

ECOLOGICAL MONITORING PLAN
DINKEY LANDSCAPE RESTORATION PROJECT
 Recommended to Sierra National Forest on November 21, 2013

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1.0 Introduction

This document describes the long-term monitoring program of the Dinkey Landscape Restoration Project (DLRP). It explains the goals, principles, organizational structure, and

monitoring approach of the DLRP project. It was developed by the members of the DLRP Monitoring Work Group during the years 2011, 2012 & 2013 and represents a common vision for evaluating and improving forest restoration efforts in the Dinkey Landscape. The document is organized around the objectives of the Collaborative Forest Landscape Restoration Program (CFLRP) and Dinkey Collaborative in support of forest restoration in the region.

The primary role of monitoring on the Dinkey landscape is to determine the effectiveness of forest restoration efforts in achieving goals and desired conditions on the landscape. Monitoring informs land management decision-making through adaptive learning and communication, with the goal of achieving ecological restoration objectives with minimal impact to values at risk. Goals for ecological, social, and economic monitoring for the DLRP were articulated both within CFLRP and the Dinkey Collaborative Forest Landscape Restoration Program Proposal (see http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5351833.pdf for original proposal). Using the Program Proposal as a guide, the Monitoring Work Group identified five major goal areas for monitoring over the 10-year life of the DLRP: biodiversity of plants and animals, fire and fuel dynamics, soil and water quality, economic impacts, and social implications. An important interest of the DLRP is to identify the effectiveness of various forest treatments in achieving restoration objectives at a landscape scale.

2.0 CFLRP/Dinkey Background and Goals

Congress established the Collaborative Forest Landscape Restoration Program (CFLRP) under Title IV of the Omnibus Public Lands Act of 2009. The purpose of the CFLRP is to encourage the collaborative, science-based ecosystem restoration of priority forest landscapes within the National Forest System of the USDA Forest Service. The primary goals of the CFLRP are to:

- reduce the risk of uncharacteristic wildfire, including through the use of fire for ecological restoration and maintenance and reestablishing natural fire regimes, where appropriate;
- improve fish and wildlife habitat, especially for endangered, threatened, and sensitive species;
- maintain or improve water quality and watershed function;
- prevent, remediate, or control invasions of exotic species;
- maintain, decommission, and rehabilitate roads and trails;
- use woody biomass and small-diameter trees produced from projects implementing the strategy;
- fully maintain or contribute toward the restoration of the structure and composition of old growth stands according to the pre-fire suppression old growth conditions characteristic of the forest type;
- benefit local economies by providing local employment or training opportunities through contracts, grants, or agreements for restoration planning, design, implementation, or monitoring.

A national competition was held to identify ten representative landscapes across the nation where restoration activities would take place over a 10-year period from 2010-2019. The Sierra National Forest and the Dinkey Planning Forum (now the Dinkey Collaborative) was awarded a Collaborative Forest Landscape Restoration Program grant in 2010. The Dinkey Collaborative Forest Landscape Restoration Program Proposal addressed each of the stated goals of the CFLRP and identified appropriate activities specific to the region for forest restoration. The proposal was selected for funding by the Forest Service after review by the CFLRP Resource Advisory Committee (RAC). Beginning in the summer of 2010, the Collaborative initiated plans to implement forest restoration treatments, as well as, an integrated monitoring program to evaluate the effectiveness of CFLRP activities. The Dinkey Collaborative agreed early in the proposal development phase of the CFLRP that monitoring the effects of forest treatments was a high priority for the project and established a Monitoring Work Group in January 2011. The Monitoring Work Group recommended that at least 10% of each year's allocation of CFLRP resources (both appropriated and matching funds) would be applied toward monitoring. CFLRP monitoring is expected to continue at least five years beyond implementation of CFLRP restoration treatments, extending the monitoring program to 2024.

2.1 Dinkey Landscape Restoration Strategy

The Dinkey Landscape Restoration Strategy (see http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5351832.pdf) is a science-based ecological restoration strategy that covers 154,000 acres in the southern Sierra Nevada within the Sierra National Forest, Pacific Southwest Region, located in Fresno County, California. The strategy is both a landscape- and stand-level approach that recognizes that fire is the dominant ecological process influencing ecosystem processes and vegetation dynamics. Coniferous forests, foothill hardwood forests, and meadows and riparian forests interact to create an integrated, fire-adapted landscape that requires a flexible and adaptive restoration strategy that promotes fire resiliency. Through the use of prescribed fire, mechanical thinning, watershed improvements (e.g., clearing and cleaning culverts, stabilizing gullies in meadows) and other restoration treatments (e.g., road restoration and decommissioning), the DLRP seeks to restore key features of diverse, fire-adapted forests. Promoting forest structural heterogeneity at multiple scales while, reducing surface and ladder fuels, and creating and maintaining terrestrial and aquatic habitats for sensitive wildlife species is the framework from which this strategy will build.

The DLRP will implement restoration treatments that are collaboratively developed to achieve multiple goals: reduce hazardous fuels; retain and promote large tree and denning/nesting and other habitat structures (e.g., canopy cover, small tree basal area, snag basal area) needed by the Pacific fisher and California spotted owl; promote stand and landscape heterogeneity; and provide sufficient natural regeneration of shade-intolerant tree species to retain fire-adapted forests into the future. The foundation of much of this DLRP restoration strategy rests upon a

Pacific Southwest Research Station General Technical Report- PSW-GTR-220 and associated PSW-GTR-237 (North et al. 2009, North 2012), as well as published research that addresses Dinkey-related issues, that provides the management direction for much of the DLRP landscape. A major goal of this restoration strategy is to provide current and future habitat for sensitive wildlife species by fostering ecosystem function and ecological resilience.

The Dinkey Landscape Restoration Strategy combined science, collaborative planning, and local knowledge into a set of treatment schedules for strategically placed mechanical, prescribed fire, and watershed restoration (Table 1):

Table 1 below describes the acres of newly treated areas by each fiscal year.

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	Totals
Mechanical Restoration (acres)	3100	0	8314	0	5964	0	7083	0	4754	0	5277	34,492
Fire Resilience pre-treatment (acres)	0	0	0	402	651	600	600	600	0	0	0	2,853
Rx Fire (acres)	3052	4541	7881	2679	4342	4000	4000	4000	4000	4000	4000	46,495
Watershed Restoration (acres)	0	5150	5150	3858	0	0	0	0	0	0	0	14,158
Road Decommissioning (miles)	0	2	0	0	0	2	0	2	2	0	0	8
Meadow Riparian Habitat Restoration (acres)	0	0	0	0	50	100	225	50	0	0	0	425
Plantation Maintenance (acres)	230	600	800	1200	900	1200	1200	1200	1200	1200	1200	10,930
Pine/Oak Regeneration (acres)	0	0	93	0	249	0	179	0	212	0	143	876
Invasive Species Eradication or Control (acres)	4	4	5	45	45	45	45	5	5	5	0	208

3.0 Ecological, Economic and Social Monitoring

As stated above, the CFLRP stipulates that CFLR Projects will “use a multiparty monitoring, evaluation, and accountability process to assess the positive or negative ecological, social, and economic effects of projects implementing a selected proposal.” The Dinkey Collaborative contracted with the Sierra Institute for Community and Environment to oversee the economic and social monitoring on the Dinkey Landscape. The Sierra Institute’s Adaptive Socioeconomic Monitoring Program (described in Appendix A) will identify social and economic issues of importance in the Dinkey Landscape area. The Sierra Institute will work with the Collaborative to develop a process using the best available science in socioeconomic monitoring and evaluation, to engage stakeholders in identifying socioeconomic indicators of conditions, stressors, and landscape management actions. In addition, the Adaptive Socioeconomic Monitoring Program will explore ways to adaptively implement socioeconomic concerns into restoration treatment and planning of the Forest Service and the Dinkey Collaborative.

The remainder of this Monitoring Plan is focused on the ecological monitoring activities of the Dinkey Collaborative. Information on the socioeconomic indicators will be included in the

Monitoring Plan upon completion of Phase I and II of the Adaptive Socioeconomic Monitoring Program.

4.0 Types of Monitoring

Monitoring the effects of treatments via multiple quantitative and repeatable measures is an essential part of landscape restoration and a core focus of an adaptive management approach (Lindenmayer et al. 2008). Monitoring of management treatments contains two major, inter-related components, 1) implementation monitoring and 2) effectiveness monitoring (DeLuca et al. 2010), both of which will be applied within the DLRP area. Although implementation monitoring and effectiveness monitoring are being treated as separate activities in this description, there is by necessity considerable overlap in monitoring activities. For example, the baseline data gathered prior to implementing forest restoration treatments will be used to provide the foundation for both types of monitoring.

4.1 Implementation monitoring

Implementation monitoring tracks project activity before, during, and after treatments to ensure that design features, best management practices, and mitigation measures are implemented as specified within thresholds set by laws, regulations, applicable standards, or critical objectives so that the activity or the project may be modified as necessary. Implementation monitoring seeks to answer questions like, “Are projects being implemented as planned?” “Are prescriptions being followed?” “Are targets being met?”

Both quantitative and qualitative approaches are used in implementation monitoring. Quantitative approaches include for example collecting data from stand exam plots after a project implementation or activities which produce metrics like basal area, canopy cover, and fuel loading on a per acre basis. Qualitative approaches often rely on professional judgment. Professional judgment is improved over time by reference to new scientific information, perspective, and summary and interpretation of quantitative data at various scales. Following well established protocols, qualitative monitoring is useful for determining general trends, spot checking that basic assumptions appear to be correct, or to aid in determining treatments which may need additional effectiveness monitoring due to unexpected outcomes. The anticipated minimum standard for qualitative monitoring is a walk-through and narrative text describing conditions relevant to the design criteria, prescriptions, constraints, and mitigation in the treatment area. Simple and quick measures of different conditions and photographs may be taken and included in the narrative.

4.2 Effectiveness monitoring

Effectiveness monitoring addresses the question of how successful a project ultimately is at restoring the forest ecosystem to the desired conditions. It measures changes in specific conditions relative to desired outcomes and seeks to answer questions like “What are the project

effects on ecological conditions?” and “Are management activities resulting in desired outcomes?” Effectiveness monitoring investigates treatment consequences, including the ancillary, unanticipated, and summative effects of management actions. Effectiveness monitoring can provide considerable added value to our understanding of the ability of forest treatments to attain restoration goals, and is the centerpiece of an adaptive management approach.

4.3 Parameters measured with effectiveness monitoring

The initial set of indicators (developed by the Dinkey Monitoring Work Group) developed to evaluate treatment effectiveness can be grouped into three overarching categories: biodiversity, fire and fuel dynamics, and soil and water effects. Multiple attributes will be monitored within each category. To gain maximum efficiencies and more robust knowledge of landscape change, the measurement of indicators will take advantage of the existing, ongoing monitoring programs already conducted by state agencies, the USFS, and other science-based organizations (e.g., university researchers) that operate in the Dinkey LRP area.

The broad category of *biodiversity* relates to a series of restoration interests, including the structure and composition of native vegetation, the interactions of biotic and abiotic factors to enhance habitats for both terrestrial and aquatic wildlife species, and the threats posed by invasive species. At the landscape level, existing vegetative mapping protocols, permanent inventory plots, and applied forest growth models will play an important role in characterizing vegetation and its trajectory based on treatment locations and relative intensities of management applications. At the stand and project level, new and original indicators specific to each vegetation type will be vital to evaluate and identify the successes of the ongoing management interventions.

Fire and fuel dynamics are of particular significance. Pre-treatment measurement of fuel distributions through remote sensing and ground-based tools will guide the selection and prioritization of treatments across the landscape. For each fuels management project, pre- and post-treatment fuel measurements will be completed. Effectiveness of these treatments at the landscape scale will be evaluated via more sophisticated tools (e.g., BehavePlus software) that examine fuel connectivity and suppression capabilities based on identified fire regimes, fire weather, and predicted/actual fire behaviors.

Soil and water effects include important considerations for sustaining watershed function and maintaining or improving aquatic, riparian, and meadow habitat quality. Monitoring activities will focus on the ability of treatments to reduce or control sediment delivery to streams and sustain both stream bank stability and soil condition. The effects of treatments, such as the decommissioning of roads, on soil and water conditions will be directly measured at the appropriate watershed scale.

5.0 Design of the Monitoring Projects

Another distinction in approaches to monitoring is that between observational and experimental methods. Observational approaches draw conclusions about treatments without the use of experimental controls or the ability to randomly allocate treatments. An experimental design approach is based on several statistically-based principles, such as randomization, replication, sampling independence, blocking, and use of scientific controls for comparison to treatment units. Meaningful insights can be gained from both approaches, although the methods and strength of the conclusions often differ considerably. A controlled experiment allows for more robust conclusions about treatment effects, especially when many other potential factors are accounted for as part of the experimental design. The Dinkey monitoring program will strive to incorporate an experimental approach grounded in sound statistical principles whenever possible, though the use of observational data may also help inform the effectiveness of forest treatments. There are a variety of constraints the monitoring data collection design will need to consider. For example, treatments will be strategically located and based primarily on fuels conditions and modeled fire behavior; therefore, only the monitoring plots can be randomized, not the treatments.

The Dinkey Collaborative recognizes that the goals of the monitoring program are not to conduct independent research, but to inform Forest Service managers about the effects of their activities under CFLRP. In this respect, monitoring directly contributes to adaptive management on the Dinkey landscape and has an interactive role to play with the actual selection and prioritization of treatments to be able to apply treatments that allow the detection of landscape change. In the long term, an integrated management design will modify treatment allocation (e.g., location, extent, and type of forest restoration treatments) to better address crucial monitoring needs in the Dinkey Landscape. This information should lead to better understanding of treatment effects within a dynamic, complex social/biophysical setting. The monitoring program will take advantage of existing agency programs and personnel while integrating new approaches and resources to address specific questions regarding forest management effectiveness at multiple scales.

