



# Lower Colorado River Multi-Species Conservation Program

*Balancing Resource Needs*

## Draft Final Science Strategy



August 4, 2006

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

## **Federal Participant Group**

Bureau of Reclamation  
Fish and Wildlife Service  
National Park Service  
Bureau of Land Management  
Bureau of Indian Affairs  
Western Area Power Administration

## **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

## **Other Interested Parties Participant Group**

QuadState County Government Coalition  
Desert Wildlife Unlimited

## **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

## **Nevada Participant Group**

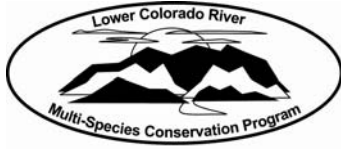
Colorado River Commission of Nevada  
Nevada Department of Wildlife  
Southern Nevada Water Authority  
Colorado River Commission Power Users  
Basic Water Company

## **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.



# Lower Colorado River Multi-Species Conservation Program

## Draft Final Science Strategy

Lower Colorado River  
Multi-Species Conservation Program Office  
Bureau of Reclamation  
Lower Colorado Region  
Boulder City, Nevada  
<http://www.usbr.gov/lc/lcrmcp>

August 4, 2006

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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)*<sup>1</sup>, to provide input and oversight functions in support of LCR MSCP implementation.

The HCP<sup>2</sup> 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).<sup>3</sup> 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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<sup>1</sup> Provided in Exhibit A of the LCR MSCP HCP (LCR MSCP 2004).

<sup>2</sup> Conservation measures are identified in LCR MSCP Chapter 5, Conservation Plan.

<sup>3</sup> 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.

1 HCP implementation based on monitoring and research results. The monitoring  
2 element of the Science Strategy includes compliance monitoring. Compliance  
3 monitoring will be undertaken specifically to provide Reclamation with the  
4 information necessary to demonstrate regulatory compliance with the terms of the  
5 HCP and incidental take permits.

## 6 **Purpose and Need**

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

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

27 The Science Strategy addresses two decision making functions:

- 28 • how the strategy will operate in Reclamation's implementation decision  
29 making process and
- 30 • the processes that can be used to identify uncertainties and knowledge  
31 gaps, develop monitoring and research priorities, and to incorporate new  
32 knowledge into the decision making process.



1 **Figure 1** Lower Colorado River MSCP Planning Area and River Reaches



2



1 Given the funding available for implementation, development and approval of  
2 specific actions in Reclamation’s Annual Work Plans<sup>4</sup> should be directed to those  
3 actions needed to ensure the achievement of the LCR MSCP biological goals.

## 4 **Information Sharing**

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

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

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

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

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<sup>4</sup> 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).

<sup>5</sup> LCR MSCP Partners are the member entities of the Steering Committee.

1 *implementation elements*) addressed by the Science Strategy include the  
2 following:

- 3 • species research,
- 4 • habitat creation research,
- 5 • system monitoring, and
- 6 • post-development monitoring.

## 7 **Document Organization**

8 This document is organized into the following Chapters:

- 9 • Chapter 2: *Science Strategy Process* describes the overall Science Strategy  
10 process for identifying and approving monitoring and research priorities  
11 and providing for adaptive implementation of the HCP.
- 12 • Chapter 3: *Science Strategy Implementation Elements* describes the  
13 implementation elements for which science-based processes are needed  
14 and Reclamation's process for identifying monitoring and research needs  
15 for each implementation element.
- 16 • Chapter 4: *Monitoring and Research Plans* describes Reclamation's  
17 process for developing science-based monitoring and research plans based  
18 on the best available information.

# 1 **Chapter 2. Science Strategy Process**

## 2 **Introduction**

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

## 7 **Role of Reclamation and the Steering Committee**

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

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

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

# 1 Planning Processes

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

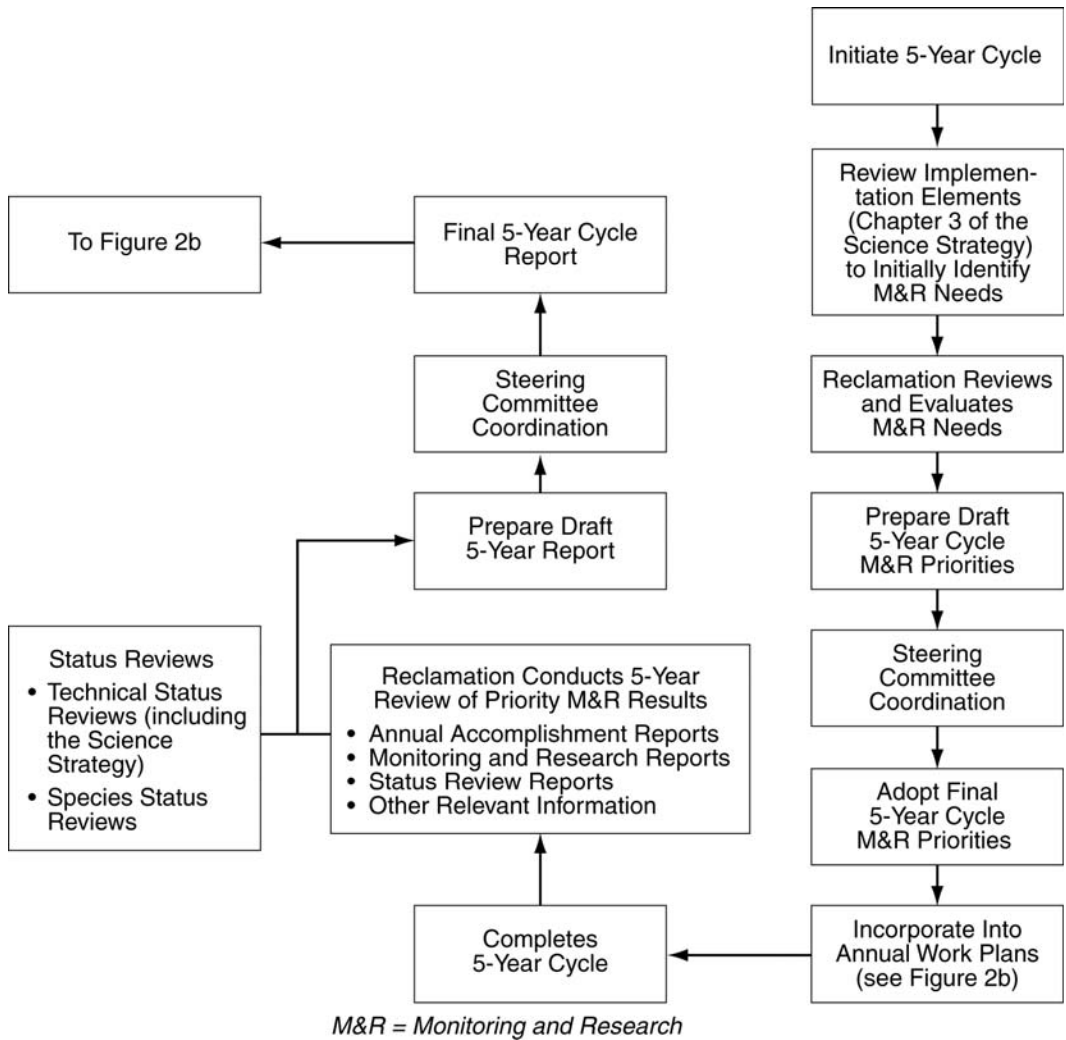
- 15 • specific monitoring and research activities that will be undertaken during  
16 each year of the 5-year cycle are identified to achieve the 5-year cycle  
17 monitoring and research priorities; and
- 18 • adaptive changes to HCP implementation are identified and approved.

