DESCHUTES COLLABORATIVE FOREST PROJECT ECOLOGICAL MONITORING PLAN

A WORKING DOCUMENT

FINAL DRAFT

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DCFP 2014 Ecological Monitoring Plan

A Working Document

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Executive Summary

Purpose and need

Monitoring ecological effectiveness of Deschutes Collaborative Forest Project (DCFP) activities across the DCFP landscape and on individual DCFP projects is a national requirement and will help the Collaborative evaluate how well its activities are addressing national and local restoration priorities and desired outcomes. In addition, the monitoring process and results can build trust and common ground by answering questions about the need for and effects of restoration activities.

In 2012, the USFS Washington Office approved national guidance for ecological monitoring that directs Collaborative Forest Landscape Restoration (CFLR) projects, including the DCFP, to use effectiveness monitoring to evaluate progress toward their stated desired conditions at both the landscape and the NEPA project level. The national guidance instructs CFLR projects on specific monitoring requirements for each of four broad indicators – Fire Regime Restoration, Fish and Wildlife Habitat Condition, Watershed Condition, and Invasive Species Severity. In addition, each CFLR project is directed to monitor progress toward desired conditions stated in its landscape proposal.

Process used to develop and select monitoring questions and methods

In late 2012 and early 2013, Deschutes National Forest (DNF) program leaders and the DCFP monitoring sub-committee coordinator met to develop a broad framework and questions for each indicator that would address national requirements and provide useful information to the DNF. In summer and fall 2013, the DCFP monitoring sub-committee reviewed each framework, adding questions of interest to DCFP stakeholders and developing criteria for selecting questions for monitoring. Working groups were then formed to refine the questions and develop monitoring protocols for each of the monitoring questions. In December 2013 and January 2014 the sub-committee prioritized questions for monitoring in 2014 using the following criteria:

- · meets national requirement
- · addresses a DCFP proposal goal
- · informs adaptive management
- · builds common ground
- · builds scientific knowledge
- · informs future planning
- · can be measured using feasible and defensible methods

The questions recommended for monitoring in 2014 are listed in Table 1 below. All of the questions address a national requirement, DCFP proposal goal, and/or issue of particular concern to DCFP stakeholders. In addition, all questions either inform future planning or provide feedback for adaptive management. Several address ongoing debates and will build common ground among stakeholders, and all can be measured using feasible and defensible methods. Several of the monitoring questions address multiple indicators, and some will be monitored at both the project scale and the landscape scale.

Questions in Table 1 are organized by landscape or project scale, and questions that will be monitored using the same methods are grouped together. Questions in Table 1 are numbered in order for ease of discussion. Tables 2-5 (the monitoring protocols) and Table 6 use a different numbering system linked to each indicator.

Table 1. Questions to be monitored in 2014

	Est. cost in 2014 (5-year report)	Est. cost in non-reporting years (2015-2018)
Landscape-scale questions*		
1. What is the change in acres of forest successional classes for all plant association groups (PAGs) and the ecological departure (condition class) for each PAG relative to its historic range of variability?	$4,000	$1,000
2. What are the effects of restoration treatments on fire behavior and forest resilience to fire within dry forest ponderosa pine, dry mixed conifer, and moist mixed conifer PAGs at the landscape-level and the project level?	$10,000	$2,500
3. What is the change in watershed condition score for all HUC 6 subwatersheds within the landscape?	$8,000	$0
4. What is the change in total system road and trail densities on the landscape? What is the change in total system road and trail density in each HUC 6 subwatershed? What is the change in total system road and trail density in riparian zones and sensitive land types in each HUC 6 subwatershed?	$1,000	$0
5. What is the change in miles of hydrologically connected total system roads and trails with all streams in each HUC 6 subwatershed?	$20,000	$0
6. What are the effects of terrestrial and aquatic restoration treatments on water quality in the Upper Whychus subwatershed?	$0	<$1,000
7. What is the change in acres of core habitat at the landscape level and at the project level?	$500	$500
8. What is the change in acres of open, single-story, late-successional ponderosa pine forest habitat at the landscape level and at the project level?	$1,000	$500
9. How many acres of high-priority invasive plant infestations are treated across the landscape? Where are treatments located relative to known invasive plant infestations?	$1,200	$4,000
10. What is the average percent reduction in invasive plant density across all treated areas?	$20,000	$5,000
Project-scale questions*		
11. What is the change in understory cover in ponderosa pine, dry mixed conifer, and moist mixed conifer PAGs? What is the effect of restoration treatments on understory cover as it relates to restoring more characteristic fire regimes in ponderosa pine, dry mixed conifer, and moist mixed conifer PAGs?	$6,000	$0
12. How do restoration treatments affect fire behavior when wildfire burns through treated stands in ponderosa pine, dry mixed conifer, and moist mixed conifer PAGs?	<$2,500	<$2,500
13. What is the change in acres of hiding cover and thermal cover for deer and elk?	$500	<$500
14. What is the change in acres and improvement of meadow habitat (wet and dry)?	$6,000	Variable
15. What is the change in riparian vegetation health in response to restoration treatments?	$5,500	Variable
16. What is the change in aquatic ecosystem health in response to stream channel, floodplain, wetland, and meadow restoration treatments?	$5,500	Variable
17. What is the effect of aquatic restoration treatments on aquatic organisms and species of concern?	$0	$0
18. How are DCFP projects affecting fish passage?	$1,000	Variable
19. How many new invasive species sites are found in selected NEPA project areas?	$2,000	$4,000
ESTIMATED TOTAL COST	**$94,700**	**<$40,000**

*Most landscape-scale questions are monitored once every 5 years. Project-scale questions are monitored pre- and post-project implementation.

Several of the questions listed in Table 1 synergistically address two or more indicators. For example, question 11 addresses effects of changes in understory cover composition on wildlife habitat, fire regimes, and invasive species. The road density questions and project-level questions 13-18 apply to both watershed condition and Fish and Wildlife Habitat Condition monitoring. Questions 2, 7, and 8 will be monitored at both the project scale and the landscape scale using the same method at each scale.

Explanation of costs

The total estimated cost for monitoring these questions in 2014 is $94,700. The total estimated cost for monitoring them in non-reporting years is less than $40,000.

Some landscape-scale questions have high costs in 2014 either to develop a monitoring model or to gather baseline data, but will be relatively inexpensive to monitor after 2014. Questions 1 and 2, for example, require development of new monitoring models. Questions 5 and 10 will require extensive fieldwork to gather baseline data in 2014, but costs will be much lower in subsequent years. Similarly, question 10 has a high up-front cost for baseline data collection in 2014, when all sites on the DCFP landscape that are treated for invasive species will be monitored.

Some monitoring questions have variable costs depending on the number of subwatersheds or projects being monitored in any given year. Questions selected for monitoring each year will depend on specific NEPA objectives and monitoring requirements of projects being implemented. For example, question 6 will be monitored in Whychus Creek but not Tumalo Creek in 2014. Questions 13-18 each may be monitored on one or more projects per year, depending on NEPA requirements and implementation timelines, but monitoring is not expected to exceed $6,000 for any of these questions in any given year, and for some will be considerably lower. Thus the total cost of monitoring questions 1-19 in non-reporting years is expected to be less than $40,000.

There may be additional questions added to the monitoring plan in future years. For instance, monitoring questions related to aspen/hardwood habitat and mixed conifer habitat were ranked high priority but not selected for monitoring in 2014 because they did not apply within DCFP projects implemented to date. These and other questions that may be reconsidered by the monitoring subcommittee in future years are listed in the Appendix. Even with the possible addition of a few monitoring questions, total CFLR monitoring expenses in non-reporting years are expected to be less than the $62,250-$73,690 per year budgeted for monitoring in the DCFP proposal addendum for years 2015-2018.

Data collection and analysis

Data collection and analysis for all of the 2014 monitoring questions will be completed between April 1 and September 30, 2014, so that results can be interpreted and reported by November. Individuals and/or organizations responsible for data collection and analysis are listed in the monitoring protocols. For most protocols, responsible parties are DNF staff, usually program managers. For some questions, The Nature Conservancy, Upper Deschutes Watershed Council, USFS Western Wildlands Environmental Threat Center and Region 6 Regional Office staff will provide data collection or analysis assistance. In addition, seasonal Forest Service hires and/or volunteers will help with data collection for some questions; these individuals will be supervised by DNF staff.

Virtually all monitoring questions, and particularly project-level monitoring questions involving field surveys, require qualitative as well as quantitative data analysis. This is because a wide range of variables, ranging from natural disturbances to economic conditions to unexpected recreational use can affect forest conditions. A narrative assessment of both site-level and landscape-level conditions will be an important part of the data analysis for most of the monitoring questions in this plan. Often, these qualitative data provide information that is as or more useful than the numbers reported.

Interpreting and using results

Data interpretation and annual monitoring reports are largely the responsibility of the DCFP monitoring sub-committee and DNF program managers, who compile and analyze data, interpret results, develop an annual monitoring report, and recommend management actions based on their findings.

Monitoring is an excellent tool to help managers and decisionmakers systematically evaluate their work and adapt plans and management actions based on what they have learned. The challenge is finding the time to interpret and evaluate monitoring results and then identify and apply change mechanisms. To address this challenge, the DNF and DCFP steering committee may choose to adopt the following process:

1. *Technical review:* DNF program managers, key data collection and analysis individuals, and the DCFP sub-committee monitoring coordinator meet in September or October to:
   - Share and interpret monitoring results, identifying cross-cutting findings and identifying external factors that may have influenced outcomes;
   - Highlight findings to be shared with larger stakeholder group and decisionmakers.

2. *Multi-stakeholder review:* DCFP monitoring sub-committee and DNF decisionmakers meet in October to:
   - Review monitoring results presented by DNF program managers and the DCFP monitoring sub-committee;
   - Discuss implications for future planning and management and recommend changes to improve outcomes.

3. *Annual monitoring report:* By the end of December, the DCFP monitoring sub-committee and DCFP staff, with input from DNF program managers, write an annual monitoring report.

4. *Formal written recommendations*: By the end of January, DCFP monitoring sub-committee makes formal written recommendations for revised planning and/or management actions to the DCFP steering committee for review, approval, and submission to DNF line officers.

5. *Monitoring plan review and revision:* By the end of February, the monitoring sub-committee reviews the 2014 DCFP monitoring plan and Appendix to determine which monitoring questions should be measured in the coming year.

Introduction

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All of the questions selected for monitoring in 2014 address a national requirement, DCFP proposal goal, and/or issue of particular concern to DCFP stakeholders. In addition, all questions either inform future planning or provide feedback for adaptive management. Several address ongoing debates and will build common ground among stakeholders, and all can be measured using feasible and defensible methods. Several of the monitoring questions address multiple indicators, and some will be monitored at both the project scale and the landscape scale.

