Lower Colorado River Multi-Species Conservation Program

Balancing Resource Needs

Final Science Strategy

November 2007
Lower Colorado River Multi-Species Conservation Program
Implementation Steering Committee Members

Federal Participant Group
Bureau of Reclamation
U.S. Fish and Wildlife Service
National Park Service
Bureau of Land Management
Bureau of Indian Affairs
Western Area Power Administration

California Participant Group
California Department of Fish and Game
City of Needles
Coachella Valley Water District
Colorado River Board of California
Bard Water District
Imperial Irrigation District
Los Angeles Department of Water and Power
Palo Verde Irrigation District
San Diego County Water Authority
Southern California Edison Company
Southern California Public Power Authority
The Metropolitan Water District of Southern California

Arizona Participant Group
Arizona Department of Water Resources
Arizona Electric Power Cooperative, Inc.
Arizona Game and Fish Department
Arizona Power Authority
Central Arizona Water Conservation District
Cibola Valley Irrigation and Drainage District
City of Bullhead City
City of Lake Havasu City
City of Mesa
City of Somerton
City of Yuma
Electrical District No. 3, Pinal County, Arizona
Golden Shores Water Conservation District
Mohave County Water Authority
Mohave Valley Irrigation and Drainage District
Mohave Water Conservation District
North Gila Valley Irrigation and Drainage District
Town of Fredonia
Town of Thatcher
Town of Wickenburg
Salt River Project Agricultural Improvement and Power District
Unit “B” Irrigation and Drainage District
Wellton-Mohawk Irrigation and Drainage District
Yuma County Water Users’ Association
Yuma Irrigation District
Yuma Mesa Irrigation and Drainage District

Nevada Participant Group
Colorado River Commission of Nevada
Nevada Department of Wildlife
Southern Nevada Water Authority
Colorado River Commission Power Users
Basic Water Company

Native American Participant Group
Hualapai Tribe
Colorado River Indian Tribes
The Cocopah Indian Tribe

Conservation Participant Group
Ducks Unlimited
Lower Colorado River RC&D Area, Inc.

Other Interested Parties Participant Group
QuadState County Government Coalition
Desert Wildlife Unlimited
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Chapter 1. Introduction

Background

The Lower Colorado River Multi-Species Conservation Program (LCR MSCP) is a multi-stakeholder federal and non-federal partnership responding to the need to balance the use of lower Colorado River (LCR) water resources and the conservation of native species and their habitats in compliance with the Endangered Species Act. This is a long-term (50-year) plan to conserve at least 26 species along the LCR from Lake Mead to the Southerly International Boundary with Mexico through the implementation of a Habitat Conservation Plan (HCP) (LCR MSCP 2004). Most of the covered species are state and/or federally listed threatened and endangered species. The Bureau of Reclamation (Reclamation) is the entity responsible for implementing the LCR MSCP over the 50-year term of the program. A Steering Committee, currently consisting of 54 entities, has been formed as described in the LCR MSCP Funding and Management Agreement (FMA)\(^1\), to provide input and oversight functions in support of LCR MSCP implementation.

The HCP\(^2\) conservation measures are designed to meet the biological goals for the 26 covered species and potentially benefit the five evaluation species that were included in the LCR MSCP. The Science Strategy addresses 20 of the covered species for which Reclamation is responsible for implementing HCP conservation measures (see Appendix A).\(^3\) The biological goals and a summary of HCP conservation measures for these 20 covered and evaluation species are presented in Appendices B and C, respectively. The planning area for the LCR MSCP is shown in Figure 1.

The Science Strategy provides a process for identifying monitoring and research priorities using a 5-year planning cycle and a process for annually implementing these 5-year priorities during each planning cycle. The Science Strategy also provides for an adaptive management process for improving the effectiveness of

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\(^1\) Provided in Exhibit A of the LCR MSCP HCP (LCR MSCP 2004).
\(^2\) Conservation measures are identified in LCR MSCP Chapter 5, Conservation Plan.
\(^3\) HCP conservation measures for the humpback chub, desert tortoise, flat-tailed horned lizard, relict leopard frog, sticky buckwheat, and three-corner milkvetch require Reclamation to provide funding to other specified conservation programs to implement measures to conserve these species. Consequently, conservation measures for these species are not addressed by the Science Strategy. Reclamation through the LCR MSCP annual work plan process, however, is responsible for ensuring that these funds are used to implement conservation actions that are consistent with the requirements of the HCP.
HCP implementation based on monitoring and research results. The monitoring element of the Science Strategy includes compliance monitoring. Compliance monitoring will be undertaken specifically to provide Reclamation with the information necessary to demonstrate regulatory compliance with the terms of the HCP and incidental take permits.

Purpose and Need

The purpose of this Science Strategy is to provide Reclamation with a science-based process for ensuring that relevant new information generated over the 50-year term of LCR MSCP is used to guide implementation of HCP conservation measures. New information regarding covered species, their habitat requirements, and methods for establishing and managing created habitats will be generated through monitoring and research conducted by Reclamation and others.

The HCP provides program-level guidance for ensuring that implementation of the conservation measures will be based on scientific information, methods, principles, and standards (see HCP Section 5.3.2). As new information on species and their habitats is developed, the HCP also provides for use of an adaptive management process to review and incorporate this new information as appropriate. In addition, implementation of the HCP is funded to levels specified in the FMA. Based on these funding levels, HCP implementation needs to be both biologically effective in meeting the biological goals and financially cost-efficient. Successful implementation of the HCP with scientific rigor, adaptive management, and cost efficiency requires development of a science strategy to provide a structural framework for incorporating these factors into Reclamation’s planning, implementation, and decision making processes. Further, it is the intent of Reclamation that the Science Strategy provide a means to allow the implementation decision making process to be as transparent as possible.

The Science Strategy addresses two decision making functions:

- how the strategy will operate in Reclamation’s implementation decision making process and
- the processes that can be used to identify uncertainties and knowledge gaps, develop monitoring and research priorities, and to incorporate new knowledge into the decision making process.
**Figure 1** Lower Colorado River MSCP Planning Area and River Reaches
Given the funding available for implementation, development and approval of specific actions in Reclamation’s Annual Work Plans\(^4\) should be directed to those actions needed to ensure the achievement of the LCR MSCP biological goals.

**Information Sharing**

A key component of the science strategy is coordination with entities and groups within and external to the LCR MSCP Steering Committee (Steering Committee) whose knowledge and experience will provide significant benefits to HCP implementation. This coordination will facilitate the exchange of data and results of experiments or pilot projects among LCR MSCP Partners\(^5\) (Partners).

With such knowledge sharing, duplication of efforts that address similar research or habitat questions can be minimized with resultant time and cost savings. Coordinated monitoring programs can result in greater data-gathering power and resolution to enhance results. Potential cooperators include multi-agency conservation programs, state fish and wildlife agencies (Arizona Game and Fish Department, California Department of Fish and Game, and the Nevada Department of Wildlife), Native American Tribes, national and local conservation groups, and research institutions. Coordination with others may include sharing information collected through monitoring and research through a variety of venues, including:

- providing reports and other types of LCR MSCP related information on the LCR MSCP website;
- periodically publishing results of research either as LCR MSCP technical reports or as papers presented in scientific journals;
- presentation of monitoring and research results and other science-related LCR MSCP information at conferences hosted by Reclamation or others;
- periodic publication of informational materials describing LCR MSCP implementation progress; and
- providing others with data and information maintained in the LCR MSCP Database Management System.

The HCP identifies several categories of monitoring and research that will provide information needed to achieve the biological goals for the covered species (see LCR MSCP HCP Section 5.11). The categories (hereafter referred to as

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\(^4\) Annual Work Plans are documents that are prepared by Reclamation in coordination with the Steering Committee and USFWS that identify actions that will be undertaken by Reclamation to implement conservation measures during each fiscal year (October 1-September 30).

\(^5\) LCR MSCP Partners are the member entities of the Steering Committee.
implementation elements) addressed by the Science Strategy include the following:

- species research,
- habitat creation research,
- system monitoring, and
- post-development monitoring.

**Document Organization**

This document is organized into the following Chapters:

- Chapter 2: *Science Strategy Process* describes the overall Science Strategy process for identifying and approving monitoring and research priorities and providing for adaptive implementation of the HCP.
- Chapter 3: *Science Strategy Implementation Elements* describes the implementation elements for which science-based processes are needed and Reclamation’s process for identifying monitoring and research needs for each implementation element.
- Chapter 4: *Monitoring and Research Plans* describes Reclamation’s process for developing science-based monitoring and research plans based on the best available information.
Chapter 2. Science Strategy Process

Introduction

This Chapter describes the Science Strategy process as part of Reclamation’s implementation of the HCP. The Science Strategy is the procedure by which Reclamation will incorporate science into their planning processes and coordinate with the Steering Committee as described in the FMA.

Role of Reclamation and the Steering Committee

Section 7 of the FMA describes the management and implementation of the LCR MSCP. The roles and responsibilities of Reclamation in the FMA are clear in giving Reclamation the primary responsibility to administer and implement the program through the HCP. Reclamation, through the LCR MSCP Program Manager (Program Manager), cooperates and coordinates its management and implementation activities with the Steering Committee in accordance with the terms of the FMA. The role of the Steering Committee in decision making is defined in the FMA.

As discussed in the FMA, Reclamation is responsible for developing an Annual Work Plan that describes what conservation actions will be implemented for the next year. This Annual Work Plan contains the individual work tasks identified by Reclamation as needing to be implemented to provide for continued progress to meet the biological goals in a biologically effective and cost efficient manner.

As part of the review process for the Annual Work Plans, budgets, and implementation reporting developed since the LCR MSCP was signed in 2005, Reclamation seeks input from ad hoc “Technical Work Groups” (TWG), comprised of members of the Steering Committee and other parties expressing interest. These TWGs review draft documents, provide information for development of white papers, and serve other roles as determined by Reclamation to contribute to the information base used by Reclamation in its decision making process. The Science Strategy procedures described in this chapter are designed to be incorporated into the existing roles and responsibilities of Reclamation and the Steering Committee as described in the FMA.
Planning Processes

Reclamation uses planning processes that operate on 5-year and annual cycles for identifying HCP implementation priorities. The Science Strategy uses these planning cycles as the mechanism for identifying monitoring and research activities and for making changes to implementation through the LCR MSCP adaptive management process (see Adaptive Management below). The 5-year planning process (hereafter referred to as the 5-year cycle) is used to identify monitoring and research priorities for the following 5 years of HCP implementation. The annual planning process culminates in the development of approved Annual Work Plans. Annual Work Plans identify work tasks that will be undertaken by Reclamation during each fiscal year to implement the HCP, including activities related to planning, monitoring and research, habitat creation and management, and fish augmentation. In the context of the Science Strategy, Annual Work Plans are the mechanism through which:

- specific monitoring and research activities that will be undertaken during each year of the 5-year cycle are identified to achieve the 5-year cycle monitoring and research priorities; and
- adaptive changes to HCP implementation are identified and approved.

Figure 2a illustrates the 5-year cycle. The starting point for the 5-year cycle is the consideration of the implementation elements, as this is the point at which knowledge and data gaps are identified by Reclamation staff. Figure 2b illustrates the Annual Work Plan process that would be accomplished annually for each year of the 5-year cycle. The annual cycle feeds out of the 5-year cycle at the point where the final 5-year monitoring and research priorities are determined, and feeds back into the 5-year cycle at the point where the next 5-year planning cycle is initiated.

The 5-year cycle and Annual Work Plan development processes are comprised of a series of sequential actions that provide an organized path for documenting how and where science-based processes are considered in Reclamation’s decision-making process for implementing the HCP.

5-Year Cycle Process

The 5-year cycle process entails identifying monitoring and research priorities (hereafter referred to as priorities) based on review of the information needs for the implementation elements that are identified through the processes described in Chapter 3, Implementation Elements. Priorities are designed to answer general or specific questions that identify knowledge needs or data gaps that affect the ability of Reclamation to implement the HCP in a biologically effective and cost efficient manner. A 5-year cycle was selected because it is of sufficient duration to allow for new information for use in guiding implementation planning to be
Figure 2a. 5-Year Process for Establishing Monitoring and Research Priorities
developed and is of short enough duration to provide for timely management responses to new information. For example, the 5-year planning cycle:

- provides sufficient time for the completion and analysis of multi-year research or monitoring actions;
- allows time for on-the-ground changes to occur in response to management actions (e.g., the establishment of created habitats) and be documented;
- allows time for specific monitoring and research proposals to be fully developed to include the best science; and
- is such that results of monitoring and research can be responded to quickly without a significant loss of time or funds resulting from proceeding in less desirable directions for implementation.

The 5-year cycle process entails Reclamation’s process for identifying draft priorities and the Steering Committee coordination process for identifying the
final priorities that will be addressed through Annual Work Plans. Reclamation anticipates undertaking the following 4-step process to identify 5-year cycle priorities (see Figure 2a).

