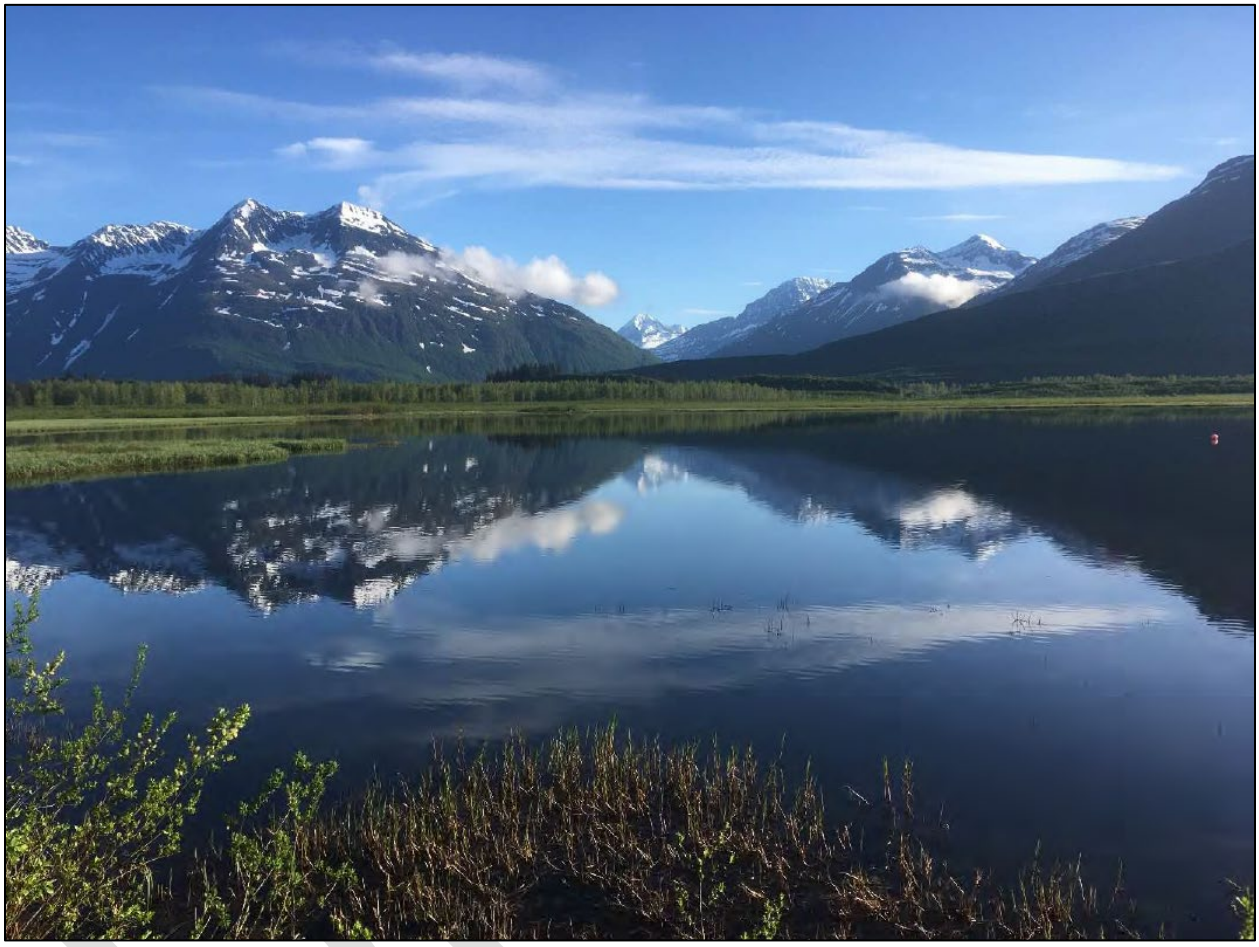
Robe Lake Ecosystem Restoration
Feasibility Study
Monitoring and Adaptive Management Plan | DRAFT
Valdez, Alaska