A working document

The remainder of this plan includes:

- Four sections – one for each indicator – describing 1) national monitoring requirements and DCFP desired outcomes; 2) priority monitoring questions with rationales for monitoring each;

and 3) monitoring protocols, including metrics, methods, data management, monitoring schedule, costs, responsible parties, and deliverables for each question.

- Detailed monitoring methods/citations to published methods
- A section on interpreting and using monitoring results
- The process for meeting national reporting requirements, including quantified desired conditions and scoring statements for relevant monitoring questions
- References
- An appendix including monitoring questions considered but not prioritized for monitoring in 2014, with rationales and a draft monitoring protocol for each question

This monitoring plan is a working document. In other words, after the first year of monitoring (2014), monitoring methods may be refined and some monitoring questions may be dropped or revised when the DCFP and DNF reassess the feasibility of data collection and analysis and the usefulness of the results. Other monitoring questions not prioritized in 2014 may be added as new NEPA projects with different forest types, habitats, and objectives are implemented in coming years or as new methods become available to address questions currently deemed unfeasible to monitor. National reporting requirements may also change, requiring adaptation of this monitoring plan. It is expected that the monitoring sub-committee will meet each year to review monitoring results and the monitoring process overall and plan the next year's monitoring. As the bulk of this monitoring plan is the responsibility of DNF personnel, their input will be critical to that review and any decisions regarding plan revision.

Fire Regime Restoration

The Collaborative Forest Landscape Restoration Act states that "a collaborative forest restoration landscape proposal shall… describe plans 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." Drawing on this requirement, the national ecological monitoring guidance states that for Indicator 1 – Fire Regime Restoration – at the landscape level, each CFLR project should monitor how well it is achieving its desired conditions "for restoring fire behavior characteristics and/or forest structure important to fire behavior within the natural range of variability." At the project level, the national guidance directs CFLR projects to monitor how well their NEPA projects are meeting objectives that were designed to contribute to achieving landscape-level desired conditions.

Desired conditions articulated in the DCFP proposal include:

- "Restore landscape-scale forest resiliency to natural disturbance regimes [using] a variety of restoration treatments … to re-establish spatial heterogeneity at the stand and landscape-level."
- Restore "natural fire regimes … by reducing the uncharacteristic fuels currently found in these forest types [ponderosa pine and dry mixed conifer] and breaking up the homogeneous stand structure found across the … landscape… [to] allow the return of fire in this landscape at ecologically appropriate lower intensities."

The proposal also states that the fire regime across the entire DCFP landscape will be reassessed at years 5 and 10 using two metrics:

- "The ecological departure, or Fire Regime Condition Class, … to compare how closely stand structure is to the historic range of variation for these forest types."
- "The fire hazard metric … using FlamMap modeling methods and analyzing outputs … to see if overall hazard rating has been reduced."

Priority questions for monitoring are listed below, with rationales for monitoring each. Each is numbered according to indicator and scale. Thus, question 1L-2 is a Fire Regime Restoration question (indicator 1) that will be monitored at the landscape scale (L) and is the second landscape-scale question listed. Similarly, 1P-1 is the first project-level Fire Regime Restoration monitoring question listed.

1L-1. What is the change in acres of forest successional classes for all PAGs and the ecological departure (condition class) of each PAG relative to its historic range of variability (HRV)?

This question will measure ecological departure from HRV, which the scientific community understands to be a more resilient condition that would support natural fire regimes and other disturbance processes, particularly in the face of future climate uncertainty. This question addresses the first DCFP desired condition and the first DCFP monitoring commitment listed above. It is also a priority Wildlife Habitat Monitoring question.

1L-2. What are the effects of restoration treatments on fire behavior and forest resilience to fire within ponderosa pine, dry mixed conifer, and moist mixed conifer PAGs at the landscape level? 1P-1. What are the effects of restoration treatments on fire behavior and forest resilience to fire within the same PAGS at the project level?

This question is intended to shed light on whether (or not) restoration treatments within the DCFP are effectively increasing forest resilience to fire and reducing acres of uncharacteristic fire behavior at the landscape scale (1L-2) and the project scale (1P-1). It addresses a national monitoring requirement, DCFP desired condition, and DCFP monitoring commitment. While the DCFP proposal directs the use of FlamMap to monitor change in fire behavior over time, these questions will likely be answered with a new model (FSIM), which was not available at the time of the original proposal's creation but reports more meaningful spatial and temporal fire behavior model outputs across landscapes. Forest structure and fuels data will be used to evaluate forest resilience in relation to the change in modeled fire behavior outputs (e.g., flame intensity level, rates of spread, torching and crown fire potential, and exposure analysis by PAG). A reduction in uncharacteristic fire behavior in conjunction with increased resilience indicates the potential for fire to function naturally or be used as a tool to restore and maintain functioning dry forests. In 2014, question 1P-1 will be answered for Glaze Meadow, SAFR, and West Tumbull projects. The cost for monitoring this question in 2014 will be up to $10,000, as it includes work by the WWETAC, DNF, and TNC staff to prepare data inputs and run baseline (2009) and 2014 fire behavior modeling in FSIM. In 2019 and 2024 the estimated cost is $2,500 to monitor this question.

1P-2. What is the effect of restoration treatments on understory composition and cover as it relates to restoring more characteristic fire regimes in ponderosa pine, dry mixed conifer, and moist mixed conifer PAGs?

Understory plant composition and cover is an important component of fire regime because of the influence of grasses, forbs, shrubs, and small trees on fire behavior. In dry forest types in particular, fine fuels facilitate frequent, low-severity fires while overabundant shrub and small tree components act as ladder fuels increasing the risk of crown fire. Understory composition and cover is also of particular interest for wildlife habitat. In 2014, this question will be monitored on Glaze, West Bend, and Rocket projects.

1P-3. How do restoration treatments affect fire behavior when wildfire burns through treated stands in ponderosa pine, dry mixed conifer, and moist mixed conifer PAGs?

Ordinarily the only way to assess the effectiveness of fuels reduction treatments is to model fire behavior before and after treatment. Opportunistic monitoring when a wildfire burns through a restoration treatment allows direct evaluation of the effectiveness of the treatment. DNF fire and fuels staff already conduct qualitative monitoring of changes in wildfire behavior resulting from restoration treatments. On fires less than 300 acres, initial attack crews capture immediate fuel treatment effects using the Fuel Treatment Effectiveness Monitoring (FTEM) protocol. On fires greater than 1000 acres, remotely sensed data is collected and analyzed using Burned Area Reflectance Classifcation (BARC) and Monitoring Trends in Burn Severity (MTBS) mapping, which can be paired with spatial treatment data to evaluate changes in fire severity within restoration treatments. To answer this question on all fires that burn into DCFP treatments, the FTEM protocol will need to be applied on all fires up to 1000 acres on the DCFP landscape. This question addresses one of the DCFP's primary fire regime restoration goals and can be readily answered on projects within the DCFP landscape if and when wildfires occur.

Other questions considered but not prioritized for monitoring in 2014

The monitoring sub-committee considered other Fire Regime Restoration monitoring questions as well; these are listed in the Appendix. These questions were not prioritized for monitoring in 2014 either because they are adequately addressed by other questions above, are not feasible to answer using cost-effective and reliable methods, or are well-researched and documented in existing peer-reviewed literature. The fire regime working group suggested that questions relating to shifting species composition, dry forest spatial pattern (i.e. gap/opening size, abundance, and distribution), and legacy tree mortality/vigor would be better addressed through 1) collaborative learning that reviews the best available research, 2) field reviews, 3) restoration sub-committee work, and 4) implementation sub-committee work.

Table 2. Fire Regime Restoration monitoring protocol

	Question	Metrics	Methods	Data Source(s)	Data Management	Monitoring & Cost Schedule	Responsible Party	Products
1L-1	What is the change in acres of forest successional classes for all PAGs and the ecological departure (condition class) of each PAG relative to its HRV?	Abundance and distribution of forest succession classes; Vegetation condition class	GIS analysis of change in successional class during monitoring period; structure-based landscape departure analysis modeled on LandFire tool	USFS: 2010 GNN data, PAG data, DNF treatment data; TNC: LandFire BpS data	DNF GIS database	Every 5 years. $4,000 in 2014, $1,000 in 2019, 2024	DNF AFMO and TNC Fire Research Analyst	Mapped and tabular results with narrative interpretation
1L-2 & 1P-1	What are the effects of restoration treatments on fire behavior and forest resilience to fire within ponderosa pine, dry mixed conifer, and moist mixed conifer PAGs?	Fire Behavior: model outputs (may include fire intensity level, rates of spread, torching, crown fire potential, exposure analysis). Forest Structure: Change in average stand diameter and stand density (QMD and TPA/size class or BA/size class). Forest Fuels: Scott and Burgan 40 fuels model inputs (e.g., canopy closure, canopy base height, tree height)	Fire behavior model (FSIM) informed by Scott and Burgan 40 fuel models, GIS analysis, photoseries analysis	May include: LiDAR, GNN, FACTS, DNF GIS layers, site assessment, prescription specifications photo points	DNF GIS database	1L1: Every 5 years; 1P1: Pre- and post-project. $10,000 in 2014, then $2,500 per analysis	USFS (WWTEC, DNF AFMO) and TNC Forest Ecologist	Mapped and tabular results with narrative interpretation
1P-2	What is the effect of restoration treatments on understory cover as it relates to restoring more characteristic fire regimes in ponderosa pine, dry mixed conifer, and moist mixed conifer PAGs?	Understory vegetation lifeforms (e.g. grass, forb, shrub, seedlings/saplings) Presence/absence of invasive plants (for Invasive Species Severity monitoring)	Photo points stratified by PAG and treatment type, including controls (no treatment); Photo point analysis; Field assessment using appropriate photoseries where photo points are not available	Photographs; Field assessments using appropriate photoseries	DNF and TNC	Every 5 years. $6,000 to analyze photos for fire regime, wildlife habitat, and invasives	DNF AFMO	Photoseries with narrative interpretation
1P-3	How do restoration treatments affect fire behavior when wildfire burns through treated stands in ponderosa pine, dry mixed conifer, and moist mixed conifer PAGs?	Number of acres where fire achieves resource benefit and observed changes in fire behavior (may include flame length, tree mortality, dominant fire spread type inside and outside of treated unit, scorch height, visual soil effects)	Qualitative assessment using FTEM protocol on fires <1000 acres and MTBS protocol on fires 1000 acres and larger	FTEM database (NW Portal) MTBS database	DNF	Pre- and post-project, up to $2,500/yr	DNF AFMO	Tabular and narrative results

Fish and Wildlife Habitat Condition

National monitoring guidance for Indicator 2 – Fish and Wildlife Habitat Condition – recommends that monitoring focus on habitat for a variety of species, while recognizing that in some cases there may be a desire to focus on a specific suite of species of concern.