6.0 Monitoring Principles

The Dinkey Monitoring Work Group and the Collaborative will strive to adhere to the following set of principles to guide monitoring:

- Clear and compelling questions – The monitoring plan should be based on specific, unambiguous questions that are of critical interest to the Dinkey Collaborative. Clear and concise questions are critical because they determine the variables to be measured, sampling design, spatiotemporal extent of data collection and analysis, and utility of the results.

- **Validity and Reliability**– To the extent practicable, the measurements taken during monitoring activities within the Dinkey Landscape will adhere to established protocols of experimental design, measurement accuracy, and analytical rigor established by the standards of science within each disciplinary area. Monitoring based on repeatable procedures resulting in quantitative data increases the strength and learning of the monitoring program. However, in some instances an experimental approach may be infeasible and observational and other alternative approaches may be required.
- **Multiparty development and execution** – The Dinkey Monitoring Plan represents a collaborative effort with input from a diverse array of stakeholders and participating organizations. Successful development and execution of the monitoring plan will depend on continued commitment to collaborative monitoring that incorporates both USFS and non-USFS monitoring sources.
- **Replication and experimental controls** – Treatments will be replicated within and across ecological sites to facilitate greater learning about treatment effects. Untreated control sites will be an important component of monitoring and the evaluation of treatment effectiveness. When feasible, sufficient pre-treatment baseline data will be collected on all monitoring projects.
- **Geospatial identification** – Monitoring data will be spatially referenced for specific on-the-ground actions, and where feasible, measured sites will be permanently marked to facilitate accurate re-measurement of monitoring indicators.
- **Integration of monitoring and treatment design** – CFLRP stresses adaptive management as a vital part of assessing projects at the local and landscape scales. Moreover, monitoring builds trust among the collaborative group and the public. Consequently, the incorporation of monitoring designs and information should be considered fundamental to the planning and modification of ecological restoration treatments. For example, to encourage adaptive management and collaborative learning it would be ideal to design restoration treatments under an experimental framework (replication) rather than an opportunistic approach based on unreplicated observations.
- **Transparency and accessibility** – All data collected from Dinkey LRP actions will be made publicly available and accessible to stakeholders using an online data portal or other information system. The justification of future actions depends on open review, analysis, and input by all interested parties.
- **Integration** – The data collected during monitoring activities will be incorporated into Forest Service corporate databases, where possible, and applied to other examinations and analyses that support resource management by private landowners and state and local governments. Forest Service corporate data will be used to address monitoring questions when relevant and available.

7.0 Monitoring Program Coordination

7.1 Role of Monitoring Work Group

The Dinkey Monitoring Work Group was established as a subgroup of the Dinkey Collaborative. The Monitoring Work Group is an open, voluntary group, comprised of experts in a range of subjects and includes agency personnel, industry and NGO staff, and community members. The Monitoring Work Group makes recommendations to the Collaborative on potential monitoring actions which may then be forwarded to the Sierra National Forest. The Forest Service makes the final decisions on the allocation of financial resources and maintains full responsibility for completing projects based on agency work in combination with contracting and grants/agreements procedures. The process to make decisions on monitoring priorities and operations is based on a close relationship between Forest Service line officers, National Forest staff, the Monitoring Work Group, and the Collaborative. It has been the practice and will continue to be the intention of the Monitoring Work Group to work in conjunction with technical counterparts within the Forest Service to develop monitoring projects, measurement protocols, and monitoring responsibilities.

The Monitoring Work Group is co-chaired by a Forest Service representative and a non-agency participant. The Monitoring Work Group and the Collaborative identified the need to assign responsibility for the organization, reporting, data assembly, and maintenance of data integrity to a designated staff person, hired specifically to coordinate monitoring activities. Consequently, a Monitoring Coordinator (half-time) was hired to support the work of the Monitoring Work Group. The Monitoring Coordinator position was established through a Challenge Cost Share Agreement between The Wilderness Society and the Sierra National Forest. The Monitoring Coordinator will work as a consultant for The Wilderness Society.

7.2 Multi-party monitoring and public engagement

The CFLRP specifically requires a multi-party monitoring program. While all monitoring is about learning, in a multiparty monitoring process, stakeholders with different backgrounds and perspectives learn together, develop a better understanding of each other's viewpoints, and build trust in each other and in specific management activities (Moote 2011). This can allow projects to move forward when there is uncertainty about potential outcomes and hopefully reduce longstanding conflicts. The benefits of a multiparty monitoring approach are (Moote 2011):

- Provide a way to develop and answer questions by engaging people with diverse perspectives,
- Promote mutual learning and build trust among participants,
- Help build positive relationships and prevent potential conflicts,
- Facilitate project implementation under uncertainty,
- Leverage the expertise and capacity of resources outside the Forest Service, and
- Provide educational experiences on forest restoration for local citizens.

The Dinkey Monitoring Work Group is fortunate to have multiple partners that bring significant expertise on forest restoration to the program (Table 2). The involvement of these various groups will leverage Forest Service resources with additional monitoring knowledge, data, intellectual diversity, and matching funds required by CFLRP. They will also ensure a fair assessment of restoration success.

Table 2. Monitoring Work Group Partners

US Forest Service
Pacific Southwest Research Station
Sierra National Forest
Region 5 Ecology Program
Region 5 Remote Sensing Lab
Academia
UC Merced -- Sierra Nevada Research Institute
University of Washington
NGOs
Sierra Forest Legacy
The Wilderness Society
Defenders of Wildlife
Center for Biological Diversity
Sierra Club
California 4 Wheel Drive Clubs
Stewards of the Sierra National Forest
Place-based organizations
Terra Bella Mill
Southern California Edison
Highway 168 Fire Safe Council
North Fork Mono Tribe
Other federal, state, and local agencies
California Department of Fish and Wildlife
Yosemite Sequoia Resource Conservation & Development
US Fish and Wildlife Service
Sierra Nevada Conservancy
Local Landowners

7.3 Citizen-science

The practical implications of the collection of multiple forms of information will require the contributions of many people who reside or work in the Dinkey LRP area. In addition to the

current USFS data collection, we intend to develop additional monitoring support through collaboration with existing educational institutions in the area, including local high schools and students at nearby UC Merced and Fresno State University. Our goal is to create a team of well-distributed volunteers to collect several of the straightforward measures of treatment effects. Although these students will require training and direct oversight during data collection operations involving the monitoring program, there are a series of straightforward indicators that are highly amenable to “citizen-science” data collection. Other teams will utilize trained professionals from the USFS, state agencies, and non-governmental organizations to conduct measurements.

7.4 Reporting of results

The Monitoring Work Group will provide regular updates to the Collaborative and will coordinate with the Dinkey Communications Work Group to maintain current information on the Dinkey LRP webpage. Links to the monitoring data, analysis, and work plans will be publically available via a web link from the main Dinkey LRP webpage. In addition, the Monitoring Work Group will host public educational events (e.g., field trips), to provide opportunity for citizen commentary, deliberation, and learning regarding the effectiveness of forest treatments and monitoring.

7.41 Annual and periodic reporting

The Collaborative Forest Landscape Restoration Program reporting requirements include an annual CFLRP report, and more extensive 5-, 10-, and 15-year reports. Data gathered for individual monitoring projects contributing to the long-term monitoring plan will be analyzed for use in producing annual reports to the Monitoring Work Group on both implementation and effectiveness monitoring activities. Monitoring progress and results will be summarized within the annual reports, but more user-friendly updates will also be provided annually on the Dinkey LRP webpage. The 5-, 10-, and 15-year reports will also include more complete analyses of the monitoring efforts across the longer period.

7.42 National Indicators

In June 2011, Forest Service Washington Office, Regional, and Forest personnel met with CFLRP partners to develop a suite of national indicators for the 5-year report to Congress. The result of this meeting was five draft indicators covering the purposes of the CFLRP. These indicators covered topics including: collaboration, leveraged funds, cost of fire suppression, ecology, and jobs/economic impacts. The leveraged funds and job/economic impacts indicators were folded into the CFLR Annual Reporting requirements for fiscal year (FY) 2012. The fire cost indicator (a tool called R-CAT), must be run in conjunction with a team of specialized modelers and economists in Region 1. This team is working on running the R-CAT tool for each CFLR and High Priority Restoration Project (HPRP), and this task will likely be completed in 2014 to 2015. The Forest Service will not be implementing the ‘collaboration’ indicator, but is

committed to continuing to gather information about community and project successes through CFLR Annual Reports.

The ecological indicator assesses the ecological outcomes of CFLR treatment on the landscapes in a way that is relevant to the individual collaborative groups and their specific desired conditions, while also allowing for a national summary for the 5-year report to Congress (Appendix B). The Dinkey Monitoring Work Group will focus primarily on: 1) the national ecological indicators for the 5-year report to congress, and 2) ecological indicators of significant concern to the members of the Dinkey Collaborative.

7.43 Data management and access

The Monitoring Work Group determined that the integration of data and the archiving of information over the long-term would require a stable, institutional home to sustain quality control, public accessibility, and analytical support. The Sierra National Forest is cooperating with the Monitoring Work Group to provide this service. Details of the project are currently under development.

8.0 Monitoring Funding

A funding estimate for each fiscal year (2010 to 2020) is provided in the Dinkey LRP Program Proposal of 2010. http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5351833.pdf Each annual funding estimate includes a funding table and/or a brief narrative of funding category, matching funds, and the Collaborative Forest Landscape Restoration Program (CFLRP) request for each fiscal year. The Dinkey LRP requested \$15.1 million over the 10 year period of the project. This request includes \$13.4 million for implementation and \$1.7 million for monitoring in years 2010 to 2020. Total matching funds for the 10 year period are \$18 million. The largest matching funds come from Pacific fisher and California spotted owl implementation monitoring (\$7 million) and mill infrastructure restoration support (cost avoidance) (\$4.4 million). The Pacific fisher and California spotted owl monitoring funding estimates are displayed for each year beginning on page 24 (page 3 of "Funding Estimate") of the Dinkey LRP Program Proposal. The line item identified as "Other (specify)" is the funding estimate for the fisher and owl monitoring. Additionally, Southern California Edison (\$220,000) and Sierra Forest Legacy (\$330,000) committed private matching funds for implementation monitoring of \$.55 million over the ten year planning period.

9.0 Monitoring Questions and Indicators

Effective long-term monitoring is a question-driven process. To acquire meaningful information, however, good questions must be scientifically tractable and linked to objectives and desired conditions from which to measure progress toward restoration. The Monitoring Work Group endeavored to achieve this end by formulating questions to evaluate achievement of the goals

and objectives stated in FLRP and the Dinkey Collaborative Landscape Restoration Strategy. The goals, objectives and questions were grouped into three overarching categories: biodiversity, fire and fuel dynamics, and soil and water effects. The Monitoring Workgroup, with input from subject area experts, developed a set of initial questions based on the objectives, as well as monitoring indicators to be used to answer the questions. Sampling designs and methods for data collection and analysis were then developed. The Monitoring Work Group used a matrix format to develop a framework for displaying this information (see Ecological Monitoring Matrix Section 12.0) in a summary fashion.

10.0 Use of Monitoring to Inform Management and Planning

Decisions for actions on National Forest lands are the responsibility of the Forest Service line-officers, fulfilling public objectives as designated by Congress and the federal administration. The National Environmental Policy Act (NEPA) provides a process for all citizens to inform and comment on proposed actions before their implementation. The Dinkey Collaborative, an open, voluntary organization that contains diverse participants (from both the Dinkey landscape area and from communities outside the landscape area), provides input prior to and during the NEPA process with the purpose of realizing the goals identified in the Forest Landscape Restoration Act. The monitoring program of the Dinkey LRP is designed to monitor forest treatments conducted using CFLRP and matching funds to determine their impacts on forest resources and their effectiveness in moving towards desired conditions. The results of the monitoring program will be used within an adaptive management framework to inform the planning of future management activities.

10.1 Adaptive management

The complexity and interconnectedness of ecological systems, combined with technological and financial limitations, makes a complete understanding of all the components and linkages associated with forest ecosystems virtually impossible. Consequently, planning and implementing forest restoration is fraught with a great deal of uncertainty. Because management outcomes cannot be assured where there is high uncertainty, public land managers are employing the process of adaptive management which provides for continually adjusting management in response to new information, knowledge, or technologies (Bormann et al. 2007, Holling 1978, Waters 1986). Variability and uncertainty in ecosystem dynamics mean that management actions must be flexible and adaptable to new data and new theories that further our understanding of how nature works. The basis for an adaptive management approach is that since we do not always know what will happen when we apply a treatment to an area, we must monitor ecosystem response and assess whether goals were, in fact, met by the treatment or if unforeseen circumstances altered the response. Each management action is seen as an experiment to be performed, with outcomes that can be empirically assessed using various metrics or objective assessments. Essential to an adaptive management approach is the identification of management objectives that are clear and can be used to measure progress and indicate when a change in

management direction is necessary (USDI 2009). Thus, an adaptive management approach can foster higher levels of on-the-ground success in the face of unavoidable uncertainties and inevitable change.

The Dinkey FLR monitoring plan is designed to accommodate the adaptive management process by facilitating learning to reduce uncertainty. By including a clear feedback loop for communication and adaptive planning, we can connect lessons learned from monitoring directly to actual change in management actions (Nie and Schultz. 2012). Through the establishment of clear objectives and desired conditions, specific questions and indicators that measure progress toward these desired conditions, and by establishing mutually agreed upon trigger points, monitoring will provide the necessary data to determine if restoration activities are having undesired effects on the resources.

As described above, the Dinkey Monitoring Work Group identified an initial set of questions and indicators to monitor the ecological categories (biodiversity, fire and fuel dynamics, and soil and water effects). With assistance from a team of subject area experts, the Monitoring Work Group established desired conditions for each indicator as well as an undesirable result or trigger point that would lead the Dinkey Collaborative to reassess and perhaps change management actions. However, as the primary goal of adaptive management is to learn by doing (Walters and Holling 1990), we expect that thresholds and value ranges for adaptive management triggers may be adjusted over time as baselines are developed or new information is generated by this and other landscape-scale forest restoration projects.

The following considerations (University of Michigan, 2004) will be used to help guide the adaptive management process.

