CHAPTER 7. MONITORING AND ADAPTIVE MANAGEMENT

7.1 INTRODUCTION

This chapter presents the Butte Regional Conservation Plan (BRCP) monitoring program and adaptive management plan. The monitoring program provides the framework within which Butte County Association of Government (BCAG) as the Implementing Entity will develop and implement a monitoring plan for specified BRCP elements as described in Section 7.2.4, *Monitoring Plan Content and Schedule*. The adaptive management plan describes the framework and the processes that will be undertaken by BCAG to adjust BRCP implementation in response to results of BRCP monitoring, directed studies, and relevant new information collected by others over the term of the BRCP.

7.2 MONITORING PROGRAM

This section describes the elements of the BRCP monitoring program. Monitoring can be defined as the "systematic and usually repetitive collection of information typically used to track the status of a variable or system" (Atkinson et al. 2004). The BRCP monitoring program is designed to guide the collection and compilation of relevant data and information necessary to 1) demonstrate compliance with permit terms and conditions, 2) assess the effectiveness of BRCP implementation over time, and 3) ensure that the adaptive management decision-making process described in Section 7.3, *Adaptive Management Plan*, is informed by the best available science.

The purpose of the monitoring program is to periodically assess the status of species and natural communities on BRCP conservation lands as the basis for their ongoing conservation and recovery. By tracking the success of the BRCP protection, enhancement, and restoration activities, the monitoring program will provide the justification for adjusting BRCP implementation over time through the adaptive management process to improve conservation effectiveness and to increase the precision and utility of the monitoring data. As described in Section 7.3, BCAG may also implement or collaborate in directed studies to address specific scientific questions regarding covered species, natural communities, and ecosystem processes to increase the base of knowledge about these resources such that conservation measures can be adaptively implemented to more effectively achieve the biological goals and objectives. While Habitat Conservation Plans (HCPs) and Natural Community Conservation Plans (NCCPs) are not specifically required to include directed studies, the uncertainty regarding the level of anticipated beneficial outcomes for some covered species highlight the need for focused studies and research to better inform BRCP implementation and monitoring.

The monitoring program, in concert with BRCP directed studies, will be designed to provide a means by which information necessary to implement the BRCP over time will be collected and compiled, and that the adaptive management process is informed by the best available science.

BRCP implementation, monitoring, directed studies, and adaptive management are all part of a feedback loop process that is illustrated in Figure 7–1, *BRCP Implementation, Monitoring, Directed Research, and Adaptive Management Feedback Loop* (see separate file).

7.2.1 Regulatory Context

The monitoring framework is consistent with the guidance provided by the U.S. Fish and Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) Five-Point Policy for HCPs[1] and provisions of the Natural Community Conservation Planning Act (NCCPA)[2] for monitoring the implementation of HCPs and NCCPs. As described in the Five-Point Policy, the monitoring program of a conservation plan should generate information sufficient to guide plan implementation, particularly with respect to the following matters.

"The monitoring program should reflect the measurable biological goals and objectives. The following components are essential for most monitoring protocols (the size and scope of the HCP will dictate the actual level of detail in each item): 1) assess the implementation and effectiveness of the HCP terms and conditions (e.g., financial responsibilities and obligations, management responsibilities, and other aspects of the incidental take permit, HCP, and the IA, if applicable); 2) determine the level of incidental take of the covered species; 3) determine the biological conditions resulting from the operating conservation program (e.g., change in the species' status or a change in the habitat conditions); and 4) provide any information needed to implement an adaptive management strategy, if utilized. An effective monitoring program is flexible enough to allow modifications, if necessary, to obtain the appropriate information."[3]

By regulation, an HCP specifically must incorporate monitoring of conservation measures and the response of covered species to these measures.[4] Likewise, NCCPA provisions and requirements related to monitoring are as follows:

"(f) 'Monitoring program' means a program within an approved natural community conservation plan that provides periodic evaluations of monitoring results to assess the adequacy of the mitigation and conservation strategies or activities and to provide information to direct the adaptive management program. The monitoring program shall, to the extent practicable, also be used to meet the monitoring requirements of Section 21081.6 of the Public Resources Code. A monitoring program includes all of the following:

- Surveys to determine the status of biological resources addressed by the plan, including covered species.
- Periodic accountings and assessment of authorized take.
- Progress reports on all of the following matters:

[1] 65 FR 106, June 1, 2000.
[2] Fish and Game Code section 2810(a)(7).
[3] 65 FR 106: 35254, June 1, 2000.
[4] [50 *Code of Federal Regulations* (CFR) 17.22(b)(1)(iii) and 50 CFR 222.22(b)(5)(iii).

a. Establishment of habitat reserves or other measures that provide equivalent conservation of covered species and providing funding where applicable.

b. Compliance with the plan and the implementation agreement by the wildlife agencies, local governments, and landowners who have responsibilities under the plan.

c. Measurements to determine if mitigation and conservation measures are being implemented roughly proportional in time and extent to the impact on habitat or covered species authorized under the plan.

d. Evaluation of the effectiveness of the plan in meeting the conservation objectives of the plan.

e. Maps of land use changes in the Plan Area that may affect habitat values or covered species.

f. A schedule for conducting monitoring activities."[5]

7.2.1.1 Responsibility for the Monitoring Program

BCAG is responsible for developing and implementing the monitoring program. Components of monitoring, however, may be implemented by multiple parties, including staff of BCAG or, with the oversight of BCAG, other BRCP participants (e.g., Permittees, Project Applicants, USFWS, California Department of Fish and Game [CDFW], and NMFS), academic institutions, consulting firms, or other qualified entities. Monitoring conducted under existing programs implemented by other entities (e.g., universities, Central Valley Regional Water Control Board, USFWS, NMFS, CDFW, and United States Geological Survey [USGS]) may also be used by BCAG to assess the effectiveness of conservation measures in achieving biological goals and objectives. BCAG, however, is responsible for ensuring that monitoring and directed studies undertaken by others on behalf of BCAG comply with BRCP implementation requirements.

BCAG will coordinate and share monitoring and directed study results, as appropriate, with other regional restoration and management programs. Effective data sharing requires standardization of protocols, sampling design, and training of personnel, as well as integrative data analyses. Programs and organizations with which BCAG should coordinate include approved and developing HCPs and NCCPs that adjoin the Plan Area; USFWS, NMFS, CDFW, and other federal and state resource agency monitoring programs; and organizations conducting monitoring of existing conserved lands within and adjacent to the Plan Area.