According to the DCFP proposal, "Our desired outcome is to restore a forested landscape that can be managed within natural range of variability and provide a diversity of habitats…." DCFP's landscape priorities include conserving and enhancing wildlife habitat, in particular those open habitats shown to be at the greatest deficit as a result of forest densification during the era of fire suppression and exclusion. Restoration treatments, the proposal states, will aim to re-establish spatial heterogeneity at the stand- and landscape-level to restore the mix of wildlife habitat types that support diverse species dependent on open, closed, and intermixed forest conditions.

The proposal also describes objectives and restoration activities to facilitate the reintroduction of steelhead and Chinook salmon to Whychus Creek, including restoring natural stream channel morphology, restoring floodplain connection to the stream to reduce streambank instability, restoring native riparian plant communities, and addressing barriers to fish passage.

The DCFP proposal also describes specific water quality and fish and wildlife habitat monitoring that will be conducted during the life of the project: "The Upper Deschutes Watershed Council and Deschutes National Forest will collect data on streamflow, temperature, macroinvertebrate and fish populations, fish passage and screening, and other habitat parameters to evaluate the effectiveness of their watershed restoration activities."

As with Fire Regime Restoration monitoring questions, the numbering system below refers to the indicator (2 – Fish and Wildlife Habitat Condition) and scale (L–landscape or P–NEPA project).

2L-1. What is the change in acres of forested habitat types (successional classes) for all PAGs and the ecological condition (condition class) of each PAG relative to its historic range of variability (HRV)?

One of the principle DCFP goals for forest restoration is to move the landscape toward more natural and heterogeneous structural conditions closer to its HRV, which the scientific community understands to be a more resilient condition, providing a wider range of wildlife habitat types supporting diverse species dependent on open, closed, and intermixed forest conditions. This is also a Fire Regime Restoration Monitoring question.

2L-2. What is the change in total system road and trail densities?

Roads and trails, both motorized and non-motorized, affect virtually all wildlife species. The DCFP landscape has a high density of both roads and trails and these are heavily used by the public, recreationists, and land managers. Baseline data and data on changes in road and trail density on the DCFP landscape may be used to build common ground by increasing stakeholder understanding of the effects of roads and trails on functional habitat and habitat quality and on the tradeoffs between roads and wildlife. It also will inform future planning (i.e., Are our projects affecting road density? How? Do we want to address road density more in future projects? If so, where?). This is also a Watershed Condition Monitoring question, because roads and trails have a range of impacts on watershed function.

2L-3. What is the change in acres of core habitat at the landscape level? 2P-2. What is the change in acres of core habitat at the project level?

Core habitat is defined as habitat undisturbed by forest roads and trails (motorized and non-motorized). Core habitat helps maintain species viability and functional habitat by reducing disturbance, and benefits virtually all wildlife species on the landscape. Monitoring core habitat across the DCFP landscape (2L-3) will produce information that can be used by the DCFP and DNF to increase stakeholder understanding regarding the quantity, distribution, and condition of core habitat to inform future project planning (i.e., Do we want to protect or increase core habitat areas?). Monitoring this question at the project level (2P-2) may inform adaptive management by helping evaluate how the extent of core habitat within a NEPA planning area is affected by project activities. Glaze, SAFR, and West Tumbull projects will be monitored in 2014 because mechanical treatments in these projects are complete and post-treatment data are available.

2L-4. What is the change in acres of open, single-story, late-successional ponderosa pine forest habitat at the landscape level? 2P-1. What is the project-scale change in acres of open, single-story, late-successional ponderosa pine forest habitat at the project level?

This habitat type is important for species such as white-headed woodpecker and has been shown to be the forest habitat type at the greatest deficit on the DCFP landscape due to past management and fire exclusion. Answering this question at the landscape scale will build understanding of broad changes in this habitat type. Project-scale monitoring will provide feedback on the effectiveness of restoration treatments in this forested habitat***.*** In 2014 this question will be monitored at the landscape scale and for the Glaze, Sisters Area Fuels Reduction (SAFR), and West Tumbull projects, where mechanical treatments have been completed in ponderosa pine forest habitat.

2P-2. What is the change in acres and improvement of meadow habitat (wet and dry)?

Meadows are interfaces of diversity important to many wildlife species, including several birds and insects. They are a relatively rare habitat on the DCFP landscape and are at risk due to fire exclusion and associated conifer encroachment. In 2014 the only DCFP project where meadow restoration has been completed is Glaze Meadow, so this question will be monitored on that project. This is also a Watershed Condition monitoring question.

2P-3. What is the change in riparian vegetation health in response to restoration treatments?

Riparian areas are the most important habitat for wildlife density and diversity due to the abundance of species that utilize riparian habitat at various stages of their life cycle. This question will be monitored on projects where treatments were designed to restore riparian vegetation. In 2014, this question will be monitored on the Glaze, Three Sisters Irrigation District, Ryan Ranch, Whychus Floodplain, and Indian Ford Restoration projects. This is also a Watershed Condition Monitoring question.

2P-4.What is the change in understory plant cover in ponderosa pine, dry mixed conifer, and moist mixed conifer plant association groups?

Increasing understory plant abundance and diversity is critical to improving habitat for many wildlife species and is a goal of many DCFP stakeholders. Quantitatively monitoring changes in plant composition using a plot-based method would be prohibitively expensive, but this question can be monitored using photo points with enough accuracy to evaluate general trends in grass, forb, and shrub composition and cover. In 2014 this question will be monitored on the Glaze project (post-treatment) and Rocket and West Bend projects (pre-treatment). This is also a Fire Regime Restoration and Invasive Species Severity monitoring question.

2P-5. What is the change in acres of hiding cover and thermal cover for deer and elk?

Elk and deer are culturally and economically important game species on the DCFP landscape. A 2009 assessment that included the DCFP landscape found that forage for mule deer have declined 20% to 30% since fire exclusion. Changes in elk and deer cover also provide a proxy for changes in vegetation clumps and openings on the landscape. In 2014, this question will be monitored on the Glaze, SAFR, and West Tumbull projects, where mechanical treatments have been completed.

Other questions considered but not prioritized for monitoring in 2014

Other monitoring questions considered by the monitoring subcommittee are described in the Appendix. Some of these, including questions related to mixed conifer habitats, aspen and hardwood habitat, user-created roads, and gaps in ponderosa pine and dry mixed conifer forests were considered high priority, but were not selected for monitoring in 2014 either because projects addressing these habitat types have not yet been implemented, feasible and reliable methods have not yet been identified, or the method identified would require substantial outside funding. For instance, no projects have been completed in mixed conifer wet-successional forest habitat, and the sub-committee has not yet identified a reliable and feasible method for monitoring user-created roads or gap size, abundance, and distribution. It is likely that some of these questions will be added to the monitoring plan in future years.

Table 3. Fish and Wildlife Habitat Condition monitoring protocol

Question		Indicator Species	Metrics	Methods	Data Source(s)	Data Management	Monitoring and Cost Schedule	Responsible Party	Products
2L-1	What is the change in acres of successional classes for all PAGs and the ecological departure (condition class) of each PAG relative to its HRV?	All forest wildlife species		See Fire Regime Restoration Monitoring Protocol					
2L-2	What is the change in total system road and trail densities?	All wildlife species	Total system road and trail densities	GIS density analysis	DNF system road and trail data	DNF GIS database	Every 5 years. $1,000 per analysis	DNF Wildlife Program Manager and Transportation Planner	Mapped and tabular results; narrative interpretation
2L-3 & 2P-1	What is the change in acres of core habitat?	All wildlife species	Acres of core habitat	GIS buffer analysis	DNF system road and trail data	DNF GIS database	2L-3: 5 yrs, 2P-2: pre- and post-project. $500/analysis	DNF Wildlife Program Manager and Transportation Planner	Mapped and tabular results; narrative interpretation
2L-4 & 2P-2	What is the change in acres of open, single-story, late-successional ponderosa pine forest habitat?	White-headed woodpecker; Pygmy nuthatch	PAG; Seral Stage; Structure Class; Tree Density	Wildhab modeling of forest structural components required by the indicator species	DNF PAG data; 2010 GNN data; DecAid Habitat Type; Viable Model; FACTS	DNF GIS database	2L-5: 5 years 2P-3: pre- and post-project. $500/analysis	DNF Wildlife Program Manager and USFS Regional Office	Mapped and tabular results; narrative interpretation
2P-3	What is the change in acres and improvement of meadow habitat (wet and dry)?	Great gray owl	Historical acreage; Soil profile; Soil description; PAG	Wildhab modeling of forest structural components required by Great gray owl; soil survey, photo points.	PAG data, 2010 GNN data, DecAid Habitat Type, photo points, soil survey	DNF GIS database	Pre- and post project. $6,000 per project	DNF Wildlife Program Manager and Soil Scientist	Mapped and tabular results; narrative interpretation
2P-4	What is the change in acres of hiding cover and thermal cover for deer and elk?	Elk and mule deer	TPA, tree size and height, patch size, and canopy cover	Wildhab modeling of forest structural components required for elk and mule deer	2010 GNN data	DNF GIS database	Pre- and post-project; $500/project	DNF Wildlife Program Manager and USFS Regional Office (R6)	Maps, tabular results, narrative interpretation

Fish and Wildlife Habitat Condition monitoring protocol, continued

Monitoring Question		Indicator Species	Metrics	Methods*	Data Source(s)	Data Management	Monitoring and Cost Schedule	Responsible Party	Products
2P-5	What is the change riparian vegetation health in response to restoration treatments?	Project-dependent		See Watershed Condition Monitoring Protocol					
2P-6	What is the change in aquatic ecosystem health in response to stream channel, floodplain, wetland, and meadow restoration treatments?	Project-dependent		See Watershed Condition Monitoring Protocol					
2P-7	What is the effect of aquatic restoration treatments on aquatic organisms and species of concern?	Project-dependent		See Watershed Condition Monitoring Protocol					
2P-8	How are DCFP projects affecting fish passage?	Project-dependent		See Watershed Condition Monitoring Protocol					
2P-9	What is the change in understory plant cover in ponderosa pine, dry mixed conifer, and moist mixed conifer PAGs?	All wildlife species		See Fire Regime Restoration Monitoring Protocol					

Watershed Condition

The national monitoring guidance for Indicator 3 – Watershed Condition – states that every CFLRP project should use the Watershed Condition Framework (WCF) to monitor Watershed Condition in every 6th Order HUC subwatershed on the CFLR landscape. In addition, CFLR projects are to monitor progress toward specific Watershed Condition goals identified in their original proposals

The DCFP proposal describes one of the principal goals of the CFLR project as "…supporting the re-introduction of anadromous fish in to the upper Deschutes Basin.... Key objectives for restoring these watersheds and facilitating the re-introduction of steelhead and Chinook salmon to Whychus Creek are restoring natural stream channel morphology and floodplain connection, reducing road densities, restoring native riparian plan communities (particularly hardwoods), and addressing barriers to fish passage." Restoration activities outlined in the proposal to achieve these objectives include geomorphic stream restoration and re-connection of the channel...to its floodplain, fish screening and passage projects…, road maintenance and decommissioning, large woody debris enhancement,…re-establishment of riparian plant communities, and thinning post-fire ponderosa pine plantings to reduce fuels and invigorate aspen and spruce stands in riparian areas. Water quality and aquatic habitat monitoring described in the DCFP proposal (see Fish and Wildlife Habitat Condition) also apply here. In addition, "The City of Bend will collect water quality data … during the 7 year period that restoration activities are occurring [in the Drink NEPA planning area]."

