US Army Corps
of Engineers®
Los Angeles District

Prado Basin Ecosystem Restoration and Water Conservation Study

APPENDIX E

Monitoring and Adaptive Management Plan

This page intentionally left blank.

Contents

1.0 INTRODUCTION 3
1.1 Statutory Basis for Monitoring and Adaptive Management....4
1.2 Adaptive Management Team 5
1.2.1 Team Structure 6
2.0 MONITORING 6
2.1 Project Objectives 7
2.2 Rationale for Monitoring....7
2.3 Monitoring Plan 7
2.3.1 Monitoring Period 8
2.3.2 Performance Measures and Monitoring Design 8
2.3.3 Monitoring Procedures 13
2.3.4 Use of Monitoring Results and Analysis 16
3.0 PROJECT ADAPTIVE MANAGEMENT PLANNING....16
3.1 Management and Restoration Actions 17
3.2 Sources of Uncertainty....21
4.0 RATIONALE FOR ADAPTIVE MANAGEMENT 21
5.0 ASSESSMENT 22
5.1 Database Management 22
5.2 Documentation and Reporting 23
6.0 DECISIONMAKING....23
6.1 Decision Criteria 23
6.1.1 In-stream hydrologic, geomorphic, and topographic conditions triggers: 23
6.1.2 Vegetative community, cover, and structure triggers: 25
6.1.3 Non-native wildlife and non-native aquatic species populations triggers: 26
6.2 Potential Adaptive Management Measures....26
Performance Measure 1: In-stream hydrologic, geomorphic, and topographic conditions....27
Performance Measure 2: Vegetative community, cover, and structure....27
Performance Measure 3: Non-native wildlife and non-native aquatic species populations....28
6.3 Conclusion of Monitoring for Project Features....28
7.0 COSTS FOR IMPLEMENTATION OF MONITORING AND ADAPTIVE MANAGEMENT PROGRAMS....28
7.1 Costs for Implementation of Monitoring Program....28

7.2 Costs for Implementation of Adaptive Management Program.....29

1.0 INTRODUCTION

The U.S. Army Corps of Engineers, Los Angeles District (Corps), in partnership with the Orange County Water District (OCWD), has developed feasibility level plans for the Prado Basin Feasibility Study (PBFS) in Corona, California. The purpose of this ecosystem restoration project is to:

1. Improve hydraulic and fluvial geomorphic functions to promote habitat growth and wildlife connectivity to regionally significant core habitats at Prado Basin and associated main watercourses within the proposed project area.
2. Restore riparian and riparian associated habitats suitable to native species within the proposed project area.
3. Reduce presence and effects of non-native wildlife on habitat suitability and function for native wildlife species.

Native species that would benefit from this restoration include, but are not limited to, the federally endangered least Bell's vireo (*Vireo bellii pusillus*), southwestern willow flycatcher (*Empidonax traillii extimus*), Santa Ana sucker (*Catostomus santaanae*) and Arroyo chub (*Gila orcuttii*), a species of special concern of the State.

This document outlines the feasibility level Monitoring and Adaptive Management Plan (MAMP) for the PBFS. The MAMP is focused on the ecosystem restoration measures identified for Alternative 2as identified in the Integrated Feasibility Report (IFR), and describes the monitoring and adaptive management activities proposed and estimates their cost and duration.

The general purpose of the MAMP is to provide a systematic approach for improving resource management outcomes and a structured process for recommending decisions, with an emphasis on uncertainty about resources response to management actions and the value of reducing that uncertainty to improve management.

More specifically, the MAMP will:

- Establish the framework for effective monitoring, assessment of monitoring data, and decision making for implementation of adaptive management activities in the project focal areas.
- Provide the process for identifying adaptive management actions if monitoring demonstrates that restoration measures are not achieving established success criteria in the project focal areas.

- Establish decision criteria for vegetation and wildlife evaluation and modification of adaptive management activities.
- Establish decision criteria for the habitat or in-stream management measures evaluation and modification of adaptive management activities.
- Provide estimated cost and duration of the monitoring and adaptive management measures.

This plan will be reviewed and revised as needed during the Preconstruction, Engineering, and Design (PED) phase as specific design details are made available.

1.1 Statutory Basis for Monitoring and Adaptive Management

Section 2039 of WRDA 2007, as amended, requires to specify information required to be included in monitoring plans for ecosystem restoration projects, and to direct when non-federal operation and maintenance responsibilities of these projects may cease.

Section 2039 of WRDA 2007, as amended, directs the Secretary to ensure that, when conducting a feasibility study for a project (or component of a project) for ecosystem restoration, the recommended project includes a plan for monitoring the success of the ecosystem restoration. The monitoring plan shall include a description of:

a. Types and number of restoration activities to be carried out;
b. Physical actions to be undertaken to achieve project objectives;
c. Functions and values that will result from the restoration plan;
d. Monitoring activities to be carried out;
e. Criteria for ecosystem restoration success;
f. Estimated cost and duration of the monitoring; and
g. A contingency plan (adaptive management plan) for taking corrective actions in cases in which the monitoring demonstrates that restoration measures are not achieving ecological success in accordance with criteria described in the monitoring plan.

This MAMP includes all elements required by Section 2039, as amended, and as described in the Corps' WRDA 2016 implementation guidance for section 1161, dated 19 October 2017 (Section 7.b), including:

- the rationale for monitoring (Section 2.2), including:
  - key project specific parameters to be measured (Section 2.3.2)
  - how the parameters relate to achieving the desired outcomes or making a decision about the next phase of the project (Sections 2.3.2, 6.1),
- the intended use(s) of the information obtained (Section 2.3.4)
- the nature of the monitoring including duration and/or periodicity (Sections 2.3.2, 2.3.3),

- the disposition of the information and analysis (Sections 2.3, 5.0)
- the cost of the MAMP (Section 7.0)
- the party responsible for carrying out the MAMP (Section 1.2)
- a project closeout plan (Section 6.4).
- a contingency (adaptive management) plan (Section 6.3)

1.2 Adaptive Management Team

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 the Corps, the OCWD, and interested resource agencies. Although the Corps and OCWD have coordinated with the entities that will be invited to compose the AMT in development of the IFR, the AMT will be officially established during the PED.