1. **Identify knowledge needs and data gaps.** Reclamation will initially review existing information, including results from monitoring and research conducted prior to adoption of the Science Strategy, to identify knowledge needs and data gaps for each of the implementation elements. Reclamation’s process for developing priorities for each implementation element is described in Chapter 3. At the end of each 5-year cycle, Reclamation will evaluate, as appropriate, the results of priority-related monitoring and research implemented during the completed 5-year cycle. Results of this evaluation will be documented in a report and this information will be used, as appropriate, to develop draft priorities for the next 5-year planning cycle. In addition, Reclamation may periodically provide status reviews of the entire program that would also inform the process for establishing 5-year priorities. These reviews could include program-level status, 5-year cycle priorities, or focus on particular issues (see Status Reviews below). The format of these reviews is at the discretion of Reclamation, and would be determined after completion of Reclamation’s internal review processes.

2. **Initial ranking of data needs.** Reclamation staff will review the knowledge needs and data gaps identified in Step 1 for each implementation element to initially rank them in order of importance for gathering the information necessary to ensure successful HCP implementation. Considerations for ranking knowledge needs and data gaps for each implementation element include, but are not limited to, the following.

   **Species Research:** The information needs to be obtained during the 5-year cycle to establish effective created habitat design and management requirements to provide for the creation of habitat in accordance with the HCP implementation schedule.

   **Created Habitat Research:** The information needs to be obtained to identify techniques that will effectively establish and maintain habitats to be created during the 5-year cycle.

   **System Monitoring:** The subject of monitoring is needed to manage the direction of future HCP implementation and to effectively evaluate HCP implementation success.

   **Post-Development Monitoring:** The monitoring needs to be conducted to determine if habitat creation and management methods are successful.
3. **Review initial data ranking and propose priorities.** Following initial ranking of priorities, Reclamation will establish an internal review team comprised of senior Reclamation staff with relevant expertise in biological and physical sciences, scientific method, habitat restoration design and engineering, and resource management. The internal review team will review the initial priorities identified in Step 2 to identify the proposed priorities that should be addressed in the 5-year cycle. Considerations for identifying priorities may include:

- evaluating the monitoring and research projects to ensure they focus on implementation of the HCP conservation measures;
- evaluating the likelihood that the monitoring and research will:
  - provide information without which implementation efforts may be significantly hindered or rendered unsuccessful;
  - provide baseline information needed to initiate the implementation of other activities;
  - provide information necessary to develop or establish a part of the administration of the program by Reclamation;
  - provide the opportunity to obtain synergies with other conservation programs to obtain information needed by both programs at a savings of time or cost;
- assessing the amount of funding available for each implementation element over the 5-year period and the amount of funding needed to meet habitat creation, habitat management, and fish augmentation objectives during the 5-year cycle;
- assessing whether or not the opportunity to implement the monitoring and research is time-dependent or can be implemented in subsequent 5-year cycles;
- assessing the relationship of the proposed priorities to projects currently under development or being planned; and
- other considerations as identified by Reclamation.

4. **Determine final data need priorities.** At the beginning of each 5-year cycle, Reclamation will provide the Steering Committee with a description of the draft priorities and initiate coordination to identify the final 5-year priorities. The description of each priority will document, as appropriate, the basis used to develop the priorities, the rationale for each priority and how addressing the priority is expected to inform HCP implementation, and why each of the priorities need to be addressed during the current 5-year planning cycle. The Steering Committee coordination process may include formation of a TWG, workshops, other reviews with Partners or
other cooperating entities, or other suitable means identified by
Reclamation. Information on how the final priorities are identified will be
documented as part of the transparency of the decision making process.

Annual Planning Cycle

Once the priorities for a 5-year cycle have been identified, the Annual Work Plans
developed for that cycle will use the priorities as one factor in developing specific
work tasks for that Annual Work Plan. Reclamation will annually evaluate the
5-year priorities to determine if they should be implemented, in whole or in part,
under each Annual Work Plan. This evaluation is necessary to ensure that work
tasks can be accomplished within the annual implementation budget and all
components of HCP implementation should be considered in determining which
specific monitoring and research proposals to address. The 5-year priorities will
be funded. New priorities not related to the 5-year cycle priorities would
generally not be funded unless some significant new information was developed
that prompts a review by Reclamation to determine the need for a change in
priorities. If new monitoring and research priorities are identified within a 5-year
cycle, the need for the new priority would be documented through the Annual
Work Plan process described below and would be incorporated as an identified
priority in the next 5-year cycle planning process.

This annual review of 5-year cycle priorities is accomplished and documented, in
part, through annual monitoring and research project reports and Reclamation’s
preparation of its annual Accomplishments Report at the end of each fiscal year.
The Accomplishments Report summarizes the HCP implementation progress for
that year and is provided for Steering Committee review through the Steering
Committee coordination process. Accomplishments Reports include information
obtained through the priority monitoring and research conducted during that year.
The reported information for each priority could include:

- a description of the purpose of the monitoring and research priority (e.g.,
  what new information is to be obtained and why is it needed to inform
  implementation);

- summary of the funded monitoring and research results;

- any minor modifications to HCP implementation of funded tasks that
  resulted from findings of the monitoring and research during the fiscal
  year;

- any major modifications to HCP implementation of funded tasks that
  resulted from findings of the monitoring and research during the fiscal
  year; and

- a recommendation, based on the sufficiency of new information gathered
  through the monitoring and research, of whether or not the monitoring and
  research should be continued as originally described or in a modified form
  or discontinued.
Reclamation anticipates a 5-step process to develop and implement Annual Work Plan work tasks for priority monitoring and research.

1. Reclamation will review results of monitoring and research conducted in the previous year to determine if their purpose has been achieved and if previously approved monitoring and research should be continued, modified, or discontinued (this review is documented in the Accomplishments Report described above).

2. Reclamation will review 5-year priorities that were not addressed in previous years within the 5-year cycle to identify monitoring and research that should be identified for implementation in the current Annual Work Plan. Considerations for identifying research and monitoring include:
   - an assessment of costs to implement the research and monitoring relative to the available annual budget and other implementation priorities;
   - the need to implement the research and monitoring to answer questions necessary to implement other elements of the HCP; and
   - whether or not the results of previous monitoring and research indicate that the priority is still valid or should be discontinued.

3. Each research and monitoring work task proposed in the draft Annual Work Plan should include a description of:
   - the purpose of the monitoring and research, including questions that will be answered, the rationale for why the question needs to be answered (i.e., how it is expected to guide HCP implementation), and why it needs to be answered during the annual work plan cycle;
   - estimated budget;
   - anticipated duration of the monitoring and research;
   - a general description of the methods used to implement the monitoring and research; and
   - if applicable, a description of coordination that may be undertaken with other monitoring and research projects implemented by other programs within and outside of Reclamation.

4. Following completion of the draft Annual Work Plan, the draft will undergo coordination with the Steering Committee. Reclamation will prepare the final Annual Work Plan based on results of coordination with the Steering Committee as appropriate.
5. Following approval of the final Annual Work Plan, Reclamation will prepare detailed monitoring and research plans for implementing the approved monitoring and research tasks as described in Chapter 4.

Adaptive Management

The state of current knowledge surrounding covered species requirements and the ability to create their habitats is such that uncertainty regarding outcomes of implementing the HCP relative to achieving biological goals is unavoidable. To address these uncertainties, the HCP provides for monitoring and research to address knowledge gaps and uncertainties and provides for adaptively managing implementation based on new information. The LCR MSCP adaptive management process allows for adjusting HCP implementation based on new information that may be developed through monitoring and research over the term of the LCR MSCP. The adaptive management process is consistent with the USFWS’s Five-Point Policy for HCPs (65 FR 106, June 1, 2000), which broadly defines adaptive management:

as a method for examining alternative strategies for meeting measurable biological goals and objectives, and then if necessary, adjusting future conservation management actions according to what is learned.

Adaptive Management Structure and Process

The Science Strategy provides for effecting adaptive implementation of the HCP through the 5-year cycle and Annual Work Plan development process described above under Planning Processes. The adaptive management process addresses adaptive implementation of the HCP at the project-level and program-level. Program-level adaptive management addresses adjustments to HCP implementation that would require concurrence by the Steering Committee and USFWS to effect. Examples of program-level adaptive management decisions would be changes to HCP conservation elements or the overall direction of the HCP. Project-level adaptive management addresses adjustments to HCP implementation that can be effected by the Program Manager without requiring participation by the Steering Committee or USFWS. Reclamation, however, will provide opportunities, as appropriate, for participation by the Steering Committee, USFWS, and other entities to contribute to information used to make implementation-level decisions.

Both levels of adaptive management rely on the initial receipt of new information, the analysis of that information, and the incorporation of the new information into the design or direction of future work tasks. This process will occur in some degree of detail for each Annual Work Plan task that relies on the Science Strategy at the end of each implementation year through preparation of annual Accomplishments Reports, the beginning of each 5-year planning cycle and
Annual Work Plan cycle, and at other appropriate times as determined by Reclamation.

**Project Adaptive Management**

Project adaptive management relies on the 5-year cycle and Annual Work Plan development processes. The project adaptive management process begins for each project with the review of completed or interim reports presenting results of monitoring and research from funded proposals developed to meet 5-year cycle priorities. This is a Reclamation staff-level review. The information in the reports is assessed to determine if the new information indicates that a change in HCP implementation is warranted. If indicated through this assessment, the Reclamation staff leads for the affected work tasks will draft recommended changes, including supporting information, to HCP implementation. The draft recommendations are then reviewed by Reclamation’s technical adaptive management team for their approval.

If the technical adaptive management team determines that proposed changes to HCP implementation would have more than a minor effect on existing 5-year cycle priorities or result in potentially significant changes to projects being implemented, the Steering Committee, USFWS, and other entities, as appropriate, will be provided an opportunity to review and discuss Reclamation’s analysis and recommendations. Reclamation may provide for such reviews in a number of ways, including a technical work group, peer review by recognized experts, workshops, or other forms of information review. The result of this expanded review is a recommendation to Reclamation for changes to 5-year cycle priorities or projects for the next year. Reclamation will make the final decision on the implementation of recommendations.

Proposed changes to HCP implementation that are recommended by Reclamation through this adaptive decision making process are proposed and documented, as appropriate, through the 5-year cycle and Annual Work Plan Steering Committee coordination processes (see Figures 2a and 2b.).

**Program Adaptive Management**

Program-level adaptive management provides for adjustments to HCP implementation that, to effect, would require adjustments to LCR MSCP funding levels, revisions to HCP conservation measures, adoption of alternate conservation measures, or other significant changes that affect what the HCP includes as part of the conservation direction. Reclamation will, during the program adaptive management process, determine if recommended changes to HCP implementation are significant enough to warrant program modification. If Reclamation makes that decision, the Steering Committee must be involved in the review of the recommendations. Reclamation has several options as to how this could be done, including a technical work group, peer review by recognized experts, workshops, other forms of information review, or through use of
procedures described in the FMA regarding coordination between Reclamation and the Steering Committee.

Program-level adaptive management is not anticipated to occur often over the 50-year term of the LCR MSCP because the HCP conservation direction was developed using the best available information and accepted principles of conservation planning. Consequently, with the exception of possibly providing coverage for evaluation species under the HCP, the likelihood that new information would be developed of a magnitude that would necessitate a change in the conservation direction sufficiently to trigger this process makes its use likely to be rare. This process would not be used in the event of changed circumstances or unforeseen circumstances. Regulations for section 10(a)(1)(B) permits, and for changes to biological opinions under section 7 have specified pathways for consideration and resolution that would be used if these situations occur.

**Process for Covering Evaluation Species**

In addition to the covered species, the HCP addresses five evaluation species: the California leaf-nosed bat, pale Townsend’s big-eared bat, desert pocket mouse, Colorado River toad, and lowland leopard frog. These species could become covered under the HCP during the term of the LCR MSCP through the process described under *Program Adaptive Management* above.

These evaluation species could become listed in future years, but were not covered under the HCP because sufficient information was not available at the time the HCP was prepared to determine their status in the LCR MSCP planning area, to assess the potential effects of covered activities, or to develop specific conservation measures. The HCP, however, does include monitoring and research measures for these species that provide for gathering information necessary to better define their status, distribution, and habitat requirements in the LCR MSCP planning area (see Appendix C). Implementation of these research and monitoring measures will be implemented as described for the covered species in Chapters 2 through 4. The evaluation species could be proposed for coverage through the program adaptive management process if sufficient information is gathered through monitoring and research to identify conservation measures that would, at a minimum, meet the HCP conservation goal of avoiding, minimizing, and fully mitigating adverse effects of the covered activities and HCP implementation for each of the species (see HCP Section 5.2.1).

**Status Reviews**

In addition to evaluations of HCP implementation that are conducted to inform adaptive decision making in the 5-year cycle and Annual Work Plan development processes, Reclamation may conduct periodic program-wide status reviews of
HCP implementation. The purpose of these status reviews is to provide Reclamation with a methodical process to periodically evaluate its HCP implementation procedures and the conservation needs of covered species. Results of status reviews would be used to adjust implementation procedures and approaches to species conservation if needed. Two types of status reviews, technical status reviews and species status reviews, may be conducted. Unlike evaluations of monitoring and research results conducted for the 5-year cycle and Annual Work Plan processes, status reviews would also include evaluations to determine if implementation procedures (e.g., monitoring protocols) require updating based on the best available information and regional assessments of the status of covered species to determine if their status has changed sufficiently to affect their conservation needs. These reviews will be conducted at the discretion of Reclamation as needed.