Question numbering for this indicator is as follows: the first number refers to the indicator (3 – Watershed Condition); the letter refers to scale (L–landscape; S–subwatershed, or P–NEPA project).

3L-1. What is the change in watershed condition score for all HUC 6 subwatersheds within the landscape?

This question meets the national requirement to use the USFS Watershed Condition Framework (WCF) for landscape-scale monitoring. WCF offers a coarse-scale integrated assessment tool to evaluate the combined effectiveness of all DCFP treatments (aquatic and terrestrial) aimed at improving watershed function.

3S-1. What are the effects of terrestrial and aquatic restoration treatments on water quality in Upper Whychus subwatershed?

This question helps the DCFP track progress toward two major goals – maintaining municipal drinking water and facilitating the reintroduction of anadromous fish. In 2014, this question will be monitored in the Upper Whychus subwatershed using water quality metrics important to aquatic ecosystem health for anadromous fish. These are compiled by the Upper Deschutes Watershed Council. In future years, drinking water quality will be monitored in the Upper Tumalo Watershed before, during, and after implementation of the Drink project. This is also a Fish and Wildlife Habitat Condition monitoring question.

3S-2. What is the change in total system road and trail density in each HUC 6 subwatershed?
3S-3. What is the change in total system road and trail density in riparian zones and sensitive land types in each HUC 6 subwatershed?

Roads and trails have a range of impacts on watershed function, both terrestrial and aquatic. For instance, roads and trails are principal sources of sedimentation, and so measuring road and trail density in riparian zones and sensitive land types provides a proxy measure of change in water quality due to erosion and sedimentation. Reducing road density is a key DCFP watershed restoration objective. Also, 'system roads and trails' is a terrestrial indicator within the Watershed Condition Framework assessment, and having spatial monitoring data regarding road and trail density will improve the WCF evaluation process (question 3L-1).

3S-4. What is the change in miles of hydrologically connected open and closed system roads and trails with all streams in each HUC 6 subwatershed?

This question has the greatest potential to evaluate actual road and trail impacts on aquatic ecosystem health, unlike questions 3S-2 and 3S-3, which are proxies of aquatic impacts. While the initial cost to collect baseline data is high, this question and associated data are of great interest to the Deschutes National Forest as a means to improve future planning and management by targeting the most impactful roads and trails for repair or decommissioning. Future monitoring costs will be significantly lower.

3P-1. What is the change in riparian vegetation health in response to restoration treatments?

Riparian vegetation health is important to watershed function for several reasons, including bank stability, sediment and nutrient trapping, nutrient and wood debris inputs to streams, and streamside shade to regulate water temperature. Riparian ecosystem restoration is a major interest of many DCFP stakeholders and a key objective in the DCFP proposal, and several NEPA projects on the DCFP landscape include treatments designed to restore riparian vegetation and require riparian vegetation monitoring. In 2014 this question will be monitored on Glaze, Indian Ford Restoration, Whychus Floodplain, Three Sisters Irrigation District, and Ryan Ranch projects. This is also a Fish and Wildlife Habitat Condition monitoring question.

3P-2. What is the change in aquatic ecosystem health in response to stream channel, floodplain, wetland, and meadow restoration treatments?

This question addresses a key objective in the DCFP proposal: facilitating the reintroduction of anadromous fish by restoring stream channel morphology, floodplain connectivity, and wetland function. This question would only be monitored on projects where treatments are designed to restore those components of the aquatic ecosystem. In 2014 this question will be monitored on the Three Sisters Irrigation District and Whychus Floodplain projects. This is also a Fish and Wildlife Habitat Condition monitoring question.

3P-3. What is the effect of aquatic restoration treatments on aquatic organisms and species of concern? Like 3P-2, this question addresses the effects of restoration treatments on aquatic organisms and species of concern, particularly anadromous fish. In 2014 this question will be monitored by the

Upper Deschutes Watershed Council in the Upper Whychus subwatershed. This is also a Fish and Wildlife Habitat Condition monitoring question.

3P-4. How are DCFP projects affecting fish passage?

As noted above, an important objective of the DCFP is to facilitate the reintroduction of anadromous fish in the Upper Deschutes Basin. The DCFP proposal states that its projects will include fish screening and passage projects at water diversions and road crossings. In 2014 this question will be monitored on the Three Sisters Irrigation District and Whychus Floodplain projects. This is also a Fish and Wildlife Habitat Condition monitoring question.

Table 4. Watershed Condition monitoring protocol

	Question	Metrics	Methods	Data Source(s)	Data Management	Monitoring & Cost Schedule	Responsible Party	Products
3L -1	What is the change in WCF condition score for all HUC 6 subwatersheds within the CFLR landscape?	Individual and weighted WCF Score	USFS ID team process to integrate treatments, evaluate effects, and recalculate WCF condition and function score based on methodology in 4 WCF technical guides (insert citations)	USFS DNF databases and GIS data; WCATT database	USFS national WCATT database	5 years, $8,000 every 5 yrs	DNF Watershed Program Leader, USFS ID Team	Tabular results, Narrative
3S -1	What are the effects of terrestrial and aquatic restoration treatments on water quality in the Upper Whychus subwatershed?	Anadromous fish water quality measures (water quality, temperature, stream flow)	See UDWC *Whychus Creek Water Quality Status, Temperature Trends, and Stream Flow Restoration Targets* (2014) and UDWC *Whychus Creek Stream Flow* (2013)	UDWC	UDWC databases and annual report	Annual. $0 in 2014; <$1,000 for Tumalo in future years	UDWC, DNF Watershed Program Leader	UDWC annual report and narrative
3S -2	What is the change in total system road and trail density in each HUC 6 (subwatershed)?	Miles of Class 1-5 roads and system trails/square mile	GIS analysis of system road and trail density by HUC6 and NEPA project	USFS DNF system road and trail GIS data	USFS DNF GIS databases	5 years. No additional cost if 2L-2 is monitored.	DNF Watershed Program Leader, DNF Transportation Planner	Mapped and tabular results
3S -3	What is the change in total system road and trail density in riparian zones and sensitive land types in each HUC 6 (subwatershed)?	Miles of Class 1-5 roads and trails/square mile in riparian zones and sensitive land types as defined by DNF	GIS analysis of system road and trail density within riparian zones and sensitive land types, by HUC 6 and NEPA project	USFS DNF system road and trail GIS data	USFS DNF GIS databases	Every 5 years. No cost if 2L-2 is monitored.	DNF Watershed Program Leader, DNF Transportation Planner	Mapped and tabular results
3S -4	What is the change in miles of hydrologically connected total system roads and trails with all streams in each HUC 6 (subwatershed)?	Miles of hydrologically connected open and closed system roads and trails	Baseline Data Collection: Field surveys and GPS mapping by seasonal and/or volunteer crew. Data to be compiled in USFS DNF GIS database for subsequent analysis of miles of hydrologically connected roads and trails	USFS DNF GIS database	USFS DNF GIS databases	Every 5 years. $20,000 in 2014, $1,000 in 2019, 2024	DNF Watershed Program Leader, seasonal and/or volunteer crew	Mapped and tabular results

Watershed Condition monitoring protocol, continued

	Question	Metrics	Methods	Data Source(s)	Data Management	Monitoring & Cost Schedule	Responsible Party	Products
3P -1	What is the change in riparian vegetation health in response to restoration treatments?	Project-specific. May include: canopy density, riparian vegetation abundance and diversity, species composition	Glaze, Whychus Floodplain, Indian Ford Restoration: Angular canopy density/Solar Pathfinder Three Sisters Irrigation Dist., Ryan Ranch: Repeat photography Ryan Ranch: Vegetation transects	Field surveys, photographs	USFS DNF databases	Pre- and post-project. $5,500 in 2014	DNF Watershed Program Leader	Mapped and tabular results; narrative interpretation
3P -2	What is the change in aquatic ecosystem health in response to stream channel, floodplain, wetland, and meadow restoration treatments?	Project-specific. Include stream morphology metrics (channel dimension, pattern, and profile)	Three Sisters Irrigation District: cross sections, longitudinal profile; Whychus Floodplain: cross section, sediment survey (Wolman pebble count and/or bed cores); Indian Ford: repeat photography	Field surveys, photographs	USFS DNF databases	Pre- and post-project. $5,500 in 2014	DNF Watershed Program Leader	Mapped and tabular results; narrative interpretation
3P -3	What is the effect of aquatic restoration treatments on aquatic organisms and species of concern?	Project-specific; include benthic macroinvertebrate surveys	See UDWC *Effectiveness Monitoring in Whychus Creek; Benthic Macroinvertebrate Communities in 2005, 2009, and 2011-2013 (2013)*	Field surveys	UDWC database	Annual. $0 in 2014	Upper Deschutes Watershed Council	Mapped and tabular results; narrative interpretation
3P -4	How are DCFP projects affecting fish passage?	Project-specific; include number of fish barriers removed and miles of stream re-connected	Photo points, repeat photography	Field surveys, photographs	FACTS	Pre- and post-project. $1,000 in 2014	DNF Watershed Program Leader	Mapped and tabular results; narrative interpretation

Invasive Species Severity

According to the national monitoring guidance for Indicator 4 – Invasive Species Severity – CFLR projects are to monitor whether the landscape has met its objectives with respect to invasive species management actions taken on both existing and new infestations. For known infestations, monitoring should address 1) the number of acres to be restored and 2) the desired average treatment efficacy level. For previously undetected infestations addressed through Early Detection and Rapid Response (EDRR), the monitoring should evaluate spatial and temporal effects of treatment and specify a planned treatment efficacy level of 100%.

The DCFP's 2012 CFLRP proposal addendum states that the Collaborative will treat 9,800 acres of invasive species infestations from 2009 to 2019. The DNF Invasive Species Environmental Impact Statement states that the desired efficacy level for known infestations is an 80% reduction in invasive plant density. DNF Weed Coordinators note that all Forest EDRR treatments have a planned treatment efficacy level of 100%, and this is assessed immediately post treatment. However, due to a number of factors, most notably seedbank persistence, it is not feasible to achieve 100% treatment efficacy at any time except immediately post-treatment.

