US Army Corps
of Engineers ®
Walla Walla District

SWEETWATER CREEK ECOSYSTEM RESTORATION

Feasibility Report with
Integrated Environmental Assessment

Appendix G

Monitoring and Adaptive Management Plan

This page intentionally left blank.

SWEETWATER CREEK ECOSYSTEM RESTORATION
FEASIBILITY REPORT WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

APPENDIX G, MONITORING AND ADAPTIVE MANAGEMENT PLAN

TABLE OF CONTENTS

SECTION 1 - INTRODUCTION G-1

1.1 Authority and Purpose G-1

SECTION 2 - PROJECT ADAPTIVE MANAGEMENT PLANNING G-2

2.1 Project Goals, Objectives, and Restoration Measures G-2

2.2 Project Uncertainty and Risk G-4

2.3 Objectives Monitored G-4

SECTION 3 - MONITORING, SUCCESS CRITERIA, ADAPTIVE MANAGEMENT TRIGGER AND ACTIONS G-6

3.1 Adaptive Management Process G-6

3.1.1 Monitoring G-6

3.1.2 Reporting G-8

3.1.3 Success Criteria G-9

3.1.4 Adaptive Management Triggers and Actions G-11

SECTION 4 - MONITORING AND ADAPTIVE MANAGEMENT COST ESTIMATE G-15

SECTION 5 - REFERENCES G-16

TABLES

Table 1. Summary of Success Criteria for Post-Restoration Monitoring G-10

Table 2. Proposed Adaptive Management Actions for Riparian Plantings G-13

Table 3. Preliminary Native Plant List for Sweetwater Creek Riparian Restoration G-14

Table 4. Cost Estimate for Monitoring and Adaptive Management G-15

SECTION 1 - INTRODUCTION

This appendix presents the feasibility level monitoring and adaptive management plan for the Sweetwater Creek Ecosystem Restoration Project (Project) under the U.S. Army Corps of Engineers (Corps) Tribal Partnership Program. This plan identifies and describes the monitoring and adaptive management activities proposed for the Project and estimates associated costs and duration. This plan will be further developed in the pre-construction, engineering, and design (PED) phase as specific design details are made available.

1.1 AUTHORITY AND PURPOSE

Section 2039 of the Water Resources Development Act (WRDA) of 2007, requires feasibility studies for ecosystem restoration to include a plan for monitoring the success of the ecosystem restoration. According to the WRDA 2007, "monitoring includes the systematic collection and analysis of data that provides information useful for assessing project performance, determining whether ecological success has been achieved, or whether adaptive management may be needed to attain project benefits." Section 2039 states that a contingency plan (adaptive management plan) should be developed for all ecosystem restoration projects.

This document lays out the monitoring and adaptive management requirements for the Sweetwater Creek Ecosystem Restoration project, and established success criteria and associated adaptive management triggers.

SECTION 2 - PROJECT ADAPTIVE MANAGEMENT PLANNING

The resulting adaptive management plan for the Sweetwater Creek Ecosystem Restoration describes and discusses whether adaptive management is needed in relation to Recommended Plan identified in the Feasibility Report/ Environmental Assessment. The plan also identifies how adaptive management would be conducted for the project and who would be responsible for this Project-specific adaptive management. The developed plan outlines how the results of the Project-specific monitoring program would be used to adaptively manage the Project, including specification of conditions that will define Project success.

The primary intent of the Adaptive Management Plan is to develop monitoring and adaptive management actions appropriate for the Project's restoration goals and objectives. The specified management actions permit estimation of adaptive management costs and duration for the Project. This Section of the Adaptive Management Plan 1) Identifies the restoration goals and objectives identified for the Project; and 2) Lists sources of uncertainty that would recommend the use of adaptive management for this Project.

Subsequent sections describe monitoring, assessment, and decision-making in support of adaptive management. 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 monitoring and adaptive management plan, including costs, were similarly estimated using currently available information.