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

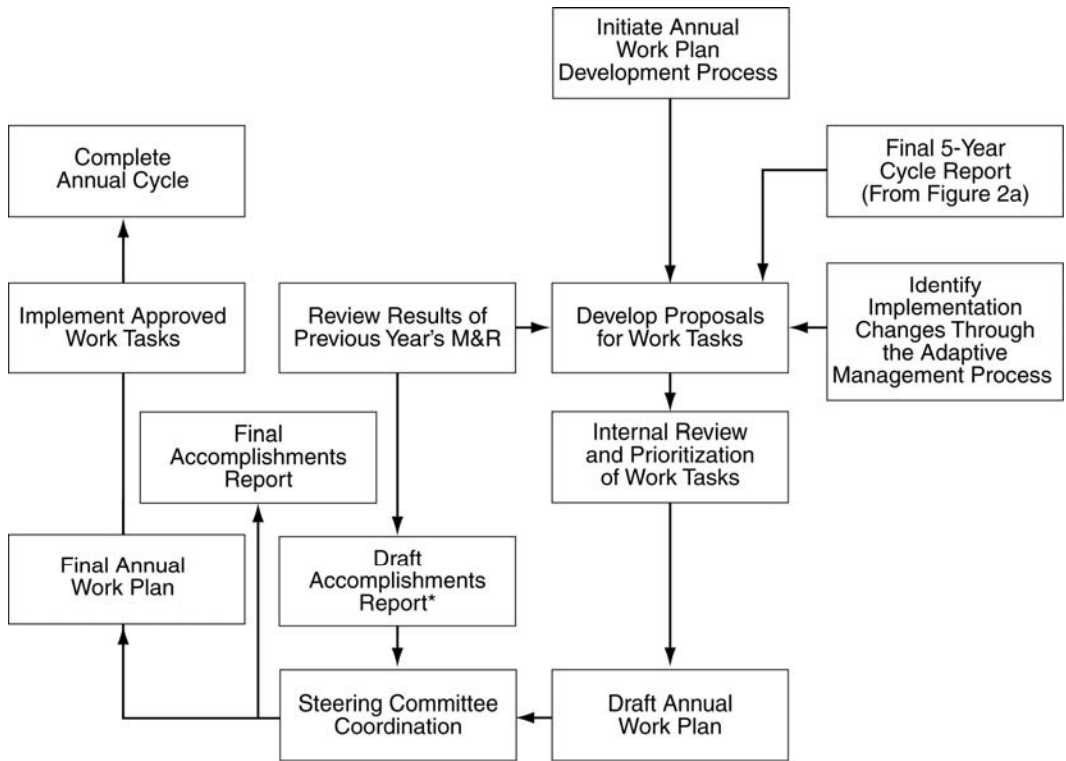
27 The 5-year cycle and Annual Work Plan development processes are comprised of  
28 a series of sequential actions that provide an organized path for documenting how  
29 and where science-based processes are considered in Reclamation's decision-  
30 making process for implementing the HCP.

## 31 5-Year Cycle Process

32 The 5-year cycle process entails identifying monitoring and research priorities  
33 (hereafter referred to as *priorities*) based on review of the information needs for  
34 the implementation elements that are identified through the processes described in  
35 Chapter 3, *Implementation Elements*. Priorities are designed to answer general or  
36 specific questions that identify knowledge needs or data gaps that affect the  
37 ability of Reclamation to implement the HCP in a biologically effective and cost  
38 efficient manner. A 5-year cycle was selected because it is of sufficient duration  
39 to allow for new information for use in guiding implementation planning to be



**Figure 2a. 5-Year Process for Establishing Monitoring and Research Priorities**



\*Prepared for work tasks implemented in the previous fiscal year  
M&R = Monitoring and Research

**Figure 2b. Annual Work Plan Development Process**

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



1 final priorities that will be addressed through Annual Work Plans. Reclamation  
2 anticipates undertaking the following 4-step process to identify 5-year cycle  
3 priorities (see Figure 2a).

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

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

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

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

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

38 **Post-Development Monitoring:** The monitoring needs to be conducted  
39 to determine if habitat creation and management methods are successful.

1           **3. Review initial data ranking and propose priorities.** Following initial  
2 ranking of priorities, Reclamation will establish an internal review team  
3 comprised of senior Reclamation staff with relevant expertise in biological  
4 and physical sciences, scientific method, habitat restoration design and  
5 engineering, and resource management. The internal review team will  
6 review the initial priorities identified in Step 2 to identify the proposed  
7 priorities that should be addressed in the 5-year cycle. Considerations for  
8 identifying priorities may include:

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

31           **4. Determine final data need priorities.** At the beginning of each 5-year  
32 cycle, Reclamation will provide the Steering Committee with a description  
33 of the draft priorities and initiate coordination to identify the final 5-year  
34 priorities. The description of each priority will document, as appropriate,  
35 the basis used to develop the priorities, the rationale for each priority and  
36 how addressing the priority is expected to inform HCP implementation,  
37 and why each of the priorities need to be addressed during the current  
38 5-year planning cycle. The Steering Committee coordination process may  
39 include formation of a TWG, workshops, other reviews with Partners or

1 other cooperating entities, or other suitable means identified by  
2 Reclamation. Information on how the final priorities are identified will be  
3 documented as part of the transparency of the decision making process.

#### 4 **Annual Planning Cycle**

5 Once the priorities for a 5-year cycle have been identified, the Annual Work Plans  
6 developed for that cycle will use the priorities as one factor in developing specific  
7 work tasks for that Annual Work Plan. Reclamation will annually evaluate the  
8 5-year priorities to determine if they should be implemented, in whole or in part,  
9 under each Annual Work Plan. This evaluation is necessary to ensure that work  
10 tasks can be accomplished within the annual implementation budget and all  
11 components of HCP implementation should be considered in determining which  
12 specific monitoring and research proposals to address. The 5-year priorities will  
13 be funded. New priorities not related to the 5-year cycle priorities would  
14 generally not be funded unless some significant new information was developed  
15 that prompts a review by Reclamation to determine the need for a change in  
16 priorities. If new monitoring and research priorities are identified within a 5-year  
17 cycle, the need for the new priority would be documented through the Annual  
18 Work Plan process described below and would be incorporated as an identified  
19 priority in the next 5-year cycle planning process.

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

- 28 • a description of the purpose of the monitoring and research priority (e.g.,  
29 what new information is to be obtained and why is it needed to inform  
30 implementation);
- 31 • summary of the funded monitoring and research results;
- 32 • any minor modifications to HCP implementation of funded tasks that  
33 resulted from findings of the monitoring and research during the fiscal  
34 year;
- 35 • any major modifications to HCP implementation of funded tasks that  
36 resulted from findings of the monitoring and research during the fiscal  
37 year; and
- 38 • a recommendation, based on the sufficiency of new information gathered  
39 through the monitoring and research, of whether or not the monitoring and  
40 research should be continued as originally described or in a modified form  
41 or discontinued.

1 Reclamation anticipates a 5-step process to develop and implement Annual Work  
2 Plan work tasks for priority monitoring and research.

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

8 2. Reclamation will review 5-year priorities that were not addressed in  
9 previous years within the 5-year cycle to identify monitoring and research  
10 that should be identified for implementation in the current Annual Work  
11 Plan. Considerations for identifying research and monitoring include:

- 12 • an assessment of costs to implement the research and monitoring  
13 relative to the available annual budget and other implementation  
14 priorities;
- 15 • the need to implement the research and monitoring to answer  
16 questions necessary to implement other elements of the HCP; and
- 17 • whether or not the results of previous monitoring and research  
18 indicate that the priority is still valid or should be discontinued.

19 3. Each research and monitoring work task proposed in the draft Annual  
20 Work Plan should include a description of:

- 21 • the purpose of the monitoring and research, including questions  
22 that will be answered, the rationale for why the question needs to  
23 be answered (i.e., how it is expected to guide HCP  
24 implementation), and why it needs to be answered during the  
25 annual work plan cycle;
- 26 • estimated budget;
- 27 • anticipated duration of the monitoring and research;
- 28 • a general description of the methods used to implement the  
29 monitoring and research; and
- 30 • if applicable, a description of coordination that may be undertaken  
31 with other monitoring and research projects implemented by other  
32 programs within and outside of Reclamation.

33 4. Following completion of the draft Annual Work Plan, the draft will  
34 undergo coordination with the Steering Committee. Reclamation will  
35 prepare the final Annual Work Plan based on results of coordination with  
36 the Steering Committee as appropriate.

- 1           5. Following approval of the final Annual Work Plan, Reclamation will  
2           prepare detailed monitoring and research plans for implementing the  
3           approved monitoring and research tasks as described in Chapter 4.