The AMT focuses on the ecological function of the habitats through related management actions to maintain and provide functional riverine habitat for general species and special status (threatened and endangered species) within the project area. This MAMP provides a monitoring plan and identifies triggers upon which an adaptive management action may be implemented. 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 Corps shall have final determination on all adaptive management actions recommended.

The Corps is responsible for ensuring that monitoring data and assessments are properly used in the adaptive management decision-making process. If the Corps determines that adaptive management actions are needed, it will coordinate with the AMT on implementation of those actions. The Corps 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 Corps and/or sponsor during the monitoring period, to review the results of monitoring and assess whether project objectives are being met. If objectives are not being 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 consider other related projects along the River and its tributaries 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
- Past and predicted response by target species

1.2.1 Team Structure

The Adaptive Management Team shall include representatives from the Corps, Los Angeles District and OCWD, the non-Federal sponsor.

U.S. Army Corps of Engineers

The Corps may be represented by the Project Ecologist as well as the Project Hydrology and Hydraulics (H&H) representative and the Project Geotechnical representative as needed. Other Corps attendees may include the Project Manager, the Project Environmental Coordinator, and/or Operations and Maintenance designees, as needed.

Orange County Water District

OCWD, as the non-Federal sponsor for the project, is responsible for Operations, Maintenance, Repair, Replacement, and Rehabilitation (OMRRR) activities once the Corps notifies OCWD of completion of the project or each functional element thereof. Prior to final project completion, the Corps will transfer responsibility of functional elements of the project to OCWD as they are completed.

The AMT shall 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 shall include, upon their acceptance:

- U.S. Fish and Wildlife Service, Palm Springs Office
- California Department of Fish and Wildlife, South Coast Region
- California Regional Water Quality Control Board, Santa Ana Region

Additional expertise may be provided by other entities and stakeholders with knowledge of the Santa Ana River ecosystem, hydrology, and wildlife species, at the discretion of the primary AMT participants.

2.0 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.

2.1 Project Objectives

The study objectives for the *ecosystem restoration* component of the PBFS include:

1. Improve hydraulic and fluvial geomorphic functions to promote habitat growth and wildlife connectivity to regionally significant core habitats at Prado Basin and associated main watercourses within the proposed project area.
2. Restore riparian and riparian associated habitats suitable to native species within the proposed project area.
3. Reduce presence and effects of non-native wildlife on habitat suitability and function for native wildlife species.

2.2 Rationale for Monitoring

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 implementation (i.e., management actions) and natural ecosystem variability.

Achieving objectives will require monitoring that focuses on the target habitats and the hydrologic and geomorphic processes that support them.

2.3 Monitoring Plan

According to the Corps' implementation guidance , "Monitoring includes the systemic collection and analysis of data that provides information necessary to determine if the project is meeting its performance standards and to determine when ecological success has been achieved or whether adaptive management measures are necessary to ensure that the project will attain project benefits."

The following discussion outlines a monitoring plan that 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 to further understand the interrelationships of restoration features and external environmental variability and to corroborate project effects.

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 2.3.2 and 6.1 respectively.

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.

2.3.1 Monitoring Period

Upon completion of construction of each phase or feature of the project, the non-federal sponsor will begin OMRRR and the Corps will initiate cost-shared monitoring for ecological success and adaptive management, which will continue until ecological success criteria are met. Cost shared monitoring and adaptive management will continue for a period of up to 10 years, depending on the restoration measure, until restoration success is achieved, for no longer than ten years. The monitoring and adaptive management period requirement would vary based on the data needs of the site specific monitoring programs to assess a particular measure and/or focal area.

Although Section 2039 of WRDA 2007, as amended, allows for up to ten years of cost-shared monitoring, this plan anticipates that five years of monitoring and adaptive management will likely be sufficient for successful establishment of native riparian vegetative cover and abatement and control of non-native wildlife. However, once the Corps determines that ecological success for a measure has been fully achieved, even if this occurs in less than five years, no further monitoring will be performed.

If performance criteria for project objectives have not been met within the first five years, as is expected, then cost-shared monitoring and adaptive management would continue within those areas until performance criteria are met or for a maximum of five additional years, whichever is less, resulting in no more than 10 years of cost-shared monitoring.

For restoration of in-stream hydrologic, geomorphic, and topographic conditions, ten years of monitoring and adaptive management may be needed, as these measures are expected to require more time to achieve success due to their episodic nature in relation to flood cycles.

If the success criteria cannot be met within the ten-year period of cost-shared monitoring allowed by law, any additional monitoring and management will be a non- Federal responsibility.

Concurrent monitoring of one or more nearby reference sites with similar conditions to the desired restored habitat is recommended to differentiate changes at the restoration site that are attributable to the restoration activity versus normal environmental variability affecting the region.

This monitoring plan includes the minimum monitoring actions to evaluate success and to determine adaptive management needs. Assuming that multiple construction contracts or phases will be required to implement all of the restoration elements associated with the recommended plan, monitoring and adaptive management will be initiated at the completion of each phase of construction.

2.3.2 Performance Measures and Monitoring Design

This section outlines the monitoring tasks needed to evaluate the success of restoration and the rationale for how these tasks relate to study objectives and desired outcomes. Desired outcomes are

measured as described in Section 6.1, presented as decision-making triggers for adaptive management action.

Objective 1: Improve hydraulic and fluvial geomorphic functions to promote habitat growth and wildlife connectivity to regionally significant core habitats at Prado Basin and associated main watercourses within the proposed project area.

Performance Measure 1: In-stream hydrologic, geomorphic, and topographic conditions

Desired Outcomes:

1. Increase structure and diversity of in-channel form and microhabitats as compared to reference sites and target physical parameters for microhabitats for Santa Ana Sucker.
2. Increase and maintain availability of gravel and cobble substrates as compared to reference sites.

Monitoring Design and Rationale: Bathymetry/topography/aerial LiDAR imagery surveys to evaluate widespread geomorphic changes, such as sediment aggradation, degradation, and scour, would be performed during 2 wet years over 10 years.

Field visual surveys of geomorphology would be performed documenting bank and channel conditions, with monitoring for field elevation/channel depth profiles twice annually over 10 years.