2.1 PROJECT GOALS, OBJECTIVES, AND RESTORATION MEASURES

The Sweetwater Creek Ecosystem Restoration Recommended Plan will restore contiguous reaches of aquatic and riparian habitat in a unique tributary to Lapwai Creek, which is a tributary to the Clearwater River near Spalding, Idaho. The unique properties of Sweetwater Creek include a year-round stable water temperature optimal for salmonid spawning and rearing, yet instream habitat complexity and riparian habitat quality have degraded from flood risk management measures at the private landowner level, as well as other land use practices including irrigation diversions and agricultural practices.

The goal of the Recommended Plan is to restore long-term aquatic and terrestrial ecosystem function. An effective monitoring program will determine if project outcomes are consistent with the original project planning objectives. The objectives for Sweetwater Creek are:

- Improve degraded aquatic habitat to include, quality, quantity and function in the Lapwai/Sweetwater watershed over the period of analysis.

- Improve degraded riparian habitat to include, quality, quantity and function in the Lapwai/Sweetwater watershed over the period of analysis.

A plan formulation process was conducted to identify alternative plans that address the project planning objectives. Many alternatives (combinations of measures) were considered, evaluated, and screened to identify the recommended alternative that provided the greatest benefit to the project (see main report for details).

The Recommended Plan includes site plans 1.2, 5.1, and 7.1. Measures include the following key components:

- Riparian restoration with native plant diversity, cattle exclusion fencing, and invasive species control in all three reaches.
- Channel realignment to improve sinuosity and natural riffle-run-pool sequencing in reaches 5 and 7.
- Channel enhancement in all reaches to include minor grading to create lateral pools, backwaters and side channel activation.
- In-stream structures in all reaches include strategically placed apex log jams and boulders to improve coarse physical habitat structure.
- Floodplain enhancement and connectivity in all reaches to reduce the floodplain saturation return interval and increase saturation duration.
- Bank grading in all reaches to lay back eroding vertical slopes and applying wood as a habitat enhancement that stabilizes the slope toe from erosion.
- Levee and berm work reach 1. Existing push-up berms would be notched in reach 1 to capture new floodplain connectivity.

The combination of floodplain connectivity, riparian restoration and in-stream habitat improvements encompasses maximum habitat potential for all fish and wildlife species, while tremendously improving Sweetwater Creek's function as an ESA-listed Steelhead stronghold. These improvements, combined with the presently optimal water temperature, will present year-round juvenile rearing opportunity, enhanced food sources and increase resting and spawning habitat for upstream migrating adults.

2.2 PROJECT UNCERTAINTY AND RISK

Scientific uncertainties and technological challenges are inherent with any ecosystem restoration project because available data and information about any project is never perfect or complete. Adaptive management provides a coherent process for making decisions in the face of uncertainty. Scientific uncertainties and technological challenges are inherent with any ecosystem restoration project.

Risk is defined as the probability of an undesirable consequence. In the context of ecosystem restoration, risk exists because there is uncertainty about realizing positive net benefits from implementing a project. The dominant risks associated with the Recommended Plan are the potential for undesirable ecological outcomes that could result from natural hazards or human actions. Potential risks include:

- Inadequate riparian vegetation cover and abundance of invasive and non-native species which inhibit native vegetation growth.
- Unpredictable changes to the riparian or in-stream habitat from stochastic events (e.g., record flooding) could change the physical characteristics of the stream channel and structures, reducing the overall habitat suitability.

Many risks can be avoided or minimized by proper design and correct seasonal timing for implementing the proposed measures. Nevertheless, uncertainty and an associated level of risk have potential to influence the project and compel the need for monitoring and adaptation. These risks will be considered and closely monitored to configure the appropriate adaptation approach.

2.3 OBJECTIVES MONITORED

Monitoring includes the systematic collection and analysis of data that provides information useful for assessing project performance, determining whether ecological success has been achieved, or whether adaptive management may be needed to attain project benefits. The following habitat factors will be monitored, as well as plant survival and percent non-native plants.

A. Total woody plant survival (FACStream variables Vveg).

B. Woody plant community structure (percent cover; FACStream variables Vveg).

    - Shrub structure.
    - Tree structure.

C. Herbaceous plant community structure (percent native cover; FACStream variables Vveg).

D. Percent non-native vegetation (FACStream variables Vveg).

E. Coarse in-stream habitat distribution (FACStream variables Vstr).

These habitat factors and the specifics of habitat modeling are detailed in Appendix B, *Habitat Evaluation Modeling.* Monitoring is discussed in detail for each of the above factors in Section 3.