7.2.2 Monitoring Process

A well designed monitoring program provides an unbiased, scientific way to evaluate the compliance with permit conditions and the effectiveness of the BRCP's conservation measures. This information allows BCAG to adaptively adjust conservation practices or methods when biological goals or objectives are not met, and it documents the overall success in protecting,

[5] Fish and Game Code section 2805(f).

enhancing, restoring and supporting natural communities and covered species in the Plan Area. The USGS in collaboration with CDFW and USFWS (Atkinson et al. 2004) provide a stepwise guidance for creating a monitoring program, which includes:

1. Monitoring objectives
2. Scope, scale and intensity of monitoring
3. Database development
4. Prioritization
5. Management-oriented conceptual models
6. Attributes, Metrics and Key uncertainties
7. Strategy for implementing monitoring
8. Data quality assurance, data management, analysis, and reporting
9. Feedback to decision-making

The purpose of this section is to briefly describe the tenets of USGS's monitoring approach (Atkinson et al. 2004) to provide sufficient guidance to BCAG to ensure that the monitoring program will meet regulatory standards and that the monitoring program is sufficiently flexible to address uncertainties and input of new information over the term of the BRCP. The exact location and extent of the conservation activities and target areas for monitoring are not known at this time, thus precluding the ability to establish specific monitoring actions and requirements (e.g., monitoring protocols, thresholds, triggers, and other key variables). These specific monitoring requirements will be addressed in monitoring plans that will be development by BCAG during BRCP implementation as described in Section 7.2.4.

7.2.2.1 Monitoring Objectives

The overall purpose of an HCP/NCCP monitoring program is to provide information to evaluate compliance with permit terms and conditions and to assess the effectiveness of implementation in achieving the biological goals and objectives. More specifically, BRCP monitoring will be conducted primarily to:

- Establish baseline conditions of biological resources in the Plan Area from which deviations can be detected (e.g., changes in the ecological functions of protected natural communities and in the distribution and abundance of covered species over time);
- Produce scientifically valid data which are relevant and informative to the adaptive management process and which integrate with other monitoring efforts (e.g., adjacent HCP/NCCP plan areas, state-wide and nation-wide monitoring of biological resources);
- Document compliance with terms and conditions of BRCP permits, including limits set on the incidental take of covered species;

- Document and evaluate the effectiveness of conservation measures in achieving BRCP biological goals and objectives;
- Provide information necessary to indicate whether adjustments to BRCP implementation and necessary to better ensure that biological goals and objectives are achieved; and
- Assess progress towards achieving the biological goals and objectives.

7.2.2.2 Scope, Scale, and Intensity

The scope of the monitoring program will be commensurate with the scope and duration of the Conservation Strategy and impacts of the covered activities, of sufficient scale to assess the range of ecological conditions across the entire Plan Area, and to evaluate progress towards achieving the biological goals and objectives. As described in Section 5.3, *Biological Goals and Objectives*, the BRCP Conservation Strategy operates at multiple ecological scales, including habitat patches, habitat components, natural communities, and populations up to the landscape-level scale of Conservation Acquisition Zones (CAZs) and the Plan Area. The monitoring program also operates at corresponding scales as appropriate to detect change at the species, natural community, and landscape scales. At the broadest spatial extent, landscape-level monitoring is designed to detect large-scale changes in ecosystem processes, shifts in natural community distribution, the composition and integrity of landscape linkages, and the abundance and distribution of covered and other native species across the Plan Area. Because these types of changes are typically slow and widespread, monitoring to detect landscape change often is typically conducted at multi-year intervals.

Natural community-level monitoring is focused on the BRCP conservation lands system and is designed to detect changes in the composition and function of protected natural communities, covered species habitats, key predator or prey populations, invasive species, and other important habitat factors for covered species. Species-level monitoring focuses on assessing the distribution and abundance of covered species within the BRCP conservation lands system (e.g., the size and distribution of covered plant species occurrences, nesting success of covered bird species). The frequency of natural community-level and species-level monitoring ranges from annual to multi-year intervals, depending on the conservation land-specific parameters being assessed. Monitoring intensity is closely related to the specified level of precision required to determine effectiveness of conservation measures. For example, sampling of plants in a restoration area typically is conducted at high initial intensity to ensure that planted individuals survive and become established (e.g., compliance with a habitat restoration target). After that point, intermittent sampling can ascertain that the development of desired ecological functions is following the expected trajectory (e.g., effectiveness of restoration for a given covered species). Similarly, baseline surveys may be conducted at a higher initial monitoring intensity to ascertain species presence and status then ongoing routine monitoring of conservation lands once they have been protected and the continued presence of covered species need only be verified. Other decisions regarding monitoring intensity are related to the specific biological characteristics of

species (e.g., different emergence and flowering of covered vernal pool plant species, seasonal habitat use patterns of covered wildlife species).

7.2.2.3 Database Development and Maintenance

BCAG will develop and maintain a comprehensive spatially-linked database to track implementation of the BRCP. Monitoring data, results of directed studies, geospatial data, and information collected by others (e.g., USFWS, NMFS, and CDFW) that is relevant to covered species and conservation lands will be integrated into the BRCP database. The BRCP data will also be shared, upon request, with USFWS, NMFS, and CDFW. The database will thus serve as the repository of the current understanding of species and natural communities in the Plan Area and will serve as a tool for identifying data gaps and additional information necessary to ensure that the biological goals and objectives are achieved.

The database will be "user friendly" and allow for future expansion and integration with external databases if desired (e.g., linkage to USFWS, NMFS, and CDFW databases). The database will be designed to support the following services.

- Data documentation such that future users can determine why, how, and where data were collected (i.e., metadata);
- Quality assurance and control of the data and data entry;
- Provide the most current information for analysis and decision making; and
- Evaluation of data by all users, as appropriate, and incorporation of corrections and improvements in the data.

Major types of information expected to be maintained within the database include:

- Monitoring, directed study, and adaptive management data and results;
- BRCP funding and expenditures;
- Status of covered activities, including implementation and impacts;
- Implementation status of conservation measures;
- Implementation status of directed studies and adaptive management assessment results;
- Adopted changes to BRCP implementation through the adaptive management process; and
- All reports and documents generated by BCAG and relevant data and reports generated by other entities.

BCAG may choose to develop a web-linked database to facilitate controlled transference of information into and out of the database by other entities. If the BRCP Implementing Entity

chooses to allow access to the database by others, the database will incorporate strict controls and monitoring to ensure the integrity of the database is maintained.

7.2.2.4 Prioritization

Threats to covered species and natural communities, and operational constraints (e.g., funding) dictate that BCAG must prioritize "what" and "how much" information is to be collected through the monitoring program. Grouping covered species with similar management and monitoring requirements is a cost effective approach for tracking the status of each species and natural communities. Whenever possible, BRCP monitoring will use a multispecies approach.

7.2.2.5 Management-Oriented Conceptual Models

Conceptual models based on ecological functions can help develop management plans by organizing the existing knowledge and assumptions about a particular landscape, natural community, or species, and thus aid in defining the scope and scale of the monitoring. This facilitates assessments of key uncertainties and provides a direction for future improvements in management and identification of data needs. Conceptual models provide a framework and basis for discussion among scientists, stakeholders, and managers. Although conceptual models are not a required to be included in NCCPs and HCPs, BCAG will consider developing basic conceptual models to support the design of management-relevant monitoring of conservation actions, especially for covered species which are poorly understood (e.g., Blainesville's horned lizard) or for highly dynamic, complex natural systems (e.g., vernal pools).