For this indicator, questions demarked by an *L* are landscape-scale, *P* refers to NEPA project-scale, and *T* refers to invasive species treatment scale, as treatment areas are generally not linked to NEPA projects.

4L-1a. How many acres of high priority invasive plant infestations are treated across the DCFP landscape? 4L-1b. Where are treatments located relative to known invasive plant infestations?

The first part of this question responds to the national requirement. Spatially displaying the location of treatments sites relative to known invasive plant populations provides a useful tool to build common understanding of both the rate of treatment and the rate and pattern of spread of invasive species across the landscape.

4L-2. What is the average percent reduction in invasive plant density across all treated areas?

Invasive species treatments generally decrease the density of plants within infestations but not the size of infestations, due to the presence of a seedbank. Therefore it is more useful to measure changes in invasive plant density than size of infestations. This monitoring question is explicitly required in the national guidance. In 2014, this question will be monitored on all invasive species treatment sites within the DCFP landscape. Based on analysis of the 2014 data, monitoring in future years will focus on treatment types where a significant number of treatments did not achieve 80% efficacy in 2014. Future monitoring may also focus on select EDRR sites to measure temporal effects of EDRR treatments. Focusing monitoring on key treatment methods and treatment sites will reduce costs and inform adaptive management.

4T-1. How many new invasive plant infestations are found in selected NEPA project areas?

Monitoring this question provides feedback on the effectiveness of project mitigation measures intended to reduce the likelihood of new infestations in invasive species-free areas and could inform future refinement of mitigation measures and best management practices. The monitoring method is qualitative and would NOT determine causes of new infestations. In 2014 this question will be monitored in the Pole Creek project. In future years it will be monitored in the Ursus project on the Bend-Fort Rock Ranger District.

4P-1. What is the change in understory cover composition in ponderosa pine, dry mixed conifer, and moist mixed conifer plant association groups?

This question evaluates resilience and resistance to invasive species infestation by identifying changes in understory plant cover, including presence/absence of invasive plants pre- and post-treatment. It is cost-effective to monitor because data can be gathered using the photo point method also used for Fire Regime Restoration and Wildlife Habitat Condition monitoring.

Table 5. Invasive Species Severity monitoring protocol

Question		Metrics	Methods	Data Source(s)	Data Management	Monitoring & Cost Schedule	Responsible Party	Products
4L 1a	How many acres of high-priority invasive plant infestations are treated across the DCFP landscape?	Acres treated	Query NRM Invasive Plant Inventory Database for total acres of high-priority infestations. Query FACTS for total acres treated that year.	NRM Invasive Plant Inventory Database; FACTS	NRM Invasive Plant Inventory Database (IPID)	5 years $600	DNF Invasive Plant Manager; District Weed Coordinators	Acres treated and narrative interpretation
4L 1b	Where are treatments located relative to known invasive plants infestations?	Mapped location of infestations & treatments	GIS analysis: overlay treatment sites on known invasive plant site polygons	NRM Invasive Plant Inventory Database; FACTS	DNF GIS database	5 years $600	DNF Invasive Plant Manager, District Weed Coordinators	Map and narrative interpretation
4L 2	What is the average percent reduction in invasive plant density across all treated areas?	Percent reduction in invasive plant density	Professional inventory of all treatment sites to collect site data and population density estimates pre- and post-treatment	Site inventory; Deschutes/ Ochoco Invasive Plant Inventory Form	Deschutes/ Ochoco Invasive Plant Inventory Form (IPIF); FACTS; NRM IPID	Annual $20,000 in 2014; then $5,000/yr	DNF Invasive Plant Manager, District Weed Coordinators,	Average percent reduction and narrative interpretation
4T 1	How many new invasive plant sites were found in treatment areas on selected NEPA projects areas?	Presence/ absence, Site characteristics, Mitigation measures	Strategic sampling in high probability areas (skid roads, landings, reconstructed/ decommissioned roads, etc)	Site surveys; Deschutes/ Ochoco Invasive Plant Inventory Form	Deschutes/ Ochoco IPIF FACTS; NRM IPID	Pre- and post-treatment $4,000/yr	DNF Invasive Plant Manager, District Weed Coordinators	Narrative description of site characteristics, potential vectors, mitigation measures used
4P 1	What is the change in understory cover in ponderosa pine, dry mixed conifer, and moist mixed conifer PAGs?		See Fire Regime Restoration Monitoring Protocol					

Detailed Monitoring Methods

Section contents

This section contains detailed methods for and/or citations to published methods for questions to be monitored in 2014. Project-level methods apply to projects being monitored this year and will be used for pre- and post-project monitoring on these projects. The project-level methods may or may not be used on future projects depending on project-specific objectives and NEPA monitoring requirements. Landscape-level methods will not change over the life of the DCFP project.

Table 6. Monitoring methods for each monitoring question

Q#	Monitoring method(s)	Page #
1L-1	Measuring forest structure and condition class departure from modeled reference conditions	26
1L-2	Fire behavior modeling	27
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1P-3	Treatment effects on fire behavior using FTEM and MTBS	30
2L-1	Measuring forest structure and condition class departure from modeled reference conditions	26
2L-2	GIS analysis of DNF system road and trail data	32
2L-3	GIS buffer analysis for core habitat	32
2L-4	Management Indicator Species (MIS) modeling	33
2P-1	GIS buffer analysis for core habitat	32
2P-2	Management Indicator Species (MIS) modeling	33
2P-3	Soil survey and site assessment for meadow monitoring	41
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2P-5	Repeat photography, Angular canopy density, Vegetation transects	29, 43
2P-6	Repeat photography, Stream morphology transects	29, 43
2P-7	Benthic macroinvertebrate surveys	43
2P-8	Repeat photography	29
2P-9	Understory monitoring using photo points	28
3L-1	Watershed Condition Framework protocol	41
3S-1	Water quality	41
3S-2, 3S-3	GIS analysis of DNF system road and trail data	32
3S-4	Road-Stream Interaction Survey Protocol	41
3P-1	Repeat photography, Angular canopy density, Vegetation transects	29, 43
3P-2	Repeat photography, Stream morphology transects	29, 43
3P-3	Benthic macroinvertebrate surveys	43
3P-4	Repeat photography	29
4L-1	Acres and mapped location of invasive species treatments	44
4L-2	Invasive plant density	44
4T-1	Strategic sampling for invasive plants	44
4P-2	Understory monitoring using photo points	26

Measuring forest structure and condition class departure from modeled reference conditions

Successional class departure within each Plant Association Group (PAG) is calculated using baseline (2009) acres and 5, 10, or 15 year successional class (s-class) layer according to the LandFire tool (see FRCC Mapping Tool User Guide v3.0.0 2012). Five, 10, and 15 year s-class layers will be derived from a crosswalk informed by exert opinion based on pre-treatment condition, the treatment size and type, and the resulting post-treatment forest structure condition.

Changes in successional class abundance (S-Class) within each PAG can be shown as follows:

Plant Association Group	S-Class A *acres*					S-Class B *acres*					S-Class C *acres*					S-Class D *acres*					S-Class E *acres*				
	200	RC	5yr	10yr	15yr	200	RC	5yr	10yr	15yr	200	RC	5yr	10yr	15yr	200	RC	5yr	10yr	15yr	200	RC	5yr	10yr	15yr
Lodgepole Pine Dry																									
Lodgepole Pine Wet																									
Mixed Conifer Dry																									
Mixed Conifer Wet																									
Mountain Hemlock Dry																									
Ponderosa Pine Dry																									
Ponderosa Pine Moist																									

Structure-based landscape departure analysis of forested PAGs will be modeled on the LandFire tool (see FRCC Mapping Tool User Guide v3.0.0 2012). Specific inputs to this analysis include:

- DNF forest PAG layer (crosswalk from LandFire BPS layer);
- DNF s-class layer;
- DCFP landscape boundary layer;
- DNF PAG reference condition table.

Inputs are run through LandFire Mapping Tool selecting outputs for “Stratum Veg Departure” and “Stratum Veg Condition Class”, which compares the abundance of each s-class for each PAG to its Historic Range of Variability (derived from modeled reference condition) creating a metric of ecological departure referred to as vegetation condition class (VCC).

Percent of each Plant Association Group in each Vegetation Condition Class (VCC) can be shown as follows:

Plant Association Group	VCC 1 %				VCC 2 %				VCC 3 %			
	2009	5yr	10yr	15yr	2009	5yr	10yr	15yr	2009	5yr	10yr	15yr
Lodgepole Pine Dry												
Lodgepole Pine Wet												
Mixed Conifer Dry												
Mixed Conifer Wet												
Mountain Hemlock Dry												
Ponderosa Pine Dry												
Ponderosa Pine Moist												

Fire behavior modeling

Draft methods are provided below. These will be further developed, tested, and finalized in spring 2014. Responsible Parties: Deana Wall, Fuels Program Lead, Central Oregon Fire Management Service and Pete Caligiuri, Forest Ecologist, The Nature Conservancy, working with Chris Zanger, Forest Analyst, The Nature Conservancy and Nicole Vaillant, Fire Ecologist, Western Wildlands Environmental Threat Assessment Center.

Forest structure

1. Input baseline DCFP forest structural conditions (average stand diameter and stand density). Dataset options include LiDAR and GNN.
2. Create updated post-treatment structural condition layer based on Forest and Project treatment specifications, silviculturist and marking crew input, and FACTS database within treatment polygons to create crosswalk: pre-treatment condition → treatment type → post-treatment structure condition.
3. Compare pre- and post-treatment structure to report change in average stand diameter and stand density.

Forest fuels

1. Utilize fuels planning data to determine pre-treatment forest fuels conditions as defined in Scott and Burgan 40 fuel models.
2. Perform rapid qualitative field survey methodology based on locally appropriate fuel model photoseries to evaluate treatment effects on fuel model change.
3. Incorporate and utilize photo point monitoring data whenever available to further inform fuel model change.
4. Compare pre- and post-treatment fuel model to report change forest fuels conditions.

Fire behavior

1. Input baseline (2009) DCFP forest structure and fuel model conditions and run FSIM fire behavior model.
2. Input updated post-treatment forest structure and fuel model conditions and run FSIM fire behavior model.
3. Compare pre- and post-treatment model outputs to report change in key fire behavior metrics (e.g. fire intensity level, rates of spread, torching and crown fire potential, and exposure analysis by PAG).

Understory monitoring using photo points

Monitoring units will be selected based on a stratification of ponderosa pine, dry mixed conifer, and moist mixed conifer PAGs and the principal treatment types within each project. The objective is to visually document effects of the major treatments and so consequently, some treatments may not be monitored. Unit access will also be a factor in unit selection to facilitate establishment of the desired number of photo point plots across the DCFP landscape.