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Alaska District

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PROJECT OVERVIEW

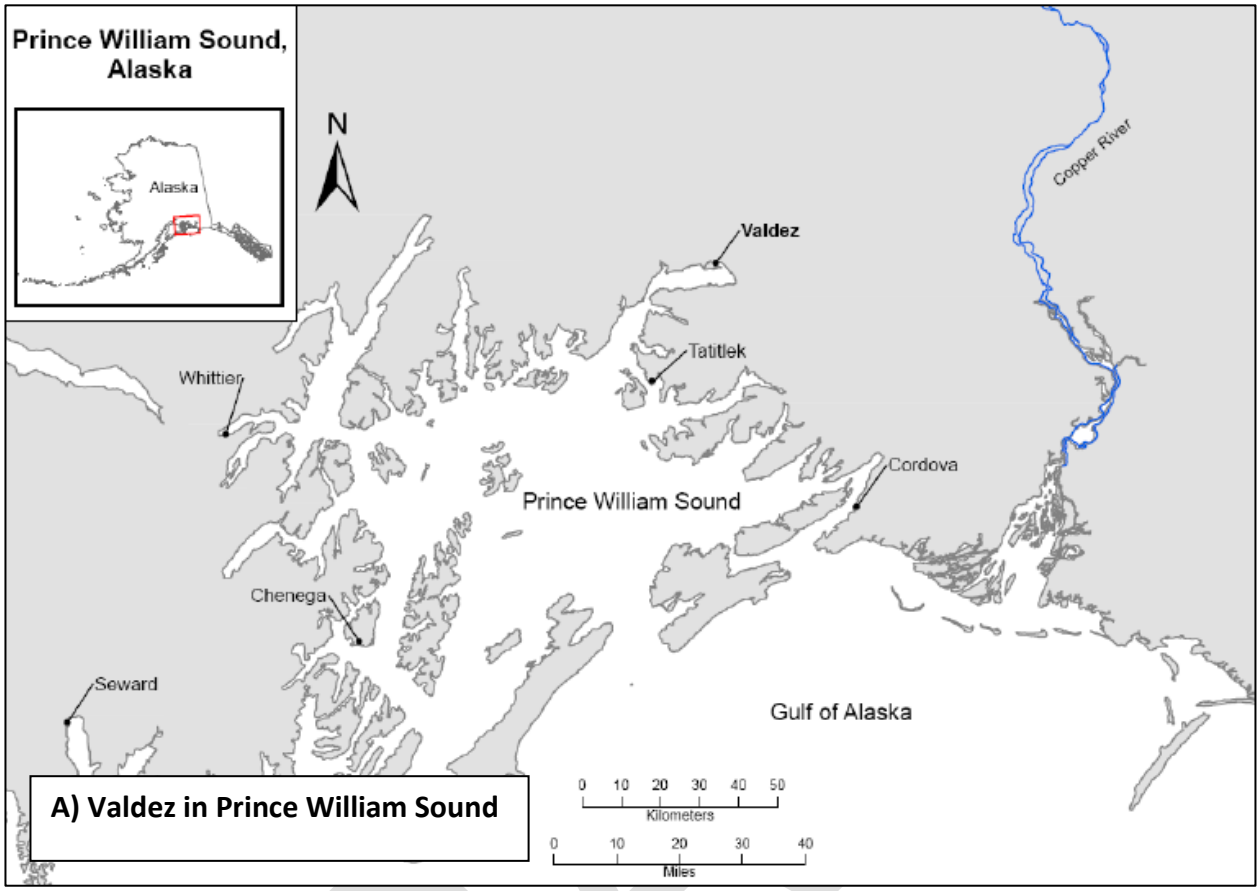
1.1. Background and History

Robe Lake is located within the northern portion of Prince William Sound (Figure 1A) in southcentral Alaska and lies within the city limits of Valdez (Figure 1B). Robe Lake is the largest freshwater lake in the Valdez area, with three tributary streams: Brownie Creek, Deep Creek, and Old Corbin Creek (Figure 2). Robe Lake empties into Robe River, which then flows under the Richardson Highway into the Lowe River.