SECTION 3 - MONITORING, SUCCESS CRITERIA, ADAPTIVE MANAGEMENT TRIGGER AND ACTIONS

This section describes project potential adaptive management actions, success criteria, adaptive management triggers, and site monitoring.

3.1 ADAPTIVE MANAGEMENT PROCESS

Adaptive management redirects the restoration effort in the event that the system does not function or evolve as predicted. The adaptive management process consists of the following steps, which rely on monitoring.

Step 1. Monitor and assess progress of restoration.

Step 2. Identify potential adverse conditions impacting restoration progress.

Step 3. Identify if potential adverse conditions can or should be remedied.

Step 4. Implement the appropriate adaptive management action, as required.

Step 5. Replant or replace physical habitat features.

3.1.1 Monitoring

Post-construction monitoring is required to determine whether the project is achieving the success criteria and to support the adaptive management decision-making process. Monitoring is the responsibility of the local sponsor per requirements of Continuing Authorities Program projects.

The post-construction monitoring program is designed to track the initial development of the project area to determine if riparian habitat is developing as projected, and that any adverse impacts are within the expected ranges. Monitoring will consist of plant survival, density and cover, and coarse physical in-stream habitat surveys conducted at a time within the year preferable for the sponsor, but shall be consistent across year. Ten years of post-construction monitoring is anticipated.

A. Total woody plant survival (FACStream variables Vveg).

Plant survival must be monitored and will consist of a consensus of all shrub and tree species planted. Survival should be reported as percent of the total within each reach for trees and shrubs separately to inform adaptive management decision-making. Survival metrics are presented in Section 3.1.3.

B. Woody plant community structure (percent cover; FACStream variables Vveg).

For plant density and cover metrics, a total of 4 random points within each reach, 2 occurring on both sides of the creek and spaced approximately 300 linear feet apart, will be assigned for sampling for the first monitoring season. The same points sampled in year 1 will be used for all future monitoring for successional comparisons.

At each point, surveyors will measure the following specific habitat factors with their associated methods within a 9.9-foot (3 meter) radius plot using the point latitude and longitude as the plot center, and photo document habitat conditions. Plot sizes and measurements for the habitat factors below were based on standard plant cover measurement practices but modified for this specific monitoring effort. Plot sizes and shrub canopy measurements are not standardized for forestry practices; however, they are appropriate for monitoring riparian growth as the plots will be compared to themselves over time. Standardizing sampling across years and surveys within these methods for this project is recommended.

- Shrub structure.

The percent deciduous shrub canopy cover will be measured with a densiometer, 3.3 feet (1 meter) from the ground surface in approximately the middle of the plot. Densiometers are designed to measure canopy cover at chest height for trees, not shrubs. Therefore, measuring shrub crown cover closer to the ground surface at a standardized height is appropriate for deciduous plants that will reach a maximum height of ≤ fifteen feet. The surveyor should exclude cottonwood, or other tree canopy cover from this measurement as it is shrub-specific. This can be done by ignoring cover reflected in the densiometer from overhead trees, which can be identified by leaf shape and color.

- Tree structure.

The percent overall canopy cover will be measured with a densiometer at chest height, including all overhead cover at approximately the middle of the plot.

C. Herbaceous plant community structure (percent native cover; FACStream variables Vveg).

Visually estimate the total percent ground cover, percent grass cover, percent forb cover, percent “other” if applicable, and percent bare ground within each 9.9-foot (1 meter) radius plot using 3 randomly placed 3.3-feet (1 meter) radius subplots.

D. Percent non-native vegetation (FACStream variables Vveg).

The percentage of noxious weeds and non-native vegetation, if too high within a given plot, may inhibit the establishment of native vegetation. Therefore, within each subplot of the 9.9-foot (3 meter) radius plot, visually estimate the percentage of non-native plants and document species for future treatment.

Additionally, during the plant survival survey, survey crews will visually estimate the species and percentage throughout the reach, marking "hot spots" [greater than or equal to 54 square feet (5 square meters)] with a global positioning system (GPS) to map high densities of non-native species for treatment.