7.2.2.6 Attributes, Metrics, and Key Uncertainties

Selection of the attributes (i.e., monitoring variables) for covered species and natural communities is a critical step in designing a monitoring program. "An attribute is any component or condition of the system that can be quantifiably measured, for example, forest cover, precipitation or arthropod species diversity" (Atkinson et al 2004). For covered species, presence/absence and abundance or population size are most commonly measured attributes, but additional metrics may be required (e.g., for giant garter snake the proportion of young in the population is a recovery criterion). Attributes should be selected such that the hypotheses regarding conservation actions can be evaluated. Metrics provide the unit in which the attribute is measured. Metrics should be relevant to management and regulatory parameters, have strong scientific underpinnings, and be measurable, feasible, statistically rigorous, and easily understood and interpreted (Atkinson et al. 2004). Metrics should provide a logical link to biological goals, such as abundance, density, trend, age composition, or spatial distribution of a covered species.

Uncertainties are those aspects or functional relationships of a species, natural community or ecosystem that are poorly understood. Uncertainties that constrain decision-making are key uncertainties, and thus should be prioritized. While not all uncertainties must be resolved at the same time, and some are perhaps impossible to eliminate, it is important to understand and

evaluate possible consequences for interpretation of monitoring results. BCAG, through the development of conceptual models and expert input, will identify and prioritize key uncertainties that may impact the effectiveness of conservation measures or the measurement of attributes. High priority key uncertainties will be addressed by increasing the intensity of monitoring, implementing directed studies, or conducting management experiments.

7.2.2.7 Monitoring Strategy, Data Quality Assurance, Data Management, and Reporting

BCAG will develop a monitoring strategy that documents specific protocols and schedules for monitoring (see Section 7.2.4). Quality assurance of monitoring data is a critical feature of a long-term monitoring program, if long-term trends are to be reliably assessed (Atkinson et al. 2004). The quality of data collection will be addressed through adoption and adherence to statistically sound sampling designs and survey protocols as described in Sections 7.2.3, *Monitoring and Survey Requirements*, and 7.2.4. Because monitoring results are a primary source of information for supporting adaptive management changes in BRCP implementation over time and to measure progress toward achieving the BRCP biological goals and objectives, monitoring plans need to be based on the best available science and subject to rigorous standards, including statistically sound sampling designs and analysis methods. Biased or unreliable monitoring data could result in erroneous decision making and therefore could reduce the effectiveness of the implemented conservation measures. Development of standardized monitoring protocols, will allow for comparison of monitoring data among different monitoring locations, different individuals conducting the monitoring, and among monitoring years over the term of the BRCP.

Following permitting of the BRCP, BCAG will develop detailed monitoring schedules for compliance and effectiveness monitoring. In addition, site-specific monitoring schedules will be developed for each BRCP conservation land parcel or group of parcels as they are acquired. Monitoring plans will include survey protocols, attributes and metrics, sampling design, and methods (e.g., statistical techniques) used to analyze monitoring data. Where appropriate, BCAG may adopt existing and generally accepted methods (e.g., USFWS survey protocols for listed species, protocols for monitoring status and trends in abundance and distribution of covered bird species). BCAG may develop new monitoring procedures, if scientifically-reviewed procedures as they might be applicable to the BRCP have not been developed for the subject of monitoring. In this case, BCAG will solicit information from resource agency experts, independent scientists, and other experts as appropriate. Draft procedures may be field tested and revised as necessary based on test results to ensure that they can be effectively implemented and yield the desired monitoring information.

7.2.2.8 Analysis of Monitoring Data and Scientific Reviews

BCAG will use the best available technology and science to ensure quality control of all monitoring data. Steps will be instituted to maintain the accuracy and functionality of any

installed monitoring devices, and protocols will be established to govern the collection, transcription, and storage of data. BCAG will involve internal and external scientific reviews as appropriate throughout BRCP implementation, and whenever significant changes are necessitated within the adaptive management framework (see Section 7.3). Internal scientific review will predominantly focus on cost effectiveness of techniques for implementing conservation measures, scheduling of implementation, and interrelationships between BRCP elements (i.e., prioritization). These reviews will consider monitoring and other evidence on the current scientific knowledge of the covered species and habitats and the effectiveness of conservation measures as they are implemented. External scientific review will be conducted by recognized experts for the respective species, natural community, or ecological process under review. The need for external reviews will be determined by BCAG.

BCAG will document all standardized analytical procedures and update procedures as necessary. Results of the analysis of monitoring data will feed back into the adaptive management decision making process as described Section 7.3 (see Chapter 8, *Plan Implementation*, for reporting and review of monitoring and adaptive management programs).

7.2.2.9 Feedback to Decision-Making

The following are considered by Atkinson et al. 2004 to be important elements of decision support systems:

- Managing plan implementation including monitoring, management, targeted studies, and the conservation strategy.
- Periodic evaluation of monitoring and management projects and targeted studies regarding scientific rigor and reliability of knowledge gained.
- Synthesizing and compacting information for managers.
- Evaluation of monitoring objectives, priorities and corrective actions.
- Revision of conceptual models and recommendations for changes to conservation strategy, management plans and monitoring program design.
- Integration of external scientific input and review.
- Triggers for adjustments, additions or deletions, changes in monitoring intensity or scale, and other adaptive changes to the implementation of the conservation strategy.

BCAG's decision support system for effectively integrating the data and knowledge collected by the monitoring program into the BRCP adaptive management decision making framework is described in Section 7.3 (for a discussion of reporting and review of monitoring and adaptive management actions see Chapter 8, *Plan Implementation*).

7.2.3 Monitoring and Survey Requirements

BCAG will conduct monitoring and surveys to collect information necessary to demonstrate compliance with BRCP permits and to assess the effectiveness of BRCP implementation in achieving the biological goals and objectives. The type and intensity of monitoring will vary over the term of the BRCP as the conservation lands system is assembled and data is accumulated (e.g., as the response of covered species to particular conservation actions during early implementation years is documented, the need to monitor the response of covered species to implementation of those same actions in later implementation years may be reduced). Compliance and effectiveness monitoring and survey requirements are described below. In addition, BCAG will routinely monitor the condition of habitat management infrastructure on BRCP conservation lands to determine if infrastructure maintenance or replacement is needed to maintain habitat conditions over time (e.g., road and fence maintenance, pump replacement).

7.2.3.1 Compliance Monitoring

The purpose of compliance monitoring is to ensure compliance with terms and conditions of the BRCP and its associated permits during implementation of covered activities. It also tracks progress of BRCP implementation in accordance with the implementation schedule (see Chapter 8, *Plan Implementation*). Compliance monitoring actions and procedures are presented in Table 7–1, *Compliance Monitoring Actions* (see separate file).

The compliance monitoring actions will be implemented, as applicable, for all covered activities by the responsible entities as indicated in Table 7–1. The procedures to be used by the Permittees and third party project proponents for documenting compliance with the BRCP are described in Section 8.7, *Process for BRCP Implementation*. Results of compliance monitoring may also serve the purposes of effectiveness monitoring (see below). For example, documenting the protection of a specified amount of a covered species habitat for compliance also documents progress towards achieving the biological objective for protection of that species habitat. Results of compliance monitoring will also be used by BCAG along with results of effectiveness monitoring to determine if BRCP implementation should be adjusted under the provisions or the BRCP adaptive management plan (see Section 7.3).