In the 1950s a gravel berm was constructed on Corbin Creek, which heads at the terminus of Corbin Glacier, to divert flow and prevent flooding and washout of the Richardson Highway. Prior to this diversion, the main channel of Corbin Creek originally flowed into Robe Lake (Figure 3). Currently, Corbin Creek is a tributary of Valdez Glacier Stream and does not flow into Robe Lake (Figure 2). Corbin Creek's historic channel is now known as Old Corbin Creek, a relic channel with minimal flow.

Robe Lake supports stocks of various anadromous fish species and is an important salmon (*Oncorhynchus* spp.) spawning and rearing site in the Valdez area. However, the berm constructed to re-direct the flow of Corbin Creek has altered the ecology and watershed dynamics of the lake. The loss of cold, turbid, glacial flow input from the Corbin Creek tributary has facilitated an overgrowth of macrophytes (aquatic plants). The overgrowth of macrophytes have reduced the available rearing and spawning habitat for salmonid species.

Valdez Fisheries Development Association (VFDA) has a long history of maintaining salmonid spawning habitat within the Robe Lake watershed. VFDA has conducted mechanical weed harvesting of excess macrophytes since the 1990s. However, mechanical harvesting of excess macrophytes has a high operational cost, is time-consuming, and has limited overall success.



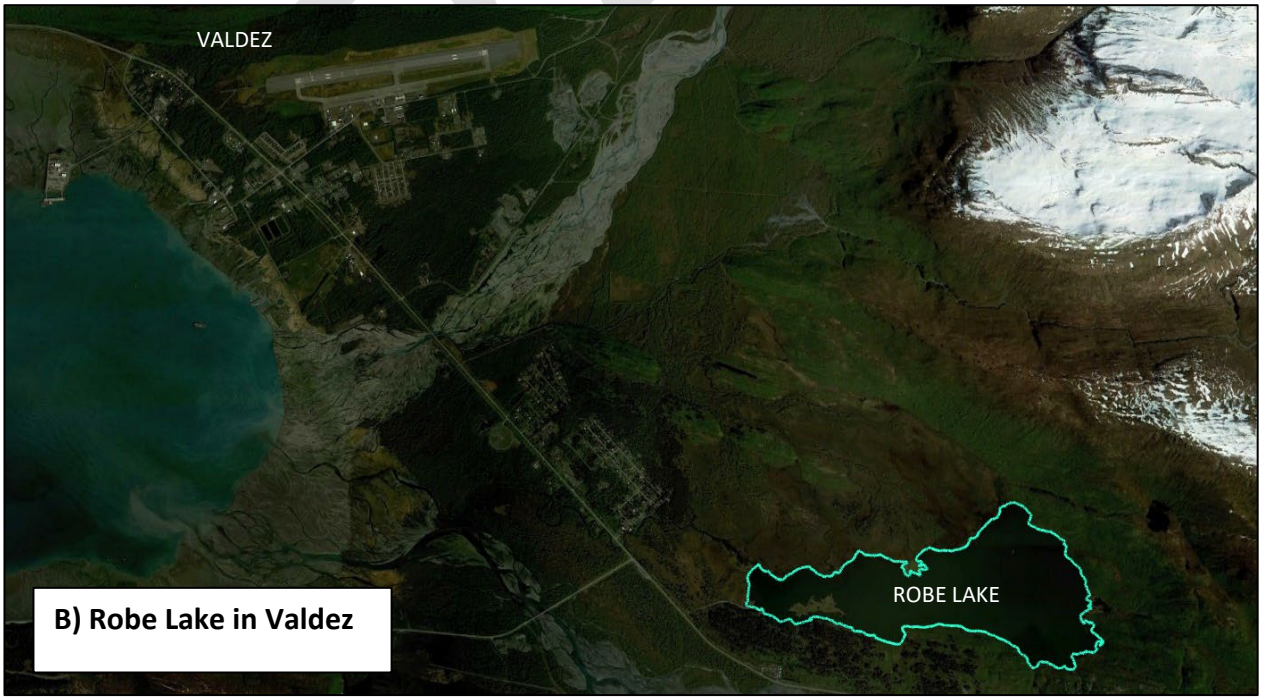


Figure 1. Location and vicinity of Robe Lake and surrounding Valdez area.

