measures, which reflect the objectives of the restoration actions.

The results of the monitoring program will be assessed annually through the AMT. Monitoring results will be compared to the desired project outcomes and decision-making triggers as set forth by the project performance measures. This assessment process will measure the progress of the project in relation to the stated project objectives, evaluate project effectiveness and consider if adaptive management actions are needed. Assessments will also inform the AMT if other factors are influencing the response that may warrant further research.

USACE will document and report the monitoring results, assessments, and the results of the AMT deliberations to the managers and decision-makers designated for the project. USACE, with assistance from the monitoring team, will also produce annual reports that show progress towards meeting project objectives as characterized by the performance measures. Results of the assessments will be used to evaluate adaptive management needs and inform decision-making.

3.2.1 Database Management

Database management is an important component of the monitoring plan and the overall adaptive management program. Data collected as part of the monitoring and adaptive management plans will be archived as prescribed in the refined monitoring and adaptive management plan developed during PED. The database manager will be responsible for storing final monitoring reports and other study documentation (decisions, agendas, reports) and making them available when requested. Monitoring reports will be searchable by topic and principle author.

Data standards, quality assurance and quality control procedures and metadata standards will also be prescribed in the refined monitoring and adaptive management plan. The database will be designed to store and archive the monitoring and adaptive management data. The format of each data set will vary as appropriate to the type of monitoring. Therefore, data are expected to be archived separately, rather than collated in one master database. Each dataset will include data and metadata transfer and input policies and standards; data validation procedures; and mechanisms to ensure data security and integrity.

3.3 DECISION-MAKING

Decisions on the implementation of adaptive management actions are informed by the assessment of monitoring results. The information generated by the monitoring plan will be used by USACE and the NFS in consultation with other AMT members to guide decisions on adaptive management that may be needed to ensure that the ecosystem restoration project achieves success. Final decisions on implementation of adaptive management actions are made by USACE.

If monitoring determines that a management trigger has been “activated” then there are three possible response pathways:

1. Determine that more data is required and continue (or modify) monitoring.
2. Identify and implement a remedial action.
3. Modify project goals and objectives (this option would only be considered as a last resort and upon careful consideration by and consensus of the PDT and AMT).

3.3.1 Decision Criteria

Decision criteria, also referred to as adaptive management triggers, are used to determine if and when adaptive management opportunities should be implemented. They can be qualitative or quantitative based on the nature of the performance measure and the level of information necessary to make a decision. Desired outcomes can be based on reference sites, predicted values, or comparison to historic conditions. Several potential decision criteria are identified below, based on the project objectives and performance measures. More specific decision criteria, possibly based on other parameters such as hydrology, geomorphology, and vegetation dynamics, may be developed during PED.

If assessments show that any of these triggers are met, USACE would consult with the AMT to discuss whether an adaptive management action is warranted, and if so, what that action should be. Investigations may be required to determine the cause of failure in order to inform the type of adaptive management actions that should be implemented, if needed. Additionally, prior to enacting any adaptive management measures, USACE would assess whether supplemental environmental analyses are required. Adaptive Management triggers with potential decision criteria for each element below:

Element: Inspection

Performance Measure:
Conduct and document 100 percent of scheduled inspections within 30 days of qualifying flow events, with all corrective action reports closed within 90 days of identification.

Desired Outcome:
Inspections occur on schedule and identify issues early, ensuring project features remain functional and self-sustaining.

Trigger:
• Missed inspection window by more than 30 days.
• Corrective actions remain unresolved beyond 90 days.

Possible Causes:
• Limited staff availability.

• Restricted site access due to flows or weather.
• Incomplete or unclear inspection procedures.

Adaptive Management:
• Reallocate inspection staff or contract additional support.
• Adjust access points or seasonal inspection timing.
• Revise inspection forms and responsibilities for clarity.

Beaver Dam Analogs (BDAs)

Performance Measure:
Maintain at least 80 percent of BDAs functioning by Year 5 and thereafter.

Desired Outcome:
BDAs spread water into floodplain benches, slow flows, and trap sediment as intended.

Trigger:
• Less than 80 percent of BDAs are impounding water or remain structurally intact.

Possible Causes:
• High-flow damage.
• Improper anchoring or construction.
• Lack of natural sediment and wood recruitment.

Adaptive Management:
• Repair damaged BDAs and improve anchoring.
• Add woody material or sediment to support structural function.
• Reassess placement strategy to align with flow regime.

Gravel Path/Landing

Performance Measure:
Maintain more than 90 percent of O&M gravel path/landing length or area in stable, passable condition by Year 3 and beyond.

Desired Outcome:
Reliable access for monitoring and maintenance with minimized erosion or rutting.

Trigger:
• More than 10 percent of the path becomes impassable or exhibits erosion exceeding 2 inches depth.

Possible Causes:
• Concentrated runoff or poor drainage.

• Unauthorized use or vehicle overloading.
• Lack of routine leveling.

Adaptive Management:
• Improve drainage features or install water bars.
• Conduct resurfacing or grading.
• Add signage limiting access to appropriate vehicles.