**Technical Status Reviews**

Reclamation may undertake technical status reviews of HCP implementation processes to ensure that they incorporate current information and reflect current Reclamation practice. Elements subject to technical status reviews include:

- system and post-development monitoring plans,
- research plans (if applicable),
- habitat management prescriptions,
- approaches to created habitat designs,
- guidelines for screening and evaluating potential conservation areas,
- the Science Strategy, and
- Geographic Information Science (GIS) and database structure, software, documentation, user manuals and other elements of Reclamation’s data management system.

Reclamation will prepare a document summarizing review results and recommending corrective actions and schedules for their implementation. Recommended corrective actions, depending on Reclamation’s assessment of their level of effect on HCP implementation, will undergo Steering Committee coordination, as appropriate, as described above under *Project Adaptive Management*.

**Species Status Review**

Reclamation may undertake periodic reviews of the status of covered species for which habitat is created under the HCP to identify:

- LCR and regional population trends;
- occupancy of created habitats;
• new information related to the creation and management of habitats established by others;
• new information regarding the habitat requirements and behavior of species;
• new information regarding factors that may be limiting species populations; and
• new techniques for species management.

This information will be evaluated to determine if changes in HCP conservation measures or implementation techniques may be warranted to improve conservation of covered species. Recommendations developed through this process, depending on Reclamation’s assessment of their level of effect on HCP implementation, will undergo Steering Committee coordination, as appropriate, as described under Adaptive Management.
Chapter 3. Science Strategy
Implementation Elements

Introduction

This Chapter provides guidance for developing and identifying monitoring and research activities that will be undertaken by Reclamation for each of the four Science Strategy implementation elements.

Species Research. The species research element implements research to address information gaps in the knowledge of the life history and habitat requirements of covered and evaluation species that is necessary for directing the successful establishment and management of created habitats.

Created Habitat Research. The created habitat research element implements research to address uncertainties related to the techniques for creating habitat and managing covered species habitats to maintain habitat values over the term of the LCR MSCP.

System Monitoring. The system monitoring element implements monitoring to determine the ongoing status of covered species and their habitats in the LCR MSCP planning area.

Post-Development Monitoring. The post-development monitoring element implements monitoring to determine the progress of implementation towards achieving HCP biological goals and to collect information necessary to assess the efficacy of habitat creation designs and habitat management prescriptions.

Monitoring and research data collected under each of these implementation elements are expected to inform implementation of one or more of the other elements. The information and adaptive management linkages among the elements are illustrated in Figure 3.

The HCP specifies monitoring and research that will be undertaken to address knowledge needs and data gaps to help ensure successful HCP implementation. These monitoring and research conservation measures are listed in Table 1. As described for each of the implementation elements below, Reclamation may identify and undertake additional monitoring and research if needed to better manage implementation of the HCP.
Figure 3  Information and Adaptive Management Linkages Among Science Strategy Implementation Elements

* Species and created habitat research are not expected to be implemented over the term of the LCR MSCP as data gaps are addressed by research conducted early in implementation.
### Table 1. LCR MSCP Monitoring and Research Conservation Measures

<table>
<thead>
<tr>
<th>LCR MSCP Code</th>
<th>Summary Description Conservation Measure</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General Monitoring and Research Conservation Measures</strong></td>
<td></td>
</tr>
<tr>
<td>MRM1</td>
<td>Conduct surveys and research to better identify covered and evaluation species habitat requirements.</td>
</tr>
<tr>
<td>MRM2</td>
<td>Monitor and adaptively manage created covered and evaluation species habitats.</td>
</tr>
<tr>
<td>MRM3</td>
<td>Conduct research to determine and address the effects of nest site competition with European starlings on reproduction of covered species.</td>
</tr>
<tr>
<td>MRM4</td>
<td>Conduct research to determine and address the effects of brown-headed cowbird nest parasitism on reproduction of covered species.</td>
</tr>
<tr>
<td>MRM5</td>
<td>Monitor selenium levels in created backwater and marsh land cover types, and study the effect of selenium released as a result of dredging activities.</td>
</tr>
<tr>
<td><strong>Species-Specific Monitoring and Research Conservation Measures</strong></td>
<td></td>
</tr>
<tr>
<td>BONY3</td>
<td>Bonytail augmentation program</td>
</tr>
<tr>
<td>BONY5</td>
<td>Conduct monitoring and research, and adaptively manage bonytail augmentations and created habitat</td>
</tr>
<tr>
<td>RASU3</td>
<td>Razorback sucker augmentation program</td>
</tr>
<tr>
<td>RASU6</td>
<td>Conduct monitoring and research, and adaptively manage razorback sucker augmentations and created habitat</td>
</tr>
<tr>
<td>RASU7</td>
<td>Provide funding and support for continuation of the Reclamation/SNWA ongoing Lake Mead razorback sucker studies.</td>
</tr>
<tr>
<td>WRBA1</td>
<td>Conduct surveys to determine the distribution of the western red bat.</td>
</tr>
<tr>
<td>WYBA1</td>
<td>Conduct surveys to determine the distribution of the western yellow bat.</td>
</tr>
<tr>
<td>CRCR1</td>
<td>Conduct research to better define Colorado River cotton rat habitat requirements.</td>
</tr>
<tr>
<td>YHCR1</td>
<td>Conduct research to better define Yuma hispid cotton rat habitat requirements.</td>
</tr>
<tr>
<td>FLSU3</td>
<td>Assess flannelmouth sucker management needs and develop management strategies.</td>
</tr>
<tr>
<td>MNSW1</td>
<td>Conduct surveys and research to locate MacNeill’s sootywing skipper habitat and to better define its habitat requirements.</td>
</tr>
<tr>
<td>CLNB1</td>
<td>Conduct surveys to locate California leaf-nosed bat roost sites.</td>
</tr>
</tbody>
</table>
Table 1. LCR MSCP Monitoring and Research Conservation Measures

<table>
<thead>
<tr>
<th>LCR MSCP Code</th>
<th>Summary Description Conservation Measurea</th>
</tr>
</thead>
<tbody>
<tr>
<td>PTBB1</td>
<td>Conduct surveys to locate pale Townsend’s big-eared bat roost sites.</td>
</tr>
<tr>
<td>CRTO1</td>
<td>Conduct research to better define the distribution, habitat requirements, and factors that are limiting the distribution of the Colorado River toad.</td>
</tr>
<tr>
<td>CRTO3</td>
<td>Conduct research to determine feasibility of establishing the Colorado River toad in unoccupied habitat.</td>
</tr>
<tr>
<td>LLFR1</td>
<td>Conduct research to better define the distribution, habitat requirements, and factors that are limiting the distribution of the lowland leopard frog.</td>
</tr>
<tr>
<td>LLFR3</td>
<td>Conduct research to determine feasibility of establishing the lowland leopard frog in unoccupied habitat.</td>
</tr>
</tbody>
</table>

aFull descriptions of conservation measures are provided in the LCR MSCP HCP. A summary of all species conservation measures is provided in Appendix C.

Species Research Element

The goal of the Science Strategy’s species research element is to undertake research necessary to fill information gaps in the understanding of the life history and habitat requirements of covered and evaluation species as they relate to informing the successful creation and management of habitat. The HCP specifies research to be undertaken to fill existing information gaps for some of the covered species (Table 1). Reclamation may identify and undertake additional species research if needed to better manage implementation of the HCP. Research plans would be prepared as described in Chapter 4, Monitoring and Research Plans for each species research study approved through the Annual Work Plan development process.

Reclamation anticipates that most species research will be implemented early in HCP implementation and that, as the species-related information needed to implement the HCP is gathered, the need for species research will eventually diminish and may be discontinued in later years of implementation.

Identifying Species Research Needs

As indicated by the conservation measures in Table 1, research for covered species will be directed primarily towards gathering the information needed to understand species habitat requirements and current distribution in the LCR MSCP planning area sufficiently to create and manage functioning habitats. This information will be used, as appropriate, to guide the design and management of
habitats to be created for these species. A guiding principle of the HCP is that habitat created for the yellow-billed cuckoo and southwestern willow flycatcher will also provide habitat for the other cottonwood-willow associated covered species. Consequently, species research is anticipated to initially focus primarily on identifying the physical and biological components of yellow-billed cuckoo and southwestern willow flycatcher habitat to provide the information necessary to effectively design, establish, and manage cottonwood-willow habitats for these species.

Reclamation anticipates identifying future research needs using the following 6-step process.

1. **Prepare species accounts.** Reclamation will initially prepare detailed species accounts describing the current knowledge about each covered species’ life history and habitat requirements, behavior, and management as it relates to the creation and management of their habitats. Reclamation will use these species accounts to identify information gaps for each species that, if addressed, would better inform the creation and management of covered species habitats. Species accounts will be periodically updated, as appropriate, as new information is collected through monitoring and research conducted by Reclamation and others during the status review process (see Chapter 2).

2. **Identify research conducted by others.** Reclamation will contact state and federal resource agencies, Partners, universities, and other appropriate entities to identify ongoing research being conducted by others that is relevant to implementation of the HCP.

3. **Review results of LCR monitoring and research.** Reclamation will initially evaluate results of relevant monitoring and research previously conducted along the LCR, as appropriate, to determine if additional species research is required or if ongoing research should be modified. Evaluation of results of ongoing and future LCR MSCP monitoring and research will be evaluated by Reclamation as described under Step 6 below.

4. **Identify LCR MSCP research priorities.** Reclamation anticipates initially identifying species research needs and priorities based on an assessment of information developed for the species accounts and on research being conducted by Reclamation and others. As HCP monitoring and research is implemented, results of monitoring and research will also be used to identify future research priorities. The highest priorities for research are anticipated to be those that address uncertainties that are the most important for ensuring the successful creation and management of habitats. Final research priorities will be determined through Reclamation’s process for establishing 5-year priorities and developing Annual Work Plans (see Chapter 2).
5. **Develop and implement species research plans.** Reclamation will develop and implement research plans\(^6\), as appropriate, for each species research project approved through the Annual Work Plan development process. The process for development and science review of research plans is described in Chapter 4.

6. **Adjust LCR MSCP species research priorities.** As information is collected and analyzed through monitoring and research, species research priorities are expected to change over the term of the LCR MSCP. Reclamation will review, as appropriate, results of monitoring and research and re-evaluate species research priorities during the Annual Work Plan and 5-year cycle plan processes (see Chapter 2). If indicated through this re-evaluation, species research priorities may be adjusted through the adaptive management process described in Chapter 2.

**Research Associated with Fish Augmentations**

The HCP includes conservation measures to provide for the stocking of up to 620,000 bonytail and 660,000 razorback sucker. Based on an assessment of the current body of knowledge surrounding the behaviors, habitat requirements, and conservation of razorback sucker and bonytail, Reclamation anticipates initially focusing research and monitoring of these stocked fish to determine:

- important environmental correlates affecting growth and survival during rearing;
- mechanisms affecting fish survival and health during fish transporting and stocking processes and methods to improve survival and health; and
- post-stocking distribution and survival and factors affecting distribution and survival.

Reclamation will, as appropriate, develop and implement research plans as described in Chapter 4 to address these knowledge gaps. Information from these research studies will be used to guide implementation of fish augmentations and created razorback sucker and bonytail habitat design and management in future years. Consequently, the focus of research may change in future years if indicated by results of this initial research and monitoring through the adaptive management process (see Chapter 2). Reclamation has initiated several fish-augmentation monitoring research studies, which are described in the LCR MSCP Fish Augmentation Plan.

**Approaches to Research**

Species research is expected to be primarily directed towards addressing knowledge gaps related to the habitat, ecology, and behaviors of covered species

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\(^6\) Research plans prepared by Reclamation are termed “study plans.”
that need to be filled to effectively implement the conservation measures and
achieve the biological goals. Most research is anticipated to be directed towards
providing information related to the following three areas of uncertainty.

1. **Determining key habitat parameters to support the design and**
   **management of created habitats.** This type of research is directed
towards identifying the physical and biological conditions that must be
present to create functioning habitat for species whose habitat
requirements along the LCR are not well known. An example of this type
of research would include studies undertaken to determine the timing,
duration, and extent of moist soil conditions that must be present to
support food production (i.e., flying insects) in southwestern willow
flycatcher breeding habitat.

2. **Determining species distribution along the LCR.** This type of research
is directed towards determining the distribution of covered species for
which this information is required to ensure created habitats are
established in locations that are used by the species. This research would
apply primarily to species that are not well distributed along the LCR and
whose movements along the LCR are limited. For example, conducting
research to locate western red bat and western yellow bat roost sites will
enable foraging habitats to be created in locations that are within their
flight ranges from roost sites.

3. **Determining the effects of and responses to nest parasitism and**
   **competition.** This type of research is directed towards determining the
adverse effects of brown-headed cowbird nest parasitism and nest site
competition with European starlings on covered bird species. This
research would focus on determining the level of effect cowbirds and
starlings are having on the reproductive success of affected covered
species, the level of adverse effect on reproduction that would be
necessary to trigger management actions to reduce their effects, and
effective methods for reducing nest parasitism and nest site competition.