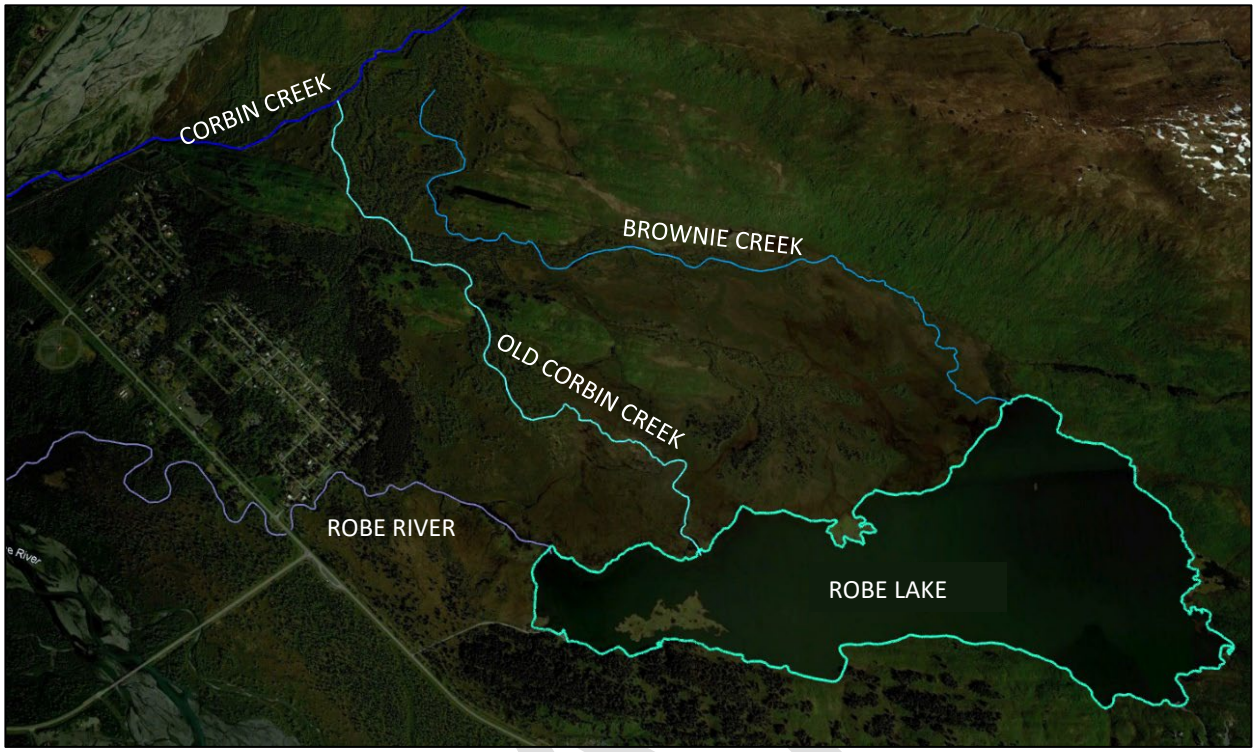


Figure 2. Current imagery of Robe Lake and the surrounding area.

The boundaries of the tributaries Old Corbin Creek and Brownie Creek, perimeter of Robe Lake, and the outflow of Robe River are highlighted.