Permanent monitoring stations will be established for ground-truthing and monitoring channel cross-sections through the expected area of influence. Geomorphology and in-channel habitat elements would be monitored, including stream gradient; channel form, dimensions, and dynamics; substrate composition and distribution; gravel bars or riffle-pool-run complexes and distributions; flood refugia and back-channel areas; large woody debris; and primary constituent elements (PCE) for the Santa Ana sucker and Arroyo chub (including gravel beds exposed).

Cross-section locations would be determined in the PED phase. Monitoring will be performed annually, plus baseline, in all focal areas except Chino Creek and Mill Creek.

> *Supporting Information Need – Water Quality & Hydrology*: Water quality, flow velocities, and hydroperiod will be assessed twice annually (wet season and dry season) for up to 10 years, plus baseline, and at storm events for up to 10 years post construction to support evaluation of the quality of fish habitat.

Monitoring of these features is necessary to determine the successful establishment of a stable, native arid southwestern stream channel. Monitoring these features would also indicate the successful establishment of native fish habitat, including for Santa Ana sucker (*Catostomus santaanae*) and Arroyo chub (*Gila orcuttii*), which require gravel and cobble

substrates for foraging and spawning, shade over water that supports cooler water temperatures, inputs of large woody debris to support structural diversity and refugia, in-channel geomorphic diversity to support all stages of life requirements, and perennial flowing water.

Changes to geomorphic processes will affect the vegetation component of target habitats, which would also impact wildlife movement through the project area. If vegetative cover and structure criteria are not being met, data from monitoring of geomorphic and hydrologic processes may provide additional information on the underlying causes of failure.

Bathymetry/topography surveys will also provide data on sedimentation that can be used to assess channel conveyance capacity.

Results of the monitoring for hydrologic, geomorphic, and topographic conditions would also indicate whether the PCEs for Santa Ana sucker and Arroyo chub have been successfully established.

Decision-making triggers can be found in Section 6.1.1.

Objective 2: Restore riparian and riparian associated habitats suitable to native species within the proposed project area.

Performance Measure 2: Vegetative community, cover, and structure

Desired Outcomes:

1. Increase percent cover of native riparian and riparian-associated habitat, including but not limited to: riparian woodland, riparian scrub, and transitional riparian habitats.
2. Maintain appropriate structural diversity of native riparian habitats to support survival and reproductive requirements for riparian obligate species and to support regional wildlife movement.
3. Increase percent native vegetative cover over water to reduce water temperatures to support native fish such as the Santa Ana sucker and Arroyo chub.
4. Decrease percent cover of non-native invasive vegetative species that out-compete natives.

Monitoring Design and Rationale: Permanent quantitative vegetation monitoring stations will be established for assessing vegetation communities in the focal areas. These stations will be monitored annually for five years post construction, plus baseline. Hyperspectral imagery mapping of non-native vegetation with ground truthing would be performed at baseline and during 2 of 5 monitoring years. As drone mapping technology improves in the

future, it may be used for a cost savings.

Supporting Information Need – Depth to Groundwater: Depth the groundwater will be monitored twice annually (wet season and dry season) post construction, plus baseline, and at storm events for five years, along with the hydrologic monitoring as set forth in performance measure 1.

Supporting Information Need – Wildlife Surveys: Inventories of general wildlife would be documented annually post construction for five years, in addition to a baseline inventory taken during the first annual vegetation monitoring effort.

In addition to general wildlife surveys, focused wildlife surveys, including protocol surveys for least Bell's vireo and southwestern willow flycatcher will be performed annually for five years post construction, in addition to a baseline survey. Focused amphibian and reptile surveys would be performed at baseline, as well as Year 1, Year 3, and Year 5 after construction. Native fish surveys would be performed annually for 5 years, plus baseline.

Bird counts from permanent monitoring stations would be taken twice annually for five years, plus baseline to document the differences between wintering and nesting season bird species diversity and locations. Data on large mammal use would be compiled at baseline and quarterly thereafter from studies performed by existing USGS WERC monitoring programs and from camera traps in the Prado Basin. Roadkill counts would also be used to document wildlife movement patterns.

Monitoring of vegetation (including percent cover, structural diversity, cover over water, and cover of invasives) and depth to groundwater will indicate if target habitats and the hydrology that supports them have been successfully restored. Shallow depth to groundwater is essential for riparian habitats to persist and be self-sustaining.

Results of monitoring for vegetation communities would also indicate whether habitat components necessary to provide habitat connectivity and support increased wildlife movement have been successfully established.

Wildlife surveys, as a supporting information need, serve to provide supplemental information on restoration success, and will indicate whether target habitats and habitat connectivity for wildlife movement have been successfully restored.

If geomorphic conditions or vegetative cover and structure criteria are not being met, wildlife species presence, distribution, and diversity may provide supplemental information on habitat elements and underlying ecosystem functions that have not been achieved in target habitats.

Consequently, if geomorphic conditions or vegetation cover and structure has met

requirements based on the prescribed triggers, but common obligate wildlife use or use by extirpated wildlife has not improved, then additional studies may be warranted to understand if habitat is lacking critical elements and functions to support species use and movement.

While wildlife presence is not a requirement for success, the presence of riverine obligate and facultative species that use the target habitats for all or a portion of their life requirements is an indicator of successful habitat establishment, as well as the successful establishment of a functional, self-sustaining ecosystem.

Decision-making triggers can be found in Section 6.1.2.

Objective 3: Reduce presence and effects of non-native wildlife on habitat suitability and function for native wildlife species.

Performance measure 3: Non-native wildlife and non-native aquatic species populations

Desired Outcomes:

1. Reduce brown-headed cowbird population and vireo nest parasitism to support use and occupation of riparian habitats by endangered vireos and flycatcher.
2. Reduction in populations and class size of non-native aquatic species, particularly large predatory fish species such as carp, bass, and catfish, to support use and occupation of riverine habitats by endangered native fish.

Monitoring Design and Rationale: Monitoring of non-native wildlife will indicate if target habitats are less suitable, as their presence may inhibit use and occupation of target habitats by native species. Results of this monitoring will inform whether adaptive management actions related to these non-native wildlife species are needed.