7.2.3.2 Effectiveness Monitoring

Effectiveness monitoring will be conducted for three purposes: 1) to assess the effectiveness of habitat restoration, enhancement, and management techniques in achieving the desired habitat conditions for covered and other native species (i.e., are the hypotheses supporting the actions validated), 2) to assess covered species responses to the implementation of conservation measures, and 3) to document progress made toward achieving the BRCP biological goals and objectives. Effectiveness monitoring actions are identified at the landscape-, natural community, and species-levels. These monitoring actions will provide the data necessary to assess the status and trend of covered species populations at Plan Area-wide and BRCP conservation land unit

scales and will provide the basis for tracking progress towards achieving the biological goals and objectives. In addition, initial baseline ecological surveys will be conducted on all BRCP conservation lands from which the effectiveness of BRCP habitat enhancement and management actions will be measured.

Results of effectiveness monitoring will inform BCAG as it considers adjustments to implementation through the adaptive management plan (see Section 7.3). The effectiveness monitoring requirements for specific conservation actions will be determined by BCAG prior to implementing the actions and will be designed to collect information necessary to improve their effectiveness over time and to resolve key uncertainties. It is anticipated that the extent of effectiveness monitoring will be reduced over time as causal relationships between the implementation of conservation actions and the responses of covered species and natural communities to those actions are better understood. For example, if relationships between a specific habitat enhancement action and the response of a particular covered species to the action are established through monitoring, then effectiveness monitoring for assessing the species response to the same action in another location may be reduced or no longer required.

7.2.3.2.1 Baseline Ecological Surveys

Conservation measure CM5, Enhance Protected Natural Communities for Covered Species (see Section 5.4, *Conservation Measures*) provides for conducting surveys of acquired conservation lands within two years of acquisition to collect information necessary to describe the baseline ecological conditions present on the lands. All or a portion of ecological baseline condition data may be collected during pre-acquisition surveys (see Section 5.4.1.1.1, *Pre-Acquisition Surveys*) before a parcel is protected by BCAG.[6] BCAG will prepare standardized survey protocols that include a description of the attributes and metrics for describing the baseline conditions. Depending on the biological resources present on a protected parcel or collection of parcels, the description of baseline ecological conditions will include the following items (see Table 7–2, *Landscape-Level Effective Monitoring Actions and Example Monitoring Approaches and Metrics* [separate file]).

- A vegetation/habitat type map, including tree snags, and a description of dominant species and vegetation structure in each vegetation type;
- A description of percent canopy cover in each mapped riparian vegetation polygon;
- A description of hydrologic conditions, including a map of water features (e.g., vernal pools, ponds, intermittent and perennial stream channels);
- A description of current and historical land uses (e.g., livestock grazing regimes, cropping practices);
- A map (if applicable) and description of areas infested with nonnative invasive plants;

[6] BCAG will need to collect biological and other information necessary to determine if a parcel being considered for protection meets the conservation land site selection criteria and, if applicable, to document site conditions in conservation easements.

- Mapped locations of covered plant species occurrences and estimated abundance of the number of plants in each occurrence;[7]
- Occurrence of covered wildlife species and documentation of key habitat uses (e.g., presence of covered bird species nest sites), including mapped locations of raptor nest sites; and
- CWA section 404 jurisdictional wetlands and other waters of the United States delineation on all BRCP acquired non-agricultural conservation lands and agricultural conservation lands on which natural communities and covered species habitats will be restored.

Results of baseline ecological surveys will establish baseline conditions from which the ecological effectiveness of BRCP enhancement, restoration, and management actions will be measured. Depending on the types of habitat enhancements or management actions that may be implemented on a particular parcel, additional information may need to be collected before those actions are implemented to ensure that the sufficient baseline data has been collected to evaluate the effects of those actions. Baseline ecological survey results will also be used to document the natural resources and their characteristics and condition of lands protected under BRCP conservation easements at the time of the easement transfer. Provisions of the baseline ecological surveys are intended to comply with the statutory requirement for baseline studies pursuant to U.S. Treasury Department Regulations that stipulate requirements for conservation easements[8] (see Section 8.7).

7.2.3.2.2 Landscape-Level Monitoring Actions

Landscape-level monitoring includes actions to: 1) monitor trends in ecological conditions, including the status and trends in covered species populations, Plan Area-wide and in the context of the regional conditions and trends and 2) monitor progress towards achieving the biological goals and objectives. Landscape-level monitoring actions are presented in Table 7–2. Landscape-level monitoring includes the use of data collected for other BRCP purposes (e.g., pre-acquisition surveys implemented under CM1 [Section 5.4.1.1, *Acquire Lands*] and planning surveys implemented under AMM1, Conduct Planning Surveys [Chapter 6, *Conditions on Covered Activities*]). Landscape-level monitoring is intended to complement natural community- and species-level monitoring (see below) by helping to determine causality when examining a biological response, or lack thereof, to implementation of a conservation action. Results of landscape-level monitoring will provide a basis for assessing biological changes above and beyond those related to individual conservation measures. Information within the scope of landscape-level monitoring includes the overall status, distribution, and trends related to covered species populations and the status of the natural communities, including the ecological functions they provide for covered and other native species. Results of landscape-level monitoring will

[7] As appropriate, the estimated size of each plant occurrence will be augmented by any available historical descriptions of the occurrences.

[8] Treasury Regulations § 1.170A-14(g)(5)(i).

help BCAG to discriminate whether any observed response to a conservation action can be attributed to the implementation of the BRCP or if the lack of response indicates failure of that particular action. Landscape-level monitoring will be important in particular for covered wildlife species that are migratory, nomadic, or otherwise highly mobile (i.e., dispersing readily in and out of the Plan Area). For these species, factors external to the Plan Area can readily obscure the type and extent of response to the implementation of the conservation measures. For example, it may be that a conservation measure intended to restore habitat for a covered species is not followed by use of that habitat by the species. The apparent lack of response, however, may be due to a population decline of the covered species caused by reduced production or increased mortality outside of the Plan Area. Thus, landscape-level monitoring is important to provide context for interpretation of results of effectiveness monitoring and other monitoring and results of directed studies and other research. It also provides BCAG with information necessary to make implementation adjustments through the adaptive management process in advance of large-scale changes in the ecological conditions of the Plan Area that appear forthcoming.

Status of Natural Communities within the Plan Area. BCAG will map each natural community within the Plan Area at least every five years over the term of the BRCP to determine the extent (areal or linear) and distribution of each natural community. It is anticipated that the mapping will be performed using aerial imagery taken at each analysis point for this purpose. Natural community mapping results will be used by BCAG to identify changes in the extent and distribution of natural communities and associated covered species habitats within the Plan Area over time. This information will be used by BCAG to determine if there is a need to adjust BRCP implementation through the adaptive management process to better address the conservation needs of covered species if substantial and unanticipated changes in the distribution and extent of natural communities and covered species habitats are detected within the Plan Area.

Concurrent with the periodic monitoring and assessment of natural communities within the Plan Area, BCAG will review and evaluate available data regarding the acreage and distribution of agricultural crop types within the Plan Area every five years. Results of the evaluation will be used to determine if agricultural land uses have changed sufficiently to warrant any change in BRCP implementation to ensure conservation of covered species whose habitats are supported by agricultural lands. For example, if agricultural cropping patterns change in the Plan Area such that Swainson's hawk agricultural foraging habitats are substantially reduced relative to the Plan Area abundance of Swainson's hawk, modification of BRCP implementation to improve habitat conditions for the Swainson's hawk through the adaptive management process may be appropriate. Monitoring tools will include relevant information currently collected by the Butte County Agricultural Commissioner and other agencies, such as NRCS; information regarding trends in agricultural practices from the agricultural community; and relevant reports by local, state, and federal agencies regarding trends in agricultural production and practices; and other relevant information sources that may become available over the term of the BRCP.