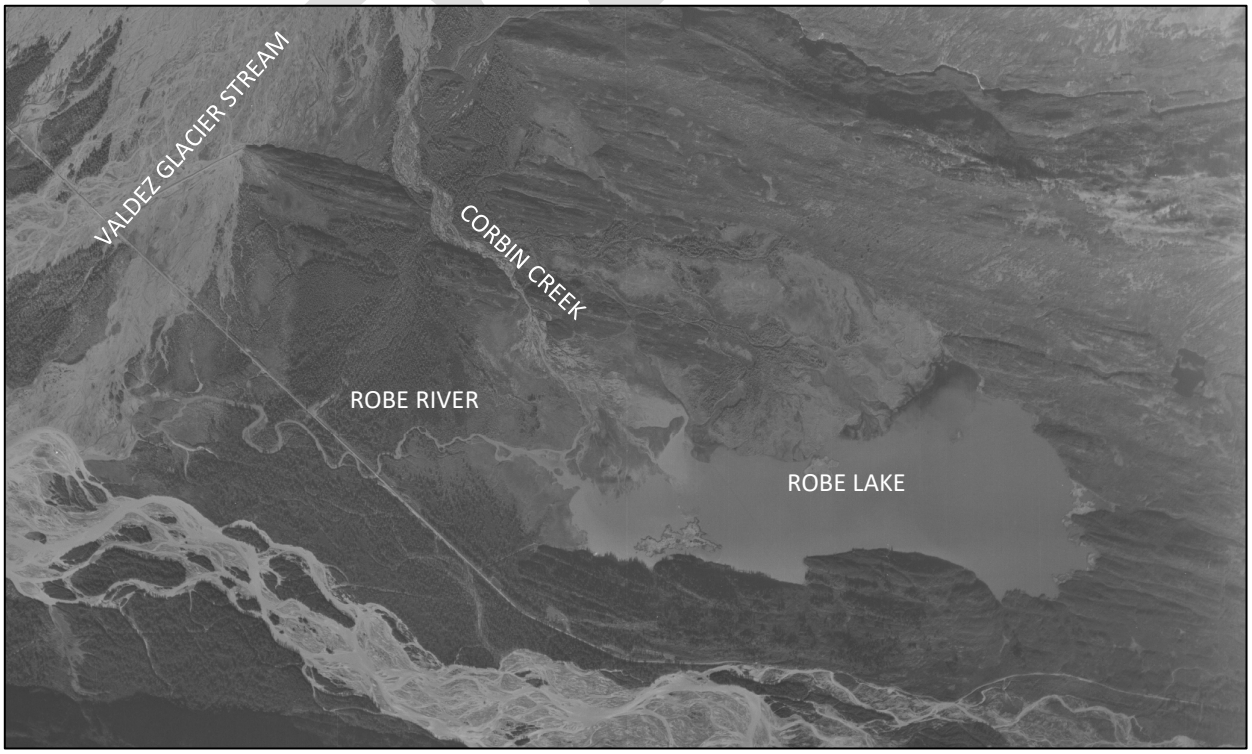


Figure 3. Historic imagery of Robe Lake and the surrounding area.

1.2. Purpose

The purpose of this CAP Section 206 study is to improve the Robe Lake ecosystem function in a self-sustaining way that reduces the amount of human intervention and maintenance required, while improving existing salmonid rearing and spawning habitat.

1.3. Problem Statement

At Robe Lake, human induced hydrologic impacts resulting from a diversion of Corbin Creek have resulted in broad scale effects. The loss of cold, turbid, glacial flow from the Corbin Creek tributary has led to an excessive overgrowth of macrophytes. The macrophytes have impacted salmonid habitat by reducing available rearing and spawning habitat. Current mitigation requires mechanical harvesting of excess macrophytes. Mechanical harvesting of excess macrophytes has a high operational cost and is time-consuming.

1.4. Proposed Action

The selected alternative is intended to improve the Robe Lake ecosystem function in a self-sustaining way that reduces the amount of human intervention and maintenance required, while improving existing salmonid rearing and spawning habitat. The Robe Lake IFR-EA contains further details regarding the selected alternative, project goals, objectives, and constraints.

1.4.1. Alternative B-3

The entire flow of Corbin Creek would be rerouted back into the relic channel of Old Corbin Creek by constructing a training dike across Corbin Creek. A channel approximately 275-foot-long would be excavated along Old Corbin Creek to connect to Corbin Creek. Approximately 1.5 miles of Old Corbin Creek would be excavated to deepen channel geometry. The culverts under the ALPETCO trail system on Old Corbin Creek would be replaced with a trail bridge. A berm approximately 450-foot-long would be placed in the low-lying area between the two bluffs near the Old Corbin Creek culverts to prevent overland flow from entering historic channels that flow towards the Robe River subdivision. The two culverts with a diameter of approximately 12.75 ft. at the Robe River crossing would be replaced with three culverts with a diameter of approximately 14 ft. for increased flow capacity and to improve fish passage.