Rootwads

Performance Measure:
Ensure at least 75 percent of rootwads remain stable and provide cover or roughness through Year 10.

Desired Outcome:
Functional fish habitat, bank roughness, and sediment retention.

Trigger:
• More than 25 percent of rootwads become dislodged, buried, or ineffective.

Possible Causes:
• Unexpected high-flow events.
• Insufficient embedment.
• Sediment starvation or excessive deposition.

Adaptive Management:
• Reinstall or improve anchoring.
• Add supplemental rootwads or ballast.
• Reevaluate placement relative to hydraulics.

Vegetation Maintenance:

Performance Measure:
Achieve 70 percent survival of planted native vegetation by Year 5 and maintain 80 percent native dominance through Year 25.

Desired Outcome:
Stable, native-dominated riparian and wetland vegetation supporting habitat development.

Trigger:
• Survival drops below 70 percent.
• Non-native cover exceeds 20 percent.

Possible Causes:
• Poor soil moisture conditions.
• Flood scouring or drought.

• Invasive species establishment.
• Herbivory.

Adaptive Management:
• Replant or infill areas with native species.
• Increase invasive species removal frequency.
• Install temporary exclosure or irrigation during establishment.
• Adjust species selection based on site performance.

Channel Maintenance

Performance Measure:
Maintain channel cross-sections within plus or minus 10 percent of design dimensions and sustain at least 80 percent of intended side-channel wetted length during design flows through Year 25.

Desired Outcome:
Consistent connectivity and sediment routing without major regrading needs.

Trigger:
• Over widening, aggradation, or incision beyond 10 percent of design.
• Side-channel becomes disconnected for more than 20 percent of intended length.

Possible Causes:
• Sediment pulses from upstream.
• Flow regime anomalies.
• Beaver activity altering flow paths.

Adaptive Management:
• Conduct targeted regrading or sediment removal.
• Install grade controls or roughness elements.
• Adjust flow distribution structures if needed.

Gravel 2-inch Surfacing

Performance Measure:
Maintain 95 percent of surfaced areas with no more than 2 inches of rutting at each 5-year evaluation.

Desired Outcome:
Stable surfaces that reduce sediment delivery to the river and maintain access.

Trigger:
• More than 5 percent of surfaced areas exceed 2 inches of rutting or erosion.

Possible Causes:
• Concentrated flow or washouts.

- Heavy equipment traffic.
- Improper compaction.

Adaptive Management:
- Regrade and resurface eroded sections.
- Install drainage improvements.
- Limit access during saturated conditions.

Riprap

Performance Measure:
Maintain 90 percent toe integrity and rock interlock at all riprap sites through Year 10.

Desired Outcome:
Long-term bank stability and prevention of lateral erosion.

Trigger:
- Loss of interlock or visible voids in more than 10 percent of treated areas.
- Undermining of toe by scour.

Possible Causes:
- Higher-than-expected velocities.
- Toe exposure or settlement.
- Ice scour or foot traffic.

Adaptive Management:
- Add supplemental riprap or rework toe.
- Increase embedment depth.
- Combine with vegetative stabilization for added resilience.

3.4 PROJECT CLOSE-OUT

Once ecological success has been documented by the District Engineer in consultation with the Federal and State resource agencies, and a determination has been made by the Division Commander that ecological success has been achieved, no further monitoring or adaptive management will be required, and the project can be closed out. Ecological success will be documented through an evaluation of the predicted outcomes as measured against the actual results. Success would be considered to have been achieved when project objectives have been met or when it is clear they will be met based upon the trend of site conditions and processes.

The project could also be closed out when the maximum 10-year monitoring period has been reached. If that should occur prior to ecological success being achieved, the NFS would be responsible for monitoring and adaptive management beyond the 10 years.

3.5 ADAPTIVE MANAGEMENT COSTS

The MAMP establishes a feedback mechanism whereby monitored conditions will be used to adjust or refine construction or maintenance actions to better achieve project goals and objectives. Monitoring and adaptive management are not used as a substitute for OMRRR. Per WRDA 1986, as amended by Section 210 of WRDA 1996, the NFS would be responsible for all OMRRR. This includes operations and maintenance (O&M) that provides day-to-day activities necessary to properly operate a component of a system and routine maintenance activities to keep the system operating as designed. This also include non-routine or beyond the scope of typical O&M activities of repair or fixing damage caused by an event; rehabilitation or fixing long-term wear and tear; and replacement of components when the useful life is exceeded.

In contrast, periodic monitoring of performance indicators which contain trigger values informs the iterative process of implementing specified adaptive management measures to help achieve ecological success. However, the project area is susceptible to several uncertainties that could significantly impact the ecological success of constructed restoration features as described in Section 3.

This cost will be presented in the main report, as those numbers will have a contingency cost attached that will be developed by the cost engineer.

SECTION 4 - REFERENCES

Fischnecich, C., et al. 2012. The Application of Adaptive Management to Ecosystem Restoration Projects. EBA Technical Notes Collection. ERDC TN-EMRRP-EBA-10. Vicksburg, MS: US Army Engineering Research and Development Center. www.wes.army.mil/el/emrrp.