Cowbirds would be monitored and counted annually for five years through the general wildlife inventories and protocol wildlife surveys (performance measure 1b). Parasitism of vireo nests by cowbirds would also be monitored at baseline and Year 1, Year 3, and Year 5. Monitoring for cowbirds will indicate if target habitats are less suitable due to the potential for nest parasitism, which may inhibit occupation by and populations of riparian obligate songbirds. Results of this monitoring will inform whether adaptive management actions related to cowbird control are needed, and which focal areas would benefit most from removal.

Aquatic species surveys would be performed annually for five years plus baseline. Surveys may include seining, electroshocking, dip nets, or other approved methods. All species would be identified and counted, and native fish released. As surveys are being performed, non-native fish would be removed. Monitoring for non-native aquatic species will indicate if

target habitats are less suitable due to the potential for non-natives to prey upon native aquatic species. Results of this monitoring will inform whether adaptive management actions related to additional non-native aquatic species control is needed.

Decision-making triggers can be found in Section 6.1.3.

2.3.3 Monitoring Procedures

The following monitoring procedures will provide the information and data necessary to meet the success criteria and objectives for the project.

In-stream hydrologic, geomorphic, and topographic conditions: To assess the overall stream health and available habitat for native fish and wildlife movement, a California Stream Bio-assessment Worksheet (CDFG 1999) will be completed annually for up to 10 years plus baseline at permanent monitoring stations in all focal areas except Chino Creek and Mill Creek. This assessment is meant to rapidly assess the stream and be able to give it a habitat value score based on the physical characteristics of the site. Some of the physical factors that are assessed include the stream gradient, substrate composition, organic material in the stream (woody debris and leaf litter), and vegetative cover above the stream.

In-stream characteristics will also be recorded during this time by taking channel cross-sections at permanent monitoring stations. Methods involve placing a transect line perpendicular to flow at the up and downstream extents of 100 meter monitoring sites. Substrate composition and size (silt, sand, gravel, cobble, boulder, sandbars, and emergent vegetation), channel width, channel depth, mid-column current velocity, and riffle/pool microhabitat depths and velocities will be measured at 1.0 meter intervals along each transect line.

Field visual surveys of geomorphology would be performed documenting bank and channel conditions, with monitoring for field elevation/channel depth profiles twice annually over 10 years. At each survey, benchmark locations would be monitored for erosion and deposition.

Bathymetry, topography, and aerial imagery surveys would occur during 2 wet years over 10 years post construction, and would be generated using LiDAR.

Supporting Information Need - Water Quality: Water quality parameters will be measured at baseline, twice annually (wet season and dry season) each monitoring year for up to 10 years, and at storm events to assess the quality of native fish habitat. Parameters to be measured include water temperature (ºF), dissolved oxygen ([DO]%, saturation. and mg/L), turbidity (neophelometric turbidity units [NTUs]), pH levels, conductivity (uS/cm), and salinity (mg/g). Measurements will be taken using Hanna HI 9928 and HI 93703 water quality meters or other similar water quality meters.

Supporting Information Need - Hydrology: Hydrology will be assessed at baseline, twice

annually (wet season and dry season) each monitoring year for up to 10 years, and at storm events. Mid-column current velocities will be measured at 1.0 meter intervals along each in-stream cross-section transect line. Measurements for current velocity will be taken using a hand-held flow meter, such as the Global Water Flow Probe, following methods described in Gore (2007). Hydroperiod metrics (depth, duration, and frequency of flooding) will be obtained from documented elevations and recorded water levels. Depth to groundwater will be assessed using installed piezometers.

Vegetation: Quantitative vegetation transect monitoring will occur annually for five years, plus baseline, at 20 transects each in the SARM Upstream and SARM Downstream focal areas, at 10 transects each in the Chino Creek and Mill Creek focal areas, and at 10 transects in a reference site for the duration of the monitoring period. Sampling will occur during spring months, at the peak of growing season, and will consist of permanent field monitoring plots along one or more transects either perpendicular to the stream centerline or parallel to the floodplain slope and hydraulic gradient. Plots will be located randomly within each focal area, and the distance between plots and along transects will be dependent on the conditions and variability in the focal area. Monitoring will measure percent cover of native and non-native plant species, structural diversity, and percent cover over water. Photograph stations are also important for documenting vegetation conditions. All plots and photograph stations will be documented via Global Positioning System (GPS) coordinates to reoccupy in each year of sampling.

General observations, such as fitness and health of plantings, native plant species recruitment, plant composition and structure, and signs of drought stress would be noted during the surveys. Additionally, potential soil erosion, flood damage, vandalism and intrusion, trampling, and pest problems would be qualitatively identified.

As noted above, general wildlife surveys would also be performed during the annual vegetation monitoring, to include an inventory of all wildlife species observed and detected, and any nesting sites, roosting sites, animal burrows, and other signs of wildlife use.

Hyperspectral imagery mapping of non-native plants with ground truthing would also be performed at baseline and during 2 of 5 monitoring years. This mapping would ensure comprehensive assessment of non-native cover in the project area and identify problem areas that may require adaptive management.

Supporting Information Need – Depth to Groundwater: Hydrology will be assessed twice annually (wet season and dry season), plus baseline, and at storm events as a supporting information need as described under “In-stream hydrologic, geomorphic, and topographic conditions”. Depth to groundwater will be assessed using installed piezometers.

Supporting Information Need - Wildlife Surveys: A general inventory of all wildlife

species observed and detected using the project area would be documented annually for five years, plus baseline during vegetation monitoring. Bird counts from permanent monitoring stations would be taken twice annually for five years, plus baseline, to document the differences between wintering and nesting season bird species diversity and locations. Bird counts along riparian edges would inform whether edge habitat is being successfully managed.

U.S. Fish and Wildlife (USFWS) protocol surveys for least Bell's vireo and southwestern willow flycatcher would be conducted annually for five years plus baseline. Protocol surveys for least Bell's vireo require 8 surveys performed between April 1 and July 31. Protocol surveys for southwestern willow flycatcher require a minimum of 1 survey in each of 3 survey periods from May 15 to July 17.

Wildlife use and movement would also be assessed using focused amphibian and reptile surveys at baseline, as well as Year 1, Year 3, and Year 5 after construction using counts, fence arrays, or pit fall traps. Data on large mammal use would be compiled quarterly from studies performed by existing USGS WERC monitoring programs and from camera traps in the Prado Basin. Roadkill counts and locations would also be used to document wildlife movement patterns near the Chino Creek focal area (which is the only focal area bisected by a road). Fish surveys would be performed annually for five years, plus baseline, as described below under "Non-Native Aquatic Species Control".