- What is the range of acceptable values (natural range of variation) or conditions for each indicator?
- Is there a threshold value, above or below which results are unacceptable?
- What indicator results would trigger a need to reassess management practices?
- What is the time frame for reaching the desired condition?
- What specific actions should be taken if the indicator's threshold or trigger point is exceeded?
- Who is responsible taking action?

11.0 Prioritization of Ecological Monitoring Questions

Budget uncertainty regarding the CFLR program will have a significant effect on the design, implementation, and ability of the monitoring projects to assess treatment effectiveness and inform the adaptive management process. It is anticipated that allotted funding for monitoring activities will not be adequate to pursue monitoring activities to answer all of the questions displayed in the monitoring matrix (Section 12.0). Therefore, the Monitoring Work Group

developed a prioritization process to provide guidance in making decision on budget allocations. (see Appendix C). It is anticipated that this process will be reviewed on an annual basis.

12.0 Ecological Monitoring Matrix for 2012 – 2024

The Ecological Monitoring Matrix provides a transparent framework designed to address the full range of goals and objectives identified within the Dinkey Collaborative Landscape proposal. The Monitoring Work Group developed a set of resource categories (Section 4.3) for the Dinkey LRP based on goals within the CFLRP, objectives identified in the Dinkey proposal and subsequent prioritization work, and proposed treatments to be conducted under CFLRP. For each of these objectives, the Working Group developed a series of questions to be addressed and then identified a set of corresponding monitoring indicators for each question. The Monitoring Work Group established desired conditions for each indicator and an associated adaptive management trigger point with potential for future modification based on monitoring trends. The Work Group also developed suggested sampling designs, methods for data collection and analysis, and identified the organizations responsible for potentially collecting the data. Data collection for these identified indicators will be conducted over the ten-year span of the CFLR program, and as stated in the CFLRP, out to 15 years after program initiation.

Information in the matrix will be used to guide the monitoring program as projects are developed and implemented. It is very likely that all of the monitoring questions in every category will not be used for all projects. The set of questions have been developed with consideration for both landscape and project level process. Project specific monitoring plans will be developed using questions from the matrix as the restoration treatments are implemented.

12.1 Definitions for terms in matrix

Indicator – A unit of information measured over time that documents changes in a specific condition.

Desired condition – The desired state to be achieved or progressed towards upon completion of an individual project. Since current conditions may be considerably different than historic or reference conditions, desired conditions may represent a transition state toward reference or historic conditions. Also, desired conditions may not reflect reference or historic conditions because of other management objectives (e.g., public safety, may be a higher priority) and local community concerns.

Trigger point – A predetermined value of an indicator that suggests a need to reevaluate, stop, or change management activities.¹ These trigger points should be reassessed after several years to incorporate the most recent science.

Data gathering methods – Actions taken to collect information.

¹ *Measuring Progress: An Evaluation Guide for Ecosystem and Community-Based Projects.*
www.snre.umich.edu/ecomgt/evaluation/templates.htm

Scale of analysis – Distinguishes the spatial or temporal scale for the analysis. Some monitoring information may only be relevant when collected over long periods of time or large landscapes. Some monitoring results may require aggregation with monitoring data from other studies to achieve a sample size sufficient for making inferences about treatment effects.

At what point measured -- Points in time of measurement include the following time periods: (0) during operations, (1) immediately after treatment within administrative constraints (typically <3 months following treatment), (2) first growing season following treatment (<1 year after treatment), (3) 1 to 3 years following treatment (mid-term response; whenever seems appropriate), (4) five and ten years post-treatment (long-term response), (5) simulated forest stand and fire dynamics. When possible, indicators for effectiveness monitoring will be measured prior to treatment to obtain baseline data and following treatment to evaluate their effects.

Party responsible – This is the entity which would take the lead on implementing the monitoring activity.

Burn severity classes††-- 1 = unchanged within fire perimeter, 2 = low severity, 3 = moderate severity, and 4 = burned completely at high severity. Fire severity is a **post-fire** metric that is quantified using the Composite Burn Index and Relative differenced Normalized Burn Ratio (RdNBR) developed by Miller and Thode (2007).

*V** -- This refers to a measure of the relative volume of fine sediment in a pool. The weighted mean value for a particular stream reach (V^*_w) is a sensitive indicator of a channel's response to the volume of fine sediment delivered from its watershed.

Fire Regime – The long-term fire pattern characteristic of an ecosystem described as a combination of seasonality, fire return interval, size, spatial complexity, intensity, severity, and fire type (Sugihara et al. 2006).

IMPLEMENTATION MONITORING

Questions	Indicators	Desired Condition	Trigger Point	Data Gathering Methods	Scope of Analysis	At What Point Measured	Party Responsible
Were the instructions prepared to reasonably match the approved plan?	<ul style="list-style-type: none"> • Key plan elements included in instructions • Trained marking crews, burning crews and road survey crews. 					Pre-Treatment	USFS
How well were project protocols and contract specifications followed?	<ul style="list-style-type: none"> • Tree or stump diameters • Basal area retention • Species harvested and species retained • Native seed species used for erosion control • Endemic species planted • Riparian buffers • Road bed returned to natural land contours • Erosion control actions 					After Treatment (Time Period 0 or 1)	USFS
Are target outputs being met?	<ul style="list-style-type: none"> • Acres mechanically treated • Acres treated with wildland fire (prescribed fire and managed 					Annual Report	USFS

	wildfire including variable fire severities) <ul style="list-style-type: none"> • Miles of road restored • Number of individuals trained • Volume of biomass removed • Miles of stream habitat and acres of riparian habitat restored • Number of community outreach events • Number of trees girdled (for large snag creation) 						
Were cultural resources identified and protected?	<ul style="list-style-type: none"> • Cultural resource sites identified and protected 	•		<ul style="list-style-type: none"> • Cultural resource surveys 		Pre and Post Treatment	USFS
Were BMPs implemented properly?	<ul style="list-style-type: none"> • Depends on habitat type and wildlife concerns and specific BMPs designated for a particular project 	•		<ul style="list-style-type: none"> • Best Management Practice Evaluation Program protocols. 		Post-Project (Time Period 0 or 1)	USFS
Did tree markers and contractors do their jobs correctly?	<ul style="list-style-type: none"> • Post-treatment retention of marked wildlife trees 	<ul style="list-style-type: none"> • All marked wildlife trees were retained post-treatments 	Contractor or markers consistently cutting marked trees or markers consistently mis-marking wildlife trees	<ul style="list-style-type: none"> • Wildlife Marking guidelines 	<ul style="list-style-type: none"> • Project area 	Pre and Post Treatment (Pre- did markers mark the correct trees?)	USFS and contractor

EFFECTIVENESS MONITORING

Biodiversity

Forest Structure

CFLRP Goal: Fully maintains, or contributes toward the restoration of, the structure and composition of old-growth conditions characteristic of the forest type, taking into account the contribution of the stand to landscape fire adaptation and watershed health and retaining the large trees contributing to old growth structure.

DRLP Objective: Promote old-growth or late-seral conditions consistent with the frequent fire regimes of the Sierra Nevada and provide ecosystem features resilient to changing regional climate conditions.

DRLP Objective: Restore heterogeneity and diversity in forest structure and composition.

Questions	Indicators	Desired Condition	Trigger Point	Data Gathering Methods	Scope of Analysis	At What Point Measured	Party Responsible
Do forest restoration treatments bring small trees (2"-12" DBH) closer to expected/natural conditions?	<ul style="list-style-type: none"> Tree density (# live stems/acre) by topographical position and forest type 	<p>Mixed-Conifer</p> <ul style="list-style-type: none"> Ridges and upper slope <100 trees/ acre Middle slopes <175 trees/ acre Lower slopes/Canyons <250 trees/acre <p>Yellow Pine (>50% basal area <i>Pinus</i> species)</p> <ul style="list-style-type: none"> Ridges and upper slopes < 70 trees/ acre Middle slopes < 200 trees/ acre 	Tree densities exceed desired conditions.	<ul style="list-style-type: none"> Pre –treatment Stand Exams Post-treatment stand exams FVS LiDAR 	<ul style="list-style-type: none"> Stand level Patch, plot or landscape 	<ul style="list-style-type: none"> After mechanical treatment After fire treatment 	USFS (SNF, R5 Remote Sensing Lab), outside researchers (UW)

		<ul style="list-style-type: none"> • Lower slopes/Canyons < 25 trees/ acre <p>Red fir</p> <ul style="list-style-type: none"> • Ridges and upper slopes < 150 trees/ acre • Middle slopes < 230 trees/ acre • Lower slopes/Canyons < 300 trees/acre <ul style="list-style-type: none"> • Density of small trees should be variable and could range from 0-1,000 trees/acre in patchy areas within a stand 					
Did thinning treatments retain and protect large trees?	<ul style="list-style-type: none"> • Percent reduction in density of medium (12.1 - 24" dbh) and large (>24" dbh) trees or largest diameter class following treatment 	<ul style="list-style-type: none"> • No change in density of large diameter trees • No change in density of medium diameter trees planned for retention 	<ul style="list-style-type: none"> • > 5% Decrease in density of large diameter trees • > 5% Decrease in density of medium diameter trees planned for retention 	<ul style="list-style-type: none"> • Pre –treatment Stand Exams • Post-treatment stand exams • FVS 	<ul style="list-style-type: none"> • Stand level 	<ul style="list-style-type: none"> • After treatment (Time period 3, 4) 	USFS

<p>Did forest treatments significantly alter canopy cover?</p>	<ul style="list-style-type: none"> • Percent canopy cover 	<ul style="list-style-type: none"> • Canopy cover exceeds > 40% on average across all of treated area • <30% reduction following treatment • Canopy cover exceeds > 50% in spotted owl HRCA • Meet other Standards and Guidelines in Forest Plan 	<ul style="list-style-type: none"> • Canopy cover <40% or loss exceeds > 30% reduction; • Values exceed those issued in Forest Plan Standards and Guidelines • 	<ul style="list-style-type: none"> • Stand Exams • FVS • LiDAR 	<ul style="list-style-type: none"> • Stand and landscape levels • 	<ul style="list-style-type: none"> • After treatment (Time period 3, 4) • 	<p>USFS, outside researchers (UW)</p>
<p>Did forest treatments significantly alter snag abundance of medium to large (>20" dbh) snags?</p>	<ul style="list-style-type: none"> • Snag density and basal area by size class 	<p>No change or increase in snag abundance, especially in large diameter classes</p> <p>Position on slope:</p> <p>1. Lower Slope:</p> <ul style="list-style-type: none"> • ≥ 7 snags/acre <p>2. Mid & Upper Slope & Ridge:</p> <ul style="list-style-type: none"> • ≥ 2 snags/acre <p>estimated from Lydersen & North 2010.</p>	<ul style="list-style-type: none"> • > 5% Decrease in snag abundance, especially in large diameter classes 	<ul style="list-style-type: none"> • Stand Exams • FVS • LiDAR 	<ul style="list-style-type: none"> • Stand level 	<ul style="list-style-type: none"> • After treatment (Time period 3, 4) 	<p>USFS, outside researchers (UW)</p>

<p>Did forest treatments increase the heterogeneity and abundance of habitat structures within a stand (e.g., trees within a stratum are clumped)?</p>	<ul style="list-style-type: none"> • Variance in stand height and canopy closure within stands • Tree clustering metric (Ripley's K) • Variance or CV (coefficient of variation) in dbh 	<ul style="list-style-type: none"> • Greater variance in stand height and canopy closure • Random distribution of trees at larger spatial scales (>60 m) <p>Increased variance or CV in dbh</p>	<ul style="list-style-type: none"> • No change in heterogeneity metrics within a stand following treatments • Clustered or regular distribution of trees at larger spatial scales (>60 m) <p>No change in dbh variance</p>	<ul style="list-style-type: none"> • LiDAR 	<ul style="list-style-type: none"> • Stand level (within-stand CV) • Landscape (between-stands CV) 	<ul style="list-style-type: none"> • After treatment 	<p>USFS, outside researchers (UW)</p>
<p>Did forest treatments increase tree growth rates and basal area in medium and large trees (in the long term)?</p>	<ul style="list-style-type: none"> • Percent change in annual growth increment • Change in basal area (by size class) 	<ul style="list-style-type: none"> • Greater tree growth rates in medium and large trees treated compared to untreated stands 	<ul style="list-style-type: none"> • No difference in tree growth rates between treated and untreated stands 	<ul style="list-style-type: none"> • Stand Exams 	<ul style="list-style-type: none"> • Stand level 	<p>Comparison of pre-treatment or control trees with Time 4 and 5 (basal area)</p>	<p>USFS, not currently measured</p>

Landscape Level Processes

CFLRP Goal: Fully maintains, or contributes toward the restoration of, the structure and composition of old-growth conditions characteristic of the forest type, taking into account the contribution of the stand to landscape fire adaptation and watershed health and retaining the large trees contributing to old growth structure.

DRLP Objective: Promote old-growth or late-seral conditions consistent with the frequent fire regimes of the Sierra Nevada and provide ecosystem features resilient to changing regional climate conditions.

DLRP Objective: Restore heterogeneity and diversity in forest structure and composition.