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**Created Habitat Research Element**

The goal of the Science Strategy’s created habitat research element is to
undertake applied research necessary to address uncertainties related to habitat
creation and management techniques for maintaining habitat values over the term
of the LCR MSCP. Reclamation anticipates that most created habitat research
will be implemented early in HCP implementation and that, as habitats are created
and habitat creation-related information needed to establish habitats is gathered,
the need for created habitat research will diminish and likely be discontinued
before the full extent of HCP habitat has been created.
Identifying Created Habitat Research Needs

Reclamation anticipates identifying created habitat research needs using the following 6-step process.

1. **Review of existing information.** Reclamation will initially review habitat creation-related literature and identify the current body of information related to the techniques and considerations for the establishment and management of covered species habitats. Reclamation will also review, as appropriate, previous and ongoing habitat restoration projects implemented in the LCR MSCP planning area and relevant projects implemented elsewhere to identify areas of uncertainty regarding methods used to establish and manage habitats.

2. **Identify other research.** Reclamation will contact state and federal resource agencies, Partners, universities, and other appropriate entities, as appropriate, to identify ongoing habitat creation-related research being conducted by others that is relevant to HCP implementation.

3. **Review results of LCR monitoring and research.** Reclamation will initially evaluate results of relevant monitoring and research previously conducted along the LCR, as appropriate, to determine if additional created habitat research is required or if ongoing research should be modified. Evaluation of results of ongoing and future LCR MSCP monitoring and research will be evaluated by Reclamation as described under Step 6 below.

4. **Identify LCR MSCP created habitat research priorities.** Reclamation anticipates initially identifying created habitat research needs and priorities based on an assessment of information provided through the review of existing information and research identified under items 1 and 2 above. As HCP monitoring and research is implemented, results of monitoring and research will also be used to identify future research priorities. Currently, the highest priorities for research are anticipated to be those that address uncertainties that are the most important for the initial and successful creation of habitat. As habitat is created, research emphasis is expected to shift towards developing and refining management techniques for maintaining habitat values for covered species. Final research priorities will be determined through Reclamation’s process for establishing 5-year priorities and developing annual work plans (see Chapter 2).

5. **Develop and implement created habitat research plans.** Reclamation will develop and implement research plans, as appropriate, for each created habitat research project approved through the Annual Work Plan development process. The process for development and science review of created habitat research plans is described in Chapter 4.
6. **Adjust LCR MSCP created habitat research priorities.** As information is collected and analyzed through monitoring and research, created habitat research priorities are expected to change over the term of the LCR MSCP. Reclamation will review, as appropriate, results of monitoring and research conducted by Reclamation and others and re-evaluate created habitat research priorities during the Annual Work Plan and 5-year cycle processes (see Chapter 2). If indicated through this re-evaluation, created habitat research priorities may be adjusted through the adaptive management process described in Chapter 2.

**Approaches to Research**

Reclamation anticipates that created habitat research may be undertaken as pilot projects, as research studies conducted in created habitats, and as directed research. Created habitat research will generally be directed towards answering specific questions regarding techniques to ensure the effective establishment and management of created habitats.

**Pilot Projects**

Reclamation may implement specific pilot projects or demonstration projects designed to test different habitat creation and management methods. Pilot projects are defined as small habitat creation projects that will test one or more implementation techniques to determine the most effective and cost efficient methods for establishing components of habitat. Pilot projects will generally be designed such that the lands on which they are located will have the potential to develop as created habitat. Examples of pilot projects that may be undertaken include testing:

- techniques for propagating key plant species that support covered species habitat;
- methods for establishing cottonwood-willow vegetation with the structure necessary to achieve habitat objectives for cottonwood-willow associated species;
- techniques for establishing key plant species; and
- irrigation methods.

Reclamation anticipates that pilot projects would be implemented before the large scale commitment of resources are made for creating certain habitats using specific techniques. Research plans would be prepared for each pilot project and undergo science review as described Chapter 4.

**Conservation Area Research Studies**

As habitats are created on conservation areas, Reclamation anticipates that small scale research studies will be undertaken to address uncertainties specifically
related to management of created habitats. These studies could involve testing the
effectiveness of different habitat management prescriptions on portions of created
habitat set aside for this purpose. Examples of these types of research studies
include testing:

• methods for setting back vegetative succession;
• methods for controlling invasive plant species;
• methods for controlling non-native fish in created backwaters;
• different irrigation schedules (i.e., timing, frequency, and quantity of
irrigation) to identify the most efficacious schedules for establishing and
maintaining key plant species and to provide moist surface soil conditions
for the southwestern willow flycatcher and other species;
• other physical parameters for creating habitat; and
• quantifying water use needs for specific habitat types.

Research plans would be prepared for each conservation area research study as
described in Chapter 4.

Directed Research

Reclamation may conduct research directed to answering specific questions
related to techniques for creating habitats. Examples of directed research may
include, but not be limited to, determining:

• the best methods for collection of plant propagules from native plants;
• specific ecological factors important to the establishment and survival of
key plant species in different riparian and marsh systems; and
• the best methods for controlling and reducing soil salinity in managed
habitats.

Research plans would be prepared for each directed research project and undergo
science review as described in Chapter 4.

Management Observations

Reclamation will maintain, as appropriate, records of management activities
undertaken to maintain created habitats at each conservation area (e.g., timing and
frequency of irrigation). Review of these records will allow Reclamation to
identify potential linkages between specific management actions and the observed
outcomes of those actions as determined through post-development monitoring.
These cause and effect observations will contribute to the body of information
that would be used by Reclamation to adaptively manage created habitats as
described in Chapter 2.
System Monitoring Element

The goal of the Science Strategy’s system monitoring element is to undertake monitoring necessary to determine the ongoing status of covered species and their habitats in the LCR MSCP planning area. System monitoring will provide information necessary to identify the status and trends of covered species on a regional scale and determine the contributions of created habitats to species conservation. To facilitate regional monitoring of species status and trends, Reclamation will coordinate, as appropriate, with other regional monitoring efforts (e.g., state Partners in Flight monitoring programs) to ensure that Reclamation’s monitoring protocols and analytical methods are compatible with these monitoring efforts. A component of system monitoring may also include ongoing review of monitoring and research results from elsewhere in the range of covered species to determine if factors that cannot be addressed by the LCR MSCP may be adversely affecting the status of covered species in the LCR MSCP planning area (e.g., changes in wintering habitat conditions of neotropical migrants, such as southwestern willow flycatcher and Arizona Bell’s vireo) and if trends occurring along the LCR are different from trends elsewhere in a species range.

System monitoring is intended to provide a “big picture” view of the status of covered species and their habitats that will provide Reclamation with information necessary to help determine HCP implementation priorities and to inform the adaptive management process. For example, if the status of a species appears to be substantially improving, creation of additional habitat for the species may be deferred to provide earlier funding to create additional habitat for covered species not faring as well.

System monitoring information may be collected and analyzed from the following sources:

- monitoring undertaken by Reclamation specifically for the purpose of system monitoring;
- results of post-development monitoring (see Post-Development Monitoring Element below) and species research (see Species Research Element above)\(^7\);
- results of Reclamation’s water use accounting monitoring; and
- results of monitoring and research conducted by others.

\(^7\) Includes ongoing monitoring conducted by Reclamation under conditions of the 2001 ISC/SIA biological opinion (USFWS 2001).
Determine Changes from Baseline Conditions

System monitoring will provide the information necessary to determine changes from the baseline status and condition of covered species and their habitats in the LCR MSCP planning area over time. The approach for determining changes from baseline conditions in the LCR MSCP planning area may include the following activities.

Determining the extent and distribution of land cover types that provide habitat for covered species. Reclamation anticipates this will be accomplished through interpretation of aerial imagery (e.g., aerial photographs or other remote imagery of appropriate resolution) using a land cover type classification system that is compatible with the classification system used to prepare the HCP. Land cover types would be delineated and maintained in Reclamation’s GIS database. Reclamation anticipates that changes in the extent of covered species habitats within the LCR MSCP planning area from baseline conditions would be determined through application of the HCP habitat models developed for the following species.

- Western red bat
- Western yellow bat
- Yuma hispid cotton rat
- Yellow-billed cuckoo
- Elf owl
- Gilded flicker
- Gila woodpecker
- Vermilion flycatcher
- Arizona Bell’s vireo
- Sonoran yellow warbler
- Summer tanager

Identifying the distribution and abundance of covered species and the extent and distribution of their habitats. Reclamation anticipates this will be accomplished through review of existing species and habitat distribution information and results of monitoring and research conducted by Reclamation and others. Species occurrence and distribution data will be digitized into Reclamation’s GIS database. Habitat for the southwestern willow flycatcher will be delineated through field surveys conducted for this purpose. Reclamation may also delineate habitat for the Yuma clapper rail, California black rail, western least bittern, and Colorado River cotton rat through interpretation of aerial imagery if the known vegetative and other characteristics of their habitats can be effectively identified on the imagery.

8 Habitat models for these species are described in LCR MSCP HCP Table 3-9.
It is anticipated that current conditions for covered species and their habitats will be determined concurrently with preparation of the species accounts described above under *Species Research Element*. Reclamation will update this information, as appropriate, if environmental conditions present along the LCR were to substantially change in the future.

**Identifying System Monitoring Needs**

Reclamation anticipates that system monitoring will initially focus on conducting species-specific and multi-species monitoring to collect data needed to assess the status and trends of covered species in the LCR MSCP planning area. As the body of information acquired through system monitoring increases, the frequency with which system monitoring would need to be conducted is expected to decrease over time (e.g., as the understanding of the habitat requirements, habitat use areas, and abundance of a species in the LCR MSCP planning area increases, the frequency with which that species would need to be monitored would lessen unless the species’ habitat conditions along the LCR were to change substantially). Reclamation may identify additional system monitoring efforts using the following 5-step process.

1. **Identify existing monitoring efforts.** In 2006, Reclamation initiated identification monitoring and research relevant to system monitoring being conducted by Reclamation and others in the LCR MSCP planning area. Reclamation will evaluate the types of data being collected under each monitoring and research effort for which data can be made available to Reclamation to determine its relevancy for use in system monitoring.

2. **Review results of monitoring and research.** As described in Chapter 2, Reclamation will evaluate results of LCR MSCP monitoring and research during the Annual Work Plan development and during 5-year cycle processes. Results of monitoring and research will be evaluated, as appropriate, to determine if additional system monitoring is required or if ongoing monitoring should be modified. Reclamation may also identify the need to modify system monitoring to ensure ongoing compatibility of data with other regional monitoring programs should those monitoring programs change in the future.

3. **Identify system monitoring priorities.** Reclamation will initially identify system monitoring needs and priorities based on the evaluation of existing monitoring and research efforts identified under items 1 and 2 above.

4. **Develop and implement system monitoring plans.** Reclamation will develop and implement monitoring plans, as appropriate, for each system monitoring effort approved through the Annual Work Plan development process. The process for development and science review of monitoring plans is described in Chapter 4.
5. **Adjust system monitoring priorities.** As information is collected through monitoring and research, system monitoring priorities may change over the term of the LCR MSCP. Reclamation will review results of monitoring and research conducted by Reclamation and others, as appropriate, and re-evaluate system monitoring priorities during the Annual Work Plan development and 5-year cycle processes. If indicated through this reevaluation, Reclamation will adjust system monitoring priorities through the adaptive management process described in Chapter 2.

**Post-Development Monitoring**

The goal of the Science Strategy’s post-development monitoring element is to undertake monitoring necessary to determine progress of HCP implementation towards achieving HCP biological goals and to collect information necessary to assess the effectiveness of habitat creation designs and habitat management prescriptions. Post-development monitoring includes compliance monitoring, implementation monitoring, and response monitoring. Compliance monitoring will be conducted, as appropriate, to ensure that implementation is proceeding in compliance with the HCP and incidental take permits. Implementation and response monitoring will provide Reclamation with the information necessary to improve implementation over the term of the LCR MSCP through the adaptive management process.

Monitoring plans will be developed for each type of post-development monitoring undertaken by Reclamation as described in Chapter 4. This section describes the broad objectives of compliance, implementation, and response monitoring. The specific monitoring objectives, sampling designs, protocols, schedules, and analytical methods for each habitat creation project and fish monitoring activity will be identified in project-specific monitoring plans.

**Compliance Monitoring**

Reclamation will conduct compliance monitoring to demonstrate that LCR MSCP implementation is proceeding in accordance with the terms of the HCP, incidental take permits, and the Implementing Agreement. In the context of the Science Strategy, compliance monitoring includes monitoring to document progress towards achieving the biological goals and minimum habitat requirements described in Appendix B, Tables B-1 and B-2, respectively. The types of information that may be collected through compliance monitoring includes:

- documenting fish releases, including time, numbers and size, and location;
- documenting when habitat creation activities are initially undertaken and completed;
• documenting when created habitat objectives have been achieved for each
  habitat creation site; and
• documenting the total extent of habitat that has been created for each
  covered species and annually maintained over the term of the LCR MSCP.

Results of compliance monitoring will be summarized in annual Accomplishment
Reports.