Nesting sites, roosting sites, animal burrows, and other signs of wildlife use of the newly created habitat would be recorded. These notes would be important for early identification of species colonization patterns. Presence and counts of non-native and nuisance wildlife species will be noted.

Cowbird Monitoring: Cowbirds would be monitored and counted annually for five years, plus baseline, through the general wildlife inventories and protocol wildlife surveys. From cowbird trapping implemented through the project, data would be collected on the number of cowbirds trapped, other unintended species trapped, and their location. Parasitism of vireo nests by cowbirds would also be monitored at baseline and at Year 1, Year 3, and Year 5, during the nesting season. Regular monitoring across the focal areas would help identify which locations would most benefit from cowbird trapping as an adaptive management task.

Non-Native Aquatic Species Monitoring: Fish surveys would be performed annually for five years, plus baseline, specifically after flushing flows have passed through focal areas (primarily the low-flow channel of the SAR, OCWD wetlands, and localized pools throughout the focal area and near Prado Dam). Surveys may include seining, electroshocking, dip nets, or other approved methods. All species would be identified and counted, documenting fish percent composition, native versus non-native, and class size. As surveys are being performed, native fish that are caught would be

released and non-native fish would be removed.

2.3.4 Use of Monitoring Results and Analysis

Results of the 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 implementation of adaptive management actions, as identified in Section 6.2, to remedy the underlying problems.

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

3.0 PROJECT ADAPTIVE MANAGEMENT PLANNING

The MAMP 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 MAMP reflects a level of detail consistent with the feasibility study phase. The primary intent was to develop monitoring and adaptive management actions appropriate to assess and achieve the project's restoration goals and objectives. The specified management actions, as well as expected timelines for achieving successful establishment and self-sustaining maturity of restored habitat features, were used to develop an estimation of the adaptive management program costs and duration for the project.

The following section outlines restoration actions that will be undertaken to achieve the project objectives and lists sources of uncertainty that may impact the need for adaptive management actions. Subsequent sections describe assessment of monitoring results, data management, and decision-making on the implementation 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 may remain concerning the exact project features, monitoring elements, and adaptive management opportunities. Components of the MAMP, including costs, were similarly estimated using currently available information. Uncertainties will be addressed in the PED phase, and the MAMP may be amended to incorporated additional detail as part of the design phase.

3.1 Management and Restoration Actions

The PDT performed a thorough plan formulation process to identify potential management measures and restoration actions that address the project objectives. Many alternatives were considered, evaluated, and screened in producing a final array of alternatives. The Corps subsequently identified a NER Plan.

The NER (National Ecosystem Restoration) Plan, is referred to as Plan 11, also known as the Proposed Action Alternative. The NER Plan is described in detail in Section XXX of the Integrated Feasibility Report (IFR). The restoration actions have been divided into four focal areas, as described below. See Figure XXX of the IFR.

1- **Santa Ana River Upstream** focal area includes the existing channel of the Santa Ana River from the Hamner Avenue crossing. This represents the river reach upstream of Prado Dam where there are no physical barriers to ecological restoration or connectivity of the active river channel and the adjacent floodplain that provides riparian forest and associated habitats that rely on the river and floodplain for their character and ecological functions, primarily because of overbank flows in the floodplain and the river's contribution to the shallow water table in the alluvial aquifer.

2- **Santa Ana River Downstream** focal area includes the existing channel of the Santa Ana River from the Prado Dam downstream to the upstream limit of the engineered flood control channel of the Santa Ana River near the crossing of Yorba Linda Boulevard. This reach is referred to as Reach 9 of the Santa Ana River Mainstem Project (SARM) which is a component of the SARM project area for flood damage reduction. The focal area includes the mainstem of the Santa Ana River through Reach 9, along with the associated floodplains within the boundaries of the bank stabilization features of SARM.

3- **Chino Creek** focal area was defined based on the restoration opportunities presented by the active Channel of Chino Creek, which is perennial due to the upstream flow contributions that include discharge of treated wastewater from active municipal treatment plants. Open areas along Chino Creek provide restoration opportunities for the creek channel and adjacent riparian habitats from Pine Avenue downstream to Euclid Avenue. Restoration in this focal area would provide connectivity to Prado Regional Park and to the downstream reach of Chino Creek that is influenced by operation of Prado Dam.

4- **Mill Creek** focal area extends along the minor valley of the Mill Creek tributary of Prado Basin from an area due west of the OCWD constructed wetlands to Chino Corona Road to the north. While Mill Creek is an ephemeral stream, the focal area provides opportunities for restoration of vegetation for riparian habitats and provides connectivity to the existing habitat in the lower part of the basin south of this focal area.

Table 1 below identifies the list of restoration measures proposed in the NER Plan for each focal area and which study objective(s) each would meet.

Table 1 NER Plan - Restoration Measures/Description

Focal Area	Measure	Description	Objectives
SARM Upstream	Sediment Management	Includes small, deep sediment trap, deep transitional channel, wetlands transitional channel, bio-engineered grade control, slurry pipeline to sediment stockpile area, sediment stockpile area, sorting of dredged sediment in stockpile area, management of stockpiled sediment	1 & 2

Focal Area	Measure	Description	Objectives
	Invasive Plant Management	Initial biomass removal and treatment of invasive plants. Any necessary plantings, cuttings, seeding and maintenance of plant management areas is also assumed to be captured by this measure.	2
	Native Plantings	Cuttings, container plants, or seeding of the 'Pheasant Field.' It is assumed that this field will require some initial removal or treatment of biomass, but not as much as described in Invasive Plant Management measure.	2
	Riparian Edge Management	Management of a 25' wide corridor on both sides of the transitional channel, sediment trap (and overflow channel and trap, if included) to maximize habitat values of the riparian edge habitat created by the implementation of these features.	2
	Non-Native Aquatic Fauna Management	Covers all non-native aquatic species that might be encountered. Management efforts are likely to be implemented after flushing flows have passed through the site and may include trapping, seining, electroshocking, or any other approved methods. Management events would be expected to occur on an average of 2-5 times per year, with 1-2 days spent on each watercourse per event.	3
	Cowbird Trapping	Placement and management of cowbird traps during appropriate times of the year.	3
SARM Down-stream	Invasive Plant Management	Initial biomass removal and treatment of invasive plants. Any necessary plantings, cuttings, seeding and maintenance of plant management areas is also assumed to be captured by this measure.	2