Sampling design:

1. Determine which treatment combinations are represented, and how they are distributed across the districts.
2. Identify prospective units with good access, preferably units near each other (less time driving/hiking means more plots accomplished).
3. Select measurement units, at least one per district if possible, and prioritize a first and second choice. (Aim for one unit per PAG/treatment combination, but it's handy to have a backup plan.)
4. Monitoring teams will create a grid of six photo points within each selected unit. If time permits, more plots may be added on the grid.

Sampling schedule:

1. Photographs should be taken when grasses are in seed. In most years this timeframe will be late June through August, depending on elevation.
2. A team will probably be able to complete 1-3 units per day, depending on drive time. Measuring thirty different units in a week is ambitious, but could potentially be accomplished with three teams. (Five or six volunteers, plus a monitoring coordinator who will provide training and oversight for the volunteer teams collecting data.)
3. Initial photo monitoring will be done in 2014, and repeated in 5-year intervals. The 2019 and 2024 monitoring will identify when treatment(s) occurred AND which treatments have been completed as of the photomonitoring date (e.g., mechanical completed; prescribed fire not completed) and therefore how many years post-treatment is shown in the repeat photos.

Protocol for photo points

A. Flag and tag the tree nearest plot center (avoiding trees marked for cutting. NOTE: in most DCFP restoration treatments in dry and moist forest types thinning from below is the most common prescription, so choosing the largest, most vigorous tree to tag is a good bet). On the plot form, record distance and bearing FROM the tagged tree to the photo point. If possible, make a small rock cairn at the photo point and include the tagged tree in one of the cardinal photos.

B. Standing at plot center, take five photos:
    1. Focused on the plot form to identify plot number and date. (e.g., "DCFP-23: 06-28-14")
    2. Looking North and level.
    3. Looking East and level.
    4. Looking South and level.
    5. Looking West and level.

C. Anchor a measuring tape at plot center and stretch the tape 3 meters to the North. Lay the 2'x2' Nested Rooted Frequency (NRF) frame so that its left edge touches the tape and its top left corner is at the 3 meter mark.
    1. Take a photo of the plot form AGAIN. (As before, this will identify the next four photos. It is superfluous, but when transferring and labelling photo files, it is easier to track a set of ten using the file numbers.)
    2. Take a photo looking straight down at the NRF frame, so that it nearly fills the camera frame.
    3. Move the tape and NRF frame so that it is 3 meters East of plot center, and take a photo looking down at the frame.
    4. Repeat the previous step 3 meters South of plot center.
    5. Repeat the previous step 3 meters West of plot center.

D. Using the invasive plant identification photos provided, note on each photo-point form any invasive species seen while hiking to that point, and whether the sighting included less than five plants, less than 50 plants, or more than 50 plants. Additionally, crews will note whether there are invasive species within a radius of 11.7' of any plot center (1/100th acre).

E. Record unit, site, location, and species data on photo monitoring form.

Data management
Photographs will be stored digitally in two locations: at the Deschutes National Forest and The Nature Conservancy's Central Oregon Field Office.

Repeat photography
For riparian vegetation health, stream channel treatments, and projects affecting fish passage, locate original photo points and follow the photo point protocol used for the pre-project photos.

For repeat photography on the Glaze project, relocate original Firemon plot centers and re-measure them using the above protocol for understory monitoring using photo points.

Treatment effects on fire behavior using FTEM and MTBS

For each fire up to 1,000 acres that burns into DCFP treatments:

1. As soon as possible after the fire, complete the Fuel Treatment Effectiveness Monitoring (FTEM) protocol. *(See excerpt from User Guide for Fuel Treatment Effectiveness (FTE) on the following page. The complete user guide is available from Deana Wall, Fuels Program Leader, Central Oregon Fire Management Service.)* Complete as many fields as possible, including:
    a. Treatment unit name
    b. Treatment type
    c. Acres of treatment burned
    d. Treatment data
    e. Fuel model inside treated area
    f. Fuel model outside treated area
    g. Flame length
    h. How did the treatment contribute to the control of the fire
    i. Dominant type of fire spread outside the unit
    j. Dominant type of fire spread inside the unit

2. Before November 1, review the FTEM data, including any maps, photos, or other written documentation included in the FTEM report, and write a brief narrative description of the effects of the restoration treatments on fire behavior/effects.

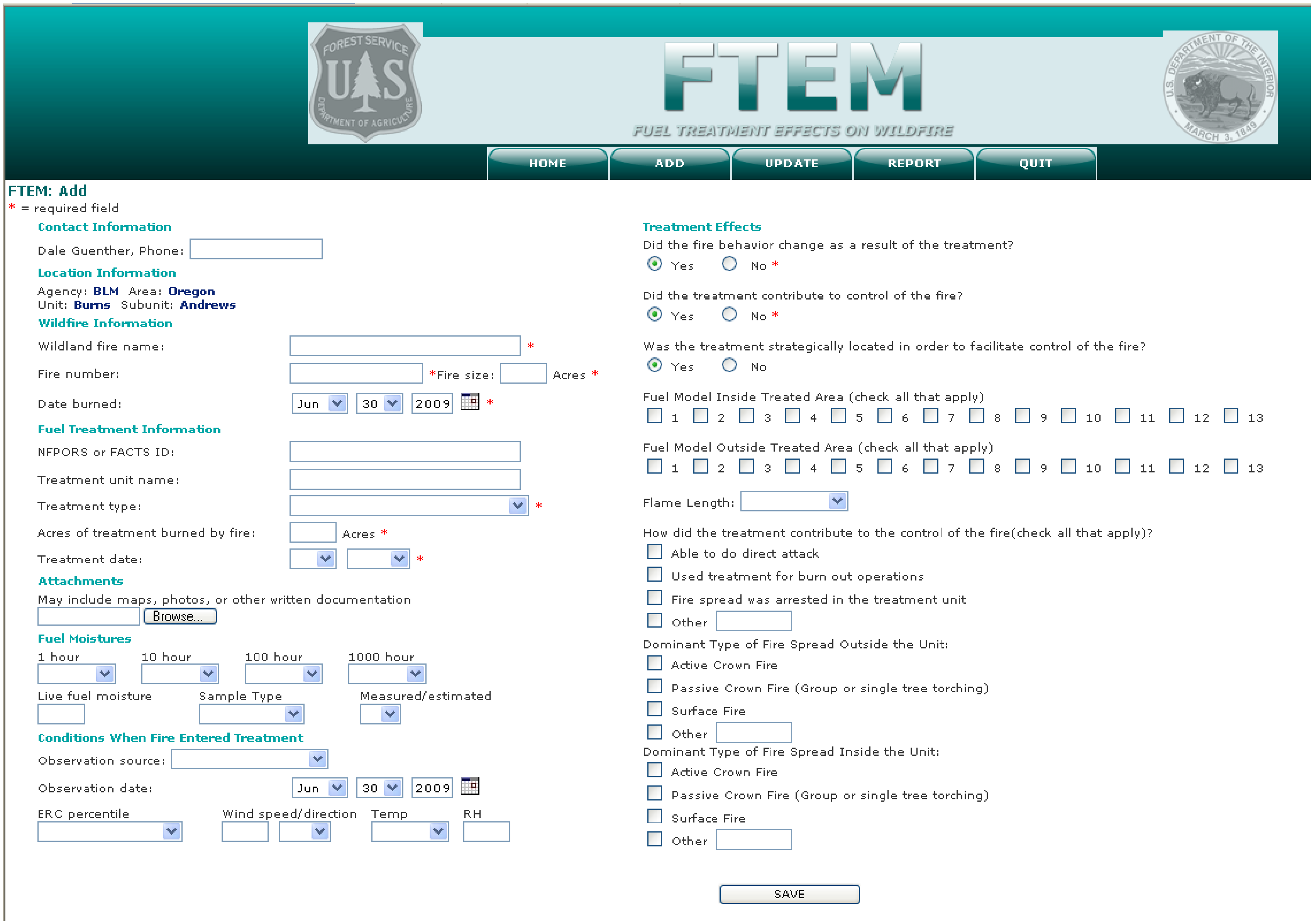
For each fire 1,000 acres and larger that burns into DCFP treatments:

1. Review Burned Area Reflectance Classification (BARC) data as soon as it is available and extract:
    a. Summary of high, moderate and low soil burn severity and the spatial location of restoration treatments within the mapped burn perimeter.
2. Review Monitoring Trends in Burn Severity (MTBS) data as soon as it is available and extract:
    a. Summary of high, moderate, and low burn severity and the spatial location of restoration treatments within the mapped burn perimeter.
3. Before November 1, review the complete BARC and/or MTBS-derived summaries from the fire and write a brief narrative description of the effects of restoration treatments on fire behavior/effects.

For a full description of BARC analysis, see: http://www.fs.fed.us/eng/rsac/baer/barc.html#A4

For the full MTBS analysis methodology, see:

Eidenshink, J., B. Schwind, K. Brewer, Z. Ahu, B. Quayle and S. Howard. 2007. A project for monitoring trends in burn severity. *Fire Ecology* 3(1):3-21. Available at: http://www.mtbs.gov/documents_references.html



FTEM
FUEL TREATMENT EFFECTS ON WILDFIRE

HOME | ADD | UPDATE | REPORT | QUIT

FTEM: Add

* = required field

Contact Information

Dale Guenther, Phone:

Location Information

Agency: **BLM** Area: **Oregon**
Unit: **Burns** Subunit: **Andrews**

Wildfire Information

Wildland fire name: *

Fire number: *Fire size: Acres *

Date burned: Jun 30 2009 *

Fuel Treatment Information

NFPORS or FACTS ID:

Treatment unit name:

Treatment type: *

Acres of treatment burned by fire: Acres *

Treatment date: *

Attachments

May include maps, photos, or other written documentation

Browse...