## 4   **Adaptive Management**

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

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

## 19   **Adaptive Management Structure and Process**

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

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

1 Annual Work Plan cycle, and at other appropriate times as determined by  
2 Reclamation.

### 3 ***Project Adaptive Management***

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

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

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

### 30 ***Program Adaptive Management***

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



1 procedures described in the FMA regarding coordination between Reclamation  
2 and the Steering Committee.

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

### 15 **Process for Covering Evaluation Species**

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

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

### 36 **Status Reviews**

37 In addition to evaluations of HCP implementation that are conducted to inform  
38 adaptive decision making in the 5-year cycle and Annual Work Plan development  
39 processes, Reclamation may conduct periodic program-wide status reviews of

1 HCP implementation. The purpose of these status reviews is to provide  
2 Reclamation with a methodical process to periodically evaluate its HCP  
3 implementation procedures and the conservation needs of covered species.  
4 Results of status reviews would be used to adjust implementation procedures and  
5 approaches to species conservation if needed. Two types of status reviews,  
6 technical status reviews and species status reviews, may be conducted. Unlike  
7 evaluations of monitoring and research results conducted for the 5-year cycle and  
8 Annual Work Plan processes, status reviews would also include evaluations to  
9 determine if implementation procedures (e.g., monitoring protocols) require  
10 updating based on the best available information and regional assessments of the  
11 status of covered species to determine if their status has changed sufficiently to  
12 affect their conservation needs. These reviews will be conducted at the discretion  
13 of Reclamation as needed.

#### 14 **Technical Status Reviews**

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

- 18 • system and post-development monitoring plans,
- 19 • research plans (if applicable),
- 20 • habitat management prescriptions,
- 21 • approaches to created habitat designs,
- 22 • guidelines for screening and evaluating potential conservation areas,
- 23 • the Science Strategy, and
- 24 • Geographic Information Science (GIS) and database structure, software,  
25 documentation, user manuals and other elements of Reclamation's data  
26 management system.

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

#### 33 **Species Status Review**

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

- 36 • LCR and regional population trends;
- 37 • occupancy of created habitats;

- 1 • new information related to the creation and management of habitats  
2 established by others;
- 3 • new information regarding the habitat requirements and behavior of  
4 species;
- 5 • new information regarding factors that may be limiting species  
6 populations; and
- 7 • new techniques for species management.

8 This information will be evaluated to determine if changes in HCP conservation  
9 measures or implementation techniques may be warranted to improve  
10 conservation of covered species. Recommendations developed through this  
11 process, depending on Reclamation's assessment of their level of effect on HCP  
12 implementation, will undergo Steering Committee coordination, as appropriate, as  
13 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.

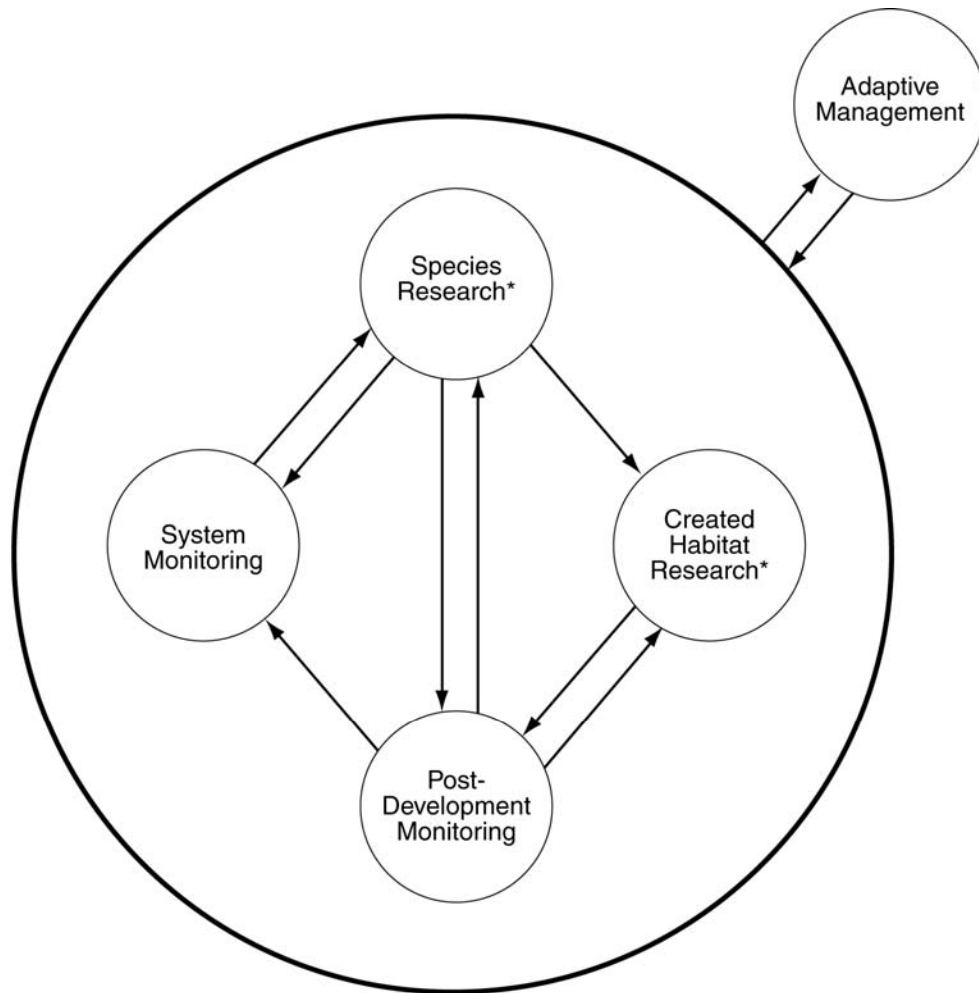
**Created Habitat Research.** The created habitat research element implements research to address uncertainties related to the techniques for creating habitat and managing covered species habitats to maintain habitat values over the term of the LCR MSCP.

**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.



1 *\* Species and created habitat research are not expected to be implemented over the term of*  
 2 *the LCR MSCP as data gaps are addressed by research conducted early in implementation.*

3 **Figure 3 Information and Adaptive Management Linkages Among Science**  
 4 **Strategy Implementation Elements**

5  
 6

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**Table 1. LCR MSCP Monitoring and Research Conservation Measures**

<i>LCR MSCP Code</i>	<i>Summary Description Conservation Measure<sup>a</sup></i>
<b>General Monitoring and Research Conservation Measures</b>	
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.
MRM4	Conduct research to determine and address the effects of brown-headed cowbird nest parasitism on reproduction of covered species.
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.
<b>Species-Specific Monitoring and Research Conservation Measures</b>	
BONY3	Bonytail augmentation program
BONY5	Conduct monitoring and research, and adaptively manage bonytail augmentations and created habitat
RASU3	Razorback sucker augmentation program
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.
WRBA1	Conduct surveys to determine the distribution of the western red bat.
WYBA1	Conduct surveys to determine the distribution of the western yellow bat.
CRCR1	Conduct research to better define Colorado River cotton rat habitat requirements.
YHCR1	Conduct research to better define Yuma hispid cotton rat habitat requirements.
FLSU3	Assess flannelmouth sucker management needs and develop management strategies.
MNSW1	Conduct surveys and research to locate MacNeill's sootywing skipper habitat and to better define its habitat requirements.
CLNB1	Conduct surveys to locate California leaf-nosed bat roost sites.

2



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2

**Table 1. LCR MSCP Monitoring and Research Conservation Measures  
(continued)**

<i>LCR MSCP Code</i>	<i>Summary Description Conservation Measure<sup>a</sup></i>
PTBB1	Conduct surveys to locate pale Townsend’s big-eared bat roost sites.
CRT01	Conduct research to better define the distribution, habitat requirements, and factors that are limiting the distribution of the Colorado River toad.
CRT03	Conduct research to determine feasibility of establishing the Colorado River toad in unoccupied habitat.
LLFR1	Conduct research to better define the distribution, habitat requirements, and factors that are limiting the distribution of the lowland leopard frog.
LLFR3	Conduct research to determine feasibility of establishing the lowland leopard frog in unoccupied habitat.
<sup>a</sup> Full descriptions of conservation measures are provided in the LCR MSCP HCP. A summary of all species conservation measures is provided in Appendix C.	