Old Corbin Creek would be enhanced through nature-based features, such as stream bed improvements to mimic the narrow and deep channel geometry seen on other creeks (i.e., Brownie Creek and Deep Creek). These improvements include channelization of Old Corbin Creek to accommodate increased flows, adding pools-riffle complexes, and increasing amount of large woody debris. These nature-based features would be implemented to work in concert with natural processes to mimic natural conditions.

1.4.2. Alternative B-3 Adaptive Management

There are uncertainties related to the physical and/or biological performance of the measures in Alternative B-3 that could affect the ability to meet the project goals and objectives. Rerouting Corbin Creek back into Old Corbin Creek may have delayed restoration benefits given the complex nature of the system. These measures will be monitored following project construction or after initial implementation to inform decision-makers whether 1) The project is meeting performance measures and should continue as implemented 2) The project is not meeting performance measures and should be adjusted, or 3) The project has met success criteria and no further monitoring for ecological performance is needed.

USACE Implementation Guidance for Section 1161 (Monitoring Ecosystem Restoration) of the Water Resources Development Act of 2016, and Section 2036 (Mitigation for Fish and Wildlife and Wetlands Losses) of the Water Resources Development Act of 2007 require monitoring sufficient to evaluate ecosystem restoration and mitigation success. USACE is required to consider adaptive management (or contingency plans) for ecosystem restoration projects and mitigation projects because they often involve uncertainty that can be reduced through an adaptive management approach. For this project, adaptive management is an appropriate management strategy because there is: 1) uncertainty regarding the outcome of the management measures, 2) an ability to monitor and evaluate the system response to management measures, 3) capacity to learn from monitoring, and 4) the ability to apply a decision to change management if needed.

RESTORATION OBJECTIVES

An important part of the monitoring and adaptive management plan is the translation of the management goals and objectives from the planning process into specific performance measures (sometimes called metrics), success criteria (sometimes called targets), and decision triggers (triggers for implementing a contingency plan or other decision). During development of the monitoring and adaptive management plan the team worked from the planning study conceptual model(s) and impact/benefit assessments to define the physical, chemical, biological, and ecological criteria that will be monitored to assess project performance. The monitoring plan will also specify that the monitoring will continue until such time as the Secretary determines that the success criteria will be met. Within a period of ten years from completion of construction of an ecosystem restoration project, monitoring shall be a cost-shared project cost. Any additional monitoring required beyond 10 years will be a non-federal responsibility.

2.1. Restore the water quality within Robe Lake to a healthy, productive, self-sustaining system with natural flow regime.

Performance Measure:

The water quality of Robe Lake would improve within approximately five years post construction with an increased influx of cold, turbid, glacial flow.

Success Criteria:
The influx of turbid glacial flow and sediment deposition into Robe Lake will reduce clarity of the water. With an increase in turbidity, the temperature in Robe Lake will drop to level optimum for salmonid species occurring in Alaska (below 10°C; Weber Scannell, 1992), similar to levels observed on Corbin Creek.

Monitoring Design:
Mechanical weed harvesting of the excess overgrowth macrophytes at Robe Lake will continue for approximately five years post construction, or when the Secretary determines that the majority of restoration benefits have been achieved. As the water quality in Robe Lake becomes cold and turbid with the influx of glacial flow, the need for harvesting would decrease over time.

Decision Trigger(s):
If the water in Robe Lake were to increase in clarity to a level where macrophyte overgrowth was no longer inhibited given species specific tolerances, or if water temperatures began to increase above optimal levels for salmonid species occurring in Alaska; then a contingency plan or other alternative action may be warranted.

Contingency Measure(s):
Water turbidity and temperature loggers would be installed and monitored by the non-Federal sponsor, which would occur for approximately five years post construction. If the majority of restoration benefits are not achieved within approximately five years post construction, the results of these data would be shared with USACE if possible further mitigation efforts are required. To ensure that glacial flow into Robe Lake is maintained, dredging of Old Corbin Creek would occur. Maintenance dredging is a structural operations and maintenance (O&M) measure, which is a Federal responsibility.