Questions	Indicators	Desired Condition	Trigger Point	Data Gathering Methods	Scope of Analysis	At What Point Measured	Party Responsible
Did restoration treatments result in greater basal area and canopy cover in canyons and slopes with north-facing aspects than ridges and slopes with south-facing aspects (especially on upper slopes)?	<ul style="list-style-type: none"> Basal area and canopy cover 	<ul style="list-style-type: none"> Basal area and canopy cover values vary according to aspect and topographic position (using PSW-GTR-220) 	<ul style="list-style-type: none"> No difference in basal area and canopy cover based on aspect and topographic position 	<ul style="list-style-type: none"> Pre–post Stand Exams vegetation assessment LiDAR 	<ul style="list-style-type: none"> Landscape scale 	<ul style="list-style-type: none"> After treatment (Time period 3, 4) 	USFS, outside researchers (UW)

<p>Did forest treatments increase structural heterogeneity among stands across the project landscape?</p>	<ul style="list-style-type: none"> • Variance in stand height and canopy cover among stands • Rumple (index of canopy heterogeneity) • Frequency in canopy gaps (>0.1 ha) • Frequency distribution in gap size 	<ul style="list-style-type: none"> • Greater variance in stand height and canopy cover • Increase in rumple index • Increased frequency of canopy gaps • Distribution of gap size varies primarily between 0.1 and 1 ha 	<ul style="list-style-type: none"> • No change in heterogeneity metrics within a stand following treatments • Decrease in degree of tree clustering following treatments • No increase in frequency of canopy gaps • Distribution of gap sizes primarily outside 0.1 to 1 ha range 	<ul style="list-style-type: none"> • Pre–post Stand Exams vegetation assessment • LiDAR 	<ul style="list-style-type: none"> • Landscape scale 	<ul style="list-style-type: none"> • After treatment (Treatment 3, 4) 	<p>USFS, outside researchers (UW)</p>
<p>Are patches of dense (as defined in Forest Plan Amendment—60% canopy cover) forest connected?</p>	<ul style="list-style-type: none"> • Connectedness metric 	<ul style="list-style-type: none"> • No decrease in connectedness 	<ul style="list-style-type: none"> • Decrease in connectedness 	<ul style="list-style-type: none"> • Fragstats • PatchMorph • LiDAR 	<ul style="list-style-type: none"> • Landscape scale 	<ul style="list-style-type: none"> • After treatment (Time period 4) 	<p>PSW</p>

Forest Composition

CFLRP Goal: Fully maintains, or contributes toward the restoration of, the structure and composition of old-growth conditions characteristic of the forest type, taking into account the contribution of the stand to landscape fire adaptation and watershed health and retaining the large trees contributing to old growth structure.

DRLP Objective: Promote old-growth or late-seral conditions consistent with the frequent fire regimes of the Sierra Nevada and provide ecosystem features resilient to changing regional climate conditions.

DRLP Objective: Restore heterogeneity and diversity in forest structure and composition.

Questions	Indicators	Desired Condition	Trigger Point	Data Gathering Methods	Scope of Analysis	At What Point Measured	Party Responsible
Did treatments retain or enhance the density and basal area of oaks in suitable vegetation types?	<ul style="list-style-type: none"> Percent reduction in density (by size class), basal area of oaks following treatment (especially >7.9" dbh) 	<ul style="list-style-type: none"> No reduction in density, basal area, of oaks (esp. >7.9" dbh) 	<ul style="list-style-type: none"> Reduction in density, basal area, of oaks 	<ul style="list-style-type: none"> Stand Exams FVS 	<ul style="list-style-type: none"> Stand level 	<ul style="list-style-type: none"> After treatment (Time period 3, 4) 	USFS
Did forest treatments reduce the density of ecologically overrepresented tree species (e.g., small diameter shade tolerant white fir and incense cedar in mixed-conifer forest)?	<ul style="list-style-type: none"> Percent reduction in density of overrepresented tree species by size class 	<ul style="list-style-type: none"> Relative decrease in over-represented species 	<ul style="list-style-type: none"> No change in relative density of overrepresented species 	<ul style="list-style-type: none"> Stand Exams FVS 	<ul style="list-style-type: none"> Stand level 	<ul style="list-style-type: none"> After treatment (Time period 3, 4) 	USFS

<p>Did forest treatments increase the density of ecologically underrepresented conifer species (e.g., shade intolerant ponderosa pine, Jeffrey pine, sugar pine in mixed-conifer forest previously dominated by these species)?</p>	<ul style="list-style-type: none"> • Percent increase in density of desirable tree species by size class 	<ul style="list-style-type: none"> • Relative increase in under-represented species 	<ul style="list-style-type: none"> • No change in relative density of underrepresented species 	<ul style="list-style-type: none"> • Stand Exams • FVS 	<ul style="list-style-type: none"> • Stand level 	<ul style="list-style-type: none"> • After treatment (Time period 3, 4) 	<p>USFS</p>
<p>Did forest treatments promote the regeneration of desirable broadleaf species (e.g., oaks, aspen, cottonwood, willow)?</p>	<ul style="list-style-type: none"> • Density of seedlings of desirable tree species (e.g., density of resprouts in aspen) 	<ul style="list-style-type: none"> • Increased density of seedlings of desirable broadleaf species 	<ul style="list-style-type: none"> • No change or decrease in density of desirable broadleaf species 	<ul style="list-style-type: none"> • Stand Exams • FVS 	<ul style="list-style-type: none"> • Stand level 	<ul style="list-style-type: none"> • After treatment (Time 3, 4) 	<p>USFS</p>

Long Term Viability of Pacific Fisher

CFLRP Goal: Improve fish and wildlife habitat, including for endangered, threatened, and sensitive species.

DLRP Objective: Create a heterogeneous forest stand structure and landscape patterns consistent with sensitive and indicator species' needs.

DLRP Objective: Maintain and restore habitat that promotes a diverse and functional assemblage of wildlife species.

DLRP Objective: Support viable populations of native wildlife in the restored landscape.

Questions	Indicators	Desired Condition	Trigger Point	Data Gathering Methods	Scope of Analysis	At What Point Measured	Party Responsible
Did fisher reproductive rates change after forest treatments?	<ul style="list-style-type: none"> Fisher annual reproductive rates 	<ul style="list-style-type: none"> Increase or no change in fisher annual reproductive rates (NRV: 70-91%/year) 	<ul style="list-style-type: none"> significantly <70% annual reproductive rate in treated areas 	<ul style="list-style-type: none"> Radio tracking of fisher Demographic study 	<ul style="list-style-type: none"> Landscape (series of treated areas) 	<ul style="list-style-type: none"> Time 1, 2, 3, 4 	PSW
Did fishers utilizing non-den buffer areas avoid them during habitat modification operations?	<ul style="list-style-type: none"> Fisher habitat use 	<ul style="list-style-type: none"> No significant change in fisher use of treated habitat 	<ul style="list-style-type: none"> fisher avoid treated habitats during operations 	<ul style="list-style-type: none"> Radio collared tracking of habitat usage GPS telemetry 	<ul style="list-style-type: none"> Treatment Unit 	<ul style="list-style-type: none"> Time 1 	PSW
Did operations related to prescribed burning in a den buffer modify the behavior of fishers occupying the affected den buffer (700 acres around den)?	<ul style="list-style-type: none"> Active denning and rearing of young 	<ul style="list-style-type: none"> No significant change in fisher use of treated habitat 	<ul style="list-style-type: none"> Site abandoned 	<ul style="list-style-type: none"> Cameras and visual observation Telemetry GPS telemetry 	<ul style="list-style-type: none"> Den buffer and actual den site 	<ul style="list-style-type: none"> During operations 	PSW
Did operations related to vegetation removal by means	<ul style="list-style-type: none"> Active denning and rearing of young 	<ul style="list-style-type: none"> No significant change in fisher use of treated habitat 	<ul style="list-style-type: none"> Site abandoned 	<ul style="list-style-type: none"> Cameras and visual observation Telemetry 	<ul style="list-style-type: none"> Den buffer and actual den site 	<ul style="list-style-type: none"> During operations 	PSW

other than burning modify the behavior of fishers occupying the affected den buffer?							
Did fishers utilize areas after operations ended, including short term breaks (days) or after longer periods (weeks to years post- management activity)?	<ul style="list-style-type: none"> Fisher habitat use 	<ul style="list-style-type: none"> No significant change in fisher use of treated habitat 	<ul style="list-style-type: none"> Avoidance of treated area by resident fishers 	<ul style="list-style-type: none"> Radio collared tracking of habitat usage GPS collars Remote cameras Scat detector dogs 	<ul style="list-style-type: none"> Treatment unit 	<ul style="list-style-type: none"> Time 1, 2, 3, 4 	PSW
Does post-treatment utilization differ between mechanical treatment and prescribed fire?	<ul style="list-style-type: none"> Fisher habitat use 	<ul style="list-style-type: none"> No significant change in fisher use of treated habitat 	<ul style="list-style-type: none"> Avoidance of treated area by resident fishers 	<ul style="list-style-type: none"> Radio collared tracking of habitat usage GPS collars Remote cameras Scat detector dogs 	<ul style="list-style-type: none"> Treatment unit 	<ul style="list-style-type: none"> Time 1, 2, 3, 4 	PSW
How did the various vegetation treatments change characteristics thought to be important for fishers at the microsite scale?	<ul style="list-style-type: none"> Change in stand exam plots with FVS modeling based resting site suitability index value Need a new model because old model doesn't work for southern Sierra Nevada 	<ul style="list-style-type: none"> Retain identified clusters of large (>30" dbh), live trees Retain pre-treatment canopy cover within 50m buffer around den/rest site No significant change in habitat quality values 	<ul style="list-style-type: none"> 1 standard deviation decrease in model based resting site suitability index 	<ul style="list-style-type: none"> FVS based simulations 	<ul style="list-style-type: none"> Treatment unit Landscape (LiDAR-where available) 	<ul style="list-style-type: none"> Time 1 & 5 	PSW, USFS Remote Sensing Lab

How did the various vegetation treatments change characteristics thought to be important for fishers at the home range scale?	<ul style="list-style-type: none"> • Canopy cover 	<ul style="list-style-type: none"> • 55-60% canopy across the landscape • Maintain/create larger patches of old forest (beyond 50m of rest/den sites) 	<ul style="list-style-type: none"> • >20% of landscape with <50% canopy cover 	<ul style="list-style-type: none"> • FVS based simulations • Lidar 	<ul style="list-style-type: none"> • Treatment unit • Landscape (w. lidar or series of treatment units) 	<ul style="list-style-type: none"> • Time 1 & 5 	PSW
Did fisher mortality increase after treatments?	<ul style="list-style-type: none"> • Fisher mortality rates 	<ul style="list-style-type: none"> • No increase in fisher mortality 1-5 years post treatment 	<ul style="list-style-type: none"> • >5% increase in annual fisher mortality rates 1-5 years post treatment 	<ul style="list-style-type: none"> • Radio telemetry tracking of fisher to measure mortality 	<ul style="list-style-type: none"> • Landscape (series of treatment units) 	<ul style="list-style-type: none"> • Pre-treatment and Time Periods 2, 3, and 4 	PSW
Do forest treatments affect the number of large-diameter snags and trees available to cavity-nesting wildlife species (emphasis on fisher)?	<ul style="list-style-type: none"> • Percentage of known cavity nests surviving treatment (or % change over time in control areas) OR • # of den cavities used per female 	<ul style="list-style-type: none"> • >95% post-treatment retention of known cavity nests (or no difference between treatment and control areas assuming no pre-treatment differences) • Range = 1-6 dens/female (mean = 3.35) 	<ul style="list-style-type: none"> • <90% post-treatment retention known cavity nests (or significantly fewer nests in treatment vs. control) OR • > 6 dens/female/year 	<ul style="list-style-type: none"> • Nest surveys (spot mapping) 	<ul style="list-style-type: none"> • Project Area • Sub-watershed? 	<ul style="list-style-type: none"> • Time Period 2 or 3 	<p>PSW, University partner, PRBO/IBP</p> <p>Not currently being measured by anyone.</p>

Forest Sensitive Raptors

CFLRP Goal: Improve fish and wildlife habitat, including for endangered, threatened, and sensitive species.

DLRP Objective: Create a heterogeneous forest stand structure and landscape patterns consistent with sensitive and indicator species' needs.

DLRP Objective: Maintain and restore habitat that promotes a diverse and functional assemblage of wildlife species.

DLRP Objective: Support viable populations of native wildlife in the restored landscape.

Questions	Indicators	Desired Condition	Trigger Point	Data Gathering Methods	Scope of Analysis	At What Point Measured	Party Responsible
Did the occupancy of Northern goshawks within Protected Activity Centers (PACs) change after treatments?	<ul style="list-style-type: none"> Site Occupancy of goshawk pairs 	<ul style="list-style-type: none"> No significant change in goshawk occupancy following treatments 	<ul style="list-style-type: none"> Site abandoned = one pre-treatment occupied site with no occupancy for 2 yrs in a row post-treatment 	<ul style="list-style-type: none"> Survey to protocol (USFS 2002) with Keane's modeling method concentrating on high use habitat 	<ul style="list-style-type: none"> Treatment unit and actual nest site Landscape (series of project areas) 	<ul style="list-style-type: none"> Pre-treatment 1 and 2 years post-treatment Then, every 5 years 	USFS
Did the relative habitat use patterns by Northern goshawks change after treatment?	<ul style="list-style-type: none"> Home range size Habitat use patterns 	<ul style="list-style-type: none"> No significant change in home range size following treatments No significant change in habitat use patterns following treatments 	<ul style="list-style-type: none"> Significant increase in home range size following treatments Territorial birds avoid previous high use areas following the treatments 	<ul style="list-style-type: none"> Radio transmitters on all territorial birds in treated areas and untreated (for controls) 	<ul style="list-style-type: none"> Treatment unit and actual nest site Landscape (series of project areas) 	<ul style="list-style-type: none"> Pre-treatment 	USFS – not currently doing this work. Requires radio transmitters on birds (> \$40,000 / year to do this)
Did the occupancy change for Great gray owls with known territories within a treated area?	<ul style="list-style-type: none"> Site Occupancy of great gray owls 	<ul style="list-style-type: none"> No significant change in Great gray owl site occupancy following treatments 	<ul style="list-style-type: none"> Site abandoned = one pre-treatment occupied site with no occupancy for 2 yrs in a row post-treatment 	<ul style="list-style-type: none"> Survey to protocol (Beck and Winter 2000) 	<ul style="list-style-type: none"> Treatment unit and actual nest site Landscape (series of project areas) 	<ul style="list-style-type: none"> Pre-treatment Annually for ≥ 4 -5 years post-treatment 	USFS