E. Coarse in-stream habitat distribution (FACStream variables Vstr).

Qualitative estimates of the proportion of coarse habitat structure within each reach will be collected by walking the reach 60 days post-construction, and the same day as the plant survival estimate each subsequent year. The 60-day wait between construction and the initial evaluation is to allow the fresh earthwork and structure placement to adjust to the flow to provide a more accurate baseline.

Habitat features evaluated include large woody debris, boulders, gravel, fines, riffle, run, pool, and backwater/eddy. Large woody debris is defined as 9.9 feet long (3 meters) and 4 inches (10 centimeters) in diameter, located in water, leaning over water at 45 degrees or less (Dunham et al. 2003), and in the riparian area or on the floodplain as available debris with flood flows (Wohl et al. 2018).

The approximate number of occurrences of each feature will be tallied during a walk of the complete reach and the proportion of each estimated within the reach. Post-construction will provide a baseline and future estimates can be compared to see if unusually higher or lower frequencies of each feature are occurring within a reach over time.

3.1.2 Reporting

Following each monitoring effort, a report will be prepared that includes a summary of the findings for each of the above habitat factors, as well as the following:

- A table broken out by species planted showing the number of each species that died and the overall % survival of trees and shrubs.
- A table with the plot data showing tree and shrub canopy cover, percentage ground cover among grasses and forbs, and percentage invasive species by 3.3-foot (1 meter) subplot. Percentages should also be averaged to represent the larger 9.9-foot (3 meter) plot. Exotic and invasive species may include any species on the state noxious weed list, or considered a

noxious or problem weed by the Natural Resource Conservation Service, local conservation districts, local weed control boards, or the Nez Perce Tribe.

- Maps of the island that shows the plots and "hot zones" for high plant mortality and noxious/invasive weed abundance.
- A table that summarizes the coarse habitat feature distribution by reach.
- A discussion of trends over time relative to invasive species presence and plant survival/mortality to identify if specific species need more attention or replacement with an alternative species. Additionally, discuss any changes over time relative to coarse habitat features including wood recruitment from the floodplain, etc.
- An appendix with raw data for each plot and coarse habitat tallies by reach.
- Observation of plant disease, predation, or other disturbances.
- Observation of fish or wildlife utilizing habitat features.

Monitoring reports shall be submitted to the Corps at years 1, 3, 5, and 10 post-construction. Monitoring reports shall be submitted by a qualified, professional biologist. The biologist must verify that the conditions of approval and provisions in the adaptive management plan have been satisfied.

3.1.3 Success Criteria

Success criteria were established as follows for the above five habitat factors based on expected growth within ten years, plant survival targets, and noxious weed control. Expected plant growth was used to estimate project benefits over time and provides an appropriate metric for success criteria. Success criteria are detailed below and summarized in Table 1.

A. Total woody plant survival (FACStream variables Vveg).

Shrubs must survive at 80% annually for the first 5 years, then at 65% out to 10 years. Trees such as cottonwood and alder must survive at 80% across all 10 years.

B. Woody plant community structure (percent cover; FACStream variables Vveg).

- Shrub structure.

Percent deciduous shrub canopy cover is estimated to be approximately 25 percent overall at year 1, between 25 and 40 percent at year 3, 40 to 50 percent by year 5, and over 50 percent by year 10. Any percentage estimate within these ranges represents success. Shrub canopy cover

below these respective ranges suggests a potential growth limiting factor such as a lack water or nutrition.

- Tree structure.

Percent deciduous tree canopy cover is estimated to be less than 25 percent overall at year 1, 25 to 35% percent by year 3, 35 to 40 percent by year 5, and over 50% by year 10. Any percentage estimate within these ranges represents success. Tree canopy cover below these respective ranges suggests a potential growth limiting factor such as a lack water or nutrition.

C. Herbaceous plant community structure (percent native cover; FACStream variables Vveg).

Because no literature clearly quantified post-restoration ground cover in cottonwood gallery riparian habitats, it is assumed, based on professional judgement, that native ground cover would meet or exceed 25 percent at Year 1, 40 percent at Year 3, 50 at Year 5, and would be greater than 50 percent at Year 10.