**Implementation Monitoring**

Implementation monitoring will be conducted to monitor the success of habitat
creation techniques in achieving specific habitat design goals and the success of
fish augmentation techniques in augmenting razorback sucker and bonytail
populations. Information about the relative success of the various implementation
techniques that may be employed by Reclamation will provide the basis for
improving the effectiveness of implementation methods through the adaptive
management process.

Implementation monitoring is anticipated to collect information necessary to:
• document that habitats are established in accordance with created habitat
design plans and specifications;
• estimate the survival rate, composition, and distribution of planted
vegetation;
• document that razorback sucker and bonytail are released in accordance
with annual fish stocking plans; and
• determine the effectiveness of habitat creation techniques for initially
  establishing cottonwood-willow, honey mesquite, and marsh vegetation.

Reclamation may also conduct other types of implementation monitoring as
needed to collect information necessary to assess the success of implementation
techniques. Data collected through implementation monitoring will also serve as
an early indicator of the need for management interventions if habitats are not
developing as intended. Results of implementation monitoring will be
summarized in annual Accomplishment Reports.

**Response Monitoring**

Response monitoring will be conducted to determine the response of individuals
and populations of covered species to the establishment and management of
created habitats and species-specific conservation measures. Monitoring to
determine the response of razorback sucker and bonytail to fish augmentations
will be conducted as part of fish augmentation research studies described above
under *Research Associated with Fish Augmentations*.

Response monitoring is a key instrument for providing the information necessary
for adaptively managing HCP implementation to better ensure species are
conserved (see Chapter 2). This information will be used to identify the habitat
management activities that created the conditions used by the species, evaluate if
similar conditions are present in other habitat areas created for the species and, if
not, adjust habitat management prescriptions, if appropriate, to create the
observed conditions used by the species.

**Habitat Response**

Reclamation anticipates monitoring indicators of species habitat at creation sites
to determine if habitat conditions have developed and are maintained. Monitoring
plans for created habitats will identify, as appropriate, specific indicators that will
be monitored and indicator thresholds that, when achieved, will indicate that
created habitat objectives have been attained. Indicators selected for monitoring
are anticipated to be primary components of species habitats that can be easily
and repeatedly measured.

Response monitoring will include, as appropriate, monitoring to assess the
progression of habitat development over the term of the LCR MSCP. This type of
monitoring is anticipated to be conducted on an ongoing basis and is intended to
provide the information necessary to improve habitat creation techniques and
habitat management prescriptions and to facilitate adaptive management decision
making. Examples of this type of monitoring would include measuring:

- the annual growth of plants;
- establishment patterns and rates of invasive non-native plants;
- development of invertebrate communities in support of the foodweb;
- volunteer establishment patterns and rates of native plants; and
- development of understory and midstory canopy layers.

Comparisons of these types of monitoring data with the habitat creation
techniques and habitat management prescriptions will provide Reclamation with
information necessary to determine if the habitat creation and management
methods are effective or can be improved. This type of monitoring information
will also provide Reclamation with an early warning to execute management
interventions to preclude potential site failure based on an observed lack of habitat
development or regression of habitat conditions.

**Species Response**

Species response monitoring will focus on determining if habitats are used by
covered species and to document the timing, type (e.g., nesting, migration
stopover), and degree of use by covered species. Similarly, Reclamation will also
monitor use of nest boxes and artificial snags by gilded flickers, Gila
woodpeckers, and elf owls and survival of razorback sucker and bonytail stocked
to augment existing populations, as appropriate. Species distribution and
abundance information collected through response monitoring will also provide a
source of information for use in assessing the overall status of the species in the
LCR MSCP planning area as part of system monitoring.

The initial step for monitoring species response will be to establish baseline
conditions before habitat is created. Reclamation will also use this information to
design created habitats to avoid and minimize potential effects on covered
species. Baseline conditions form the basis from which future use of created
habitats by covered species will be measured. In areas that do not support
existing covered species habitats and that are planned for habitat creation,
baseline conditions are assumed not to support covered species. In habitat
creation areas that support existing habitat, baseline conditions will be determined
by conducting surveys, as appropriate, to determine if covered species are present
and the timing and degree of habitat use by the species.9

Science Review of Monitoring and Research Reports

Information developed through the monitoring and research implementation
elements described above is an important element for adaptively managing HCP
implementation and measuring progress. Monitoring and research reports will be
reviewed by senior Reclamation scientists and resource managers to ensure that
the reports are complete and that reported results, findings, and recommendations
are valid and supported by the data and analytical methods. Reviewers will
consult with other experts, as appropriate, to conduct reviews. If results or
findings are not supported, reviewers will identify the causes and recommend
corrective actions as appropriate (e.g., correcting mathematical errors, revising
protocols and analytical methods).

During this review process, Reclamation will also evaluate reported results to
determine if changes in monitoring and research protocols or priorities, LCR
MSCP implementation priorities, or HCP conservation measures may be
warranted. If so, reviewers will be responsible for drafting appropriate
recommendations for adopting changes in implementation, as appropriate,
through the 5-year cycle, Annual Work Plan development, and adaptive
management processes described in Chapter 2.

9  The period over which surveys should be conducted to determine if covered species are
present will vary depending on the species for which habitat is present and will be identified
for each species in monitoring plans.
Chapter 4. Monitoring and Research Plans

Introduction

This Chapter describes processes for incorporating science and review into development of monitoring and research plans that will guide Reclamation’s implementation of the HCP. These processes are important foundational elements for successful implementation of the HCP. Because results of monitoring and research provide the basis for adaptive implementation of the HCP, failure to incorporate valid scientific approaches into monitoring and research plans could jeopardize attainment of LCR MSCP biological goals (see Table B-1).

Development of Monitoring and Research Plans

Reclamation will develop monitoring and research plans for each monitoring and research activity that is approved through the Annual Work Plan process. Plans for system monitoring and research are anticipated to be stand alone documents. Reclamation anticipates that post-development monitoring plans will be included as part of conservation area management plans and fish augmentation plans. These monitoring plans will address all monitoring activities that may be undertaken on each conservation area or for each fish augmentation plan. Protocols for each type of post-development monitoring (e.g., survey protocols for detecting nesting southwestern willow flycatchers, survey protocols for measuring the growth of cottonwood trees) and methods used to analyze monitoring data (e.g., statistical tools), however, are expected to be consistent among conservation area management plans and fish augmentation plans.

The monitoring and research development process provides for review of draft plans to ensure they are based on scientific principles and the best available information.

Monitoring Plans

Monitoring plans will be developed, as appropriate, for each system monitoring and pre- and post-development monitoring activity undertaken by Reclamation. Standardized monitoring protocols and analytical methods may be provided in separate documents that may be incorporated by reference in conservation area and fish augmentation plans.
Monitoring plans should include, as appropriate, the following types of information:

- description of monitoring purpose and objectives;
- description of monitoring protocols (may be incorporated by reference) and sampling design, including citations supporting the validity of the methods and sampling design;
- procedures that will be used to analyze monitoring data (may be incorporated by reference), including citations supporting the validity of the methods;
- procedures for validating monitoring data and methods;
- monitoring schedule and duration, including citations supporting the validity of the monitoring schedule;
- schedule for submitting monitoring report;
- monitoring report content requirements;
- monitoring data storage procedures;
- references, including printed references and personal communications;
- date the monitoring plan was prepared and dates of subsequent revisions; and
- other types of information as appropriate to specific monitoring plans.

All monitoring plans, including elements such as survey protocols that may be standardized, will undergo the review process described under Monitoring and Research Plan Review Process below. Reclamation maintains a library of monitoring protocols. Reclamation anticipates that these protocols will be incorporated by reference into monitoring plans developed for each conservation area and fish augmentation plan.

Key elements of monitoring plans are survey protocols, monitoring variables or indicators, sampling design, and methods used to analyze monitoring data (e.g., statistical tools). Reclamation may develop standardized survey protocols, monitoring variables, sampling design, and methods used to analyze monitoring data for each monitoring subject (e.g., southwestern willow flycatcher breeding surveys, surveys to assess establishment of vegetation in created habitats). Standardization of these monitoring procedures will allow for comparison of monitoring data among different monitoring locations, different individuals conducting the monitoring, and among monitoring years over the term of the LCR MSCP. As described above, these standardized procedures will be incorporated into monitoring plans for conservation areas and fish augmentations.

Reclamation will review, as appropriate, relevant existing science-reviewed monitoring procedures. These existing monitoring procedures may be adopted by Reclamation without further review (e.g., USFWS monitoring protocols for...
southwestern willow flycatcher and other listed species). Reclamation will develop procedures for monitoring for which science-reviewed procedures have not previously been developed. An important consideration for development of monitoring plans includes providing for comparability of Reclamation monitoring with results of monitoring conducted by others. To develop monitoring procedures not already science reviewed, Reclamation will solicit information from the Partners and resource agency experts, independent scientists, and other experts as appropriate. Draft procedures may be field tested and revised as needed based on test results to ensure that they can be effectively implemented and yield the desired monitoring information.

Reclamation will conduct reviews of its monitoring plans to ensure that the monitoring procedures are valid for achieving the stated monitoring objectives and that they provide all the information described above that are required for monitoring plans. Reclamation will revise or replace monitoring plans, as appropriate, if indicated through the review. Reclamation also anticipates preparing monitoring plans for any ongoing efforts for which monitoring protocols are not well documented.

**Research Plans**

As described in Chapter 3, Reclamation will undertake research to collect information necessary to fill knowledge gaps and resolve uncertainties primarily related to:

- life history and habitat requirements of covered species,
- techniques for the creation of habitat,
- techniques for the management of created habitats, and
- the stocking of razorback sucker and bonytail.

The extent of uncertainties related to the above topics is large. Research will be directed only towards applied research that is likely to yield tangible results for resolving the knowledge gaps and uncertainties that are critical for ensuring successful implementation of the HCP. Information collected through research will be used in the adaptive management decision making process to improve HCP implementation success over the term of the LCR MSCP (see Chapter 2). Research will be conducted under the species research and created habitat research Science Strategy implementation elements.

Research plans should include, as appropriate, the following information:

- description of research purpose and objectives;
- hypotheses and supporting information;
- description of research methods and design, including citations supporting the validity of the methods;
• procedures that will be used to analyze and interpret research data (e.g., statistical tools), including citations supporting the validity of the methods;
• procedures for validating research data and methods
• research schedule and duration;
• research reporting schedule and content requirements;
• research data storage procedures;
• references, including printed references and personal communications; and
• other types of information as appropriate to specific research projects.

All research plans will undergo the review process described under *Monitoring and Research Plan Review Process* below.

### Monitoring and Research Plan Review Process

Because outcomes of the activities addressed in the monitoring and research plans are critical to the success of HCP implementation, it is important that they are based on the best available information and sound scientific principles. Flawed monitoring and research plans could result in decision making that results in inefficient or unsuccessful implementation. Draft monitoring and research plans, including standardized plan elements (e.g., species survey protocols), will undergo the review process described below. This process is intended to provide for timely and efficient science review of monitoring and research plans. Accordingly, the level of review will differ among plans, depending on the level of uncertainty associated with the guidance and its role in guiding implementation. For example, a monitoring plan that implements protocols that are generally accepted by the resource management community will require less extensive review than for a monitoring effort for which survey protocols do not exist.

Draft monitoring and research plans will be reviewed by internal review teams comprised of Reclamation staff with relevant expertise in biological and physical sciences, scientific method, habitat restoration design and engineering, and resource management, as appropriate to the topic of monitoring or research. These teams will review draft monitoring and research plans to ensure that methods and approaches are valid and well documented and that they will achieve their intended objectives. Draft monitoring and research plans would be revised through an iterative process (if necessary) and either approved by the Program Manager as final documents or submitted for additional review by Partners, resource agency experts, and others. This additional review may be provided if the internal review team determines that the review will better ensure that a plan is based on the best available information. Reclamation may provide for these reviews through informal communications (e.g., conference calls, email) with
experts and other knowledgeable individuals, the establishment of TWGs,
workshops, or other venues that may be identified by Reclamation.
Citations


U.S. Fish and Wildlife Service. 2001. *Biological opinion for interim surplus criteria, secretarial implementation agreements, and conservation measures on the lower Colorado River, Lake Mead to the southerly international boundary; Arizona, California and Nevada*. Phoenix, AZ.
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Appendix A. Covered and Evaluation
Species Addressed by the Science Strategy
### Table A. Covered and Evaluation Species Addressed by the Science Strategy