Did the relative habitat use patterns by Great gray owl change after treatment?	<ul style="list-style-type: none"> • Home range size • Habitat use patterns 	<ul style="list-style-type: none"> • No significant change in home range size following treatments • No significant change in habitat use patterns following treatments 	<ul style="list-style-type: none"> • Significant increase in home range size following treatments • Territorial birds avoid previous high use areas following the treatments 	<ul style="list-style-type: none"> • Radio transmitters on all territorial birds in treated areas and untreated (for controls) 	<ul style="list-style-type: none"> • Treatment unit and actual nest site • Landscape (series of project areas) 	<ul style="list-style-type: none"> • Pre-treatment 	USFS – not currently doing this work. Requires radio transmitters on birds (> \$40,000 / year to do this)
Did the occupancy of California spotted owls within Protected Activity Centers (PACs) change after forest treatments?	<ul style="list-style-type: none"> • Site Occupancy of owl pairs 	<ul style="list-style-type: none"> • No significant change in site occupancy following treatments 	<ul style="list-style-type: none"> • Owl pair abandon PAC following treatment= any 1 site with no occupancy at any time 	<ul style="list-style-type: none"> • Spotted Owl Occupancy Surveys • Demographic data 	<ul style="list-style-type: none"> • Project Area • Landscape (series of project areas) 	<ul style="list-style-type: none"> • Pre-treatment • Annually for ≥ 4 -5 years post-treatment 	PSW -- occupancy and Dinkey Landscape is part of the demography project data
Did the reproductive success of California spotted owls occupying treated areas change after treatments?	<ul style="list-style-type: none"> • # of young fledged per territorial owl pair per year 	<ul style="list-style-type: none"> • No significant change in annual reproductive output post-treatment 	<ul style="list-style-type: none"> • Significant decrease in annual reproductive output following treatments (needs to be assessed over ≥ 2 years post-treatment) 	<ul style="list-style-type: none"> • Demographic data 	<ul style="list-style-type: none"> • Project area • Landscape (series of project areas) 	<ul style="list-style-type: none"> • Pre-treatment • Annually for ≥ 4 -5 years post-treatment 	PSW - Dinkey Landscape is part of the demography project
Did the relative habitat use patterns by California spotted owls change after treatment?	<ul style="list-style-type: none"> • Home range size • Habitat use patterns 	<ul style="list-style-type: none"> • No significant change in home range size following treatments • No significant change in habitat use patterns following treatments 	<ul style="list-style-type: none"> • Significant increase in home range size following treatments • Territorial birds avoid previous high use areas following the treatments 	<ul style="list-style-type: none"> • Radio transmitters on all territorial birds in treated areas and untreated (for controls) 	<ul style="list-style-type: none"> • Treatment unit and actual nest site • Landscape (series of project areas) 	<ul style="list-style-type: none"> • Pre-treatment 	USFS – not currently doing this work. Requires radio transmitters on birds (> \$40,000 / year to do this)

Non-Forest Service Sensitive (Non-FSS) Mammal Species

CFLRP Goal: Improve fish and wildlife habitat, including for endangered, threatened, and sensitive species.

DRLP Objective: Create a heterogeneous forest stand structure and landscape patterns consistent with sensitive and indicator species' needs.

DLRP Objective: Maintain and restore habitat that promotes a diverse and functional assemblage of wildlife species.

DLRP Objective: Support viable populations of native wildlife in the restored landscape.

Questions	Indicators	Desired Condition	Trigger Point	Data Gathering Methods	Scope of Analysis	At What Point Measured	Party Responsible
Did forest relative use increase by predators (bobcat &/or mtn lion) in fisher habitat after treatments?	<ul style="list-style-type: none"> Relative frequency of use by bobcats 	<ul style="list-style-type: none"> No change or decrease in use of treated areas compared to untreated areas 	<ul style="list-style-type: none"> Increased relative use of treated areas 	<ul style="list-style-type: none"> Camera detection surveys Radiotelemetry 	<ul style="list-style-type: none"> Landscape 	<ul style="list-style-type: none"> Time Period 0, 1, 2, 3 	PSW, UC Davis
Did the density and occupancy of ringtails change after forest treatments?	<ul style="list-style-type: none"> Ringtail density and occupancy rates 	<ul style="list-style-type: none"> No change or increase in density and occupancy compared to untreated areas 	<ul style="list-style-type: none"> Significant decrease in ringtail density and occupancy 	<ul style="list-style-type: none"> Camera detection surveys (collateral data collected during fisher surveys) Mark/recapture trapping Radio telemetry 	<ul style="list-style-type: none"> Landscape 	<ul style="list-style-type: none"> Time 0, 1, 2, 3 	PSW
Did the diversity, abundance, and species composition of small mammal species change after forest treatments?	<ul style="list-style-type: none"> Small mammal species richness and evenness; total prey biomass; relative abundance of tree squirrels 	<ul style="list-style-type: none"> No change or increase in small mammal diversity and biomass No change or increase in relative abundance of tree squirrels 	<ul style="list-style-type: none"> Downward trend in species diversity, and total prey biomass Decrease in relative abundance of tree squirrels in treated areas 	<ul style="list-style-type: none"> Mark-recapture trapping Camera detection surveys Point counts (tree squirrels) 	<ul style="list-style-type: none"> Project Area 	<ul style="list-style-type: none"> Time Periods 2., 3, 4 	PSW, University partner

<p>Did the relative abundance, diversity, and species composition of bats change after forest treatments?</p>	<ul style="list-style-type: none"> • Bat species richness and evenness; relative abundance of target species (e.g., fringed myotis); community composition 	<ul style="list-style-type: none"> • No change or increase in bat diversity • No change or increase in relative abundance of target species 	<ul style="list-style-type: none"> • Downward trend in species diversity • Decrease in relative abundance of target species in treated areas 	<ul style="list-style-type: none"> • Ultrasonic bat detection surveys 	<ul style="list-style-type: none"> • Project Area 	<ul style="list-style-type: none"> • Time Periods 2, 3, 4 	<p>PSW, University partner</p>
<p>Is there Oak regeneration in key deer areas following restoration treatments?</p>	<ul style="list-style-type: none"> • Oak regeneration 	<ul style="list-style-type: none"> • Oak regeneration does not change or increases 	<ul style="list-style-type: none"> • Oak regeneration declines 	<ul style="list-style-type: none"> • Transects in select areas • Stand exams? 	<ul style="list-style-type: none"> • Stand level 	<ul style="list-style-type: none"> • After treatment 	<p>USFS</p>

Non-Forest Service Sensitive (Non-FSS) Avian Species

CFLRP Goal: Improve fish and wildlife habitat, including for endangered, threatened, and sensitive species.

DLRP Objective: Create a heterogeneous forest stand structure and landscape patterns consistent with sensitive and indicator species' needs.

DLRP Objective: Maintain and restore habitat that promotes a diverse and functional assemblage of wildlife species.

DLRP Objective: Support viable populations of native wildlife in the restored landscape.

Questions	Indicators	Desired Condition	Trigger Point	Data Gathering Methods	Scope of Analysis	At What Point Measured	Party Responsible
Did the abundance of target avian species (e.g., neotropical migrants, cavity-nesting species) change following forest treatments ?	<ul style="list-style-type: none"> Relative abundance estimator 	<ul style="list-style-type: none"> Stability of target species 	<ul style="list-style-type: none"> Downward trend in target species <p>OR</p> <ul style="list-style-type: none"> At-risk status due to rarity (e.g., which can result from a situation in which too few individuals remain to determine a trend) 	<ul style="list-style-type: none"> Point count surveys 	<ul style="list-style-type: none"> Landscape 	<ul style="list-style-type: none"> Annually 	PSW, University partner, PRBO, IBP
Did avian species richness change following forest treatments?	<ul style="list-style-type: none"> Species richness and evenness (e.g., Shannon index) Functional group richness (i.e., foraging guilds) 	<ul style="list-style-type: none"> Stability of target species <p>OR</p> <ul style="list-style-type: none"> No significant decline in avian species richness 	<ul style="list-style-type: none"> Downward trend in avian species richness 	<ul style="list-style-type: none"> Point count surveys 	<ul style="list-style-type: none"> Landscape 	<ul style="list-style-type: none"> Annually 	PSW, University partner, PRBO, IBP
Do forest treatments affect the number of snags and trees used by cavity nesting avian species?	<ul style="list-style-type: none"> Density of snags (>15") and trees usable by nesting cavity-nesting birds 	<ul style="list-style-type: none"> snag density for snags > 15" dbh: 1-3 snags/acre (Raphael & White 1984) <p>OR</p> <ul style="list-style-type: none"> Snag basal area = 30-160 ft² / acre 	<ul style="list-style-type: none"> <1 snag/acre 	<ul style="list-style-type: none"> Habitat sampling Common stand exam 	<ul style="list-style-type: none"> Project Area 	<ul style="list-style-type: none"> pre-treatment 1 year post treatment 	<p>USFS -- availability of snags and trees</p> <p>PSW – 'usable' snags and trees for cavity-nesting birds</p>
Do forest treatments	<ul style="list-style-type: none"> Density of snags 	<ul style="list-style-type: none"> Maintaining snag 	<ul style="list-style-type: none"> Snag density 	<ul style="list-style-type: none"> Common stand 	<ul style="list-style-type: none"> Project Area 	<ul style="list-style-type: none"> 1 year post 	USFS – not

<p>affect the recruitment rates of snags and large trees potentially usable by nesting avian species?</p>		<p>density of snags > 15" dbh at 1-3 snags/acre across the landscape</p>	<p>declines to < 1 snags/acre for snags > 15" dbh</p>	<p>exam • LiDAR ??</p>	<p>• Landscape – series of project areas</p>	<p>treatment • 5 years post treatment • 10 years post treatment</p>	<p>currently measuring beyond 1 year post-treatment</p>
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Yosemite Toad Occurrence and Abundance

CFLRP Goal: Improve fish and wildlife habitat, including for endangered, threatened, and sensitive species.

DLRP Objective: Create a heterogeneous forest stand structure and landscape patterns consistent with sensitive and indicator species' needs.

DLRP Objective: Maintain and restore habitat that promotes a diverse and functional assemblage of wildlife species.

DLRP Objective: Support viable populations of native wildlife in the restored landscape.

Questions	Indicators	Desired Condition	Trigger Point	Data Gathering Methods	Scope of Analysis	At What Point Measured	Party Responsible
Did Yosemite toad populations increase or decrease after treatments?	<ul style="list-style-type: none"> Abundance of adult Yosemite toads and egg masses in occupied meadows 	<ul style="list-style-type: none"> Maintained or increase in abundance following treatment 	<ul style="list-style-type: none"> Observed direct mortality of individuals from burning, crushing ≥15% decrease in abundance of adults 	<ul style="list-style-type: none"> Mark-recapture of adults during breeding 	<ul style="list-style-type: none"> Individual meadows in project areas 	<ul style="list-style-type: none"> Pre-treatment (baseline data) Post treatment up to 5-8 years 	USFS, not currently being collected w/in Dinkey boundary. USFS collected as part of adjacent KREW project 2007-2009, and 2011-2012.
Did the treatments degrade or improve breeding habitat in occupied Yosemite toad meadows?	<ul style="list-style-type: none"> Water table within meadow microclimate (solar input) Water quality Pool microhabitat data (sediment, pool depth) Stream channel condition 	<ul style="list-style-type: none"> Maintain or improve breeding pool habitat Increased or no change in water table 	<ul style="list-style-type: none"> Sediment observed to flow into meadow following storm or winter runoff Reduction of water table in meadow Meadow habitat degradation (channel downcutting, streambank instability) 	<ul style="list-style-type: none"> Piezometer Thermograph (air and water) Water chemistry Breeding pool micro habitat (TBD) 	<ul style="list-style-type: none"> Individual meadows in project area 	<ul style="list-style-type: none"> Pre-treatment (baseline data) Post treatment up to 5-8 years 	USFS, not currently being collected w/in Dinkey boundary. USFS collected as part of adjacent KREW project 2007-2009, and 2011-2012.

<p>Do terrestrial habitat locations that YT uses change after treatment?</p> <p>AND</p> <p>Do YT movement patterns change after treatments?</p>	<ul style="list-style-type: none"> • Adult YT habitat locations and movement patterns in terrestrial habitat 	<ul style="list-style-type: none"> • No significant difference in adult movement patterns • Adults utilize the same locations and terrestrial habitats • Current terrestrial habitats utilized is improved or maintained • Adults move into new habitats post treatment 	<ul style="list-style-type: none"> • YT move away from treated areas • Changes in typical habitat types/locations used by adults • Changes in typical movement patterns (i.e. increase of movements, distance traveled, timing of movements) 	<ul style="list-style-type: none"> • Telemetry • Canopy cover 	<ul style="list-style-type: none"> • Terrestrial habitats (± 1250 meters: TBD by Fish and Wildlife) around occupied individual meadows in project area 	<ul style="list-style-type: none"> • Pre-treatment (baseline data) • Post treatment up to 5-8 years 	<p>USFS, not currently being collected w/in Dinkey boundary. USFS collected as part of adjacent KREW project 2007-2009, and 2011-2012.</p>
<p>Did treatments negatively or positively affect terrestrial habitat for the Yosemite toad?</p>	<ul style="list-style-type: none"> • Acres of “high, medium and low quality” terrestrial habitat occupied by YT pre and post project in treatment areas (CWHR? Critical Habitat outlined in F&W) • Cover components (i.e. stumps, logs, burrows, lupine in open dry areas) • Canopy cover percent • Air temperature at burrow entrances 	<ul style="list-style-type: none"> • Treatments overlapping terrestrial habitat improve conditions to support juvenile and adult populations • Increase of available cover components in terrestrial habitats • Post-treatment Increase or maintenance of undisturbed open areas 	<ul style="list-style-type: none"> • Treatment degrades 30% of cover components in terrestrial habitats • Increase of average air temperature at burrow entrances • Canopy cover % trigger points will be developed later based on habitat components collected in telemetry study (this trigger point percent is unknown currently) 	<ul style="list-style-type: none"> • Telemetry Study: adult YT movement and terrestrial habitat use • Data collection of terrestrial habitat components (ex; canopy cover, vegetation, cover %) utilized by adults and how treatments changes habitat (i.e.: fire burns in these areas) 	<ul style="list-style-type: none"> • Terrestrial habitats (± 1250 meters) around occupied individual meadows in project area 	<ul style="list-style-type: none"> • Pre-treatment (baseline data) • Post treatment up to 5-8 years 	<p>USFS, data not currently being collected w/in Dinkey boundary. USFS collected as part of adjacent KREW project 2007-2009, and 2011-2012.</p>

Controlling Invasive Species

CFLRP Goal: Prevent, remediate, or control invasions of exotic species.