Status of Covered Species within the Plan Area. BCAG will assess the status, distribution, and trends of covered species within the Plan Area for at least every five years over the term of the BRCP. This assessment will be conducted based on reviews of all previous BRCP monitoring and land evaluation (e.g., preconstruction surveys, pre-acquisition surveys) results, and results of BRCP directed studies and relevant monitoring and research conducted by others (e.g., USFWS, NMFS, and CDFW survey results and status and trends assessments). Plan Area-wide monitoring for covered species will provide BCAG with information to help track long-term changes attributable to any of a number of factors (e.g., covered activities, climate change, and activities of others) that may affect the status of covered species within the Plan Area. As part of landscape-level monitoring, BCAG will also review relevant scientific data regarding the regional status of covered species whose range and life stage distribution extends beyond the Plan Area as it becomes available. This information will help inform the need for making adjustments to BRCP implementation through the adaptive management process (see Section 7.3). For birds in particular, the Breeding Bird Survey (BBS) programs, in addition to raptor counts along migration routes, provide readily available, continuously updated data on the global and regional status of species.

7.2.3.2.3 Natural Community-Level Monitoring Actions

Natural community-level monitoring includes actions to monitor the 1) effectiveness of habitat enhancement, restoration, and management techniques in maintaining and increasing the ecological functions of natural communities and covered species habitats on BRCP conservation lands, 2) change in the abundance and distribution of covered and other native species on BRCP conservation lands over time, and 3) change in the acreage and ecological functions of BRCP protected natural communities and covered species habitats over time. Natural community-level monitoring actions are presented in Table 7–3, *Natural Community-Level Monitoring Actions and Example Monitoring Approaches and Metrics* (see separate file). Results of natural community-level monitoring actions will be evaluated by BCAG to determine if adjustments in habitat enhancement, restoration, and management techniques are needed to improve their effectiveness in achieving the biological goals and objectives.

Restored Habitats. As described in conservation measure CM4: Develop and Implement Site Specific Wetland and Riparian Restoration Plans (Section 5.4), the BRCP includes actions to restore natural communities and covered species habitats. Monitoring actions NCM3-7 (Table 7–3) and SLM1 and 7 (Table 7–4, *Species-Level Monitoring Actions and Example Monitoring Approaches and Metrics* [see separate file]) address monitoring the development of ecological functions of restored riparian, emergent wetland, giant garter snake, and vernal pool and swale habitats (e.g., vegetation composition and cover) and the use of restored habitat by covered species. Prior to implementing habitat restoration actions, BCAG will develop monitoring plans and schedules for each type of habitat restoration action and/or habitat restoration site (see below). These habitat restoration monitoring plans will be incorporated into conservation land management plans as described in Section 5.2.4, *Monitoring Plan Content and Schedule*. The duration and frequency of monitoring of each type of habitat restoration is

determined by the time required for covered species habitat functions to fully develop (e.g., riparian forest habitat may require the entire term of the BRCP to fully develop habitat functions for covered species that use mature forest) and annual variability in environmental conditions that affect habitat functions (e.g., to assess the full habitat functions of restored vernal pools may require monitoring over the course of several wet water years).

The BRCP monitoring plan (see Section 5.2.4), will describe the attributes to be monitored (e.g., percent vegetation cover and composition, hydrologic conditions, and presence and abundance of covered species) and criteria that, when achieved for each of the attributes, indicate that ecological objectives of the restored habitat have been achieved or are trending towards being achieved[9]. The selected attributes should be those that represent measures of habitat function for associated covered and other native species and that can be practicably measured. Attributes for each restored habitat type that will be considered by BCAG and for which, when adopted, criteria will be established include but are not limited to the following.

- Acreage and location of restored habitat patches;
- Vegetative characteristics over time (species composition, tree height and diameter distribution, tree density, canopy closure, number of snags, ground cover, etc.);
- Complexity (e.g., edge to area ratio, percent open water to emergent vegetation in restored emergent wetland);
- Hydrographic characteristics (inundation periods, inundation depths, frequency of inundations);
- Presence of specified elements that comprise habitat for covered species;
- Presence and abundance of invasive plants, nonnative competitors or predators over time;
- Number and abundance of covered species over time; and
- Connectivity of restored habitat patches.

The criteria established for selected attributes will serve as thresholds for determining the need for subsequent management actions. Failure to achieve or trend towards achieving the criteria established for the attributes will trigger an adaptive management review by BCAG to determine if 1) remedial actions should be implemented to improve the likelihood for achieving the performance criteria, 2) the threshold criteria are inappropriate based on site capability and need to be modified, and/or 3) designs of subsequent restored habitats need to be adjusted to improve development of the desired ecological conditions.

Habitat restoration sites will also be monitored to determine their use by associated covered species over time. Use of restored habitats by associated covered and other native species is a strong indicator that the restored habitat has successfully developed the desired habitat functions

[9] The criteria for some environmental variables may not be achieved until after the term of the BRCP, depending on the variable and when a site is restored during BRCP implementation.

for these species. As previously described, failure of restored habitat to be used by covered and other native species does not necessarily indicate that the restored habitat has failed to develop the desired habitat functions.

The intensity of monitoring required for restoration of specific habitat types is expected to change over the BRCP implementation period as more is learned about how restored habitats develop under various designs. For example, initial riparian habitat restoration projects will be intensively monitored until a relationship is established between restoration actions and the development of riparian habitat attributes. As these relationships are established, the monitoring intensity of subsequent riparian habitat projects would be expected to be reduced.

Habitat Enhancement and Management Actions. As described in conservation measure CM5, Enhance Protected Natural Communities for Covered Species (Section 5.4), the BRCP includes actions to enhance and manage protected habitats to maintain and increase their functions as habitat for covered and other native species over time. Before implementing habitat enhancement and management actions, BCAG will develop and implement monitoring requirements and schedules for each type of habitat enhancement and management action and/or each specific site to be enhanced and managed. These monitoring requirements will be incorporated into conservation land management plans (see Section 5.2.4) and will describe the attributes to be monitored, thresholds for triggering adaptive management actions, and criteria that, when achieved, indicate that ecological objectives of the habitat enhancement and management actions have been achieved.

Baseline ecological conditions will be determined through results of baseline surveys conducted for each parcel as described in Section 7.2.3.2.1, *Baseline Ecological Surveys*. Additional surveys may be required if the necessary baseline variable conditions were not adequately assessed in baseline ecological surveys. Depending on the type of habitat enhancement and management actions to be undertaken, BCAG may also need to collect information necessary to evaluate the likely effects of historical land use practices (e.g., grazing regimes) on historical and current site conditions. Specified attributes for each type of enhancement and management action will be measured for and compared to the baseline ecological conditions to determine the effectiveness of the actions. Monitoring results will provide BCAG with information necessary to make project-level adaptive management adjustments in the implementation of subsequent habitat enhancement and management actions (see Section 7.3). The intensity of monitoring required is expected to change over the BRCP implementation period for the reasons described above for monitoring of restored habitats.