3 **Species Research Element**

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

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

18 **Identifying Species Research Needs**

19 As indicated by the conservation measures in Table 1, research for covered  
20 species will be directed primarily towards gathering the information needed to  
21 understand species habitat requirements and current distribution in the LCR  
22 MSCP planning area sufficiently to create and manage functioning habitats. This  
23 information will be used, as appropriate, to guide the design and management of

1 habitats to be created for these species. A guiding principle of the HCP is that  
2 habitat created for the yellow-billed cuckoo and southwestern willow flycatcher  
3 will also provide habitat for the other cottonwood-willow associated covered  
4 species. Consequently, species research is anticipated to initially focus primarily  
5 on identifying the physical and biological components of yellow-billed cuckoo  
6 and southwestern willow flycatcher habitat to provide the information necessary  
7 to effectively design, establish, and manage cottonwood-willow habitats for these  
8 species.

9 Reclamation anticipates identifying future research needs using the following  
10 6-step process.

- 11 1. **Prepare species accounts.** Reclamation will initially prepare detailed  
12 species accounts describing the current knowledge about each covered  
13 species' life history and habitat requirements, behavior, and management  
14 as it relates to the creation and management of their habitats. Reclamation  
15 will use these species accounts to identify information gaps for each  
16 species that, if addressed, would better inform the creation and  
17 management of covered species habitats. Species accounts will be  
18 periodically updated, as appropriate, as new information is collected  
19 through monitoring and research conducted by Reclamation and others  
20 during the status review process (see Chapter 2).
- 21 2. **Identify research conducted by others.** Reclamation will contact state  
22 and federal resource agencies, Partners, universities, and other appropriate  
23 entities to identify ongoing research being conducted by others that is  
24 relevant to implementation of the HCP.
- 25 3. **Review results of LCR monitoring and research.** Reclamation will  
26 initially evaluate results of relevant monitoring and research previously  
27 conducted along the LCR, as appropriate, to determine if additional  
28 species research is required or if ongoing research should be modified.  
29 Evaluation of results of ongoing and future LCR MSCP monitoring and  
30 research will be evaluated by Reclamation as described under Step 6  
31 below.
- 32 4. **Identify LCR MSCP research priorities.** Reclamation anticipates  
33 initially identifying species research needs and priorities based on an  
34 assessment of information developed for the species accounts and on  
35 research being conducted by Reclamation and others. As HCP monitoring  
36 and research is implemented, results of monitoring and research will also  
37 be used to identify future research priorities. The highest priorities for  
38 research are anticipated to be those that address uncertainties that are the  
39 most important for ensuring the successful creation and management of  
40 habitats. Final research priorities will be determined through  
41 Reclamation's process for establishing 5-year priorities and developing  
42 Annual Work Plans (see Chapter 2).

- 1       **5. Develop and implement species research plans.** Reclamation will  
2       develop and implement research plans<sup>6</sup>, as appropriate, for each species  
3       research project approved through the Annual Work Plan development  
4       process. The process for development and science review of research  
5       plans is described in Chapter 4.
- 6       **6. Adjust LCR MSCP species research priorities.** As information is  
7       collected and analyzed through monitoring and research, species research  
8       priorities are expected to change over the term of the LCR MSCP.  
9       Reclamation will review, as appropriate, results of monitoring and  
10      research and re-evaluate species research priorities during the Annual  
11      Work Plan and 5-year cycle plan processes (see Chapter 2). If indicated  
12      through this re-evaluation, species research priorities may be adjusted  
13      through the adaptive management process described in Chapter 2.

## 14      **Research Associated with Fish Augmentations**

15      The HCP includes conservation measures to provide for the stocking of up to  
16      620,000 bonytail and 660,000 razorback sucker. Based on an assessment of the  
17      current body of knowledge surrounding the behaviors, habitat requirements, and  
18      conservation of razorback sucker and bonytail, Reclamation anticipates initially  
19      focusing research and monitoring of these stocked fish to determine:

- 20      • important environmental correlates affecting growth and survival during  
21      rearing;
- 22      • mechanisms affecting fish survival and health during fish transporting and  
23      stocking processes and methods to improve survival and health; and
- 24      • post-stocking distribution and survival and factors affecting distribution  
25      and survival.

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

## 35      **Approaches to Research**

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

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<sup>6</sup> Research plans prepared by Reclamation are termed “study plans.”

1 that need to be filled to effectively implement the conservation measures and  
2 achieve the biological goals. Most research is anticipated to be directed towards  
3 providing information related to the following three areas of uncertainty.

- 4 **1. Determining key habitat parameters to support the design and**  
5 **management of created habitats.** This type of research is directed  
6 towards identifying the physical and biological conditions that must be  
7 present to create functioning habitat for species whose habitat  
8 requirements along the LCR are not well known. An example of this type  
9 of research would include studies undertaken to determine the timing,  
10 duration, and extent of moist soil conditions that must be present to  
11 support food production (i.e., flying insects) in southwestern willow  
12 flycatcher breeding habitat.
- 13 **2. Determining species distribution along the LCR.** This type of research  
14 is directed towards determining the distribution of covered species for  
15 which this information is required to ensure created habitats are  
16 established in locations that are used by the species. This research would  
17 apply primarily to species that are not well distributed along the LCR and  
18 whose movements along the LCR are limited. For example, conducting  
19 research to locate western red bat and western yellow bat roost sites will  
20 enable foraging habitats to be created in locations that are within their  
21 flight ranges from roost sites.
- 22 **3. Determining the effects of and responses to nest parasitism and**  
23 **competition.** This type of research is directed towards determining the  
24 adverse effects of brown-headed cowbird nest parasitism and nest site  
25 competition with European starlings on covered bird species. This  
26 research would focus on determining the level of effect cowbirds and  
27 starlings are having on the reproductive success of affected covered  
28 species, the level of adverse effect on reproduction that would be  
29 necessary to trigger management actions to reduce their effects, and  
30 effective methods for reducing nest parasitism and nest site competition.

## 31 **Created Habitat Research Element**

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

## 1 Identifying Created Habitat Research Needs

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

- 4 1. **Review of existing information.** Reclamation will initially review habitat  
5 creation-related literature and identify the current body of information  
6 related to the techniques and considerations for the establishment and  
7 management of covered species habitats. Reclamation will also review, as  
8 appropriate, previous and ongoing habitat restoration projects  
9 implemented in the LCR MSCP planning area and relevant projects  
10 implemented elsewhere to identify areas of uncertainty regarding methods  
11 used to establish and manage habitats.
- 12 2. **Identify other research.** Reclamation will contact state and federal  
13 resource agencies, Partners, universities, and other appropriate entities, as  
14 appropriate, to identify ongoing habitat creation-related research being  
15 conducted by others that is relevant to HCP implementation.
- 16 3. **Review results of LCR monitoring and research.** Reclamation will  
17 initially evaluate results of relevant monitoring and research previously  
18 conducted along the LCR, as appropriate, to determine if additional  
19 created habitat research is required or if ongoing research should be  
20 modified. Evaluation of results of ongoing and future LCR MSCP  
21 monitoring and research will be evaluated by Reclamation as described  
22 under Step 6 below.
- 23 4. **Identify LCR MSCP created habitat research priorities.** Reclamation  
24 anticipates initially identifying created habitat research needs and  
25 priorities based on an assessment of information provided through the  
26 review of existing information and research identified under items 1 and 2  
27 above. As HCP monitoring and research is implemented, results of  
28 monitoring and research will also be used to identify future research  
29 priorities. Currently, the highest priorities for research are anticipated to  
30 be those that address uncertainties that are the most important for the  
31 initial and successful creation of habitat. As habitat is created, research  
32 emphasis is expected to shift towards developing and refining  
33 management techniques for maintaining habitat values for covered  
34 species. Final research priorities will be determined through  
35 Reclamation's process for establishing 5-year priorities and developing  
36 annual work plans (see Chapter 2).
- 37 5. **Develop and implement created habitat research plans.** Reclamation  
38 will develop and implement research plans, as appropriate, for each  
39 created habitat research project approved through the Annual Work Plan  
40 development process. The process for development and science review of  
41 created habitat research plans is described in Chapter 4.