DRLP Objective: Pursue the eradication or control of noxious weeds.

DRLP Objective: Reduce the occurrence of invasive species and control existing populations.

Questions	Indicators	Desired Condition	Trigger Point	Data Gathering Methods	Scope of Analysis	At What Point Measured	Party Responsible
Did noxious weeds increase after treatments?	<ul style="list-style-type: none"> Density and frequency of noxious weeds in treatment stands and along adjacent transportation routes 	<ul style="list-style-type: none"> Decrease in density and frequency of noxious weeds in treatment stands and along adjacent transportation routes 	<ul style="list-style-type: none"> Increase or no change (if weeds exist) in density and frequency of noxious weeds in treatment stands and along adjacent transportation routes 	<ul style="list-style-type: none"> Pre-treatment transects/surveys Post –treatment transects/surveys Control transects/surveys 	Project Area	Pre-treatment and period 2 and 3.	USFS
Did focused weed treatments reduce or limit the occurrence of noxious weeds?	<ul style="list-style-type: none"> Density and frequency of noxious weeds in treated areas 	<ul style="list-style-type: none"> Decrease in density and frequency of noxious weeds in treatment stands and along adjacent transportation routes 	<ul style="list-style-type: none"> Increase or no change (if weeds exist) in density and frequency of noxious weeds in treatment stands and along adjacent transportation routes 	<ul style="list-style-type: none"> Pre-treatment transects/surveys Post –treatment transects/surveys Control transects/surveys 	Project Area	Time Period 3	USFS
Did restoration treatments reduce or contain the spread of non-native plant species?	<ul style="list-style-type: none"> Percent cover and frequency of occurrence of non-native plant species 	<ul style="list-style-type: none"> Decrease (or possibly no change) in cover and frequency of non-native plants 	<ul style="list-style-type: none"> Increase in cover and frequency of non-native plants 	<ul style="list-style-type: none"> To be evaluated in conjunction with Vegetation Composition desired condition no. 5 	Project Area	Time Period 3	USFS, (not currently being done. ONLY if there is new funding)

Fire and Fuel Dynamics

Reducing the Risk of Stand-Replacing Wildfire

CFLRP Goal: Reduce the risk of uncharacteristic wildfire, including through the use of fire for ecological restoration and maintenance and reestablishing natural fire regimes, where appropriate.

DRLP Objective: Reduce hazardous fuels and restore fire-adapted ecosystems, including structural heterogeneity (i.e., diversity in plant size, type, and density) at the landscape scale to approximate forest conditions produced by a frequent fire disturbance regime that shaped ecosystem processes.

DRLP Objective: Create a fire resilient landscape in support of reestablishing natural fire regimes.

Questions	Indicators	Desired Condition	Trigger Point	Data Gathering Methods	Scope of Analysis	At What Point Measured	Party Responsible
Where the goal is to reduce stand replacing fire, did the treatments significantly reduce fire behavior and stand mortality?	<ul style="list-style-type: none"> Flame length Crowning Index Fire type (surface, passive crown, active crown fire) Potential tree mortality (basal area) modeled under moderate and extreme fire weather conditions (50th, 75th, and 90th and 97.5th percentile) 	<ul style="list-style-type: none"> Flame length < 4 ft. (USDA ROD 2004) Stand mortality resulting from treatment is ≤ 20% of stand basal area Reduce crowning index Change fire type 	<ul style="list-style-type: none"> Flame length > 4 ft. (USDA ROD 2004) Tree mortality > 20% Increase or no reduction in crowning index 	<ul style="list-style-type: none"> Pre- Post Stand Exams Brown's Planar Intercept FVS FOFEM BEHAV LiDAR (canopy and ladder fuels) 	<ul style="list-style-type: none"> Stand Level 	<ul style="list-style-type: none"> After treatment (Time Period 2 or 3; possibly 5) 	USFS/Contractor
Does prescribed fire result in desired levels of logs, duff, and litter?	<ul style="list-style-type: none"> Volume and density of logs (by size and decay class), litter cover (%), and litter and duff depth 	<ul style="list-style-type: none"> ≥50% ground cover (soils BMP) Litter depth ≥3 (Meyer et al. 2008) 	<ul style="list-style-type: none"> <50% ground cover over top soil Litter depth < 2" in depth, on average, in stand 	<ul style="list-style-type: none"> Stand Exams Brown's planar fuel transects 	<ul style="list-style-type: none"> Stand Level 	<ul style="list-style-type: none"> After treatment (Time Period 2 or 3) 	USFS

Promoting Natural Fire Regimes

CFLRP Goal: Reduce the risk of uncharacteristic wildfire, including through the use of fire for ecological restoration and maintenance and reestablishing natural fire regimes, where appropriate.

DRLP Objective: Reduce hazardous fuels and restore fire-adapted ecosystems, including structural heterogeneity (i.e., diversity in plant size, type, and density) at the landscape scale to approximate forest conditions produced by a frequent fire disturbance regime that shaped ecosystem processes.

DRLP Objective: Create a fire resilient landscape in support of reestablishing natural fire regimes.

Questions	Indicators	Desired Condition	Trigger Point	Data Gathering Methods	Scope of Analysis	At What Point Measured	Party Responsible
Did treatments target areas of the landscape with a higher departure from historic fire return intervals?	<ul style="list-style-type: none"> • Fire Return Interval Departure (FRID) Index 	<ul style="list-style-type: none"> • FRID Condition Class value (CC mean FRI) for treatment areas are in Condition Class 3 or 2 	<ul style="list-style-type: none"> • FRID Condition Class value for treatment areas are in Condition Class 1 or below (1 to -3) 	<ul style="list-style-type: none"> • FRID Database 	<ul style="list-style-type: none"> • Landscape 	<ul style="list-style-type: none"> • Time Period 3, 4 	USFS
Are initial and pre-CFLRP (areas burned before 2010) burn units scheduled for 2 nd /3 rd entry burns?	<ul style="list-style-type: none"> • Acres of 2nd and 3rd entry burns scheduled for project area 	<ul style="list-style-type: none"> • 1-2 maintenance burn scheduled in 15 year period for Fire Regime class 1 or to reduce from class 2 to 1. 	<ul style="list-style-type: none"> • Not scheduled 	<ul style="list-style-type: none"> • 2nd 5-year planning schedule (contingent on USFS fire and fuels budget) 	<ul style="list-style-type: none"> • Project Level 	<ul style="list-style-type: none"> • Time Period 4 	USFS
Did fire treatments (prescribed fire and managed wildfire) promote characteristic fire behavior or reestablish natural fire regimes, where appropriate?	<ul style="list-style-type: none"> • Mean and variance fire severity index†† and proportion of area burned at each fire severity class†† (prescribed fire and managed wildfire) • Fire Return Interval 	<p>Mixed-conifer/ White fir & Yellow pine forest types:</p> <ul style="list-style-type: none"> • High fire severity 5-20% of burned area (NRV Assessment Safford et al. 2013) overall average across Dinkey Landscape over time (<i>individual fires</i>) 	<ul style="list-style-type: none"> • Fire severity, tree mortality, and other fire effects values exceed desired conditions 	<ul style="list-style-type: none"> • Remote-sensing methods • FVS/FFE modeling • Field monitoring 	<ul style="list-style-type: none"> • Stand and Landscape Levels 	<ul style="list-style-type: none"> • After treatment (Time Period 2) 	USFS – (USFS currently does not collect data to allow full estimate of CBI)

	<p>Departure (FRID) Index</p> <ul style="list-style-type: none"> • Composite Burn Index (CBI) • Tree mortality (10-20", 20-30", >30" dbh) 	<p><i>may have high severity percentages above or below this average)</i></p> <ul style="list-style-type: none"> • A distribution of high severity patch sizes will be determined • Interspersed mix of Moderate & low severity 80-95% of the burned area, on average • Tree mortality <p>Red fir & white fir forest type:</p> <ul style="list-style-type: none"> • Xeric (pure red fir, red fir/white fir) 5-20% of burned area are high severity • Red fir/Western white pine/lodgepole 15-35% of burned area are high severity • A distribution of high severity patch sizes will be determined <p>Lodgepole Pine forest type:</p> <ul style="list-style-type: none"> • Mixed severity=True mix of low, moderate, and high severities • Xeric lodgepole 5-20% of burned area are high severity • Mesic lodgepole 15-35% of burned area are high severity <p>Foothill hardwood</p>					
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		<p>forest type:</p> <ul style="list-style-type: none"> • Pre-dominately Low severity. • Area burned large, but very small high severity patches, if any. • Tree mortality: Only with the smallest size classes. Minimize all blue oak or valley oak tree mortality (USFS std, & guides #21) <p>Chaparral vegetation type:</p> <ul style="list-style-type: none"> • Fire frequency 20-35yrs (Bagely) • Mix of severities • High severity patches, cumulatively, are 85-100% of burned area on average. • Rather than worry about high severity patch size, should be a mix of stand ages across landscape 					
<p>Did fire-surrogate treatments promote characteristic fire behavior or reestablish natural fire regimes, where appropriate? (Creating landscape condition that would accept desired result.)¹</p>	<ul style="list-style-type: none"> • % tree crown scorch and torch • Torch and scorch heights • Tree mortality (10-20", 20-30", >30" dbh) 	<p>Mixed-conifer/ White fir & Yellow pine forest types:</p> <ul style="list-style-type: none"> • High fire severity 5-20% of burned area (NRV Assessment Safford et al. 2013) overall average across Dinkey Landscape over time <i>(individual fires may have high</i> 	<ul style="list-style-type: none"> • Fire severity, tree mortality, and other fire effects values exceed desired conditions 	<ul style="list-style-type: none"> • Fuel treatment effectiveness field monitoring • Remote-sensing methods • 	<ul style="list-style-type: none"> • Stand Level 	<ul style="list-style-type: none"> • 1-2 years post-wildfire 	USFS

		<p><i>severity percentages above or below this average)</i></p> <ul style="list-style-type: none"> • A distribution of high severity patch sizes will be determined • Interspersed mix of Moderate & low severity 80-95% of the burned area, on average <p>Red fir & white fir forest type:</p> <ul style="list-style-type: none"> • Xeric (pure red fir, red fir/white fir) 5-20% of burned area are high severity • Red fir/Western white pine/lodgepole 15-35% of burned area are high severity • A distribution of high severity patch sizes will be determined <p>Lodgepole Pine forest type:</p> <ul style="list-style-type: none"> • Mixed severity=True mix of low, moderate, and high severities • Xeric lodgepole 5-20% of burned area are high severity • Mesic lodgepole 15-35% of burned area are high severity <p>Foothill hardwood forest type:</p> <ul style="list-style-type: none"> • Pre-dominately 					
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		<p>Low severity.</p> <ul style="list-style-type: none"> • Area burned large, but very small high severity patches, if any. • Tree mortality: Only with the smallest size classes. Minimize all blue oak or valley oak tree mortality (USFS std, & guides #21) <p>Chaparral vegetation type:</p> <ul style="list-style-type: none"> • Fire frequency 20-35yrs (Bagely) • Mix of severities • High severity patches, cumulatively, are 85-100% of burned area on average. <p>Rather than worry about high severity patch size, should be a mix of stand ages across landscape</p>					
Are acres of prescribed fire increasing in the project area?	<ul style="list-style-type: none"> • Acres of prescribed and managed fire in the project area 	<ul style="list-style-type: none"> • Increased proportion of landscape with lower condition class values (1 to 0) over time. 	<ul style="list-style-type: none"> • Declining trend in prescribed burn acres accomplished within the DLRP 	<ul style="list-style-type: none"> • Dinkey landscape fire records 	<ul style="list-style-type: none"> • Landscape 	<ul style="list-style-type: none"> • After treatment (Time Period 3, 4) 	USFS
Are initial burn units scheduled for 2 nd /3 rd entry burns?	<ul style="list-style-type: none"> • Acres of 2nd and 3rd entry burns scheduled for project area 	<ul style="list-style-type: none"> • 1-2 maintenance burn scheduled in 15 year period for Fire Regime 1. 	<ul style="list-style-type: none"> • Not scheduled 	<ul style="list-style-type: none"> • 2nd 5-year planning schedule (contingent on USFS fire and fuels budget) 	<ul style="list-style-type: none"> • Project Level 	<ul style="list-style-type: none"> • Time Period 4 	USFS
Did use of prescribed fire create unburned,	<ul style="list-style-type: none"> • Acres of post-fire habitat in unburned, low, moderate, and 	<ul style="list-style-type: none"> • Proportion of unburned, low, moderate, and high severity within the 	<ul style="list-style-type: none"> • Fire severity classes are outside the NRV for the vegetation type 	<ul style="list-style-type: none"> • Composite burn index and RdNBR 	<ul style="list-style-type: none"> • Burn unit or inside burn perimeter 	<ul style="list-style-type: none"> • Post-fire 	USFS

low, moderate, and high severity patches within the Natural Range of Variation (NRV)?	high severity classes ^{††}	NRV for each vegetation type • See NRV listed by forest types above in 'wildland' severity question.					
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[†] This question is relevant only for mechanically treated areas that experience wildfire post-treatment.

Soil and Water Effects

Water Quality

CFLRP Goal: Maintain or improve water quality and watershed function

DLRP Objective: Promote healthy functioning watersheds, clean water and improved aquatic and riparian habitats.