Focal Area	Measure	Description	Objectives
	Sediment Management & In-Stream Habitat Management	Includes slurry pipeline to take sediment from stockpile to re-entrainment location and other features or management efforts that may be associated with the re-entrainment of material. Placement of clusters of rock and gravel in Reach 9 to provide cover, feeding opportunities for fish. Also intended to help sequester re-entrained sediment. Will provide perches habitat value for shorebirds, ducks, and other aquatic/riparian associated species.	1 & 2
Chino Creek	Chino Creek Channel Restoration	Raises the existing channel invert starting at approximately Pine Ave. Encourages main flow to be routed through new sinuous, 3-foot deep channel cut through adjacent field. Reconnects with existing invert just upstream of Euclid Ave. Associate features include flow containment berms, channel splitting/re-connecting features.	1
	Invasive Plant Management	Initial biomass removal and treatment of invasive plants. Any necessary plantings, cuttings, seeding and maintenance of plant management areas is also assumed to be captured by this measure.	2
	Native Plantings	Cuttings, container plants, or seeding of the field on the right bank (looking downstream) just downstream of Euclid Ave. It is assumed that this field will not require the initial removal or treatment of biomass described in non-native plant management measure.	2
	Cowbird Trapping	Placement and management of cowbird traps during appropriate times of the year.	3
Mill Creek	Invasive Plant Management	Initial biomass removal and treatment of invasive plants. Any necessary plantings, cuttings, seeding and maintenance of plant management areas is also assumed to be captured by this measure.	2

Focal Area	Measure	Description	Objectives
	Native Plantings	Cuttings, container plants, or seeding of the field on the left bank (looking downstream) near the wetlands. It is assumed that this field will not require the initial removal or treatment of biomass described in non-native plant management measure.	2
	Cowbird Trapping	Placement and management of cowbird traps during appropriate times of the year.	3

3.2 Sources of Uncertainty

Adaptive management provides a coherent process for making decisions in the face of uncertainty. Scientific uncertainties and technological challenges are inherent with any large-scale ecosystem restoration project. Below is a list of uncertainties associated with restoration of the aquatic and riverine habitats included in the project.

- Correct engineering and design to fully address project objectives
- Correct operational regime to fully achieve project objectives
- Ability of CHAP (Combined Habitat Assessment Protocol) method to predict project benefits
- Ability of hydrologic models to predict project impacts/benefits
- Imprecise relationships between management actions and corresponding outcomes
- Future availability of water for restored habitats due to extreme drought or other climate change issues
- Other factors which are not completely within the Corps' or Sponsor's control or ability to predict, such as high flow events that may occur before the restored habitat has fully established, vandalism, fire, or upstream watershed changes that may affect the project area.

4.0 RATIONALE FOR ADAPTIVE MANAGEMENT

The primary incentive for implementing an adaptive management program is to increase the likelihood of achieving desired project outcomes given the identified uncertainties listed above.

Given these uncertainties, adaptive management provides an organized, coherent, and documented process that suggests management actions in relation to measured project performance compared to

desired project outcomes. The adaptive management program for the project will use the results of continued project monitoring to manage restoration actions in order to achieve the previously stated project objectives. Adaptive management establishes the critical feedback of information from project monitoring to inform project management and promote learning through reduced uncertainty.

Implementation of the MAMP will provide flexibility to account for changing environmental conditions and new information and will allow project success to be measured, though it will not alleviate all uncertainty. The MAMP provides a mechanism to evaluate the effectiveness of the restoration measures implemented in this project and to implement adaptive changes, if required, to realize project objectives.

5.0 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 action.

The results of the monitoring program will be assessed annually through the AMT. Monitoring results will be compared to the desired project outcomes 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.

The AMT will compare monitoring results to decision-making triggers to evaluate project effectiveness and consider if adaptive management actions are needed.

The assessments will indicate if the habitat responses to management actions are undesirable (e.g., are moving away from restoration goals) or if the responses have met the success criteria for the project. Assessments will also inform the AMT if other factors are influencing the response that may warrant further research.

5.1 Database Management

Database management is an important component of the monitoring plan and the overall adaptive management program. As part of the AMT, individuals with responsibility for data management activities (data managers) in support of an adaptive management program will be identified from the Corps. The data managers should collaborate with the AMT in developing a data management plan to support the adaptive management program. The data management plan should describe how and where data will be archived, data standards, data upload process and format, quality assurance and quality control procedures, metadata standards, and public data release. Storage of all data will be handled by the Corps.

Data analysis and reporting will be the responsibility of the Corps, who will provide reports for the AMT to facilitate evaluation of adaptive management needs.

5.2 Documentation and Reporting

The Corps will document the monitoring results, assessments, and the results of the AMT deliberations. The Corps will produce annual reports that will measure progress towards meeting project objectives as characterized by the performance measures. Results of assessments will be used to evaluate adaptive management needs and inform decision-making.

6.0 DECISIONMAKING

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 the Corps and OCWD in consultation with the other AMT members to guide decisions on adaptive management actions that may be needed to ensure that the ecosystem restoration project achieves success. Final decisions on implementation of adaptive management actions are made by the Corps.

6.1 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 decision criteria are identified below, based on the project objectives and performance measures. More specific decision criteria based on hydrology, geomorphology, and vegetation dynamics may be developed during the PED phase of the project.

If assessments show that any of these triggers are met, the Corps would consult with the AMT to discuss which adaptive management action, as described in Section 6.2, is warranted. Investigations may be required to determine the cause of failure in order to inform which of the adaptive management actions identified should be implemented, if needed.

6.1.1 In-stream hydrologic, geomorphic, and topographic conditions triggers:

Desired Outcomes:

1) Increase structure and diversity of in-channel form and microhabitats.

   Trigger: Geomorphic and in-channel habitat elements do not achieve diversity within 3 years post-construction, as compared to reference sites, with monitoring results showing trends of channel incision that create uniform channel form (i.e., lack of sinuosity and riffle-pool-run complexes, uniform depth).