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

## 10       **Approaches to Research**

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

### 16       ***Pilot Projects***

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

- 25       • techniques for propagating key plant species that support covered species  
26       habitat;
- 27       • methods for establishing cottonwood-willow vegetation with the structure  
28       necessary to achieve habitat objectives for cottonwood-willow associated  
29       species;
- 30       • techniques for establishing key plant species; and
- 31       • irrigation methods.

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

### 36       ***Conservation Area Research Studies***

37 As habitats are created on conservation areas, Reclamation anticipates that small  
38 scale research studies will be undertaken to address uncertainties specifically

1 related to management of created habitats. These studies could involve testing the  
2 effectiveness of different habitat management prescriptions on portions of created  
3 habitat set aside for this purpose. Examples of these types of research studies  
4 include testing:

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

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

### 16 ***Directed Research***

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

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

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

### 27 **Management Observations**

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

## 1 **System Monitoring Element**

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

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

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

- 28 • monitoring undertaken by Reclamation specifically for the purpose of  
29 system monitoring;
- 30 • results of post-development monitoring (see Post-Development  
31 Monitoring Element below) and species research (see Species Research  
32 Element above)<sup>7</sup>;
- 33 • results of Reclamation’s water use accounting monitoring; and
- 34 • results of monitoring and research conducted by others.

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<sup>7</sup> Includes ongoing monitoring conducted by Reclamation under conditions of the 2001  
ISC/SIA biological opinion (USFWS 2001).



1     **Determine Changes from Baseline Conditions**

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

7     **Determining the extent and distribution of land cover types that provide**  
8     **habitat for covered species.** Reclamation anticipates this will be accomplished  
9     through interpretation of aerial imagery (e.g., aerial photographs or other remote  
10    imagery of appropriate resolution) using a land cover type classification system  
11    that is compatible with the classification system used to prepare the HCP. Land  
12    cover types would be delineated and maintained in Reclamation’s GIS database.  
13    Reclamation anticipates that changes in the extent of covered species habitats  
14    within the LCR MSCP planning area from baseline conditions would be  
15    determined through application of the HCP habitat models developed for the  
16    following species<sup>8</sup>.

- 17       • Western red bat
- 18       • Western yellow bat
- 19       • Yuma hispid cotton rat
- 20       • Yellow-billed cuckoo
- 21       • Elf owl
- 22       • Gilded flicker
- 23       • Gila woodpecker
- 24       • Vermilion flycatcher
- 25       • Arizona Bell’s vireo
- 26       • Sonoran yellow warbler
- 27       • Summer tanager

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

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<sup>8</sup>     Habitat models for these species are described in LCR MSCP HCP Table 3-9.

1 It is anticipated that current conditions for covered species and their habitats will  
2 be determined concurrently with preparation of the species accounts described  
3 above under *Species Research Element*. Reclamation will update this  
4 information, as appropriate, if environmental conditions present along the LCR  
5 were to substantially change in the future.

## 6 **Identifying System Monitoring Needs**

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

- 18 1. **Identify existing monitoring efforts.** In 2006, Reclamation initiated  
19 identification monitoring and research relevant to system monitoring being  
20 conducted by Reclamation and others in the LCR MSCP planning area.  
21 Reclamation will evaluate the types of data being collected under each  
22 monitoring and research effort for which data can be made available to  
23 Reclamation to determine its relevancy for use in system monitoring.
- 24 2. **Review results of monitoring and research.** As described in Chapter 2,  
25 Reclamation will evaluate results of LCR MSCP monitoring and research  
26 during the Annual Work Plan development and during 5-year cycle  
27 processes. Results of monitoring and research will be evaluated, as  
28 appropriate, to determine if additional system monitoring is required or if  
29 ongoing monitoring should be modified. Reclamation may also identify  
30 the need to modify system monitoring to ensure ongoing compatibility of  
31 data with other regional monitoring programs should those monitoring  
32 programs change in the future.
- 33 3. **Identify system monitoring priorities.** Reclamation will initially  
34 identify system monitoring needs and priorities based on the evaluation of  
35 existing monitoring and research efforts identified under items 1 and 2  
36 above.
- 37 4. **Develop and implement system monitoring plans.** Reclamation will  
38 develop and implement monitoring plans, as appropriate, for each system  
39 monitoring effort approved through the Annual Work Plan development  
40 process. The process for development and science review of monitoring  
41 plans is described in Chapter 4.

1       5. **Adjust system monitoring priorities.** As information is collected  
2 through monitoring and research, system monitoring priorities may change  
3 over the term of the LCR MSCP. Reclamation will review results of  
4 monitoring and research conducted by Reclamation and others, as  
5 appropriate, and re-evaluate system monitoring priorities during the  
6 Annual Work Plan development and 5-year cycle processes. If indicated  
7 through this reevaluation, Reclamation will adjust system monitoring  
8 priorities through the adaptive management process described in Chapter  
9 2.

## 10 **Post-Development Monitoring**

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

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

### 28 **Compliance Monitoring**

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

- 36       • documenting fish releases, including time, numbers and size, and location;
- 37       • documenting when habitat creation activities are initially undertaken and  
38       completed;

- 1 • documenting when created habitat objectives have been achieved for each
- 2 habitat creation site; and
- 3 • documenting the total extent of habitat that has been created for each
- 4 covered species and annually maintained over the term of the LCR MSCP.

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

## 7 **Implementation Monitoring**

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

15 Implementation monitoring is anticipated to collect information necessary to:

- 16 • document that habitats are established in accordance with created habitat
- 17 design plans and specifications;
- 18 • estimate the survival rate, composition, and distribution of planted
- 19 vegetation;
- 20 • document that razorback sucker and bonytail are released in accordance
- 21 with annual fish stocking plans; and
- 22 • determine the effectiveness of habitat creation techniques for initially
- 23 establishing cottonwood-willow, honey mesquite, and marsh vegetation.

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

## 30 **Response Monitoring**

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

37 Response monitoring is a key instrument for providing the information necessary  
38 for adaptively managing HCP implementation to better ensure species are

1 conserved (see Chapter 2). This information will be used to identify the habitat  
2 management activities that created the conditions used by the species, evaluate if  
3 similar conditions are present in other habitat areas created for the species and, if  
4 not, adjust habitat management prescriptions, if appropriate, to create the  
5 observed conditions used by the species.

## 6 ***Habitat Response***

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

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

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

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

## 32 ***Species Response***

33 Species response monitoring will focus on determining if habitats are used by  
34 covered species and to document the timing, type (e.g., nesting, migration  
35 stopover), and degree of use by covered species. Similarly, Reclamation will also  
36 monitor use of nest boxes and artificial snags by gilded flickers, Gila  
37 woodpeckers, and elf owls and survival of razorback sucker and bonytail stocked  
38 to augment existing populations, as appropriate. Species distribution and  
39 abundance information collected through response monitoring will also provide a

1 source of information for use in assessing the overall status of the species in the  
2 LCR MSCP planning area as part of system monitoring.

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

### 13 **Science Review of Monitoring and Research Reports**

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

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

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<sup>9</sup> 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.

1 Monitoring plans should include, as appropriate, the following types of  
2 information:

- 3 • description of monitoring purpose and objectives;
- 4 • description of monitoring protocols (may be incorporated by reference)  
5 and sampling design, including citations supporting the validity of the  
6 methods and sampling design;
- 7 • procedures that will be used to analyze monitoring data (may be  
8 incorporated by reference), including citations supporting the validity of  
9 the methods;
- 10 • procedures for validating monitoring data and methods;
- 11 • monitoring schedule and duration, including citations supporting the  
12 validity of the monitoring schedule;
- 13 • schedule for submitting monitoring report;
- 14 • monitoring report content requirements;
- 15 • monitoring data storage procedures;
- 16 • references, including printed references and personal communications;
- 17 • date the monitoring plan was prepared and dates of subsequent revisions;  
18 and
- 19 • other types of information as appropriate to specific monitoring plans.