Questions	Indicators	Desired Condition	Trigger Point	Data Gathering Methods	Scope of Analysis	At What Point Measured	Party Responsible
Did forest restoration treatments significantly affect sedimentation & water quality?	<ul style="list-style-type: none"> Fine sediment deposition in channels 	<ul style="list-style-type: none"> Pools support quality habitat for aquatic species 	<ul style="list-style-type: none"> Increase in sedimentation (shift in dominant particle size in riffles, or increased V* in pools) 	<ul style="list-style-type: none"> Pebble counts (riffles) V*(pools) 	<ul style="list-style-type: none"> Selected stream reaches 	<ul style="list-style-type: none"> After major runoff event OR at pre-determined interval 	USFS
Are roads causing sedimentation in aquatic systems?	<ul style="list-style-type: none"> Delivery of road-generated sediment Hydrologic-Road connectivity 	<ul style="list-style-type: none"> BMPs are fully implemented and hydrologic connectivity of roads to streams is minimized. 	<ul style="list-style-type: none"> Increase in hydrologic-road connectivity or sediment delivery 	<ul style="list-style-type: none"> Road connectivity surveys Stream Condition Inventory (SCI) surveys BMPEP 	<ul style="list-style-type: none"> Subdrainage (HUC16) and subwatershed (HUC12) scales 	<ul style="list-style-type: none"> Post-Treatment time period 2, with time period 3 and 4 as optional re-checks. 	USFS
Did forest treatments that reduce canopy cover increase the water temperature of streams?	<ul style="list-style-type: none"> Stream temperature Canopy cover 	<ul style="list-style-type: none"> $\leq 21^{\circ} C$ = desired conditions associated with local fish assemblages (ex: Rainbow trout assemblage (Moyle 2002)) 	<ul style="list-style-type: none"> Water temperature $> 21^{\circ} C$ Canopy cover is reduced below desired condition 	<ul style="list-style-type: none"> Thermograph placement into streams Canopy cover % in stream channels 	<ul style="list-style-type: none"> Representative stream channels in project area Control stream channels outside of project area 	<ul style="list-style-type: none"> Pre-treatment Post-treatment (5 years) 	USFS

Meadow Function and Stream Condition

CFLRP Goal: Maintain or improve water quality and watershed function

DLRP Objective: Promote healthy functioning watersheds, clean water and improved aquatic and riparian habitats.

Questions	Indicators	Desired Condition	Trigger Point	Data Gathering Methods	Scope of Analysis	At What Point Measured	Party Responsible
Did forest restoration treatments affect channel morphology & stability?	<ul style="list-style-type: none"> Channel type, W:D, stability ratings Bank disturbance 	<ul style="list-style-type: none"> Indicators are in ranges appropriate for channel type Bank disturbance does not exceed standard (20%) 	<ul style="list-style-type: none"> Stream type change, increasing W:D, decreasing stability, bank disturbance greater than 20% 	<ul style="list-style-type: none"> Stream Condition Inventory (SCI) BMP evaluations of bank disturbance 	<ul style="list-style-type: none"> Selected stream reaches for channel type Stability and bank disturbance can be measured in any reach 	<ul style="list-style-type: none"> Bank disturbance immediately post-treatment Other indicators after at least one runoff season Time period 2, 3 or 4. 	USFS
Did forest restoration treatments affect the hydrologic function of meadows?	<ul style="list-style-type: none"> Meadow groundwater levels 	<ul style="list-style-type: none"> Meadows are hydrologically functional. 	<ul style="list-style-type: none"> Meadow stream channel incision / headcutting affects more of meadow area, and/or vegetation assemblage indicates expansion of area with impaired meadow hydrology 	<ul style="list-style-type: none"> Piezometer data? Change in status of headcuts (active/restored) Survey of channel bed elevation? Vegetation mapping? Long term range condition and trend plots 	Could be selected meadow/s only, or broader scale including larger sample of meadows	<ul style="list-style-type: none"> Continuous data loggers Anytime post-project Post-project, after major runoff events After veg response, probably > 5 years 	USFS
Did forest restoration treatments significantly contribute to cumulative watershed effects?	<ul style="list-style-type: none"> Channel morphology and stability; sedimentation, WQ 	<ul style="list-style-type: none"> Stream channel conditions are stable or improving 	<ul style="list-style-type: none"> Stream channel condition on downward trend, field observations link changes to treatments or treatment areas 	<ul style="list-style-type: none"> SCI V* BMPEP 	Subdrainage (HUC16) scale	<ul style="list-style-type: none"> After major runoff event OR at pre-determined interval (2,3,and/or 4) 	USFS

<p>Were browsers excluded from sensitive Aspen regeneration areas in meadows?</p>	<ul style="list-style-type: none"> • Were fences constructed so that ungulates could not browse on aspen? 	<ul style="list-style-type: none"> • Exclude livestock and deer from browsing any sensitive aspen regeneration areas 	<ul style="list-style-type: none"> • Heavy browsing observed on aspen • No fence, ineffective fence, or broken fences in sensitive aspen regeneration areas 	<ul style="list-style-type: none"> • Rangeland annual utilization monitoring in these sensitive aspen regeneration areas. 	<ul style="list-style-type: none"> • Representative area within key area meadows 	<ul style="list-style-type: none"> • Pre-treatment (pre-exclusion) • 1&2 years post-exclusion 	<p>USFS-Range Manager and/or Hydrologist and/or Botanist</p>
<p>Were livestock utilization and distribution standards and guidelines achieved in meadows?</p>	<ul style="list-style-type: none"> • Vegetation Condition Ecological Status (% late seral species vs. % early seral species factored into rating) • Overall Ecological Status rooting depth and depth to water table factored into rating) • Ground cover, rilling, bank stability, floodplain erosion, riparian vegetation (e.g. age class, evidence of livestock browse, herbaceous and woody species diversity) 	<ul style="list-style-type: none"> • Limit livestock utilization of grass and grass-like plants to 40% for meadows in late seral status • Limit livestock utilization of grass and grass-like plants to 30% for meadows in early seral status • Limit browsing to ≤20% of the annual leader growth of mature riparian shrubs and no more than 20% of individual seedlings riparian shrubs and ≤20% of individual seedlings • Ensure that hydrologic function and aquatic features are at a minimum at Proper Functioning Condition 	<ul style="list-style-type: none"> • Utilization exceeds standards; satisfactory condition not attained, trend is down, bare ground greater than 10% • Distribution standards exceeded (e.g., rilling, erosion) • Functional-at-Risk rating with downward trend 	<ul style="list-style-type: none"> • R5 Long Term Rangeland Condition and Trend Plots (Vegetation Frequency Method) • Annual utilization monitoring in key areas (e.g. percent forage use by weight, stubble height and percent browse) • Range Best Management Practices (BMPEP Monitoring) • PFC Assessment and Monitoring 	<ul style="list-style-type: none"> • Representative area within key area meadows • Response reaches within allotments (note: location may or may not correlate with key area locations) 	<ul style="list-style-type: none"> • Monitoring plots re-read on a 5 year interval • Selected key areas (determined by random selection) monitored annually for compliance 	<p>USFS-Range Manager Hydrologist and Botanist</p>

Soil Condition

CFLRP Goal: Maintain or improve water quality and watershed function

DLRP Objective: Promote healthy functioning watersheds, clean water and improved aquatic and riparian habitats.

Questions	Indicators	Desired Condition	Trigger Point	Data Gathering Methods	Scope of Analysis	At What Point Measured	Party Responsible
Did forest restoration treatments maintain soil stability/condition to allow plant growth and hydrologic function?	<p>Soil Disturbance Index:</p> <ol style="list-style-type: none"> 1. Soil cover (Organic matter on top of the mineral soil) 2. Soil Disturbance 3. Large woody debris cover 	<ul style="list-style-type: none"> • Soil Disturbance Index = 0 -1. • Fine organic material covers >50% of the soil surface in the area • No evidence of soil compaction • No evidence of soil displacement • No treatment-generated soil erosion • Fine, medium, and large roots can grow and penetrate soil- NO 'J-rooting' observed. 	<ul style="list-style-type: none"> • Fine organic matter covers < 50% of the soil surface in the area. • >15% of activity area has been determined to be in 'detrimental soil disturbance' (soil disturbance index \geqD2) status 	<ul style="list-style-type: none"> • Soil-Disturbance Field Guide. USDA Forest Service, 0819 1815-SDTC, August 2009. http://www.fs.fed.us/eng/pubs/ 	<ul style="list-style-type: none"> • Stand-level or treatment area 	<ul style="list-style-type: none"> • Time Period 2, 3 & 5 	USFS

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APPENDIX A -- Launching an Adaptive Socioeconomic Monitoring Program (Document attached)



**Proposal to the Sierra National Forest and
the Dinkey Creek Planning Forum**

**Launching an Adaptive
Socioeconomic Monitoring Program**

March (revised) 2012

Sierra Institute for Community and Environment contact:
Jonathan Kusel, 530-284-1022 (ext. 22) / JKusel@SierraInstitute.us

**APPENDIX B – Tracking and Reporting Ecological Outcomes of the Collaborative Forest
Landscape Restoration Act for Report to Congress (under development)**

APPENDIX C – Monitoring Question Prioritization Process for 2013 Fiscal Year

Purpose

The purpose of the Dinkey monitoring prioritization process is to help guide our decision making in prioritizing ecological monitoring questions for long-term planning. The resulting prioritized list of monitoring questions will be used by Dinkey Collaborative to target the long-term monitoring needs in the Dinkey landscape.

Background

The monitoring prioritization process is our initial objective attempt to identify monitoring questions that are critical to our understanding of restoration treatment effects on the Dinkey landscape. This process is designed to guide monitoring priorities and is not intended to be the final comprehensive list for prioritization. This process is iterative and will require ongoing discussions and refinement based on monitoring costs, overall budget, and collaborative information needs.

The monitoring prioritization process developed by the Monitoring Work Group will focus broadly on all ecological questions related to effectiveness monitoring in the Monitoring Matrix. This includes all future monitoring and research activities planned or anticipated by the Sierra National Forest and Pacific Southwest Research Station that directly address monitoring questions and indicators in the Monitoring Matrix.

Prioritization Process:

The process is based on five prioritization criteria developed by the Dinkey Monitoring Work Group for use in ranking the 55 ecological monitoring questions. Monitoring cost was removed from the initial set of criteria and will be factored in during a later stage in the process in order to obtain more reliable cost estimates for prioritization.

Prioritization Criteria

1. **Multiple benefits:** the question will provide information that is useful for understanding and managing more than one resource.
 - a. Ranking terms: 3 or more benefits (VALUE = 6); 2 benefits (VALUE = 3); single-benefit (VALUE = 0).
2. **Comprehensiveness:** the question fills an information gap in monitoring objectives that otherwise will not be thoroughly covered by existing Sierra National Forest and Pacific Southwest Research Station monitoring activities.
 - a. Ranking terms: Less than 50% of questions for objective are covered by current monitoring (VALUE = 3); more than 50% of questions for objective are covered by current monitoring (VALUE = 0).
3. **Sensitivity** of the resource: the question will provide information about a valued resource that is sensitive to disturbance and other stressors. Will be ranked either according to “a” (species-related) or “b” (habitat-related), but not both.

- a. Ranking terms: Existing threatened or endangered species and federal candidate species (e.g., Pacific fisher, Yosemite toad) (VALUE = 6); USFS sensitive species (e.g., California spotted owl, Northern goshawk) (VALUE = 5); questions with indirect association to existing T&E and USFS sensitive species (VALUE = 3) other species and resources (VALUE = 0) (Note: each species is assigned one value only).
 - b. Ranking terms: Water quality and watershed monitoring (VALUE = 3); other resources (VALUE = 0).
- 4. **Adaptive Management Potential:** the question has potential to inform management activities and influence adaptive management decisions for the Dinkey landscape. This potential is based on time sensitivity, with greater value given to questions that can be addressed more immediately to inform decision-making.
 - a. Ranking terms: Question can be evaluated within one year following treatment (VALUE = 6); question can be evaluated between one and two years following treatment (VALUE = 3); question can be evaluated three or more years following treatment (VALUE = 0).
- 5. **Responsiveness:** the question and associated indicator is responsive (in terms of exposure and sample size) to restoration treatments. Responsiveness will be ranked based on the number of projects that will influence the resource (e.g., #54 – roads and sedimentation), the amount of treated area that will overlap with the resource (e.g., #24 – ringtails), or the number of individuals of the resource that will be potentially affected by the treatment (e.g., #35 – Great gray owl).
 - a. Ranking terms: Highly responsive (VALUE = 6); moderately responsive (VALUE = 3); mildly responsive (VALUE = 0).