Fuel Moistures

1 hour | 10 hour | 100 hour | 1000 hour

Live fuel moisture | Sample Type | Measured/estimated

Conditions When Fire Entered Treatment

Observation source:

Observation date: Jun 30 2009

ERC percentile | Wind speed/direction | Temp | RH

Treatment Effects

Did the fire behavior change as a result of the treatment?
Yes No *

Did the treatment contribute to control of the fire?
Yes No *

Was the treatment strategically located in order to facilitate control of the fire?
Yes No

Fuel Model Inside Treated Area (check all that apply)
1 2 3 4 5 6 7 8 9 10 11 12 13

Fuel Model Outside Treated Area (check all that apply)
1 2 3 4 5 6 7 8 9 10 11 12 13

Flame Length:

How did the treatment contribute to the control of the fire(check all that apply)?
- Able to do direct attack
- Used treatment for burn out operations
- Fire spread was arrested in the treatment unit
- Other

Dominant Type of Fire Spread Outside the Unit:
- Active Crown Fire
- Passive Crown Fire (Group or single tree torching)
- Surface Fire
- Other

Dominant Type of Fire Spread Inside the Unit:
- Active Crown Fire
- Passive Crown Fire (Group or single tree torching)
- Surface Fire
- Other

SAVE

GIS analysis of DNF system road and trail data

Road and trail densities are calculated with GIS data using the following process:

1. The desired road or trail layer file or geodatabase element is added from ArcCatalog into the ArcMap Table of Contents, as is the polygon file of the geographic unit within which density calculations are desired.
2. From Arc Toolbox, the "Intersect" tool is selected from the "Overlay" group, and the specific road or trail layer and geographic polygon are selected as input features.
3. The Output Feature Class pathway is established to store the output as a geodatabase element in either an existing or newly created file geodabase or as a shapefile. (NOTE: If layer files are being used to supply the data, we usually favor saving the output into the geodatabase because field labeling conventions for shapefiles truncate the label names and drop the meaningful part of the column labels.)
4. The output file is essentially the road or trail layer "clipped" to the polygon (or polygons, as when doing an intersection of roads and trails with several 12th field subwatersheds).
5. The attribute table for the new "Intersect" layer is opened, a new field is created (we call it Miles2) and mileage is recalculated for each road segment in this field using the "calculate geometry" application found when highlighting the new field and right-clicking. Once this has been done, this attribute table is exported to a spreadsheet and saved; we use the XTools extension because it provides for direct export to an Excel spreadsheet, but Arcmap also has the capability by clicking the Table Options button in the attribute table and selecting "export" and saving as a dBase file which can then be opened from its saved location and resaved as an Excel spreadsheet (which is why I use the XTools extension).
6. A pivot table is created displaying miles by whatever attribute one is analyzing (Maintenance Level, Open Roads, All Roads, motorized or non-motorized trails, or whatever) and by polygon; the area of individual polygons in square miles is inserted into the table wherever and however one wants to do that, and cell equations are written to accumulate mileage by the aforementioned attribute and divide those accumulations by the applicable polygon's area (in square miles).

GIS buffer analysis for core habitat

To determine the amount of habitat disturbed and undisturbed (core habitat):

1. Apply a 200 meter buffer to either side of system roads and motorized trails or a 100 meter buffer either side of non-motorized trails to determine the number of habitat acres within the road effect distance. This will help to determine the amount of core habitat outside the road-effect distance buffer. Acres within the road-effect distance are considered disturbed habitat.
2. Apply a 200 meter buffer to all system roads and motorized trails and a 100 meter buffer to non-motorized trails on the Deschutes National Forest regardless of road surface, travel speed or use parameters. This is to display the road- effect distance where effects to wildlife species are the greatest.

Selection of the 200-meter buffer was based on a literature review to determine at what distance from roads impacts are seen relative to disturbance and edge effects. Forman (2000) described a "road effect distance" of 200 meters for secondary roads to calculate the indirect loss of habitat and the displacement of many species. Forman also mentions the road effect zone is highly variable and is dependent on the species affected, adjacent habitat, road type, and traffic volume. Noss and Cooperrider (1994) report edge effects are nonlinear and the zone varies in width depending on what is being measured. They report edge effects as great as 240 meters. Therefore, the 200 meter road effect distance was selected to assess edge effects as well. This distance may over-estimate effects for some species and under-estimate effects for others. However, this distance captures known effects for many species and provides a relevant measure of change between the existing condition and after project implementation.

Forman, R.T. 2000. Estimate of the area affected ecologically by the road system in the United States. *Conservation Biology* 14(1):31-35.

Noss, R.F. and A.Y. Cooperrider. 1994. *Saving Nature's Legacy: Protecting and Restoring Biodiversity.* Island Press. Washington D.C.

Management Indicator Species (MIS) modeling

MIS species and why they were chosen

The Deschutes National Forest Land and Resource Management Plan (LRMP) (USDA 1990a) identified a group of wildlife species as management indicator species (MIS). These species were selected because they represent other species with similar habitat requirements. Management indicator species can be used to assess the impacts of management activities for a wide range of wildlife species with similar habitat needs (FSM 2620.5). Those management indicator species selected for the Deschutes National Forest include the bald eagle, northern spotted owl, golden eagle, red-tail hawk, osprey, northern goshawk, Cooper's hawk, sharp-shinned hawk, great gray owl, great blue heron, woodpeckers (cavity nesters), peregrine falcon, California wolverine, elk, mule deer, American marten, Townsend's big-eared bat, and waterfowl.

Deschutes National Forest's MIS modeling approach

1. We conducted a full literature search for all pertinent literature for each species, based primarily on habitat but including other aspects of their biology.
2. Based on that literature, we determined the habitat parameters for reproductive habitat. This included PAGs, seral stage, structure, and density where available.
3. For those species that were very specific in their needs and vegetation data were not available to cover it, other existing data were used. For example, Great gray owl habitat was based on structure and natural openings, Red-naped sapspucker habitat was based on hardwoods, etc.
4. We used the Viable/Wildhab model to map habitat. Wildhab has several components:
    a. PAG – based on new classification by Simpson (2007).
    b. Seral Stage – worked with Mike Simpson and used the new plant association guide to determine the dominant tree species for each seral stage, etc.
    c. Size Structure – standard classification

   d. Density – based on vegetation data from Simpson
5. We then converted this information into Wildhab codes for each species.
6. We ran this information using GNN to produce potential reproductive habitat maps.
7. For the woodpeckers, we also ran a DecAid analysis to be able to overlay the habitat information with snag information.
8. We took out activities and fires because the GNN map used was 2004 or 2006 so we needed to account for these changes to date.

Simpson, M. A. 2007. *Forested Plant Associations of the Oregon East Cascades.* U.S. Dept. of Ag, Pacific Northwest Region Tech. Paper R6-NR-ECOL-TP-03-2007. Portland, OR.

Using the DNF MIS modeling approach

The following information was excerpted from the Deschutes National Forest report, *Final Working Habitats Modeling 27 March 2012.* It describes the methods to be used to model habitat for the Management Indicator Species listed as focal species in the DCFP *Ecological Monitoring Plan.* This paper was written to document how habitat was modeled for MIS species in 2012.

This process should be used to monitor hiding cover and thermal cover for deer and elk, meadow habitat using MIS Great gray owl, and open, single-story, late-successional ponderosa pine forest habitat using MIS White-headed woodpecker.

DISCLAIMER: This document was not written specifically for public consumption and may be difficult to understand for persons not familiar with modeling, ArcMap, or other Forest Service data sets and tools. An explanation of the data and tools are at the end of this document. For more guidance on completing this modeling, contact the Deschutes National Forest Wildlife Biologist.

Big Game

Deer hiding and thermal cover

The Deschutes Forest Plan defines suitable **deer hiding cover** as one of the following:

- six acres or larger capable of hiding 90 percent of a standing adult deer from view of a human at a distance of 200 feet, or
- 6 acres or larger with an average height of 6 feet and which has not been thinned in 15 years, or
- residual clumps of one half acre or larger stands within units with advanced regeneration (trees including whips up to 7" dbh) and at least 12 greater than 7 inch trees per acre remaining after harvest (DLRMP WL-54).

Model

To be conservative hiding cover for both species was modeled using GNN with the criteria of hiding 90 percent of a standing adult elk from view of a human at a distance of 200 ft. This condition was modeled using trees with a density of at least 469 trees/hectare (190 trees/acre or a tree every 15 ft) with a dbh of 3-25 cm (1-10 in) and at least 2 m (7 ft) tall. Fields containing this data in GNN and the definitions from the data dictionary include:

- TPH_3_25 – Density of live trees 2.5-25 cm dbh in trees/ha
- STNDHGT – Stand height, computed as average of heights of all dominant and codominant trees in meters.

- Minimum six acre patch size

The resulting hiding cover was updated by removing recent (since 2002) stand replacement fire and activities that reduced densities.

Hiding cover was mapped and calculated by subwatershed and aggregated up to watershed to simulate implementation units.

Cursory ground truthing of results were found to be accurate except in black bark pine. This model tends to overestimate hiding cover in black bark pine.

Deer thermal cover was modeled using GNN with the criteria of at least 40 percent canopy cover and tree height of at least 9 meters (30 ft) across deer winter range. Fields containing this data in GNN and the definitions from the data dictionary include:

- CANCOV – Canopy cover of all live trees; calculated using methods in the Forest Vegetation simulator
- STNDHGT – Stand height, computed as average of heights of all dominant and codominant trees.

Deer thermal cover was calculated across winter range by management unit.

Elk hiding and thermal cover

Suitable **elk hiding cover** is defined similarly to deer hiding cover and the same model was used.

- being six acres or larger capable of hiding 90 percent of a standing adult elk from view of a human at a distance of 200 feet, or six acres or
- larger with an average height of 10 feet and which has not been thinned in 20 years, or
- residual clumps of two acres or larger stands within units with advanced regeneration (trees including whips up to 7” dbh) and at least 12 greater than 7 inch trees per acre remaining after harvest (DLRMP WL-47).

Elk thermal cover must be in blocks at least 10 acres in size and have an average height of at least 40 feet with a minimum canopy cover of 40 percent (DLRMP WL-50).

Elk thermal cover was modeled using GNN with the criteria of at least 40 percent canopy cover and tree height of at least 12.2 meters (40 ft) across key elk areas and a minimum patch size of 10 acres. Thermal cover was updated by removing all recent fire and activities that reduced canopy cover or tree density.

This model tends to under-estimate thermal cover except in blackbark pine where it overestimates due to the density, age and self pruning that has occurred.

Roads

Open road densities were calculated by subwatershed and aggregated up to watershed to simulate implementation unit, by deer winter range as well as Key Elk Areas. They were also determined by Oregon Department of Fish and Wildlife (ODFW) Wildlife Management units (Tumalo, Metolius, North Paulina and South Paulina) where it overlaps the forest and clipped to up to MA-7. Open roads are defined as Maintenance Level 2 and above.

ODFW wildlife management units are located at T:\FS\Reference\GIS\r06\LayerFile\USA_OR\Wildlife Management Units.lyr

Or by winter range subunit: T:\FS\NFS\Deschutes\Project\soopsDataMgmt2009\Wildlife\GIS\SIS\Workspace\mgregg\Mule_Deer

White-headed woodpecker

Modeled: Nesting habitat was modeled in Wildhab. Ponderosa pine dominated forest included ponderosa pine PAGs all seral stages and other PAGs early and mid seral stages where ponderosa pine dominates (i.e. white fir and Douglas fir). The minimum diameter 10" with structural size classes 4, 5, 6, and 7.

Fire habitat was added and is considered to be stand replacement and mixed severity fires less than five years old.

Nesting habitat was updated by removal of recent (since 2002) activities. Dead wood was quantified within potential nesting habitat using tolerance intervals from DecAID 2.1.