7.2.3.2.4 Species-Level Monitoring

Species-level monitoring includes actions to monitor the status and trends in the abundance and production of covered species on BRCP conservation lands over time. Species-level monitoring actions are presented in Table 7–4. Species-level monitoring focuses on monitoring covered and other native species for which specific types of data regarding their status are not collected

through landscape- and natural community–level monitoring actions (e.g., year over year trends in fledging success of Swainson's hawk nest sites on BRCP conservation lands). Results of species-level monitoring actions will be evaluated by BCAG to determine if adjustments in ongoing enhancement of management of conservation lands are required to maintain and improve the status covered species.

BCAG will implement periodic standardized surveys to determine the abundance and use of habitats of covered species on BRCP conservation lands over the term of the BRCP (Table 7–4). The purpose of this monitoring is to provide BCAG with information necessary to detect unanticipated and undesirable changes in the distribution and abundance of covered species that may warrant adjustments in BRCP implementation to better conserve the covered species. Based on the precision of monitoring results, BCAG may conduct additional monitoring beyond what is indicated in Table 7–4 to improve the precision and the understanding of monitoring results.

7.2.4 Monitoring Plan Content and Schedule

BCAG will prepare a detailed monitoring plan for implementing the types of monitoring and surveys described in Section 5.2.3, *Assembly of Conservation Lands*. The monitoring plan will be finalized within 18 months of issuance of Endangered Species Act (ESA) and NCCP permits. The monitoring plan will describe survey protocols and other monitoring methods for applicable monitoring actions in Tables 7–1 through 7–4 and the inter- and intra-year schedule for conducting such surveys and other monitoring actions. BCAG will develop and will incorporate site-specific monitoring requirements that are consistent with the overall monitoring plan into BRCP conservation land management plans as the conservation lands addressed by each of the management plans are acquired as described in CM5 (Section 5.4.2.2, *Enhance Protected Natural Communities for Covered Species*). All elements of the monitoring plan will be subject to change through the BRCP adaptive management decision making process (see Section 7.3) as new information is acquired during implementation.

Monitoring plan protocols will be science-based, ensuring that results are repeatable and that data has minimal bias and variance. Monitored units must reflect the units of the corresponding biological objective; if the objective is numerical (e.g., number of individuals) the monitoring program must likewise measure progress numerically. Monitoring must be based on established and accepted scientific principles.

The monitoring plan will include the following information:

- Description of the purpose and objectives of each monitoring action (e.g., assessing progress towards achieving a biological objective);
- Description of monitoring protocols, including sampling design and justification supporting the validity of monitoring methods and sampling design;

- Monitoring data storage procedures;
- Analytical and statistical methods for assessing monitoring results;
- Procedures for validating monitoring data and methods;
- Monitoring schedule, duration, and rationale;
- Content requirements and submission schedule for monitoring reports;
- References, including printed references and personal communications;
- Provisions for documenting subsequent revisions to the monitoring plan;
- Other information pertinent to specific monitoring plans; and
- Date the monitoring plan was prepared and dates of subsequent revisions.

BCAG will provide for internal science-based review of monitoring plans and external science review as appropriate. Internal review of draft monitoring plans will be conducted by individuals with relevant expertise in biological and physical sciences, scientific method, habitat restoration design and engineering, and resource management, as appropriate to the monitoring topic. The review will ensure that methods and approaches are valid and well documented and that they will achieve their intended objectives.

The monitoring element of individual BRCP conservation land management plans will describe the monitoring requirements for the lands covered under each plan, including:

- the biological goals and objectives applicable to the subject conservation lands,
- A description of the specific monitoring actions applicable to the subject conservation lands, and
- A description of the monitoring protocols, analytical methods, and schedule in the BRCP monitoring plan that are applicable to the subject conservation lands and any specified deviations from the monitoring plan.

7.2.5 Post-BRCP Permit Monitoring Requirements

Following the 50-year term of BRCP permits, BCAG will need to continue to conduct monitoring, though at a reduced scale from that required during the term of BRCP permits. Monitoring actions that will be implemented during the post-BRCP permit period include:

- Monitoring the development of habitat enhancement and restoration actions that are implemented towards the end of the BRCP permit period for which ongoing monitoring is necessary to document restoration success (see monitoring actions NCM3-7 and NCM10 in Table 7–3; and SLM1, 2, and 5-10 in Table 7–4).

- Monitoring of nonnative species on BRCP conservation lands to determine if control actions need to be implemented to maintain covered species habitat functions (see monitoring actions NCM8 in Table 7–3).
- Monitoring of ecological responses to substantial changes in management (e.g., grazing regimes) of BRCP conservation lands implemented during the post-permit period (see monitoring actions NCM1 and NCM2 in Table 7–3).
- Monitoring necessary to document the status and trends in natural communities and covered species and their habitats on BRCP conservation lands at 10 year intervals to determine to the ongoing effectiveness of the Conservation Lands System management in maintaining ecological functions (see monitoring actions NCM9 [provides for 5 year monitoring intervals during the BRCP permit period] in Table 7–3 and SLM1 in Table 7–4 [provides for 5 year monitoring intervals during the BRCP permit period]).

7.3 ADAPTIVE MANAGEMENT PLAN

The BRCP adaptive management process is consistent with the guidance for adaptive management provided in the USFWS's and NMFS's Five-Point Policy for HCPs[10], the NCCPA[11], and the U.S. Department of the Interior Applications Guide for Adaptive Management (Williams and Brown 2012). The USFWS and NMFS Five-Point Policy broadly defines adaptive management "…as a method for examining alternative strategies for meeting measurable biological goals and objectives, and then if necessary, adjusting future conservation management actions according to what is learned" and the NCCPA defines adaptive management as "…to use the results of new information gathered through the monitoring program of the plan and from other sources to adjust management strategies and practices to assist in providing for the conservation of covered species." NCCP's must include both a monitoring program and an adaptive management program[12] and also must provide for periodically reviewed adaptive management strategies subject to the results of monitoring efforts and other sources of new information.[13]

The conservation measures described in Section 5.4 were developed based on the best scientific and commercially available information and, as crafted, provide BCAG with a road map for initial implementation of the Conservation Strategy. The conservation measures are directed primarily towards the protection, enhancement, and restoration of natural communities and the covered species habitats they support. There is a relatively high certainty regarding the effectiveness of protecting existing, functioning natural communities and associated covered species habitat for effectively conserving covered species, though the specific size and configuration of the BRCP conservation land system will be tested during BRCP implementation and may require adaptive management adjustments. The adaptive management approach is

[10] 65 FR 106, June 1, 2000.
[11] California Fish and Game Code sections 2800-2835.
[12] California Fish and Game Code Section 2820[7] and [8].
[13] California Fish and Game Code Section 2820[a][2].

focused on addressing conservation actions with greater uncertainty of effectiveness; such conservation actions include habitat enhancement, restoration, and management techniques for achieving the applicable biological goals and objectives.