Prioritization Table

Question	Multiple Benefits (0,3,6)	Comprehensive (0,3)	Sensitivity (0,3,6)	Adaptive Potential (0,3,6)	Responsive (0,3,6)	Total (27)	Rank *
1. Did thinning treatments retain and protect large trees?	6	0	3	6	6	21	1
2. Did forest treatments retain live defect trees (e.g., trees with broken tops, platforms, cavities)	6	0	3	6	6	21	1
3. Did use of wildland fire create unburned, low, moderate, and high severity patches for species associated with these post-fire habitat types?	6	3	0	6	6	21	1
4. Did forest treatments increase the temperature and canopy cover of streams?	3	3	3	6	6	21	1
5. Are roads causing sedimentation in aquatic systems?	3	3	3	6	6	21	1
6. Did forest treatments significantly alter snag abundance?	3	0	3	6	6	18	2
7. Are patches of dense (as defined in Forest Plan	3	0	3	6	6	18	2

Amendment— 60% canopy cover) forest connected?							
8. Did operations related to prescribed burning in a den buffer modify the behavior of fishers occupying the affected den buffer?	0	0	6	6	6	18	2
9. Did fishers utilize areas after operations have stopped, including short term breaks (days) or after longer periods (weeks to months post- management activity)?	0	0	6	6	6	18	2
10. Did forest restoration activities promote characteristic wildfire (e.g., reduced the risk of uncharacteristi cally severe wildlife adjacent to human communities) or reestablished natural fire regimes, where appropriate)?	3	0	3	6	6	18	2
11. Do forest treatments affect the number of large-diameter snags and trees used by cavity- nesting	6	3	6	3	0	18	2

wildlife species (emphasis on fisher)?							
12. Do mitigation treatments, such as raking treatments, adequately protect large snags and trees during restoration treatments?	3	3	3	3	6	18	2
13. Did forest restoration treatments (roads, stream crossing, etc.) significantly affect sedimentation & water quality?	3	3	3	6	3	18	2
14. Did forest treatments impact nesting California spotted owls within Protected Activity Centers (PACs)?	0	3	5	6	3	17	2
15. Did forest treatments significantly reduce tree density in small size classes?	3	0	0	6	6	15	3
16. Did forest treatments significantly alter canopy cover?	0	0	3	6	6	15	3
17. Did forest treatments increase structural heterogeneity among stands across the project	0	0	3	6	6	15	3

landscape?							
18. Did treatments retain or enhance the density of oaks in suitable vegetation types?	6	0	0	3	6	15	3
19. Did forest treatments reduce the density of ecologically overrepresented tree species (e.g., small diameter shade-tolerant white fir and incense cedar in mixed-conifer forest)?	3	0	0	6	6	15	3
20. Did fishers utilizing non-den buffer areas avoid them during habitat modification operations?	0	0	6	6	3	15	3
21. Did operations related to vegetation removal by means other than burning modify the behavior of fishers occupying the affected den buffer?	0	0	6	6	3	15	3
22. How did the various vegetation treatments change characteristics thought to be important for fishers at the home range or microsite scale?	0	0	6	3	6	15	3

23. Did the fire treatments negatively change meadow and terrestrial habitat occupied by Yosemite toad?	0	3	6	3	3	15	3
24. Is there oak regeneration in key deer areas following restoration treatments (related to species composition question 1)?	6	3	0	3	3	15	3
25. Did treatments significantly raise height-to-live-crown?	3	0	0	6	6	15	3
26. Does prescribed fire result in desired levels of logs, duff, and litter?	3	0	0	6	6	15	3
27. Are acres of wildland fire increasing in the project area?	3	0	0	6	6	15	3
28. Are initial burn units scheduled for 2 nd /3 rd entry burns?	3	0	0	6	6	15	3
29. Did forest restoration treatments maintain soil productivity for plant growth and soil hydrologic function?	0	3	0	6	6	15	3
30. Does fisher utilization differ between mechanical treatment and prescribed	0	0	6	6	3	15	3

fire?							
31. Did forest treatments alter the relative use of treated habitats by Northern goshawks?	0	3	5	6	0	14	3
32. Did forest treatments alter the relative use of treated habitats by Great gray owls?	0	3	5	6	0	14	3
33. Did forest restoration treatments significantly contribute to cumulative watershed effects (e.g., are soil disturbance coefficients and recovery rates appropriate in the Cumulative Watershed Effects Model)?	0	3	0	6	3	12	4
34. Did forest treatments increase the heterogeneity and abundance of habitat structures within a stand (e.g., trees within a stratum are clumped)?	3	0	3	0	6	12	4
35. Did forest treatments promote the regeneration of desirable broadleaf species (e.g., oaks, aspen, cottonwood,	6	0	0	3	3	12	4

willow)?							
36. Did forest treatments alter the relative abundance, diversity, and species composition of bats?	0	3	3	0	6	12	4
37. Did fire treatments affect Yosemite toad abundance?	0	3	6	0	3	12	4
38. Did treatments significantly reduce fuel loading?	0	0	0	6	6	12	4
39. Did treatments target areas of the landscape with a higher departure from historic fire return intervals?	0	0	0	6	6	12	4
40. Did fire severity in wildland fire use areas meet (or trend towards) desired conditions over the project area?	3	0	3	0	6	12	4
41. Did forest restoration treatments affect channel morphology & stability?	0	3	3	3	3	12	4
42. Did forest restoration treatments affect the hydrologic function of meadows?	6	3	0	3	0	12	4
43. Did restoration treatments result in greater basal	0	0	3	0	6	9	4

area and canopy cover in canyons and slopes with north-facing aspects than ridges and slopes with south-facing aspects (especially on upper slopes)?							
44. Did forest treatments increase the density of ecologically underrepresented conifer species (e.g., ponderosa pine, Jeffrey pine, sugar pine in mixed-conifer forest previously dominated by these species)?	3	0	0	0	6	9	4
45. Did forest restoration treatments increase understory herbaceous plant species diversity?	0	0	0	3	6	9	4
46. Did forest treatments significantly alter the abundance of target avian species (e.g., neotropical migrants, cavity-nesting species) and/or avian species richness?	0	0	0	3	6	9	4
47. Did restoration treatments create suitable habitat for Management	3	3	0	0	3	9	4

Indicator Species (MIS)?							
48. Did forest treatments alter the density and occupancy of ringtails?	0	3	0	3	3	9	4
49. Did forest treatments significantly alter the diversity, abundance, and species composition of small mammal species?	0	3	0	0	6	9	4
50. Do the treatments affect the number of snags and trees used by cavity nesting avian species?	3	3	0	3	0	9	4
51. Did restoration treatments reduce or limit the occurrence of noxious weeds?	0	0	0	3	6	9	4
52. Did forest treatments increase tree growth rates and basal area (in the long term)?	0	0	0	0	6	6	5
53. Did forest treatments alter the relative use of treated habitats by bobcats?	0	3	0	3	0	6	5
54. Did forest restoration treatments affect the objective of safeguarding water quality potentially affected by	3	0	3	0	0	6	5

livestock grazing activities?							
55. Did restoration treatments reduce or contain the spread of non-native plant species?	0	0	0	3	0	3	5
56. Did forest restoration treatments affect rangeland condition and trend?	0	0	0	0	0	0	5

* Ranking scale (subject to change): Rank 1 \geq 21; Rank 2 = 17-18; Rank 3 = 14-15; Rank 4 = 9-12; Rank 5 \leq 6

Summary of Prioritized Monitoring

Priorities across all years:

1. Top priority (Rank 1):
2. Second priority (Rank 2):
3. Third priority (Rank 3):
4. Fourth priority (Rank 4):
5. Firth priority (Rank 5)

2013 Monitoring Funding Priorities

Following the ranking of the full complement of questions from the Monitoring Matrix (12.0), the individual questions were combined into overarching questions within the appropriate resource emphasis areas (i.e., Water Quality and Watershed Function, Conservation of Threatened and Endangered Species & Federal Candidate Species, Forest Structure and Composition, Natural Fire Regimes, Conservation of Forest Sensitive Species, Invasive Species, Livestock Grazing), as derived from the monitoring matrix, and the scores were averaged to provide a general comparison between the resource areas. The outcome of this overall ranking is presented below. The resource emphasis areas are listed in order of priority based on the highest average score of subcategory A. in each resource area. For example, subcategory A. “Water quality improvement through road decommissioning and/or restoration” had the highest score of all subcategories.

I. Water Quality and Watershed Function

A. Water quality improvement through road decommissioning and/or restoration (Average Score – 19.5)

Questions:

1. Did forest restoration treatments (roads, stream crossing, etc.) significantly affect sedimentation & water quality? (18)
2. Are roads causing sedimentation in aquatic systems? (21)

B. Improvement in meadow function and stream condition through restoration treatments (Average Score – 14.25)

Questions:

1. Did forest restoration treatments affect channel morphology & stability? (12)
2. Did the forest restoration treatments affect the hydrologic function of meadows? (12)
3. Did the forest restoration treatments significantly contribute to cumulative watershed effects? (12)
4. Did forest treatments increase the temperature and canopy cover of streams? (21)

C. Effects of forest restoration on soil productivity (Average Score – 13.5)

Questions

- A. Did forest restoration treatments maintain soil productivity for plant growth and soil hydrologic function? (15)
- B. Are soil disturbance coefficients and recovery rates appropriate in the Cumulative Watershed Effects Model? (12)

II. Conservation of Threatened and Endangered Species and Federal Candidate Species (Pacific fisher and Yosemite toad)

A. Effects of forest restoration treatments on long term viability of Pacific fisher (Average Score – 16.1)

Questions:

1. Did fishers utilizing non-den buffer areas avoid them during habitat modification operations? (15)
2. Did operations related to prescribed burning in a den buffer modify the behavior of fishers occupying the affected den buffer? Areas near current den site. (18)
3. Did operations related to vegetation removal by means other than burning modify the behavior of fishers occupying the affected den buffer? Areas near current den site. (15)
4. Did fishers utilize areas after operations have stopped, including short term breaks (days) or after longer periods (weeks to months post-management activity)? (18)
5. Does utilization differ between mechanical treatment and prescribed fire? (15)
6. How did the various vegetation treatments change characteristics thought to be important for fishers at the microsite scale? (15)
7. How did the various vegetation treatments change characteristics thought to be important for fishers at the home range scale? (15)
8. Do forest treatments affect the number of large-diameter snags and trees used by cavity-nesting wildlife species (emphasis on fisher)? (18)

B. Effects of forest restoration treatments on Yosemite toad occurrence and abundance (Average Score – 13.5)

Questions:

1. Did prescribed fire affect Yosemite toad abundance? (12)
2. Did the prescribed fire negatively change meadow and terrestrial habitat occupied by Yosemite toad? (15)

III. Change in Forest Structure and Composition from Forest Restoration Treatments

A. Change in forest structure resulting from forest restoration treatment (Average Score – 15.75)

Questions:

1. Did forest treatments significantly reduce tree density in small size classes? (15)
2. Did thinning treatments retain and protect large trees? (21)
3. Did forest treatments retain live defect trees (e.g., trees with broken tops, platforms, cavities) (21)
4. Did forest treatments significantly alter canopy cover? (15)
5. Did forest treatments significantly alter snag abundance? (18)
6. Did forest treatments increase the heterogeneity and abundance of habitat structures within a stand (e.g., trees within a stratum are clumped)? (12)
7. Did forest treatments increase tree growth rates and basal area (in the long term)? (6)
8. Do mitigation treatments, such as raking treatments, adequately protect large snags and trees during restoration treatments? (18)

B. Effect of forest restoration treatment on landscape level processes (Average Score – 14)

Questions:

1. Did restoration treatments result in greater basal area and canopy cover in canyons and slopes with north-facing aspects than ridges and slopes with south-facing aspects (especially on upper slopes)? (9)
2. Did forest treatments increase structural heterogeneity among stands across the project landscape? (15)
3. Are patches of dense (as defined in Forest Plan Amendment—60% canopy cover) forest connected? (18)

C. Change in forest composition resulting from forest restoration treatment (Average Score – 12.75)

Questions:

1. Did treatments retain or enhance the density of oaks in suitable vegetation types? (15)
2. Did forest treatments reduce the density of ecologically overrepresented tree species (e.g., small diameter shade-tolerant white fir and incense cedar in mixed-conifer forest)? (15)
3. Did forest treatments increase the density of ecologically underrepresented conifer species (e.g., ponderosa pine, Jeffrey pine, sugar pine in mixed-conifer forest previously dominated by these species)? (9)
4. Did forest treatments promote the regeneration of desirable broadleaf species (e.g., oaks, aspen, cottonwood, willow)? (12)

IV. Restoring Natural Fire Regimes to the Dinkey Landscape

A. Progress towards reestablishing natural fire regimes (Average Score – 15.5)

Questions:

1. Did forest restoration activities promote characteristic wildfire (e.g., reduced the risk of uncharacteristically severe wildfire adjacent to human communities) or reestablished natural fire regimes, where appropriate? (18)
2. Did fire severity in wildland fire use areas meet (or trend towards) desired conditions over the project area? (12)
3. Did treatments target areas of the landscape with a higher departure from historic fire return intervals? (12)
4. Are acres of wildland fire increasing in the project area? (15)
5. Are initial burn units scheduled for 2nd/3rd entry burns? (15)
6. Did use of wildland fire create unburned, low, moderate, and high severity patches for species associated with these post-fire habitat types? (21)

B. Success of forest restoration treatments in reducing the risk of uncharacteristic wildfire (Average Score – 14)

Questions:

1. Did the treatments significantly reduce fuel loading? (12)

2. Did the treatments significantly raise height-to-live- crown? (15)
3. Does prescribed fire result in desired levels of logs, duff, and litter? (15)

V. Conservation of Forest Sensitive Species

A. Impacts of forest restoration treatments on Forest Sensitive raptors (Average Score – 15)

Questions:

1. Did forest treatments impact nesting California spotted owls within Protected Activity Centers (PACs)? (17)
2. Did forest treatments alter the relative use of treated habitats by Northern goshawks? (14)
3. Did forest treatments alter the relative use of treated habitats by Great gray owls? (14)

B. Forest restoration treatment effects on non-Forest Sensitive mammal species (Average Score – 10.2)

Questions:

1. Did forest treatments significantly alter the diversity, abundance, and species composition of small mammal species? (9)
2. Did forest treatments alter the relative abundance, diversity, and species composition of bats? (12)
3. Did forest treatments alter the relative use of treated habitats by bobcats? (6)
4. Did forest treatments alter the density and occupancy of ringtails? (9)
5. Is there oak regeneration in key deer areas following restoration treatments? (15)

C. Forest restoration treatment effects on non-Forest Sensitive avian species (Average Score – 9)

Questions:

1. Did forest treatments significantly alter the abundance of target avian species (e.g., neotropical migrants, cavity-nesting species)? (9)
2. Did forest treatments significantly alter avian species richness? (9)
3. Do the treatments affect the number of snags and trees used by cavity nesting avian species? (9)

VI. Effects of Restoration Treatments on Reducing or Containing the Spread of Invasive Species

A. Value of forest treatment on controlling invasive species (Average Score – 6)

Questions:

1. Did restoration treatments reduce or limit the occurrence of noxious weeds? (9)
2. Did restoration treatments reduce or contain the spread of non-native plant species? (3)

VII. Impacts of Livestock Grazing on Restoration Projects

A. Impact of livestock grazing on meadow restoration (Average Score – 3)

Questions:

1. Did forest restoration treatments affect rangeland condition and trend? (0)
2. Did forest restoration treatments affect the objective of safeguarding water quality potentially affected by livestock grazing activities? (6)