Trigger: Target physical parameters for microhabitats for Santa Ana Sucker, as described in Table 2, are not achieved at specified monitoring locations within 3 to 5 years post-construction.

Table 2
Target Physical Parameters and Success Criteria for Santa Ana Sucker Habitat Enhancement

Habitat Component	Habitat Description	Target Parameters[1]
Silt/Sand	Shallow areas (depth 0.2–5.0 centimeter [cm]) and deep margins (31.0-71.0 cm)	A decrease of 15% from baseline condition within 3 years post-construction. A decrease of 30% from baseline condition within 5 years post-construction.
Riffle	Shallow areas (30-50 cm) with swift or turbulent flows (1.6 to 3.6 feet/second).	An increase of 5% from baseline condition within 3 years post-construction. An increase of 10% from baseline condition within 5 years post-construction.
Pool	Deep areas (>50 cm) with slow-flowing or non-turbulent water (0.0 to 0.6 feet/second).	An increase of 5% from baseline condition within 3 years post-construction. An increase of 10% from baseline condition within 5 years post-construction.
Gravel/Cobble	Gravel = 2-64 millimeters (mm) diameter Cobble = 65-255 mm diameter	An increase of 5% from baseline condition within 3 years post-construction. An increase of 15% from baseline condition within 5 years post-construction.

Adapted from: Aspen 2016.
[1]Target parameters may be converted to acreages once the baseline conditions survey has been completed.

2) Increase and maintain availability of gravel and cobble substrates (including gravel beds exposed).

   Trigger: Substrates are not trending towards gravel and cobble composition of comparable reference sites within 3 years post-construction.

   Trigger: Within designated monitoring locations, within 3 years, less than 10% of gravel is exposed in the riverbed. Within 5 years, less than 30% of gravel is exposed in the riverbed. Within 8 years, less than 60% of gravel is exposed in the riverbed.

Desirable geomorphic conditions would be evaluated using reference sites on the Santa Ana River or other sites of similar hydrologic character and gradient to guide quantitative thresholds for channel form and substrates.

In-stream conditions may not achieve the target composition due to improper geomorphic conditions caused by natural events or design. Flood events may wash gravel and cobble substrates out of the project area.

Adaptive management actions that may be implemented to address problematic conditions and achieve project objectives are outlined in Section 6.2.

6.1.2 Vegetative community, cover, and structure triggers:

Desired Outcomes:

1. Increase percent cover of native riparian and riparian-associated habitat, including but not limited to: riparian woodland, riparian scrub, and transitional riparian habitats.

   Trigger: Within 250 feet of the river channel, 50% cover of native riparian habitats (including herbaceous, shrub and canopy layer) is not achieved (based on locations of restoration of each habitat) within 3 years. 75% cover of native riparian habitat is not achieved (based on locations of restoration of each habitat) within 5 years.

   Trigger: Farther than 250 feet from the river channel, 35% cover of native riparian habitats (including herbaceous, shrub and canopy layer) is not achieved (based on locations of restoration of each habitat) within 3 years. 50% cover of native riparian habitat is not achieved (based on locations of restoration of each habitat) within 5 years.

2. Maintain appropriate structural diversity of native riparian habitats to support survival and reproductive requirements for riparian obligate and other species and to support regional wildlife movement.

   Trigger: Suitable structural diversity is not achieved within 5 years. If canopy cover exceeds 60% and/or shrub cover does not exceed 50%, then adaptive management action may be needed.

   Trigger: Wildlife monitoring shows trends of decreasing use or movement by common native riparian obligate species and/or target or special status species, as compared to previous studies conducted by USGS and existing regional wildlife movement and use patterns.

3. Increase percent native vegetative cover over water to reduce water temperatures to support native fish such as the Santa Ana sucker and Arroyo chub.

   Trigger: Percent cover of riparian vegetation over water along the bank does not achieve 25% within 3 years, 40% within 5 years.

4. Decrease percent cover of non-native invasive vegetative species that out-compete natives.

   Trigger: Non-native percent cover does not achieve less than 10% after 3 years. Non- native percent cover does not achieve less than 5% after 5 years.

Riparian vegetation may not achieve the target percent cover or structural conditions (needed to support habitat and connectivity) due to improper geomorphic conditions. Such conditions may include excessive distance to groundwater, sedimentation, channel incision, or scour of soils. These conditions may be created

naturally, such as during storm events, or may be the consequence of design. Lack of water due to drought may affect the establishment and persistence of vegetation, and subsequently the percent cover. Plantings may fail due to predation or trampling.

Invasive infestation may occur due to upstream inputs of seed/source material. It is expected that invasives will be adequately controlled through O&M procedures. However, if invasive infestation control is found to be ineffective, the Corps may recommend adjustments to invasive control methods utilized under O&M.

If wildlife populations in the focal areas are decreasing, it may indicate that the necessary habitat elements and underlying ecosystem functions have not been restored in target habitats, and that geomorphic conditions or vegetative cover and structure conditions require modifications through adaptive management actions.

Adaptive management actions that may be implemented to address problematic conditions and achieve project objectives are outlined in Section 6.2.

6.1.3 Non-native wildlife and non-native aquatic species populations triggers:

Desired Outcomes:

1) Reduce brown-headed cowbird population and nest parasitism to support use and occupation of riparian habitats by federally listed vireos and.

   Trigger: Wildlife monitoring shows trends of increasing cowbird populations and nest parasitism with either no change or a decrease in population of riparian obligate songbirds, including least Bell's vireo.

   Trigger: Maintain <10% nest parasitism annually.

2) Reduction in populations and class size of non-native aquatic species, particularly large predatory fish species such as carp, bass, and catfish, to support use and occupation of riverine habitats by endangered native fish.

   Trigger: Within 3 years, non-native aquatic species populations and class sizes are not reduced by more than 10%. Within 6 years, non-native aquatic species populations and class sizes are not reduced by more than 30%. Within 9 years, non-native aquatic species populations and class sizes are not reduced by more than 50%.

Restored habitats and use by native riparian obligate species and special status species may be impacted by the presence of non-native species. Cowbirds parasitize the nests of native songbirds, including endangered least Bell's vireo, reducing habitat suitability and vireo populations. Non- native fish may also outcompete natives for food resources and prey on endangered native fish populations.