<table>
<thead>
<tr>
<th>Covered Species</th>
<th>Covered Species (cont.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yuma clapper rail</td>
<td>Gila woodpecker</td>
</tr>
<tr>
<td><em>Rallus longirostris yumanensis</em></td>
<td><em>Melanerpes uropygialis</em></td>
</tr>
<tr>
<td>Southwestern willow flycatcher</td>
<td>Vermilion flycatcher</td>
</tr>
<tr>
<td><em>Empidonax trailii extimus</em></td>
<td><em>Pyrocephalus rubinus</em></td>
</tr>
<tr>
<td>Bonytail</td>
<td>Arizona Bell’s vireo</td>
</tr>
<tr>
<td><em>Gila elegans</em></td>
<td><em>Vireo bellii arizonae</em></td>
</tr>
<tr>
<td>Razorback sucker</td>
<td>Sonoran yellow warbler</td>
</tr>
<tr>
<td><em>Xyrauchen texanus</em></td>
<td><em>Dendroica petechia sonorana</em></td>
</tr>
<tr>
<td>Western red bat</td>
<td>Summer tanager</td>
</tr>
<tr>
<td><em>Lasius blossevillii</em></td>
<td><em>Piranga rubra</em></td>
</tr>
<tr>
<td>Western yellow bat</td>
<td>Flannelmouth sucker</td>
</tr>
<tr>
<td><em>Lasius xanthinus</em></td>
<td><em>Catostomus latipinnis</em></td>
</tr>
<tr>
<td>Colorado River cotton rat</td>
<td>MacNeill’s sootywing skipper</td>
</tr>
<tr>
<td><em>Sigmodon arizonae plenus</em></td>
<td><em>Pholisora gracielae</em></td>
</tr>
<tr>
<td>Yuma hispid cotton rat</td>
<td>Evaluation Species</td>
</tr>
<tr>
<td><em>Sigmodon hispidus eremicus</em></td>
<td></td>
</tr>
<tr>
<td>Western least bittern</td>
<td>Desert pocket mouse</td>
</tr>
<tr>
<td><em>Ixobrychus exilis hesperis</em></td>
<td><em>Chaetodipus penicillatus sobrinus</em></td>
</tr>
<tr>
<td>California black rail</td>
<td>California leaf-nosed bat</td>
</tr>
<tr>
<td><em>Laterallus jamaicensis coturniculus</em></td>
<td><em>Macrotus californicus</em></td>
</tr>
<tr>
<td>Yellow-billed cuckoo</td>
<td>Pale Townsend’s big-eared bat</td>
</tr>
<tr>
<td><em>Coccyzus americanus occidentalis</em></td>
<td><em>Corynorhinus townsendii pallescens</em></td>
</tr>
<tr>
<td>Elf owl</td>
<td>Colorado River toad</td>
</tr>
<tr>
<td><em>Micrathene whitneyi</em></td>
<td><em>Bufo alvarius</em></td>
</tr>
<tr>
<td>Gilded flicker</td>
<td>Lowland leopard frog</td>
</tr>
<tr>
<td><em>Colaptes chrysoides</em></td>
<td><em>Rana yavapaiensis</em></td>
</tr>
</tbody>
</table>
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Appendix B. Covered Species

Biological Goals and Habitat

Creation Requirements
## Table B-1. LCR MSCP Biological Goals for Covered Species Addressed in the Science Strategy

<table>
<thead>
<tr>
<th>Covered Species</th>
<th>Biological Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Threatened and Endangered Species</strong></td>
<td></td>
</tr>
<tr>
<td>Yuma clapper rail</td>
<td>Create and maintain 512 acres of species habitat.</td>
</tr>
<tr>
<td>Southwestern willow flycatcher</td>
<td>Create and maintain 4,050 acres of species habitat.</td>
</tr>
<tr>
<td>Bonytail</td>
<td>Create and maintain 360 acres of species habitat and rear and release up to 620,000 subadult bonytail along the LCR over the term of the LCR MSCP.</td>
</tr>
<tr>
<td>Razorback sucker</td>
<td>Create and maintain 360 acres of species habitat and rear and release up to 660,000 subadult razorback sucker along the LCR over the term of the LCR MSCP.</td>
</tr>
<tr>
<td><strong>Other Covered Species</strong></td>
<td></td>
</tr>
<tr>
<td>Western red bat</td>
<td>Create and maintain 765 acres of species roosting habitat.</td>
</tr>
<tr>
<td>Western yellow bat</td>
<td>Create and maintain 765 acres of species roosting habitat.</td>
</tr>
<tr>
<td>Colorado River cotton rat</td>
<td>Create and maintain 125 acres of species habitat in Reaches 3 and 4.</td>
</tr>
<tr>
<td>Yuma hispid cotton rat</td>
<td>Create and maintain 76 acres of species habitat in Reaches 6 and 7.</td>
</tr>
<tr>
<td>Western least bittern</td>
<td>Create and maintain 512 acres of species habitat.</td>
</tr>
<tr>
<td>California black rail</td>
<td>Create and maintain 130 acres of species habitat.</td>
</tr>
<tr>
<td>Yellow-billed cuckoo</td>
<td>Create and maintain 4,050 acres of species habitat.</td>
</tr>
<tr>
<td>Elf owl</td>
<td>Create and maintain 1,784 acres of species habitat in Reaches 3–5.</td>
</tr>
<tr>
<td>Gilded flicker</td>
<td>Create and maintain 4,050 acres of species habitat in Reaches 3–7.</td>
</tr>
<tr>
<td>Gila woodpecker</td>
<td>Create and maintain 1,702 acres of species habitat in Reaches 3–6.</td>
</tr>
<tr>
<td>Vermilion flycatcher</td>
<td>Create and maintain 5,208 acres of species habitat.</td>
</tr>
<tr>
<td>Arizona Bell’s vireo</td>
<td>Create and maintain 2,983 acres of species habitat.</td>
</tr>
<tr>
<td>Sonoran yellow warbler</td>
<td>Create and maintain 4,050 acres of species habitat.</td>
</tr>
<tr>
<td>Summer tanager</td>
<td>Create and maintain 602 acres of species habitat.</td>
</tr>
<tr>
<td>Covered Species</td>
<td>Biological Goal</td>
</tr>
<tr>
<td>------------------------------</td>
<td>---------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Flannelmouth sucker</td>
<td>Create and maintain 85 acres of species habitat in Reach 3 and provide $400,000 in funding to support existing species conservation programs.</td>
</tr>
<tr>
<td>MacNeill’s sootywing skipper</td>
<td>Create and maintain 222 acres of species habitat in Reaches 1–4.</td>
</tr>
</tbody>
</table>
Table B-2. Minimum Requirements for Achieving Covered Species Habitat Creation Goals

<table>
<thead>
<tr>
<th>Species</th>
<th>Habitat Creation Goal (acres)</th>
<th>Created Land Cover Type that will Provide Species Habitat</th>
<th>Minimum Patch Size of Created Land Cover that will Provide Habitat (acres)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Threatened and Endangered Species</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yuma clapper rail</td>
<td>512</td>
<td>Marsh with water depths no greater than 12 inches</td>
<td>5</td>
</tr>
<tr>
<td>Southwestern willow flycatcher</td>
<td>4,050</td>
<td>Cottonwood-willow types I–IV with moist surface soil conditions during the breeding season</td>
<td>10</td>
</tr>
<tr>
<td>Desert tortoise</td>
<td>0</td>
<td>Not applicable</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Bonytail</td>
<td>360</td>
<td>Backwaters that contain the physical, chemical, and biological conditions required to support native LCR fishes in a healthy condition</td>
<td>Not applicable</td>
</tr>
<tr>
<td>Razorback sucker</td>
<td>360</td>
<td>Backwaters that contain the physical, chemical, and biological conditions required to support native LCR fishes in a healthy condition</td>
<td>Not applicable</td>
</tr>
<tr>
<td><strong>Other Covered Species</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Western red bat (roosting habitat)</td>
<td>765</td>
<td>Combination of cottonwood-willow types I and II and honey mesquite type III</td>
<td>No minimum requirement</td>
</tr>
<tr>
<td>Western yellow bat (roosting habitat)</td>
<td>765</td>
<td>Combination of cottonwood-willow types I and II and honey mesquite type III</td>
<td>No minimum requirement</td>
</tr>
<tr>
<td>Colorado River cotton rat</td>
<td>125</td>
<td>Marsh</td>
<td>No minimum requirement</td>
</tr>
<tr>
<td>Yuma hispid cotton rat</td>
<td>76</td>
<td>Cottonwood-willow with a moist herbaceous understory</td>
<td>No minimum requirement</td>
</tr>
<tr>
<td>Western least bittern</td>
<td>512</td>
<td>Marsh with water depths no greater than 12 inches</td>
<td>No minimum requirement</td>
</tr>
<tr>
<td>California black rail</td>
<td>130</td>
<td>Marsh with water depths no greater than 1 inch</td>
<td>5</td>
</tr>
<tr>
<td>Yellow-billed cuckoo</td>
<td>4,050</td>
<td>Cottonwood-willow types I–III</td>
<td>25</td>
</tr>
<tr>
<td>Species</td>
<td>Habitat Creation Goal (acres)</td>
<td>Created Land Cover Type that will Provide Species Habitat</td>
<td>Minimum Patch Size of Created Land Cover that will Provide Habitat (acres)</td>
</tr>
<tr>
<td>------------------------</td>
<td>------------------------------</td>
<td>--------------------------------------------------------------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Elf owl</td>
<td>1,784</td>
<td>Combination of cottonwood-willow types I and II and honey mesquite type III</td>
<td>No minimum requirement</td>
</tr>
<tr>
<td>Gilded flicker</td>
<td>4,050</td>
<td>Cottonwood-willow types I–III</td>
<td>No minimum requirement</td>
</tr>
<tr>
<td>Gila woodpecker</td>
<td>1,702</td>
<td>Cottonwood-willow types I–IV</td>
<td>50</td>
</tr>
<tr>
<td>Vermilion flycatcher</td>
<td>5,208</td>
<td>Combination of cottonwood-willow types I–IV and honey mesquite type III</td>
<td>No minimum requirement</td>
</tr>
<tr>
<td>Arizona Bell’s vireo</td>
<td>2,983</td>
<td>Combination of cottonwood-willow types III and IV and honey mesquite type III</td>
<td>No minimum requirement</td>
</tr>
<tr>
<td>Sonoran yellow warbler</td>
<td>4,050</td>
<td>Cottonwood-willow types I–IV</td>
<td>2.5</td>
</tr>
<tr>
<td>Summer tanager</td>
<td>602</td>
<td>Cottonwood-willow types I and II</td>
<td>No minimum requirement</td>
</tr>
<tr>
<td>Flannelmouth sucker</td>
<td>85</td>
<td>Backwaters that contain the physical, chemical, and biological conditions required to support native LCR fishes in a healthy condition</td>
<td>Not applicable</td>
</tr>
<tr>
<td>MacNeill’s sootywing skipper</td>
<td>222</td>
<td>Honey mesquite type III created with quail bush to create honey mesquite–quail bush</td>
<td>No minimum requirement</td>
</tr>
</tbody>
</table>
Appendix C. Summary of Conservation Measures for Covered and Evaluation Species
**Table C. Summary of LCR MSCP HCP Conservation Measures for Covered and Evaluation Species Addressed in the Science Strategy**

<table>
<thead>
<tr>
<th>Species</th>
<th>Conservation Measures&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yuma clapper rail</td>
<td>AMM 1—To the extent practicable, avoid and minimize impacts of implementing the LCR MSCP on existing covered species habitats</td>
</tr>
<tr>
<td></td>
<td>AMM2—Avoid impacts of flow-related covered activities on covered species habitats at Topock Marsh</td>
</tr>
<tr>
<td></td>
<td>AMM3—To the extent practicable, avoid and minimize disturbance of covered bird species during the breeding season</td>
</tr>
<tr>
<td></td>
<td>AMM5—Avoid impacts of operation, maintenance, and replacement of hydroelectric generation and transmission facilities on covered species in the LCR MSCP planning area</td>
</tr>
<tr>
<td></td>
<td>AMM6—Avoid or minimize impacts on covered species habitats during dredging, bank stabilization activities, and other river management activities</td>
</tr>
<tr>
<td></td>
<td>MRM1—Conduct surveys and research to better identify covered and evaluation species habitat requirements</td>
</tr>
<tr>
<td></td>
<td>MRM2—Monitor and adaptively manage created covered and evaluation species habitats</td>
</tr>
<tr>
<td></td>
<td>MRM5—Monitor selenium levels in created backwater and marsh land cover types, and study the effect of selenium released as a result of dredging activities</td>
</tr>
<tr>
<td></td>
<td>CLRA1—Create 512 acres of Yuma clapper rail habitat</td>
</tr>
<tr>
<td></td>
<td>CMM1—Reduce risk of loss of created habitat to wildfire</td>
</tr>
<tr>
<td></td>
<td>CMM2—Replace created habitat affected by wildfire</td>
</tr>
<tr>
<td></td>
<td>CLRA2—Maintain existing important Yuma clapper rail habitat areas</td>
</tr>
<tr>
<td>Southwestern willow flycatcher</td>
<td>AMM 1—To the extent practicable, avoid and minimize impacts of implementing the LCR MSCP on existing covered species habitats</td>
</tr>
<tr>
<td></td>
<td>AMM2—Avoid impacts of flow-related covered activities on covered species habitats at Topock Marsh</td>
</tr>
<tr>
<td></td>
<td>AMM3—To the extent practicable, avoid and minimize disturbance of covered bird species during the breeding season</td>
</tr>
<tr>
<td></td>
<td>AMM5—Avoid impacts of operation, maintenance, and replacement of hydroelectric generation and transmission facilities on covered species in the LCR MSCP planning area</td>
</tr>
<tr>
<td></td>
<td>AMM6—Avoid or minimize impacts on covered species habitats during dredging, bank stabilization activities, and other river management activities</td>
</tr>
<tr>
<td></td>
<td>MRM1—Conduct surveys and research to better identify covered and evaluation species habitat requirements</td>
</tr>
</tbody>
</table>
### Table C. Summary of LCR MSCP HCP Conservation Measures for Covered and Evaluation Species Addressed in the Science Strategy (continued)