2.2. Increase the quality and/or quantity of salmonid habitat, in addition to improving existing salmonid habitat.

Performance Measure:
The available salmonid habitat at Robe Lake is anticipated to increase in both quality and quantity within approximately five years post construction as the majority of restoration benefits should be realized.

Success Criteria:
The excess overgrowth of macrophytes present within the littoral buffer of Robe Lake are anticipated to decrease within five years post construction. This will increase available spawning and rearing habitat for salmonid species.

Monitoring Design:
Macrophyte edge cover along the littoral buffer will be informally assessed by the non-Federal sponsor during mechanical weed harvesting efforts. Mechanical weed harvesting is anticipated to continue at Robe Lake for approximately five years post

construction, or when the Secretary determines that the majority of restoration benefits have been achieved.

Decision Trigger(s):
If no changes in edge cover composition occur, or if the magnitude of macrophytes present within the littoral buffer increases after approximately five years post construction, then a contingency plan or alternative action may be warranted.

Contingency Measure(s):
Additional measures may be taken to reduce the overgrowth of macrophytes. These may include increased weed harvesting, implementing additional surveys after project completion to confirm that invasive species (i.e., *Elodea*) have not become established in Robe Lake, and examining species-specific environmental tolerances of macrophytes that remain persistent within Robe Lake.

2.3. Decrease the overall maintenance required to control the overgrowth of macrophytes.

Performance Measure:
The amount of macrophytes harvested (in number of tons) is anticipated to decrease significantly after approximately five years post construction as the majority of restoration benefits are realized. The need for mechanical weed harvesting of excess macrophytes is anticipated to be reduced within this time frame.

Success Criteria:
Mechanical weed harvesting needed within Robe Lake to control the excess overgrowth of macrophytes will decrease in both frequency and acreage of harvest after approximately five years post construction.

Monitoring Design:
Hours of labor needed for mechanical weed harvesting efforts will be monitored by the non-Federal sponsor for approximately five years post construction, or when the Secretary determines that the majority of restoration benefits have been achieved. Likewise, the volume of macrophytes harvested is anticipated to decrease over time (in units of tons/year).

Decision Trigger(s):
If the amount of macrophytes mechanically harvested each year increases after approximately five years post construction, remains the same, or if mechanical harvested is required at a higher frequency than previously observed, then a contingency plan or alternative action may be warranted.

Contingency Measure(s):
Samples of macrophyte species within Robe Lake may be taken to confirm that invasive species (i.e., *Elodea*) have not become established.

MONITORING DESIGN

The monitoring design for this project includes the minimum monitoring actions necessary to evaluate success of the implemented management measures. It focuses on monitoring the performance measures of the project objectives to determine success. The monitoring design aims to be broad enough to encompass each of the restoration objectives. In doing so, monitoring efforts can be more comprehensive, effective, and efficient. Each relevant objective and the associated performance measures are described below along with information required by USACE guidance.

Recall that project includes the following restoration objectives: restore the water quality within Robe Lake to a healthy, productive, self-sustaining system with a natural flow regime; increase the quality and/or quantity of salmonid habitat, in addition to improving existing salmonid habitat; and decrease the overall maintenance required to control the overgrowth of macrophytes.

Performance Measure(s):

The water quality of Robe Lake would improve within approximately five years post construction with an increased influx of cold, turbid, glacial flow.

The available salmonid habitat at Robe Lake is anticipated to increase in both quality and quantity within approximately five years post construction as the majority of restoration benefits are realized.

The amount of macrophytes harvested (in number of tons) is anticipated to decrease significantly after approximately five years post construction as the majority of restoration benefits are realized. Likewise, the need for mechanical weed harvesting of excess macrophytes is anticipated to be reduced within this time frame.

Nature of Monitoring and Duration:
Mechanical weed harvesting of the excess overgrowth macrophytes at Robe Lake will continue for approximately five years post construction, or when the Secretary determines that the majority of restoration benefits have been achieved. During harvesting efforts if additional monitoring, or another action alternative is needed, the non-Federal sponsor would initiate contingency plan jointly with USACE. Potential additional monitoring measures are described in the section Restoration Objectives.