Adaptive management actions that may be implemented to address problematic conditions and achieve project objectives are outlined in Section 6.2.

6.2 Potential Adaptive Management Measures

The results of monitoring will be used by the AMT to evaluate project status and adaptive management needs. Identified adaptive management actions for this project are described below. Prior to implementing adaptive management measures, the Corps and OCWD shall assess whether supplemental environmental analysis is required.

Performance Measure 1: In-stream hydrologic, geomorphic, and topographic conditions

Importing of Substrates: Substrates may need to be imported if triggers for in-stream hydrologic, geomorphic, and topographic conditions are met. Suitable substrates would be provided during construction, however monitoring results may show that substrates are not sufficient to support native fish habitat. Adaptive management actions would include importing of additional gravel and cobbles. It is assumed that occasional import of substrates would not be required as part of O&M. If monitoring shows that importing of substrates is required as adaptive management more than twice during the Monitoring and Adaptive Management period, adjustments to O&M manual may be made to require recurring substrate import based on appropriate triggers informed by monitoring results.

Adjusting grade-control structure heights: If sediment degradation occurs downstream of grade- control structures, the structure heights may need to be adjusted to ensure changes to channel gradient in a controlled manner. This adaptive management action entails adjusting, adding, or removing rock on grade control structures that are constructed as part of the project in the SARM upstream and Chino Creek focal areas.

Adjusting flow volume: Flows on Chino Creek may need adjusting if monitoring shows an inadequate amount of water in the existing channel to support vegetation and riverine functions. Adjustments to the percent split of flow between the newly constructed channel and the existing channel would ensure enough water is available for successful establishment of vegetation in each channel.

Re-grading: Re-grading or re-distribution of sediments may be needed if triggers for in-stream hydrologic, geomorphic, and topographic conditions or vegetative cover are met. Monitoring results may determine that sediment aggradation or degradation, scour of soils, or channel incision or erosion has impacted the successful establishment of geomorphic habitat features or target vegetative communities, or that channel incision has prevented establishment of in-channel diversity. Adaptive management actions would include re-grading or re-distributing sediments to support the appropriate geomorphic conditions for successful establishment of habitat.

Performance Measure 2: Vegetative community, cover, and structure

Irrigation/Supplemental Water: Irrigation and/or supplemental water may be needed if triggers for vegetative cover and/or structure are met. Assessment of monitoring results may show that drought conditions are causing poor establishment, native recruitment, or die off of planted vegetation.
Adaptive management actions would include supplemental water to support achievement of percent cover criteria and successful restoration of target vegetation communities.

Invasives Control: It is expected that invasives will be adequately controlled through O&M procedures. However, if monitoring results show that triggers for invasives are met, the Corps may recommend adjustments to invasive control methods, level of effort, and/or frequency of treatments under O&M.

Replanting: Replanting may be needed if triggers for vegetative cover and/or structure are met. Monitoring results should be used to assess the underlying cause of inadequate cover, which may require that additional adaptive management actions be implemented to support successful replanting. For instance, monitoring results may show that channel incision has prevented successful establishment of vegetative communities. Adaptive management would include actions to remedy the incision (i.e., re-grading), which would be required for successful replanting.

Plant Protection: Plant protection may be needed if triggers for vegetative cover and/or structure are met. Monitoring results may show that plantings are failing due to predation or trampling from recreational use or homeless encampments. Adaptive management actions would include measures such as plant cages or protective fencing that could be installed to protect plantings.

Fence Repair/Augmentation: Fence repair or augmentation may be needed if triggers for wildlife use and movement are met. This adaptive management action entails augmenting fencing installed as part of the project by changing its height, length, or depth in response to wildlife movement patterns in the Chino Creek focal area.

Performance Measure 3: Non-native wildlife and non-native aquatic species populations

Cowbird trapping: It is expected that cowbirds will be adequately controlled through O&M procedures. However, if monitoring results show that triggers for invasive wildlife are met, the Corps may recommend adjustments to cowbird control methods, level of effort, and/or trap locations under O&M.

Non-Native Aquatic Species Control: It is expected that non-native fish will be adequately managed through O&M procedures. However, if monitoring results show that triggers for non- native aquatic species populations are met, the Corps may recommend adjustments to fish removal methods, level of effort, and/or locations under O&M.

6.3 Conclusion of Monitoring for Project Features

Ecological success of a project feature will be confirmed when desired outcomes have been achieved, as measured by meeting or exceeding the 5-year or 10-year achievement thresholds identified in the triggers in Section 6.1. Once ecological success has been documented by the District Engineer in consultation with the Federal and State resources agencies, and a determination has been made by the Division Commander that ecological success has been achieved, no further monitoring will be required. Ecological success will be documented through an evaluation of the predicted outcomes as measured against the actual results.

When monitoring has shown that project objectives and success criteria have been met, regular inspection and maintenance by OCWD would occur over the 50-year life of the project.

7.0 COSTS FOR IMPLEMENTATION OF MONITORING AND ADAPTIVE MANAGEMENT PROGRAMS

The costs associated with implementing the monitoring and adaptive management plan were estimated based on currently available data, methods, and comparable projects. The potential adaptive management actions as described in Section 6.2 and potential expected frequency of need were used as a basis for cost estimating. Costs were estimated based on the overall area of monitoring over 4 focal areas. Because uncertainties remain as to detailed designs and adaptive management needs and opportunities, the estimated costs may be refined in PED during the development of the detailed monitoring and adaptive management plans for each project phase/feature.

7.1 Costs for Implementation of Monitoring Program

Cost calculations for monitoring are displayed as a total cost including 10 years of in-stream geomorphic monitoring and 5 years of vegetation and wildlife monitoring. If ecological success is determined earlier, the

monitoring program will cease and costs will decrease accordingly.

The current total estimate for implementing the monitoring plan is approximately $5.1 million for the NER Plan.

7.2 Costs for Implementation of Adaptive Management Program

Costs for the adaptive management program were based on estimated level of effort and potential frequency of need, and include participation in the Adaptive Management Team and reporting. The current total estimate for implementing the adaptive management program is approximately $4.1 million for the NER Plan.