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

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

37 Reclamation will review, as appropriate, relevant existing science-reviewed  
38 monitoring procedures. These existing monitoring procedures may be adopted by  
39 Reclamation without further review (e.g., USFWS monitoring protocols for



1 southwestern willow flycatcher and other listed species). Reclamation will  
2 develop procedures for monitoring for which science-reviewed procedures have  
3 not previously been developed. An important consideration for development of  
4 monitoring plans includes providing for comparability of Reclamation monitoring  
5 with results of monitoring conducted by others. To develop monitoring  
6 procedures not already science reviewed, Reclamation will solicit information  
7 from the Partners and resource agency experts, independent scientists, and other  
8 experts as appropriate. Draft procedures may be field tested and revised as  
9 needed based on test results to ensure that they can be effectively implemented  
10 and yield the desired monitoring information.

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

## 18 **Research Plans**

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

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

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

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

- 35 • description of research purpose and objectives;
- 36 • hypotheses and supporting information;
- 37 • description of research methods and design, including citations supporting  
38 the validity of the methods;

- 1 • procedures that will be used to analyze and interpret research data (e.g.,
- 2 statistical tools), including citations supporting the validity of the methods;
- 3 • procedures for validating research data and methods
- 4 • research schedule and duration;
- 5 • research reporting schedule and content requirements;
- 6 • research data storage procedures;
- 7 • references, including printed references and personal communications; and
- 8 • other types of information as appropriate to specific research projects.

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

## 11 **Monitoring and Research Plan Review Process**

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

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

- 1 experts and other knowledgeable individuals, the establishment of TWGs,
- 2 workshops, or other venues that may be identified by Reclamation.

# 1 Citations

- 2 Lower Colorado River Multi-Species Conservation Program. 2004. *Lower*  
3 *Colorado River Multi-Species Conservation Program, Volume II: Habitat*  
4 *Conservation Plan*. Final. December 17. Available at:  
5 <http://www.usbr.gov/lc/lcrmscp/publications/VolumeII.pdf>
- 6 U.S. Fish and Wildlife Service. 2001. *Biological opinion for interim surplus*  
7 *criteria, secretarial implementation agreements, and conservation*  
8 *measures on the lower Colorado River, Lake Mead to the southerly*  
9 *international boundary; Arizona, California and Nevada*. Phoenix, AZ.

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1 **Appendix A. Covered and Evaluation**  
2 **Species Addressed by the**  
3 **Science Strategy**



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**Table A. Covered and Evaluation Species  
Addressed by the Science Strategy**

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

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1 **Appendix B. Covered Species**  
2 **Biological Goals and Habitat**  
3 **Creation Requirements**



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

<i>Covered Species</i>	<i>Biological Goal</i>
<b>Threatened and Endangered Species</b>	
Yuma clapper rail	Create and maintain 512 acres of species habitat.
Southwestern willow flycatcher	Create and maintain 4,050 acres of species habitat.
Bonytail	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.
Razorback sucker	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.
<b>Other Covered Species</b>	
Western red bat	Create and maintain 765 acres of species roosting habitat.
Western yellow bat	Create and maintain 765 acres of species roosting habitat.
Colorado River cotton rat	Create and maintain 125 acres of species habitat in Reaches 3 and 4.
Yuma hispid cotton rat	Create and maintain 76 acres of species habitat in Reaches 6 and 7.
Western least bittern	Create and maintain 512 acres of species habitat.
California black rail	Create and maintain 130 acres of species habitat.
Yellow-billed cuckoo	Create and maintain 4,050 acres of species habitat.
Elf owl	Create and maintain 1,784 acres of species habitat in Reaches 3–5.
Gilded flicker	Create and maintain 4,050 acres of species habitat in Reaches 3–7.
Gila woodpecker	Create and maintain 1,702 acres of species habitat in Reaches 3–6.
Vermilion flycatcher	Create and maintain 5,208 acres of species habitat.
Arizona Bell’s vireo	Create and maintain 2,983 acres of species habitat.
Sonoran yellow warbler	Create and maintain 4,050 acres of species habitat.
Summer tanager	Create and maintain 602 acres of species habitat.

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**Table B-1. LCR MSCP Biological Goals for Covered Species  
Addressed in the Science Strategy (continued)**

<i>Covered Species</i>	<i>Biological Goal</i>
Flannelmouth sucker	Create and maintain 85 acres of species habitat in Reach 3 and provide \$400,000 in funding to support existing species conservation programs.
MacNeill's sootywing skipper	Create and maintain 222 acres of species habitat in Reaches 1-4.

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1 **Table B-2. Minimum Requirements for Achieving Covered Species Habitat Creation**  
 2 **Goals**

<i>Species</i>	<i>Habitat Creation Goal (acres)</i>	<i>Created Land Cover Type that will Provide Species Habitat</i>	<i>Minimum Patch Size of Created Land Cover that will Provide Habitat (acres)</i>
<b>Threatened and Endangered Species</b>			
Yuma clapper rail	512	Marsh with water depths no greater than 12 inches	5
Southwestern willow flycatcher	4,050	Cottonwood-willow types I–IV with moist surface soil conditions during the breeding season	10
Desert tortoise	0	Not applicable	Not applicable
Bonytail	360	Backwaters that contain the physical, chemical, and biological conditions required to support native LCR fishes in a healthy condition	Not applicable
Razorback sucker	360	Backwaters that contain the physical, chemical, and biological conditions required to support native LCR fishes in a healthy condition	Not applicable
<b>Other Covered Species</b>			
Western red bat (roosting habitat)	765	Combination of cottonwood-willow types I and II and honey mesquite type III	No minimum requirement
Western yellow bat (roosting habitat)	765	Combination of cottonwood-willow types I and II and honey mesquite type III	No minimum requirement <sup>d</sup>
Colorado River cotton rat	125	Marsh	No minimum requirement
Yuma hispid cotton rat	76	Cottonwood-willow with a moist herbaceous understory	No minimum requirement
Western least bittern	512	Marsh with water depths no greater than 12 inches	No minimum requirement
California black rail	130	Marsh with water depths no greater than 1 inch	5
Yellow-billed cuckoo	4,050	Cottonwood-willow types I–III	25

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**Table B-2. Minimum Requirements for Achieving Covered Species Habitat Creation Goals (continued)**

<i>Species</i>	<i>Habitat Creation Goal (acres)</i>	<i>Created Land Cover Type that will Provide Species Habitat</i>	<i>Minimum Patch Size of Created Land Cover that will Provide Habitat (acres)</i>
Elf owl	1,784	Combination of cottonwood-willow types I and II and honey mesquite type III	No minimum requirement
Gilded flicker	4,050	Cottonwood-willow types I–III	No minimum requirement
Gila woodpecker	1,702	Cottonwood-willow types I–IV	50
Vermilion flycatcher	5,208	Combination of cottonwood-willow types I–IV and honey mesquite type III	No minimum requirement
Arizona Bell’s vireo	2,983	Combination of cottonwood-willow types III and IV and honey mesquite type III	No minimum requirement
Sonoran yellow warbler	4,050	Cottonwood-willow types I–IV	2.5
Summer tanager	602	Cottonwood-willow types I and II	No minimum requirement
Flannelmouth sucker	85	Backwaters that contain the physical, chemical, and biological conditions required to support native LCR fishes in a healthy condition	Not applicable
MacNeill’s sootywing skipper	222	Honey mesquite type III created with quail bush to create honey mesquite–quail bush	No minimum requirement

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1 **Appendix C. Summary of Conservation**  
2 **Measures for Covered and**  
3 **Evaluation Species**

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1 **Table C. Summary of LCR MSCP HCP Conservation Measures for Covered**  
 2 **and Evaluation Species Addressed in the Science Strategy**