<table>
<thead>
<tr>
<th>Species</th>
<th>Conservation Measuresa</th>
</tr>
</thead>
</table>
| Southwestern willow flycatcher (cont.) | MRM2—Monitor and adaptively manage created covered and evaluation species habitats  
MRM4—Conduct research to determine and address the effects of brown-headed cowbird nest parasitism on reproduction of covered species  
WIFL1—Create 4,050 acres of southwestern willow flycatcher habitat  
CMM1—Reduce risk of loss of created habitat to wildfire  
CMM2—Replace created habitat affected by wildfire  
WIFL2—Maintain existing important habitat areas |
| Bonytail | AMM 1—To the extent practicable, avoid and minimize impacts of implementing the LCR MSCP on existing covered species habitats  
AMM4—Minimize contaminant loads in runoff and return irrigation flows from LCR MSCP created habitats to the LCR  
AMM5—Avoid impacts of operation, maintenance, and replacement of hydroelectric generation and transmission facilities on covered species in the LCR MSCP planning area  
AMM6—Avoid or minimize impacts on covered species habitats during dredging, bank stabilization activities, and other river management activities  
MRM5—Monitor selenium levels in created backwater and marsh land cover types, and study the effect of selenium released as a result of dredging activities  
BONY1—Coordinate bonytail conservation efforts with the USFWS and recovery programs for endangered fish species in the Lower Basin  
BONY2—Create 360 acres of bonytail habitat  
BONY3—Augment bonytail populations  
BONY4—Evaluate and develop, if necessary, additional bonytail rearing capacity  
BONY5—Conduct monitoring and research, and adaptively manage bonytail augmentations and created habitat |
### Table C. Summary of LCR MSCP HCP Conservation Measures for Covered and Evaluation Species Addressed in the Science Strategy (continued)

<table>
<thead>
<tr>
<th>Species</th>
<th>Conservation Measures&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
</table>
| Razorback sucker | AMM 1—To the extent practicable, avoid and minimize impacts of implementing the LCR MSCP on existing covered species habitats  
AMM4—Minimize contaminant loads in runoff and return irrigation flows from LCR MSCP created habitats to the LCR  
AMM5—Avoid impacts of operation, maintenance, and replacement of hydroelectric generation and transmission facilities on covered species in the LCR MSCP planning area  
AMM6—Avoid or minimize impacts on covered species habitats during dredging, bank stabilization activities, and other river management activities  
MRM5—Monitor selenium levels in created backwater and marsh land cover types, and study the effect of selenium released as a result of dredging activities  
RASU1—Coordinate razorback sucker conservation efforts with USFWS and recovery programs for endangered fish species in the Lower Basin Implementation Program  
RASU2—Create 360 acres of razorback sucker habitat  
RASU3—Augment razorback populations  
RASU4—Develop additional razorback sucker rearing capacity  
RASU5—Support ongoing razorback conservation efforts at Lake Mohave  
RASU6—Conduct monitoring and research, and adaptively manage razorback sucker augmentations and created habitat  
RASU7—Provide funding and support for continuation of the Reclamation/SNWA ongoing Lake Mead razorback sucker studies  
RASU8—Continue razorback conservation measures identified in the ISC/SIA BO |
| Western red bat (roosting habitat) | AMM 1—To the extent practicable, avoid and minimize impacts of implementing the LCR MSCP on existing covered species habitats  
AMM5—Avoid impacts of operation, maintenance, and replacement of hydroelectric generation and transmission facilities on covered species in the LCR MSCP planning area  
AMM6—Avoid or minimize impacts on covered species habitats during dredging, bank stabilization activities, and other river management activities  
MRM1—Conduct surveys and research to better identify covered and evaluation species habitat requirements  
MRM2—Monitor and adaptively manage created covered and evaluation species habitats  
WRBA1—Conduct surveys to determine species distribution of the western red bat  
WRBA2—Create 765 acres of western red bat roosting habitat  
CMM1—Reduce risk of loss of created habitat to wildfire  
CMM2—Replace created habitat affected by wildfire |
### Table C. Summary of LCR MSCP HCP Conservation Measures for Covered and Evaluation Species Addressed in the Science Strategy (continued)

<table>
<thead>
<tr>
<th>Species</th>
<th>Conservation Measures</th>
</tr>
</thead>
</table>
| **Western yellow bat (roosting habitat)** | AMM 1—To the extent practicable, avoid and minimize impacts of implementing the LCR MSCP on existing covered species habitats  
AMM5—Avoid impacts of operation, maintenance, and replacement of hydroelectric generation and transmission facilities on covered species in the LCR MSCP planning area  
AMM6—Avoid or minimize impacts on covered species habitats during dredging, bank stabilization activities, and other river management activities  
MRM1—Conduct surveys and research to better identify covered and evaluation species habitat requirements  
MRM2—Monitor and adaptively manage created covered and evaluation species habitats  
WYBA1—Conduct surveys to determine species distribution of the western yellow bat  
WYBA2—Avoid removal of western yellow bat roosts trees  
WYBA3—Create 765 acres of western yellow bat roosting habitat  
CMM1—Reduce risk of loss of created habitat to wildfire  
CMM2—Replace created habitat affected by wildfire |
| **Desert pocket mouse** | AMM5—Avoid impacts of operation, maintenance, and replacement of hydroelectric generation and transmission facilities on covered species in the LCR MSCP planning area  
DPMO1—Conduct surveys to locate desert pocket mouse habitat |
| **Colorado River cotton rat** | AMM 1—To the extent practicable, avoid and minimize impacts of implementing the LCR MSCP on existing covered species habitats  
AMM2—Avoid impacts of flow-related covered activities on covered species habitats at Topock Marsh  
AMM5—Avoid impacts of operation, maintenance, and replacement of hydroelectric generation and transmission facilities on covered species in the LCR MSCP planning area  
AMM6—Avoid or minimize impacts on covered species habitats during dredging, bank stabilization activities, and other river management activities  
MRM2—Monitor and adaptively manage created covered and evaluation species habitats  
MRM5—Monitor selenium levels in created backwater and marsh land cover types, and study the effect of selenium released as a result of dredging activities  
CRCR1—Conduct research to better define Colorado River cotton rat habitat requirements  
CRCR2—Create 125 acres of Colorado River cotton rat habitat  
CMM1—Reduce risk of loss of created habitat to wildfire  
CMM2—Replace created habitat affected by wildfire |
Table C. Summary of LCR MSCP HCP Conservation Measures for Covered and Evaluation Species Addressed in the Science Strategy (continued)

<table>
<thead>
<tr>
<th>Species</th>
<th>Conservation Measuresa</th>
</tr>
</thead>
</table>
| Yuma hispid cotton rat        | AMM 1—To the extent practicable, avoid and minimize impacts of implementing the LCR MSCP on existing covered species habitats  
AMM5—Avoid impacts of operation, maintenance, and replacement of hydroelectric generation and transmission facilities on covered species in the LCR MSCP planning area  
AMM6—Avoid or minimize impacts on covered species habitats during dredging, bank stabilization activities, and other river management activities  
MRM2—Monitor and adaptively manage created covered and evaluation species habitats  
YHCR1—Conduct research to better define Yuma hispid cotton rat habitat requirements  
YHCR2—Create 76 acres of Yuma hispid cotton rat habitat  
CMM1—Reduce risk of loss of created habitat to wildfire  
CMM2—Replace created habitat affected by wildfire |
| Western least bittern         | AMM 1—To the extent practicable, avoid and minimize impacts of implementing the LCR MSCP on existing covered species habitats  
AMM2—Avoid impacts of flow-related covered activities on covered species habitats at Topock Marsh  
AMM3—To the extent practicable, avoid and minimize disturbance of covered bird species during the breeding season  
AMM5—Avoid impacts of operation, maintenance, and replacement of hydroelectric generation and transmission facilities on covered species in the LCR MSCP planning area  
AMM6—Avoid or minimize impacts on covered species habitats during dredging, bank stabilization activities, and other river management activities  
MRM1—Conduct surveys and research to better identify covered and evaluation species habitat requirements  
MRM2—Monitor and adaptively manage created covered and evaluation species habitats  
MRM5—Monitor selenium levels in created backwater and marsh land cover types, and study the effect of selenium released as a result of dredging activities  
LEBI1—Create 512 acres of western least bittern habitat  
CMM1—Reduce risk of loss of created habitat to wildfire  
CMM2—Replace created habitat affected by wildfire |
Table C. Summary of LCR MSCP HCP Conservation Measures for Covered and Evaluation Species Addressed in the Science Strategy (continued)

<table>
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<tr>
<th>Species</th>
<th>Conservation Measures&lt;sup&gt;a&lt;/sup&gt;</th>
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</thead>
<tbody>
<tr>
<td>California black rail</td>
<td>AMM 1—To the extent practicable, avoid and minimize impacts of implementing the LCR MSCP on existing covered species habitats</td>
</tr>
<tr>
<td></td>
<td>AMM2—Avoid impacts of flow-related covered activities on covered species habitats at Topock Marsh</td>
</tr>
<tr>
<td></td>
<td>AMM3—To the extent practicable, avoid and minimize disturbance of covered bird species during the breeding season</td>
</tr>
<tr>
<td></td>
<td>AMM5—Avoid impacts of operation, maintenance, and replacement of hydroelectric generation and transmission facilities on covered species in the LCR MSCP planning area</td>
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<tr>
<td></td>
<td>AMM6—Avoid or minimize impacts on covered species habitats during dredging, bank stabilization activities, and other river management activities</td>
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<tr>
<td></td>
<td>MRM1—Conduct surveys and research to better identify covered and evaluation species habitat requirements</td>
</tr>
<tr>
<td></td>
<td>MRM2—Monitor and adaptively manage created covered and evaluation species habitats</td>
</tr>
<tr>
<td></td>
<td>MRM5—Monitor selenium levels in created backwater and marsh land cover types, and study the effect of selenium released as a result of dredging activities</td>
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<tr>
<td></td>
<td>BLRA1—Create 130 acres of California black rail habitat</td>
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<td></td>
<td>CMM1—Reduce risk of loss of created habitat to wildfire</td>
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<tr>
<td></td>
<td>CMM2—Replace created habitat affected by wildfire</td>
</tr>
<tr>
<td></td>
<td>BLRA2—Maintain existing important California black rail habitat areas</td>
</tr>
<tr>
<td>Yellow-billed cuckoo</td>
<td>AMM 1—To the extent practicable, avoid and minimize impacts of implementing the LCR MSCP on existing covered species habitats</td>
</tr>
<tr>
<td></td>
<td>AMM2—Avoid impacts of flow-related covered activities on covered species habitats at Topock Marsh</td>
</tr>
<tr>
<td></td>
<td>AMM3—To the extent practicable, avoid and minimize disturbance of covered bird species during the breeding season</td>
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<tr>
<td></td>
<td>AMM5—Avoid impacts of operation, maintenance, and replacement of hydroelectric generation and transmission facilities on covered species in the LCR MSCP planning area</td>
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<tr>
<td></td>
<td>AMM6—Avoid or minimize impacts on covered species habitats during dredging, bank stabilization activities, and other river management activities</td>
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<tr>
<td></td>
<td>MRM1—Conduct surveys and research to better identify covered and evaluation species habitat requirements</td>
</tr>
<tr>
<td></td>
<td>MRM2—Monitor and adaptively manage created covered and evaluation species habitats</td>
</tr>
<tr>
<td></td>
<td>YBCU1—Create 4,050 acres of yellow-billed cuckoo habitat</td>
</tr>
<tr>
<td></td>
<td>CMM1—Reduce risk of loss of created habitat to wildfire</td>
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<tr>
<td></td>
<td>CMM2—Replace created habitat affected by wildfire</td>
</tr>
<tr>
<td></td>
<td>YBCU2—Maintain existing important yellow-billed cuckoo habitat areas</td>
</tr>
<tr>
<td>Species</td>
<td>Conservation Measures</td>
</tr>
<tr>
<td>------------------</td>
<td>-----------------------------------------------------------</td>
</tr>
</tbody>
</table>
| **Elf owl**      | AMM 1—To the extent practicable, avoid and minimize impacts of implementing the LCR MSCP on existing covered species habitats  
|                  | AMM3—To the extent practicable, avoid and minimize disturbance of covered bird species during the breeding season  
|                  | AMM5—Avoid impacts of operation, maintenance, and replacement of hydroelectric generation and transmission facilities on covered species in the LCR MSCP planning area  
|                  | AMM6—Avoid or minimize impacts on covered species habitats during dredging, bank stabilization activities, and other river management activities  
|                  | MRM1—Conduct surveys and research to better identify covered and evaluation species habitat requirements  
|                  | MRM2—Monitor and adaptively manage created covered and evaluation species habitats  
|                  | MRM3—Conduct research to determine and address the effects of nest site competition with European starlings on reproduction of covered species  
|                  | ELOW1—Create 1,784 acres of elf owl habitat  
|                  | ELOW2—Install elf owl nest boxes  
|                  | CMM1—Reduce risk of loss of created habitat to wildfire  
|                  | CMM2—Replace created habitat affected by wildfire  
| **Gilded flicker** | AMM 1—To the extent practicable, avoid and minimize impacts of implementing the LCR MSCP on existing covered species habitats  
|                  | AMM2—Avoid impacts of flow-related covered activities on covered species habitats at Topock Marsh  
|                  | AMM3—To the extent practicable, avoid and minimize disturbance of covered bird species during the breeding season  
|                  | AMM5—Avoid impacts of operation, maintenance, and replacement of hydroelectric generation and transmission facilities on covered species in the LCR MSCP planning area  
|                  | AMM6—Avoid or minimize impacts on covered species habitats during dredging, bank stabilization activities, and other river management activities  
|                  | MRM1—Conduct surveys and research to better identify covered and evaluation species habitat requirements  
|                  | MRM2—Monitor and adaptively manage created covered and evaluation species habitats  
|                  | MRM3—Conduct research to determine and address the effects of nest site competition with European starlings on reproduction of covered species  
|                  | GIFL1—Create 4,050 acres of gilded flicker habitat  
|                  | GIFL2—Install artificial snags to provide gilded flicker nest sites  
|                  | CMM1—Reduce risk of loss of created habitat to wildfire  
|                  | CMM2—Replace created habitat affected by wildfire |
### Table C. Summary of LCR MSCP HCP Conservation Measures for Covered and Evaluation Species Addressed in the Science Strategy (continued)