A key issue in adaptively managing the BRCP is the recognition and measurement of success of conservation measures. The BRCP adaptive management framework provides a learning-based decision process which ensures that progress is made toward achieving BRCP biological goals and objectives. Over the term of the BRCP, it is anticipated that ongoing modifications to implementation of the Conservation Strategy will be needed as new information is developed that addresses the uncertainties regarding the nature and magnitude of the response of covered species to habitat enhancement, restoration, and management techniques as well as the potential for substantially altered future conditions that may result from climate change (e.g., change in the hydrology of Plan Area watersheds, temporal shifts in the wet season, change in wildfire risk). Consequently, the adaptive management process is a keystone element of BRCP implementation, providing BCAG with the flexibility necessary to modify BRCP implementation to address uncertainties as the knowledge base regarding ecological processes, natural communities, and covered species is expanded. As such, the adaptive management process provides BCAG with the ability to modify conservation measures, implementation techniques, and monitoring elements (e.g., monitoring protocols, attributes and attribute criteria, and metrics) of the Conservation Strategy as indicated by new information that will be gathered over the term of the BRCP to improve their effectiveness. This new information will come from the results of BCAG's monitoring and directed studies and from monitoring and research data from other entities.

Elements of the BRCP subject to the adaptive management process include all program aspects related to implementation of conservation measures and the monitoring program. Deed restrictions specified in conservation easements are not subject to adaptive management and thus cannot be altered, changed or otherwise modified without mutual agreement of the landowner and easement holder and subsequent recordation of amendments to the easement deed.

Implementation elements of conservation measures subject to adaptive management include the following:

- Habitat restoration design and implementation methods;
- Habitat management tools and techniques;
- Changes to, discontinuation of, and addition of conservation measures;
- Shifting of implementation funds among conservation measures;
- Land acquisition criteria and conservation land assembly principles; and
- Directed studies and adaptive management conducted to inform implementation.

Implementation elements of the monitoring program subject to adaptive management include the following:

- The subjects of monitoring;
- Duration and scope of monitoring;
- Monitoring methods, metrics, and attribute criteria; and
- Analytical tools and methods.

In addition to providing BCAG with a process to better ensure effective BRCP implementation, outcomes of applying the adaptive management process are anticipated to be an important factor in BCAG's annual and long-term budgeting and funding decision-making processes.

7.3.1 Adaptive Management Decision-Making

The adaptive management process will be administered by BCAG and will operate at two levels: project-level and plan-level adaptive management. The adaptive management decision-making process for each level is illustrated in Figure 7–2, *Adaptive Management Decision Making Process* (see separate file).

A key decision point is the determination if an adaptive management response is at the project-level or the plan-level as defined below. Adaptive management roles and responsibilities among BCAG, the Permitting Agencies, and stakeholders are described in Chapter 9, *Implementation Structure*.

7.3.1.1 Project-Level Adaptive Management

Project-level adaptive management provides for ongoing adjustments in the implementation of the conservation measures and minor adjustments to the monitoring plan (e.g., improvements in monitoring techniques) by BCAG. Adaptive management responses considered to be project-level include small adjustments to techniques used to manage, enhance, and restore habitat.

Project-level adaptive management will not require participation or concurrence by the Permitting Agencies. Such adjustments will be described in BCAG's annual report (see reporting requirements in Chapter 8, *Plan Implementation*) and the USFWS, NMFS, and CDFW may provide input on those adjustments following review of the report. BCAG may choose to coordinate with the USFWS, NMFS, and CDFW at the project-level to better inform its adaptive management decision-making.

Project-level adaptive decision-making will apply to all aspects of implementing conservation measures that do not change the commitments described in the conservation measure and that do not increase costs beyond the level of funding appropriated for the conservation measure. For example, under the project-level adaptive management process, BCAG could modify methods for conducting a conservation measure based on new information indicating that doing so would

improve its effectiveness. Changes by BCAG to the monitoring plan would include adjusting monitoring protocols to improve their effectiveness or to comply with new monitoring standards established by the USFWS, NMFS, and CDFW (e.g., the establishment of new species-specific monitoring protocols). The purpose of the project-level adaptive management process is to provide for timely and effective implementation decision-making by BCAG.

7.3.1.2 Plan-Level Adaptive Management

Plan-level adaptive management provides for large adjustments to the Conservation Strategy, including:

- Revisions to conservation measures, including removal from the Conservation Strategy;
- The addition of new conservation measures to the Conservation Strategy;
- Shifting of emphasis among conservation measures, changes in acreage targets, or other elements of the Conservation Strategy (i.e., adaptive management and monitoring);
- Changes in the required schedule of implementation; and
- Major modifications to the monitoring plan, including discontinuing a monitoring effort, changing monitoring metrics, and adding new monitoring efforts.

All plan-level adaptive management changes require participation and approval from the USFWS, NMFS, and CDFW. Some plan-level adaptive management changes may involve major changes in BRCP commitments and may require a formal amendment to implement (see Section 8.6.4, *Formal Amendments*). Plan-level changes are not expected to be common over the term of the BRCP, but the process provides BCAG with the flexibility to implement such changes if needed to ensure that biological goals and objectives are achieved.

7.3.2 Adaptive Management Process Framework

Adaptive management is a decision-making process promoting flexible management by adjusting management actions in response to knowledge gained and changed conditions. The BRCP adaptive management process framework is illustrated in Figure 7–3, *Natural Community-Level Monitoring Actions and Example Monitoring Approaches and Metrics*. Monitoring the results of ecosystem and habitat management is at the heart of the adaptive decision making process. Generally, monitoring results provide both practical knowledge ("did it work") and scientific understanding ("why did it not work"). At its core, adaptive management is an experimental approach in which observations recorded through monitoring are used to update, revise, and adjust hypotheses and conceptual models of the managed system. The integration of monitoring into the adaptive management process requires a close attention to data quality, standardization, sampling designs, statistical methods, and the ongoing training of key personnel. Adaptive management tasks include the following.

- Regular evaluation and updates to improve the efficacy of monitoring protocols based on implementation experience and testing of new methods.
- Ongoing incorporation of the best available scientific information into management (see Section 7.2, *Monitoring Program*, on scientific principles and data management) based on regular reviews of literature and interaction with experts to ensure that new understanding of the covered species and monitoring approaches is incorporated into implementation.
- Regular evaluation of and refinements to conceptual models (e.g., species habitat models; see Section 7.2.2.5, *Management-Oriented Conceptual Models*) based on the availability of new information.
- Scheduled reviews of monitoring and directed studies that may be undertaken by the BRCP to revise hypotheses or expectations.
- Adjusting implementation of conservation measures or adoption of new conservation measures to be more effective in achieving the biological goals and objectives based on new information.
- Periodic evaluation of and adjustments to habitat enhancement and restoration attributes and criteria (see Section 7.2.3, *Monitoring and Survey Requirements*) if they have been determined to be ineffective measures or indicators of success.

7.3.2.1 BRCP Objectives and the Knowledge Base

The starting point for the adaptive management process is the hypotheses that underlie the biological goals and objectives and the conservation measures. These hypotheses are a reflection of the existing ecological knowledge base. The knowledge base is the totality of current scientific understanding of the ecological and biological processes and conditions of species and natural communities in the Plan Area (see large shaded box underlying the right side of Figure 7-3). The existing knowledge base supported the development of the Conservation Strategy, including the biological goals and objectives, conservation measures, conservation metrics and targets, and monitoring actions. Information and analysis derived through monitoring and directed studies conducted under the BRCP (Section 7.2) and other programs will supplement and expand the knowledge base over the term of BRCP implementation.