<i>Species</i>	<i>Conservation Measures<sup>a</sup></i>
<b>Covered Species</b>	
Yuma clapper rail	<p>AMM 1—To the extent practicable, avoid and minimize impacts of implementing the LCR MSCP on existing covered species habitats</p> <p>AMM2—Avoid impacts of flow-related covered activities on covered species habitats at Topock Marsh</p> <p>AMM3—To the extent practicable, avoid and minimize disturbance of covered bird species during the breeding season</p> <p>AMM5—Avoid impacts of operation, maintenance, and replacement of hydroelectric generation and transmission facilities on covered species in the LCR MSCP planning area</p> <p>AMM6—Avoid or minimize impacts on covered species habitats during dredging, bank stabilization activities, and other river management activities</p> <p>MRM1—Conduct surveys and research to better identify covered and evaluation species habitat requirements</p> <p>MRM2—Monitor and adaptively manage created covered and evaluation species habitats</p> <p>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</p> <p>CLRA1—Create 512 acres of Yuma clapper rail habitat</p> <p>CMM1—Reduce risk of loss of created habitat to wildfire</p> <p>CMM2—Replace created habitat affected by wildfire</p> <p>CLRA2—Maintain existing important Yuma clapper rail habitat areas</p>
Southwestern willow flycatcher	<p>AMM 1—To the extent practicable, avoid and minimize impacts of implementing the LCR MSCP on existing covered species habitats</p> <p>AMM2—Avoid impacts of flow-related covered activities on covered species habitats at Topock Marsh</p> <p>AMM3—To the extent practicable, avoid and minimize disturbance of covered bird species during the breeding season</p> <p>AMM5—Avoid impacts of operation, maintenance, and replacement of hydroelectric generation and transmission facilities on covered species in the LCR MSCP planning area</p> <p>AMM6—Avoid or minimize impacts on covered species habitats during dredging, bank stabilization activities, and other river management activities</p> <p>MRM1—Conduct surveys and research to better identify covered and evaluation species habitat requirements</p>

1 **Table C. Summary of LCR MSCP HCP Conservation Measures for Covered**  
 2 **and Evaluation Species Addressed in the Science Strategy (continued)**

<i>Species</i>	<i>Conservation Measures<sup>a</sup></i>
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

1 **Table C. Summary of LCR MSCP HCP Conservation Measures for Covered**  
 2 **and Evaluation Species Addressed in the Science Strategy (continued)**

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

1 **Table C. Summary of LCR MSCP HCP Conservation Measures for Covered**  
 2 **and Evaluation Species Addressed in the Science Strategy (continued)**

<i>Species</i>	<i>Conservation Measures<sup>a</sup></i>
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

1 **Table C. Summary of LCR MSCP HCP Conservation Measures for Covered**  
 2 **and Evaluation Species Addressed in the Science Strategy (continued)**

<i>Species</i>	<i>Conservation Measures<sup>a</sup></i>
Yuma hispid cotton rat	<p>AMM 1—To the extent practicable, avoid and minimize impacts of implementing the LCR MSCP on existing covered species habitats</p> <p>AMM5—Avoid impacts of operation, maintenance, and replacement of hydroelectric generation and transmission facilities on covered species in the LCR MSCP planning area</p> <p>AMM6—Avoid or minimize impacts on covered species habitats during dredging, bank stabilization activities, and other river management activities</p> <p>MRM2—Monitor and adaptively manage created covered and evaluation species habitats</p> <p>YHCR1—Conduct research to better define Yuma hispid cotton rat habitat requirements</p> <p>YHCR2—Create 76 acres of Yuma hispid cotton rat habitat</p> <p>CMM1—Reduce risk of loss of created habitat to wildfire</p> <p>CMM2—Replace created habitat affected by wildfire</p>
Western least bittern	<p>AMM 1—To the extent practicable, avoid and minimize impacts of implementing the LCR MSCP on existing covered species habitats</p> <p>AMM2—Avoid impacts of flow-related covered activities on covered species habitats at Topock Marsh</p> <p>AMM3—To the extent practicable, avoid and minimize disturbance of covered bird species during the breeding season</p> <p>AMM5—Avoid impacts of operation, maintenance, and replacement of hydroelectric generation and transmission facilities on covered species in the LCR MSCP planning area</p> <p>AMM6—Avoid or minimize impacts on covered species habitats during dredging, bank stabilization activities, and other river management activities</p> <p>MRM1—Conduct surveys and research to better identify covered and evaluation species habitat requirements</p> <p>MRM2—Monitor and adaptively manage created covered and evaluation species habitats</p> <p>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</p> <p>LEBI1—Create 512 acres of western least bittern habitat</p> <p>CMM1—Reduce risk of loss of created habitat to wildfire</p> <p>CMM2—Replace created habitat affected by wildfire</p>

1 **Table C. Summary of LCR MSCP HCP Conservation Measures for Covered**  
 2 **and Evaluation Species Addressed in the Science Strategy (continued)**

<i>Species</i>	<i>Conservation Measures<sup>a</sup></i>
California black rail	<p>AMM 1—To the extent practicable, avoid and minimize impacts of implementing the LCR MSCP on existing covered species habitats</p> <p>AMM2—Avoid impacts of flow-related covered activities on covered species habitats at Topock Marsh</p> <p>AMM3—To the extent practicable, avoid and minimize disturbance of covered bird species during the breeding season</p> <p>AMM5—Avoid impacts of operation, maintenance, and replacement of hydroelectric generation and transmission facilities on covered species in the LCR MSCP planning area</p> <p>AMM6—Avoid or minimize impacts on covered species habitats during dredging, bank stabilization activities, and other river management activities</p> <p>MRM1—Conduct surveys and research to better identify covered and evaluation species habitat requirements</p> <p>MRM2—Monitor and adaptively manage created covered and evaluation species habitats</p> <p>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</p> <p>BLRA1—Create 130 acres of California black rail habitat</p> <p>CMM1—Reduce risk of loss of created habitat to wildfire</p> <p>CMM2—Replace created habitat affected by wildfire</p> <p>BLRA2—Maintain existing important California black rail habitat areas</p>
Yellow-billed cuckoo	<p>AMM 1—To the extent practicable, avoid and minimize impacts of implementing the LCR MSCP on existing covered species habitats</p> <p>AMM2—Avoid impacts of flow-related covered activities on covered species habitats at Topock Marsh</p> <p>AMM3—To the extent practicable, avoid and minimize disturbance of covered bird species during the breeding season</p> <p>AMM5—Avoid impacts of operation, maintenance, and replacement of hydroelectric generation and transmission facilities on covered species in the LCR MSCP planning area</p> <p>AMM6—Avoid or minimize impacts on covered species habitats during dredging, bank stabilization activities, and other river management activities</p> <p>MRM1—Conduct surveys and research to better identify covered and evaluation species habitat requirements</p> <p>MRM2—Monitor and adaptively manage created covered and evaluation species habitats</p> <p>YBCU1—Create 4,050 acres of yellow-billed cuckoo habitat</p> <p>CMM1—Reduce risk of loss of created habitat to wildfire</p> <p>CMM2—Replace created habitat affected by wildfire</p> <p>YBCU2—Maintain existing important yellow-billed cuckoo habitat areas</p>

1 **Table C. Summary of LCR MSCP HCP Conservation Measures for Covered**  
 2 **and Evaluation Species Addressed in the Science Strategy (continued)**

<i>Species</i>	<i>Conservation Measures<sup>a</sup></i>
Elf owl	<p>AMM 1—To the extent practicable, avoid and minimize impacts of implementing the LCR MSCP on existing covered species habitats</p> <p>AMM3—To the extent practicable, avoid and minimize disturbance of covered bird species during the breeding season</p> <p>AMM5—Avoid impacts of operation, maintenance, and replacement of hydroelectric generation and transmission facilities on covered species in the LCR MSCP planning area</p> <p>AMM6—Avoid or minimize impacts on covered species habitats during dredging, bank stabilization activities, and other river management activities</p> <p>MRM1—Conduct surveys and research to better identify covered and evaluation species habitat requirements</p> <p>MRM2—Monitor and adaptively manage created covered and evaluation species habitats</p> <p>MRM3—Conduct research to determine and address the effects of nest site competition with European starlings on reproduction of covered species</p> <p>ELOW1—Create 1,784 acres of elf owl habitat</p> <p>ELOW2—Install elf owl nest boxes</p> <p>CMM1—Reduce risk of loss of created habitat to wildfire</p> <p>CMM2—Replace created habitat affected by wildfire</p>
Gilded flicker	<p>AMM 1—To the extent practicable, avoid and minimize impacts of implementing the LCR MSCP on existing covered species habitats</p> <p>AMM2—Avoid impacts of flow-related covered activities on covered species habitats at Topock Marsh</p> <p>AMM3—To the extent practicable, avoid and minimize disturbance of covered bird species during the breeding season</p> <p>AMM5—Avoid impacts of operation, maintenance, and replacement of hydroelectric generation and transmission facilities on covered species in the LCR MSCP planning area</p> <p>AMM6—Avoid or minimize impacts on covered species habitats during dredging, bank stabilization activities, and other river management activities</p> <p>MRM1—Conduct surveys and research to better identify covered and evaluation species habitat requirements</p> <p>MRM2—Monitor and adaptively manage created covered and evaluation species habitats</p> <p>MRM3—Conduct research to determine and address the effects of nest site competition with European starlings on reproduction of covered species</p> <p>GIFL1—Create 4,050 acres of gilded flicker habitat</p> <p>GIFL2—Install artificial snags to provide gilded flicker nest sites</p> <p>CMM1—Reduce risk of loss of created habitat to wildfire</p> <p>CMM2—Replace created habitat affected by wildfire</p>