<table>
<thead>
<tr>
<th>Species</th>
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</tr>
</thead>
</table>
| *Gila woodpecker* | AMM 1—To the extent practicable, avoid and minimize impacts of implementing the LCR MSCP on existing covered species habitats  
                      AMM3—To the extent practicable, avoid and minimize disturbance of covered bird species during the breeding season  
                      AMM5—Avoid impacts of operation, maintenance, and replacement of hydroelectric generation and transmission facilities on covered species in the LCR MSCP planning area  
                      AMM6—Avoid or minimize impacts on covered species habitats during dredging, bank stabilization activities, and other river management activities  
                      MRM1—Conduct surveys and research to better identify covered and evaluation species habitat requirements  
                      MRM2—Monitor and adaptively manage created covered and evaluation species habitats  
                      MRM3—Conduct research to determine and address the effects of nest site competition with European starlings on reproduction of covered species  
                      GIWO1—Create 1,702 acres of Gila woodpecker habitat  
                      GIWO2—Install artificial snags to provide Gila woodpecker nest sites  
                      CMM1—Reduce risk of loss of created habitat to wildfire  
                      CMM2—Replace created habitat affected by wildfire |
| *Vermilion flycatcher* | AMM 1—To the extent practicable, avoid and minimize impacts of implementing the LCR MSCP on existing covered species habitats  
                      AMM2—Avoid impacts of flow-related covered activities on covered species habitats at Topock Marsh  
                      AMM3—To the extent practicable, avoid and minimize disturbance of covered bird species during the breeding season  
                      AMM5—Avoid impacts of operation, maintenance, and replacement of hydroelectric generation and transmission facilities on covered species in the LCR MSCP planning area  
                      AMM6—Avoid or minimize impacts on covered species habitats during dredging, bank stabilization activities, and other river management activities  
                      MRM1—Conduct surveys and research to better identify covered and evaluation species habitat requirements  
                      MRM2—Monitor and adaptively manage created covered and evaluation species habitats  
                      MRM4—Conduct research to determine and address the effects of brown-headed cowbird nest parasitism on reproduction of covered species  
                      VEFL1—Create 5,208 acres of vermilion flycatcher habitat  
                      CMM1—Reduce risk of loss of created habitat to wildfire  
                      CMM2—Replace created habitat affected by wildfire |
Table C. Summary of LCR MSCP HCP Conservation Measures for Covered and Evaluation Species Addressed in the Science Strategy (continued)

<table>
<thead>
<tr>
<th>Species</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Arizona Bell’s vireo</td>
<td>AMM 1—To the extent practicable, avoid and minimize impacts of implementing the LCR MSCP on existing covered species habitats</td>
</tr>
<tr>
<td></td>
<td>AMM2—Avoid impacts of flow-related covered activities on covered species habitats at Topock Marsh</td>
</tr>
<tr>
<td></td>
<td>AMM3—To the extent practicable, avoid and minimize disturbance of covered bird species during the breeding season</td>
</tr>
<tr>
<td></td>
<td>AMM5—Avoid impacts of operation, maintenance, and replacement of hydroelectric generation and transmission facilities on covered species in the LCR MSCP planning area</td>
</tr>
<tr>
<td></td>
<td>AMM6—Avoid or minimize impacts on covered species habitats during dredging, bank stabilization activities, and other river management activities</td>
</tr>
<tr>
<td></td>
<td>MRM1—Conduct surveys and research to better identify covered and evaluation species habitat requirements</td>
</tr>
<tr>
<td></td>
<td>MRM2—Monitor and adaptively manage created covered and evaluation species habitats</td>
</tr>
<tr>
<td></td>
<td>MRM4—Conduct research to determine and address the effects of brown-headed cowbird nest parasitism on reproduction of covered species</td>
</tr>
<tr>
<td></td>
<td>BEVI1—Create 2,983 acres of Arizona Bell’s vireo habitat</td>
</tr>
<tr>
<td></td>
<td>CMM1—Reduce risk of loss of created habitat to wildfire</td>
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<tr>
<td></td>
<td>CMM2—Replace created habitat affected by wildfire</td>
</tr>
<tr>
<td>Sonoran yellow warbler</td>
<td>AMM 1—To the extent practicable, avoid and minimize impacts of implementing the LCR MSCP on existing covered species habitats</td>
</tr>
<tr>
<td></td>
<td>AMM2—Avoid impacts of flow-related covered activities on covered species habitats at Topock Marsh</td>
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<tr>
<td></td>
<td>AMM3—To the extent practicable, avoid and minimize disturbance of covered bird species during the breeding season</td>
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<tr>
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<td>AMM5—Avoid impacts of operation, maintenance, and replacement of hydroelectric generation and transmission facilities on covered species in the LCR MSCP planning area</td>
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<td>AMM6—Avoid or minimize impacts on covered species habitats during dredging, bank stabilization activities, and other river management activities</td>
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<tr>
<td></td>
<td>MRM1—Conduct surveys and research to better identify covered and evaluation species habitat requirements</td>
</tr>
<tr>
<td></td>
<td>MRM2—Monitor and adaptively manage created covered and evaluation species habitats</td>
</tr>
<tr>
<td></td>
<td>MRM4—Conduct research to determine and address the effects of brown-headed cowbird nest parasitism on reproduction of covered species</td>
</tr>
<tr>
<td></td>
<td>YWAR1—Create 4,050 acres of Sonoran yellow warbler habitat</td>
</tr>
<tr>
<td></td>
<td>CMM1—Reduce risk of loss of created habitat to wildfire</td>
</tr>
<tr>
<td></td>
<td>CMM2—Replace created habitat affected by wildfire</td>
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</table>
**Table C. Summary of LCR MSCP HCP Conservation Measures for Covered and Evaluation Species Addressed in the Science Strategy (continued)**

<table>
<thead>
<tr>
<th>Species</th>
<th>Conservation Measures&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
</table>
| Summer tanager              | AMM 1—To the extent practicable, avoid and minimize impacts of implementing the LCR MSCP on existing covered species habitats  
AMM3—To the extent practicable, avoid and minimize disturbance of covered bird species during the breeding season  
AMM5—Avoid impacts of operation, maintenance, and replacement of hydroelectric generation and transmission facilities on covered species in the LCR MSCP planning area  
AMM6—Avoid or minimize impacts on covered species habitats during dredging, bank stabilization activities, and other river management activities  
MRM1—Conduct surveys and research to better identify covered and evaluation species habitat requirements  
MRM2—Monitor and adaptively manage created covered and evaluation species habitats  
MRM4—Conduct research to determine and address the effects of brown-headed cowbird nest parasitism on reproduction of covered species  
SUTA1—Create 602 acres of summer tanager habitat  
CMM1—Reduce risk of loss of created habitat to wildfire  
CMM2—Replace created habitat affected by wildfire                                                                                                                                                                                                 |
| Relict leopard frog         | RLFR1—Provide funding to support existing relict leopard frog conservation programs                                                                                                                                                     |
| Flannelmouth sucker        | AMM 1—To the extent practicable, avoid and minimize impacts of implementing the LCR MSCP on existing covered species habitats  
AMM4—Minimize contaminant loads in runoff and return irrigation flows from LCR MSCP created habitats to the LCR  
AMM5—Avoid impacts of operation, maintenance, and replacement of hydroelectric generation and transmission facilities on covered species in the LCR MSCP planning area  
AMM6—Avoid or minimize impacts on covered species habitats during dredging, bank stabilization activities, and other river management activities  
MRM2—Monitor and adaptively manage created covered and evaluation species habitats  
MRM5—Monitor selenium levels in created backwater and marsh land cover types, and study the effect of selenium released as a result of dredging activities                                                                                                                                                                                                 |
<table>
<thead>
<tr>
<th>Species</th>
<th>Conservation Measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flannelmouth sucker (continued)</td>
<td>FLSU1—Create 85 acres of flannelmouth sucker habitat</td>
</tr>
<tr>
<td></td>
<td>FLSU2—Provide funding to support existing flannelmouth sucker conservation programs</td>
</tr>
<tr>
<td></td>
<td>FLSU3—Assess flannelmouth sucker management needs and develop management strategies</td>
</tr>
<tr>
<td>MacNeill’s sootywing skipper</td>
<td>AMM 1—To the extent practicable, avoid and minimize impacts of implementing the LCR MSCP on existing covered species habitats</td>
</tr>
<tr>
<td></td>
<td>AMM5—Avoid impacts of operation, maintenance, and replacement of hydroelectric generation and transmission facilities on covered species in the LCR MSCP planning area</td>
</tr>
<tr>
<td></td>
<td>MRM2—Monitor and adaptively manage created covered and evaluation species habitats</td>
</tr>
<tr>
<td></td>
<td>MNSW1—Conduct surveys and research to locate MacNeill’s sootywing skipper habitat and to better define its habitat requirements</td>
</tr>
<tr>
<td></td>
<td>MNSW2—Create at least 222 acres of MacNeill’s sootywing skipper habitat</td>
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<tr>
<td></td>
<td>CMM1—Reduce risk of loss of created habitat to wildfire</td>
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<td></td>
<td>CMM2—Replace created habitat affected by wildfire</td>
</tr>
<tr>
<td>Evaluation Species</td>
<td>MRM1—Conduct surveys and research to better identify covered and evaluation species habitat requirements</td>
</tr>
<tr>
<td></td>
<td>MRM2—Monitor and adaptively manage created covered and evaluation species habitats</td>
</tr>
<tr>
<td></td>
<td>CLNB1—Conduct surveys to locate California leaf-nosed bat roost sites</td>
</tr>
<tr>
<td></td>
<td>CLNB2—Create covered species habitat near California leaf-nosed bat roost sites</td>
</tr>
<tr>
<td></td>
<td>CMM1—Reduce risk of loss of created habitat to wildfire</td>
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<tr>
<td></td>
<td>CMM2—Replace created habitat affected by wildfire</td>
</tr>
<tr>
<td>Pale Townsend’s big-eared bat (roosting habitat)</td>
<td>MRM1—Conduct surveys and research to better identify covered and evaluation species habitat requirements</td>
</tr>
<tr>
<td></td>
<td>MRM2—Monitor and adaptively manage created covered and evaluation species habitats</td>
</tr>
<tr>
<td></td>
<td>PTBB1—Conduct surveys to locate pale Townsend’s big-eared bat roost sites</td>
</tr>
<tr>
<td></td>
<td>PTBB2—Create covered species habitat near pale Townsend’s big-eared bat roost sites</td>
</tr>
<tr>
<td></td>
<td>CMM1—Reduce risk of loss of created habitat to wildfire</td>
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<tr>
<td></td>
<td>CMM2—Replace created habitat affected by wildfire</td>
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<tbody>
<tr>
<td>Colorado River toad</td>
<td>CRTO1—Conduct research to better define the distribution, habitat requirements, and factors that are limiting the distribution of the Colorado River toad</td>
</tr>
<tr>
<td></td>
<td>CRTO2—Protect existing unprotected occupied Colorado River toad habitat</td>
</tr>
<tr>
<td></td>
<td>CRTO3—Conduct research to determine feasibility of establishing the Colorado River toad in unoccupied habitat</td>
</tr>
<tr>
<td>Lowland leopard frog</td>
<td>LLFR1—Conduct research to better define the distribution, habitat requirements, and factors that are limiting the distribution of the lowland leopard frog</td>
</tr>
<tr>
<td></td>
<td>LLFR2—Protect existing unprotected occupied lowland leopard frog habitat</td>
</tr>
<tr>
<td></td>
<td>LLFR3—Conduct research to determine feasibility of establishing the lowland leopard frog in unoccupied habitat</td>
</tr>
</tbody>
</table>

<sup>a</sup> Full descriptions of the conservation measures are provided in Chapter 5 of the LCR MSCP.