D. Percent non-native vegetation (FACStream variables Vveg).

The percentage of non-native vegetation may be as high as 50% in the first year following ground disturbance. Following treatments, the percentage is expected to be below 30 percent by year 3, below 20 percent by year 5, and at or below 10 percent at year 10.

E. Coarse in-stream habitat distribution (FACStream variables Vstr).

Given the relative proportional distribution of coarse habitat features is to be monitored qualitatively within each reach, maintaining approximate post-construction proportions within ± 10 percent through year 10 is considered successful.

Table 1. Summary of Success Criteria for Post-Restoration Monitoring

Metric	Criteria
Plant Survival	80 percent years 1 – 5 (shrubs) 65 percent at year 10 (shrubs) 80 percent across years (trees)
Shrub Cover	25 percent at year 1 25 – 40 percent by year 3

	40 – 50 percent by year 5 Over 50 percent by year 10
Tree Cover	< 25 percent at year 1 25 – 35 percent by year 3 35 – 40 percent by year 5 >50 percent by year 10
Herbaceous Cover (Native)	25 percent by year 1 40 percent by year 3 50 percent by year 5 >50percent by year 10
Percent Non-Native Vegetation	≤50 percent in year 1 ≤30 Percent in year 3 ≤20 Percent in year 5 ≤10 percent in year 10
Coarse In-stream Habitat	± 10 percent of post-construction feature distribution across years

3.1.4 Adaptive Management Triggers and Actions

As a broader adaptive management action, noxious weed control will occur throughout the restored riparian to aid in plant establishment and dominance. Herbicide and physical control methods will be employed and adjusted to the appropriate level of effort throughout the life of the project.

If annual plant survival and noxious weed presence and success criteria are not met, action will need to be taken. If after a 5 year period the success criteria are not met for habitat factors, then adaptive management actions may be necessary. Such actions may be undertaken by the sponsors prior to the end of the five years, if deemed appropriate.

Plantings must have 80 percent survival, monitored annually, for the first 5 years after planting. After the first 5 years, survival must be maintained at 65 percent for shrubs and 80 percent for

trees out to year 10. Individual plants that die must be replaced in kind (i.e., replace a tree with a tree) with species from the list agreed upon between the Corps and the Nez Perce Tribe.

As part of the adaptive management process, the Nez Perce Tribe will assess the monitoring data to determine the reasons for not meeting the above criterion. Potential adaptive management response actions are presented in Table 2, and a preliminary planting list is provided in Table 3. While all plants listed in Table 3 would be acceptable, any native plant considered appropriate by Nez Perce Tribal biologists would be considered acceptable.

Table 2. Proposed Adaptive Management Actions for Riparian Plantings

Problem	Adaptive Management Actions
Site does not meet plant survivorship or cover requirements (habitat metrics A-C) 80% annually for 5 years (all plants) 65% annually for shrubs and 80% for trees at 10 years.	• Evaluate reasons for mortality (e.g., poor soil conditions, insufficient moisture, incorrect planting, browsing by wildlife, vandalism). • Address cause for mortality and replant to exceed survivorship or cover requirements (Sponsor is responsible for replacing plant materials that die during the 10 year monitoring period). • Provide protective measures if appropriate. • Modify monitoring period, if necessary. • Replace dead plants with a different species if certain species are experiencing high mortality
Over-competition by invasive species, meaning more than 20% cover in the restoration area at year 5 (habitat metrics A-D).	• Evaluate predominant invasive species in the restoration areas. • Initiate invasive species control protocols appropriate to species type, conditions of infestation area (wetland or buffer), and level of infestation (e.g., herbicide application, mowing, etc.). • Various treatment methods to include herbicide, biological controls, and removal will be considered and implemented as appropriate.
Site meets plant survivorship, but not expected percent cover (habitat metric B)	• Evaluate reasons for poor plant performance (e.g., poor soil conditions, insufficient moisture, incorrect planting, browsing by wildlife, vandalism). • Address plant performance issues as appropriate through irrigation, fertilizer application, pruning, etc.
Site coarse in-stream habitat has become homogenous or changed dramatically from post-construction (habitat metric E)	• Evaluate reasons for unbalanced or significant change in features (e.g. either too many or too few of specific features like riffle-run-pool sequence imbalance, large wood, boulders, backwaters, etc. • Remove, add or adjust features as needed to ensure the appropriate habitat features are present to support rearing salmonids.