Data Analysis and Use:
If a contingency plan, additional monitoring measure, or other action alternative is needed the non-Federal sponsor would monitor and collect data. Data could include temperature and turbidity measurements, monitoring for invasive species (i.e., *Elodea*), and further wetlands delineation. These data would be shared with USACE if possible further mitigation efforts are required in order to achieve the majority of restoration benefits.

Costs, Responsibilities, and Project Closeout Plan:
The estimated cost for continued weed harvesting efforts is $32,000 (FY 23) per year. This cost would be the non-Federal sponsor's responsibility as non-structural operations and maintenance (O&M). Non-structural O&M by the non-Federal sponsor ends 10 years after meeting performance standards. Monitoring is a shared cost for the first 10 years, and any changes regarding a contingency plan are cost-shared. To ensure that glacial flow into Robe Lake is maintained, maintenance dredging of Old Corbin Creek would occur, a structural O&M measure that is the Federal responsibility.

ASSESSMENT

Evaluating the monitoring data includes a comparison of the results of the monitoring effort compared to predictions made in the planning process and success criteria. In summary, the non-Federal sponsor will be responsible for monitoring efforts that require human intervention (i.e., mechanical weed harvesting). The non-Federal sponsor would share data with USACE if a contingency plan is needed. The cost of continued mechanical weed harvesting at Robe Lake is considered a non-structural operations and maintenance (O&M) cost, which is the non-Federal sponsor's responsibility. The maintenance dredging of Old Corbin Creek is considered structural O&M, which is the Federal responsibility. The non-Federal sponsor is responsible for communication, documentation, and reporting significant changes within Robe Lake that may require a contingency plan to USACE.

DECISION MAKING

This section describes the process whereby the results from monitoring and assessment will be used to make decisions concerning project management. Primary components of the decision-making process include decisions to be made, decision making responsibilities, how the decision making group operates, how they report their decisions, and the required timing of decisions in order for potential adjustments to be effective. These components are described in Table 1.

Table 1. Decision-making framework.

Decisions to be Made	Is a contingency measure or plan needed?
Decision Responsibility	The non-Federal sponsor
Operation of Decision-Making Group	The non-Federal sponsor will initial communication with USACE.
Reporting of Decisions	The non-Federal sponsor will be responsible for reporting decisions to USACE if a contingency plan is warranted.
Required Timing for Decisions	Implementation timeline for reporting decisions will be determined by the non-Federal sponsor and USACE once initial communication regarding the implementation of a contingency plan has been established by the non-Federal sponsor.

Once the results of monitoring have been assessed and evaluated, the non-Federal sponsor can decide to: (1) continue the action with no adjustments because performance measures indicate a favorable trajectory; (2) adjust using a contingency plan, or reformulate the plan revisiting the planning process; or (3) decide the action is successful and complete based on meeting success criteria.

CONTINGENCY PLAN

USACE monitoring and AM guidance requires a description of the nature and cost of contingency plans. Contingency plans are pre-determined actions that could include modifying the implementation of the primary management measure if the current implementation is not achieving management or restoration goals, or could include an alternative management measure if the primary management measures aren't meeting goals.

To address potential problems with project features, the USACE has identified some potential modifications or different measures that could be implemented. The below table includes a description of potential contingency measures, under what circumstances they would be implemented, an estimated cost for implementation, and identifies responsibilities.

Table 2. Potential contingency measures.

Contingency Measure	Decision Trigger	Cost Estimate	Responsible Party
Increase mechanical weed harvesting efforts.	If the amount of macrophytes mechanically harvested each year increases, remains the same, or if mechanical harvested is required at a higher frequency than previously observed, then a contingency plan or alternative action may be warranted.	$32,000 per year (FY 23)	The non-Federal sponsor.
Confirm that invasive species have not become established.	Implement additional surveys to confirm that invasive species (i.e., *Elodea*) have not become established in Robe Lake post construction. Species-specific environmental tolerances of macrophytes that remain persistent within Robe Lake may be examined.	Included in mechanical weed harvest cost estimate of $32,000 per year (FY 23)	The non-Federal sponsor.

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