7.3.2.2 Collect and Manage Data

Critical to the adaptive management process is the collection and management of data (Figure 7-3, Box 1) to assess conservation measure performance and the achievement of biological goals and objectives. Data collection and management will be conducted through implementation of the monitoring plan (Section 7.2) and any directed studies undertaken by BCAG (see Section 7.3.5, *Directed Studies*) following the initial implementation of conservation measures. Monitoring requirements are described in Section 7.2. In addition, results of directed studies conducted under the BRCP or by other entities will contribute to the knowledge base to

support understanding of ecological cause-and-effect relationships. Monitoring data and directed studies results will provide BCAG with information to help determine the effectiveness of conservation measures in providing benefits to species and habitats, including the effectiveness of habitat enhancement, restoration, and management actions. Decisions by BCAG to modify implementation of conservation measures will be guided by information gathered through the monitoring plan and other research sources. The monitoring plan is designed to discern apparent cause and effect relationships between implementation of specific conservation actions and the type and magnitude of species responses to those actions.

7.3.2.3 Analyze Data, Assimilate Information, and Develop and Recommend Adjustments to Implementation.

Monitoring data will be analyzed, synthesized, and evaluated to determine if adaptive management thresholds established for key ecological attributes (see Section 7.2.3.2, *Effectiveness Monitoring*) have been exceeded, thus triggering implementation of adaptive management actions. Analysis of data will also inform BCAG of the cause and effect relationships between conservation measures and ecological processes, covered species, and natural communities; the status of ecosystem conditions and covered species; and the effectiveness of the conservation measures and the monitoring program (Figure 7-3, Box 2). Information gained through the analytical process may indicate the need to redefine hypotheses underlying biological objectives and conservation measures; refine, discontinue, or expand conservation measures; or develop and implement new conservation measures within limits set by the BRCP and its associated regulatory authorizations. New data and analytical results will also be used to update models (e.g., conceptual, statistical, and process models) and other analytical tools that may be used to assess the performance of conservation measures in achieving the biological goals and objectives. Based on assimilation of new information, BCAG will formulate new approaches for implementation to improve its effectiveness in achieving the biological objectives (Figure 7-3, Box 4). These new approaches would then be routed through the adaptive management decision-making process (illustrated in Figure 7-2; Box 3).

7.3.2.4 Follow a Decision-Making Process

BCAG will follow a defined decision-making process before making significant adaptive management changes (Figure 7-3, Box 5). This adaptive management decision-making process is illustrated in Figure 7-2.

7.3.2.5 Implement Modified Conservation Measures, Tools, Metrics, and Targets

Outcomes of the adaptive management decision-making process can include, within the limits set by authorizing permits, changes to conservation measures, the monitoring program, analytical tools, metrics, and targets as indicated in Figure 7-2, Boxes 6-11.

7.3.3 Internal Scientific Review and Implementation of Changes

BCAG will establish an internal process of review by technical experts within BCAG or retained (e.g., biologists, restoration ecologists, physical scientists, habitat managers) to regularly assess the results of effectiveness monitoring, the selection of directed studies, the appropriateness of analytical tools and techniques, and the relevance of new scientific information developed by others (e.g., universities). These reviews will be used to determine whether changes in the implementation of the conservation measures and the monitoring program would be desirable to improve effectiveness of the BRCP in achieving biological goals and objectives (Figure 7–2, Box 2a). BCAG may also request the assistance of the USFWS, NMFS, and CDFW and knowledgeable outside scientists and experts in the review process (Figure 7–2, Box 2b).

Recommendations made through the internal science review process will be documented and will include a description of the recommended change in implementation; a description of the justification for the recommended change; an assessment of effects the change may have on other elements of BRCP implementation, if any; and any other relevant information in support of the recommendation. Recommendations adopted by BCAG will be described in BCAG's annual work plan (see Section 8.2, *Compliance and Progress Reporting Requirements*). BCAG will document the rationale for rejection of adaptive management recommendations made through the internal science review process.

7.3.4 External Independent Scientific Review

BCAG will from time to time seek additional science input on specific adaptive management-related issues. BCAG may convene, at its discretion, experts in selected topic that are not affiliated with BCAG, Permittees, or USFWS, NMFS, and CDFW (Figure 7–2, Box 2b).

7.3.5 Directed Studies

BCAG may identify the need for and undertake adaptive management actions, such as pilot habitat restoration projects to test restoration methods, as needed over the term of the BRCP. These actions would be implemented to provide information necessary to help inform subsequent implementation of conservation measures. The types of directed studies that may be conducted include those related to resolving BRCP-specific uncertainties related to:

- Technologies and methods for effectively implementing conservation measures;
- The ecological requirements of covered species as they relate to effective implementation of conservation measures; and
- The likely response of covered species to conservation measures.

Results of directed studies would also be used to help direct and prioritize subsequent implementation of conservation measures.

Potential study needs identified in the course of BRCP development include conducting investigations necessary to:

- Develop effective methods for successfully establishing new occurrences of rare covered plant species, including Butte County meadowfoam, veiny monardella, and other covered vernal pool plant species;
- Develop livestock grazing regimes on BRCP conservation lands that promote the establishment and increase the abundance and vigor of existing occurrences of covered plant species and improve habitat conditions for covered wildlife species; and
- Develop appropriate waterfowl habitat management practices to maintain and enhance known occurrences of Ferris' milkvetch and lesser saltscale.

Additional study needs are expected to be identified by BCAG over the term of BRCP implementation.

7.3.6 Program Status Reviews

BCAG will conduct program-wide status reviews of BRCP implementation at five-year intervals over the term of BRCP implementation. The level of effort required to conduct each status review, however, will vary with the degree of change in Plan Area conditions, availability of new information relevant to BRCP implementation, and other factors that could affect implementation procedures over the course of the review period. The purpose of these status reviews is to provide BCAG with a methodical process to periodically evaluate its BRCP implementation procedures. Results of program status reviews will be used to adjust implementation procedures and approaches to species conservation through the adaptive management decision-making process if needed. Status reviews will also include evaluations to determine if implementation procedures (e.g., monitoring protocols) require updating based on the best available information and regional assessments of the status of covered species to determine if their status has changed sufficiently to affect their conservation needs.

BRCP implementation elements subject to status reviews include, but are not limited, to the following:

- The monitoring plan (see Section 7.2);
- Conservation land management plans, including habitat enhancement and management prescriptions;
- Directed studies;
- Approaches to habitat restoration;
- Guidelines for screening and evaluating lands under consideration for protection;

- Funding levels and sources (see Chapter 10, *Implementation Costs and Funding Sources*); and
- GIS and database structure, software, documentation, user manuals, and other elements of BCAG's data management system.

BCAG will prepare a document summarizing review results and recommending corrective actions and schedules for their implementation. Recommended corrective actions will be coordinated with the Permittees, USFWS, NMFS, and CDFW as appropriate.