1 **Table C. Summary of LCR MSCP HCP Conservation Measures for Covered**  
 2 **and Evaluation Species Addressed in the Science Strategy (continued)**

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

1 **Table C. Summary of LCR MSCP HCP Conservation Measures for Covered**  
 2 **and Evaluation Species Addressed in the Science Strategy (continued)**

<i>Species</i>	<i>Conservation Measures<sup>a</sup></i>
Arizona Bell's vireo	<p>AMM 1—To the extent practicable, avoid and minimize impacts of implementing the LCR MSCP on existing covered species habitats</p> <p>AMM2—Avoid impacts of flow-related covered activities on covered species habitats at Topock Marsh</p> <p>AMM3—To the extent practicable, avoid and minimize disturbance of covered bird species during the breeding season</p> <p>AMM5—Avoid impacts of operation, maintenance, and replacement of hydroelectric generation and transmission facilities on covered species in the LCR MSCP planning area</p> <p>AMM6—Avoid or minimize impacts on covered species habitats during dredging, bank stabilization activities, and other river management activities</p> <p>MRM1—Conduct surveys and research to better identify covered and evaluation species habitat requirements</p> <p>MRM2—Monitor and adaptively manage created covered and evaluation species habitats</p> <p>MRM4—Conduct research to determine and address the effects of brown-headed cowbird nest parasitism on reproduction of covered species</p> <p>BEV11—Create 2,983 acres of Arizona Bell's vireo habitat</p> <p>CMM1—Reduce risk of loss of created habitat to wildfire</p> <p>CMM2—Replace created habitat affected by wildfire</p>
Sonoran yellow warbler	<p>AMM 1—To the extent practicable, avoid and minimize impacts of implementing the LCR MSCP on existing covered species habitats</p> <p>AMM2—Avoid impacts of flow-related covered activities on covered species habitats at Topock Marsh</p> <p>AMM3—To the extent practicable, avoid and minimize disturbance of covered bird species during the breeding season</p> <p>AMM5—Avoid impacts of operation, maintenance, and replacement of hydroelectric generation and transmission facilities on covered species in the LCR MSCP planning area</p> <p>AMM6—Avoid or minimize impacts on covered species habitats during dredging, bank stabilization activities, and other river management activities</p> <p>MRM1—Conduct surveys and research to better identify covered and evaluation species habitat requirements</p> <p>MRM2—Monitor and adaptively manage created covered and evaluation species habitats</p> <p>MRM4—Conduct research to determine and address the effects of brown-headed cowbird nest parasitism on reproduction of covered species</p> <p>YWAR1—Create 4,050 acres of Sonoran yellow warbler habitat</p> <p>CMM1—Reduce risk of loss of created habitat to wildfire</p> <p>CMM2—Replace created habitat affected by wildfire</p>

1 **Table C. Summary of LCR MSCP HCP Conservation Measures for Covered**  
 2 **and Evaluation Species Addressed in the Science Strategy (continued)**

<i>Species</i>	<i>Conservation Measures<sup>a</sup></i>
Summer tanager	<p>AMM 1—To the extent practicable, avoid and minimize impacts of implementing the LCR MSCP on existing covered species habitats</p> <p>AMM3—To the extent practicable, avoid and minimize disturbance of covered bird species during the breeding season</p> <p>AMM5—Avoid impacts of operation, maintenance, and replacement of hydroelectric generation and transmission facilities on covered species in the LCR MSCP planning area</p> <p>AMM6—Avoid or minimize impacts on covered species habitats during dredging, bank stabilization activities, and other river management activities</p> <p>MRM1—Conduct surveys and research to better identify covered and evaluation species habitat requirements</p> <p>MRM2—Monitor and adaptively manage created covered and evaluation species habitats</p> <p>MRM4—Conduct research to determine and address the effects of brown-headed cowbird nest parasitism on reproduction of covered species</p> <p>SUTA1—Create 602 acres of summer tanager habitat</p> <p>CMM1—Reduce risk of loss of created habitat to wildfire</p> <p>CMM2—Replace created habitat affected by wildfire</p>
Relict leopard frog	<p>RLFR1—Provide funding to support existing relict leopard frog conservation programs</p>
Flannelmouth sucker	<p>AMM 1—To the extent practicable, avoid and minimize impacts of implementing the LCR MSCP on existing covered species habitats</p> <p>AMM4—Minimize contaminant loads in runoff and return irrigation flows from LCR MSCP created habitats to the LCR</p> <p>AMM5—Avoid impacts of operation, maintenance, and replacement of hydroelectric generation and transmission facilities on covered species in the LCR MSCP planning area</p> <p>AMM6—Avoid or minimize impacts on covered species habitats during dredging, bank stabilization activities, and other river management activities</p> <p>MRM2—Monitor and adaptively manage created covered and evaluation species habitats</p> <p>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</p>

1 **Table C. Summary of LCR MSCP HCP Conservation Measures for Covered**  
 2 **and Evaluation Species (continued)**

<i>Species</i>	<i>Conservation Measures<sup>a</sup></i>
Flannemouth sucker (continued)	FLSU1—Create 85 acres of flannemouth sucker habitat FLSU2—Provide funding to support existing flannemouth sucker conservation programs FLSU3—Assess flannemouth sucker management needs and develop management strategies
MacNeill’s sootywing skipper	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 MRM2—Monitor and adaptively manage created covered and evaluation species habitats MNSW1—Conduct surveys and research to locate MacNeill’s sootywing skipper habitat and to better define its habitat requirements MNSW2—Create at least 222 acres of MacNeill’s sootywing skipper habitat CMM1—Reduce risk of loss of created habitat to wildfire CMM2—Replace created habitat affected by wildfire
<b>Evaluation Species</b>	
California leaf-nosed bat (roosting habitat)	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 CLNB1—Conduct surveys to locate California leaf-nosed bat roost sites CLNB2—Create covered species habitat near California leaf-nosed bat roost sites CMM1—Reduce risk of loss of created habitat to wildfire CMM2—Replace created habitat affected by wildfire
Pale Townsend’s big-eared bat (roosting habitat)	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 PTBB1—Conduct surveys to locate pale Townsend’s big-eared bat roost sites PTBB2— Create covered species habitat near pale Townsend’s big-eared bat roost sites CMM1—Reduce risk of loss of created habitat to wildfire CMM2—Replace created habitat affected by wildfire

1 **Table C. Summary of LCR MSCP HCP Conservation Measures for Covered**  
 2 **and Evaluation Species (continued)**

<i>Species</i>	<i>Conservation Measures<sup>a</sup></i>
Colorado River toad	CRT01—Conduct research to better define the distribution, habitat requirements, and factors that are limiting the distribution of the Colorado River toad CRT02—Protect existing unprotected occupied Colorado River toad habitat CRT03—Conduct research to determine feasibility of establishing the Colorado River toad in unoccupied habitat
Lowland leopard frog	LLFR1— Conduct research to better define the distribution, habitat requirements, and factors that are limiting the distribution of the lowland leopard frog LLFR2—Protect existing unprotected occupied lowland leopard frog habitat LLFR3— Conduct research to determine feasibility of establishing the lowland leopard frog in unoccupied habitat
<sup>a</sup> Full descriptions of the conservation measures are provided in Chapter 5 of the LCR MSCP.	

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