Table 3. Preliminary Native Plant List for Sweetwater Creek Riparian Restoration

Common Name	Scientific Name	Planting Zone*
Coyote Willow	*Salix exigua*	SI
MacKenzie Willow	*Salix prolixa*	SI
Creeping Spikerush	*Eleocharis palustris*	SI
Softstem Bullrush	*Schoenoplectus tabernaemontani*	SI
Broad-leaved Cattail	*Typha latifolia*	SI
Black Cottonwood	*Populus balsamifera*	LT
Redosier Dogwood	*Cornus sericea*	LT
Woods Rose	*Rosa woodsii*	LT
Golden Currant	*Ribes aureum*	UT
Saskatoon Serviceberry	*Amelanchier ainifolia*	UT
Western Chokecherry	*Prunus virginiana*	UT
Gray Rabbitbrush	*Chrysothamnus viscidiflorus*	UT
Basin Big Sage	*Artemisia tridentata*	UT
Snow Buckwheat	*Eriogonum niveum*	UT
Sandberg's Bluegrass	*Poa secunda (ssp. sandbergii)*	UT
Great Basin Wildrye	*Leymus cinereus*	UT
Sand Dropseed	*Sporobolus cryptandrus*	UT
Common Yarrow	*Achillea millefolium*	UT
Camas	*Camassia quamash*	UT
Broadleaf Lupine	*Lupinus latifolius*	UT
Arrowleaf Balsamroot	*Balsamorhiza sagittata*	UT
Gray’s Biscuitroot	*Lomatium grayi*	UT
Menzies’ Fiddleneck	*Amsinckia menziesii*	UT
Orange Globe Mallow	*Sphaeralcea munroana*	UT
Showy Milkweed	*Asclepias speciosa*	UT

*SI (seasonal inundation/riparian), LT (lower transition/mesic), UT (upper transition/mesic-xeric)

SECTION 4 - MONITORING AND ADAPTIVE MANAGEMENT COST ESTIMATE

The cost estimate for monitoring and adaptation of the Sweetwater Creek Ecosystem Restoration project is based on the monitoring requirements and potential range of adaptive management measures described in Section 3. A summary of costs is presented in Table 4.

Table 4. Cost Estimate for Monitoring and Adaptive Management

Monitoring Component	Estimated Cost per year (± 20% Range)	Assumptions
Planting Success and Invasive Species Monitoring (Metrics A and D)	$5,300-$8,100	See section 3.1.1 for monitoring description. Monitoring includes vegetative survey, evaluation for invasive species, and observation of wildlife.
Plant Cover Monitoring (Metrics B and C)	$2,500-$4,000	See section 3.1.1 for monitoring description. Monitoring includes plot surveys, evaluation of tree, shrub and herbaceous ground covers.
Coarse In-stream Habitat Monitoring (Metric E)	$1,100-$1,800	See section 3.1.1 for monitoring description. Monitoring includes a qualitative survey of coarse in-stream habitat features and observation of fish utilizing habitat.
Reporting	$2,500-$4,000	See section 3.1.2 for reporting description. Annual monitoring reports shall be submitted to the Corps 1, 3, 5, and 10 years after planting. Monitoring reports shall be a summary of field survey findings sufficient to inform Project success and adaptive manage needs and decision-making. Monitoring reports shall be submitted by a qualified professional biologist.
Cost per Year	$11,000-$18,000[1]	
Total Monitoring Cost (assumes no escalation)	$48,500-$73,000	

[1]Based on rehabilitation of other restoration work, operation and maintenance costs are expected to be minimal once vegetation becomes established.

SECTION 5 - REFERENCES

Dunham, J, B Rieman and G Chandler. 2003. Influences of temperature and environmental variables on the distribution of bull trout within streams at the southern margin of its range. North American Journal of Fisheries Management 23:894-904.

Wohl, E, D Cadol, A Pfeiffer, K Jackson and D Laurel. 2018. Distribution of large wood within river corridors in relation to flow regime in the semiarid western US. Water Resources Research, 54: 1890-1904. https://doi.org/10.1002/2017WR022009.