Reported by: Subwatershed

Wildhab Attributes Used to Model White-headed Woodpecker Nesting Habitat

White-headed Woodpecker				
PAG Number	PAG Name	Seral Stage	Structure Class	Density
30	PP_Pumice (lodgepole)	all	4,5,6,7	open
31	Dry Ponderosa Pine	all	4,5,6,7	open
32	Moist Ponderosa Pine	all	4,5,6,7	open
33	PP-Incense Cedar	all	4,5,6,7	open
34	PP-White Oak	all	4,5,6,7	open
35	Cold Dry Ponderosa	all	4,5,6,7	open
41	Dry Douglas-Fir	early	4,5,6,7	open
42	Moist Douglas-Fir	early	4,5,6,7	open
51	Dry Grand Fir	early	4,5,6,7	open
52	Moist Grand Fir	early	4,5,6,7	open
56	Dry White Fir	early	4,5,6,7	open
59	Dry Cold White Fir	early	4,5,6,7	open
71	Dry Shasta Red Fir	early	4,5,6,7	open

Snag Tolerance Intervals Developed from DecAID 2.1 for White-headed Woodpecker

Snag size: ≥ 25 cm (10in)				Snag size: ≥ 50 cm (20in)			
t.i.	**#/ha**	**#/ac**	**Query on snagsge25**	**t.i.**	**#/ha**	**#/ac**	**Query on snagsge50**
0	0	0	=0	**0**	0	0	=0
0-30%	0-1.0	0-0.5	>0 and <=1.0	**0-30%**	0-1.2	0.5	>0 and <=1.2
30-50%	1.0-5.0	0.5-2	>1.0 and <=5	**30-50%**	1.2-4.5	0.5-1.8	>1.2 and <=4.5
50-80%	5.0-10.0	2.0-4	>5.0and <=10.0	**50-80%**	4.5-9.4	1.8-3.8	>4.5 and <=9.4
80%+	10.0+	4+	>10.0	**80%+**	9.4+	3.8+	>9.4

Great Gray Owl

Not modeled within Wildhab, also does not include transient habitat found with some vegetation treatments.

Definition modeled: Base nesting habitat was defined as within 0.35 miles of natural opening greater than or equal to 10 acres. Fire nesting habitat has two components inside and adjacent to fires less than five years old. Stand replacement fire was removed as habitat. No Activities were removed.

The following is a general description of the process. More details on specific step by step process are available from the Deschutes National Forest Wildlife Biologist if needed.

Openings: used the fire and Plant Association Group (PAG) with the following parameters.

- Large fire layer fires >2005,
- PAG layer selected: meadow, mesic shrub, riparian
    - Combined and eliminated any polygons less than 10 acres then buffered result 0.35 miles.

Reported by: Subwatershed

GNN

Gradient Nearest Neighbor (GNN)

GNN maps consist of 30 meter pixel (grid) maps with associated data (tree size, density, snag density, canopy cover, percent down wood cover, etc.). The maps used for this analysis were developed by the Landscape Ecology, Modeling, Mapping, and Analysis (LEMMA) team as part of the GNNPAC Pacific States Forest Vegetation Mapping project. This project involves developing detailed maps of existing forest vegetation across all land ownerships in the Pacific Coast States (Oregon, Washington, and parts of California). It is being conducted by the LEMMA team (Pacific Northwest Research Station (PNW) and Oregon State University) at the Corvallis Lab, in close collaboration with the Western Wildlands Environmental Threats Assessment Center, the Interagency Mapping and Assessment Project (IMAP), Northwest Forest Plan Effectiveness Monitoring, the Remote Sensing Applications Center, and Forest Inventory and Analysis at the PNW Research Station.

The process to create the maps involves using gradient imputation (Gradient Nearest Neighbor, or GNN). GNN uses many variables on a gradient along with satellite imagery to assign data from known field plots to pixels with no data that have the same satellite imagery signature (i.e. it "looks" the same to the computer). The species-size GNN model was used in the Rim-Paunina analysis. This model uses species composition and stand structure as components for developing maps. Accuracy of the modeling depends on how "like" pixels match up based on numerous variables. Generally speaking, forest types that had more samples like white-fir were more accurate than those with fewer samples like mountain mahogany. Information on GNN accuracy, the LEMMA group, IMAP and the GNNPac project is available at the project website: http://www.fsl.orst.edu/lemma/gnnpac.

The GNN MR 246 (2002) data set was the specific data set used. Ecologist Mike Simpson completed a comparison of the GNN data that pertained to the Deschutes National Forest by with stand exam data and found the GNN data to be as accurate at the stand level as the stand exams. This data set was used to develop the viable data set forest wide as well as for the snag and down wood analysis.

T:\FS\Reference\GIS\r06_des\Data|desviable_gnn.mdb\C_despag_gnn2
Where:
MR246_spps = GNN ID
StandID = GNN ID and Pag
R6VIABLE = Viable code
R6SCCODE = 7 structural classes
SC_Code = 5 Structural classes

<u>Viable</u>

Viable Ecosystems Model

The Ochoco and Deschutes Viable Ecosystems Management Guide (VEMG) was developed to classify vegetation on a landscape basis. "The Viable Ecosystem model provides a process to apply ecosystem management concepts to project level planning. This system compares existing vegetation with site potential. The model focuses on relationships between combinations of vegetation structure and species composition, and habitat requirements for animals, insects, and plants. Viable Ecosystems is a useful tool for cumulative effects analysis of broad scale changes in vegetation at a subwatershed to Forest-wide scale and subsequent changes in animal, insect, or plant communities."

Viable stratifies the environment along a gradient of size, structure, species composition, and relative tree density. The various classifications are then linked to wildlife habitat requirements. For example, a classification with a value of 5615**2** is white fir (56), early seral (1), medium/large structure (5), and **low density (2)** and would typically have a single story (low density) dominated by ponderosa pine (early seral in white fir) 21" diameter or greater (medium/large structure). This provides nesting habitat for white-headed woodpeckers. A value of 5635**1** would equate to white fir (56), late seral (3), medium/large structure (5), and **high density (1)** and would be a multi-storied stand dominated by white fir 21" diameter or greater and provide nesting habitat for pileated woodpeckers. All values that provide habitat for species were used. In addition to the mixed conifer value of 56152 using the white-headed woodpecker example, any seral stage dominated by ponderosa pine, medium/large structure, and low density would provide similar open ponderosa pine habitat and was used in determining amounts of white-headed woodpecker nesting habitat across the Deschutes National Forest.

GNN data was used to develop the vegetation layer to run in the Viable Ecosystem Model. Data is mapped on a 30 meter pixel grid, meaning the map is divided up on a 30 meter grid and that every 30 meter square (pixel) is assigned a value (i.e. 56351) that relates to a stratum of size, structure, tree species composition, and relative tree density.

The Viable data was used to determine habitat for each though Wildhab. The data was updated with the Forest Activities data a found in the FACTS data base.

WILDHAB

Wildhab is a matrix of conditions used to describe habitat Viable data terms. Taking the previous example for viable, the viable code 56152 is just one code that describes habitat that the white-headed woodpecker would utilize. All possible codes that provide for the white-headed woodpecker were put into a matrix to use in a GIS analysis query of viable data to determine amount and location of white-headed woodpecker nesting habitat across the forest. For each species' habitat that could be described in terms of the viable vegetation codes a matrix was developed. Each habitat type was then updated to current conditions by the use of the Forest's activity data base and fire history layer.

GIS Analysis and ArcMap

A geographic information system (GIS) integrates hardware, software, and data for capturing, managing, analyzing, and displaying all forms of geographically referenced information. The information can be related to visual data (maps), tabular data (tables, spreadsheets, or data bases), and used to run models (create new data set from existing data based on criteria or specific conditions). ArcMap is a component of the ArcGIS program. The client software developed by Economic and Social Research Institute (ESRI) was used for the processing and presentation of GIS data.

DecAID

DecAID is a web-based dataset, it is not a model. It is a synthesis of all of the best available research on dead wood. DecAID does not provide information on all life needs of a given species. It integrates current research/studies on wildlife use of dead wood (snags, down wood, dead portions of live trees) in various habitat types. From this, tolerance levels are generated.

Tolerance level (t.l.) is the percent of the studied population that would use a density of snags or down wood. For example, the following table shows the tolerance levels for white-headed woodpeckers. For a population of 100 individual white-headed woodpeckers, at the 50 percent tolerance level, 50 of them would use habitat with at least 1.7 snags per acre greater than or equal to10 inches in diameter. Basically the higher the tolerance level, the more assurance that you are providing habitat to meet the needs of more individuals in the population (Mellen et al. 2006).

Tolerance intervals (t.i.) were used to determine habitat levels in the planning area. A tolerance interval includes the range of snag density between tolerance levels. Using the example below, the 30-50 percent tolerance interval would be habitat with more than 0.3 snags per acre and less than or equal to

1.7 snags per acre. The 0-30% category is included (where 0 values are actually greater than 0) as it provides habitat for a few individuals. A zero category is included in the analysis showing what acreage does not provide habitat.

Often times, DecAID only had one study available to base its tolerance levels on. While applying findings from a single research site to another area is not always wholly applicable, DecAID provides the best available science to determine effects to a species at this time. Used as a comparison for effects across all alternatives, it can be a useful tool. Tolerance levels do not equate to population potential, nor imply viability, but they are assumed to indicate habitat at varying snag densities.

Deschutes National Forest. 2012. *MIS Habitat Modeling: Final Working Habitats Modeling 27 March 2012.* Unpublished document available from Wildlife Program Manager, Deschutes National Forest.

USFS. 1994. Viable Ecosystems Management Guide: Ochoco National Forest (Draft).

USFS. 1996. Ochoco National Forest Viable Ecosystems Management Guide Wildlife model - Draft Report.

Example of Tolerance Levels and Intervals developed from DecAID 2.1 Information

Minimum DBH		**10"**				**20"**			
		Snag Density (#/acre)				**Snag Density (#/acre)**			
Habitat type and Table used from DecAID 2.1	Tolerance Level Species		30%	50%	80%		30%	50%	80%
Table PPDF_S/L.sp-22	White-headed woodpecker		0.3	1.7	3.7		0.5	1.8	3.8
Habitat type and Table used from DecAID 2.1	Tolerance Interval Species	0-30%	30-50%	50 - 80%	80%+	0-30%	30-50%	50 - 80%	80% +
Table PPDF_S/L.sp-22	White-headed woodpecker	0-0.3	0.3-1.7	1.7-3.7	3.7+	0-0.5	0.5-1.8	1.8-3.8	3.8+

Soil survey and site assessment for meadow monitoring

To compare existing and historical extent of meadow habitat using site features and soils analysis:

1. Use LiDAR interpretation, field survey, and historical photographs (where available) to identify existing (non-forested) meadow landform.
2. Map existing meadow boundaries with GPS.
3. Dig one or two soil pits in representative section of the meadow to determine soil type. Record soil description.
4. Collect soil auger cores spatially across the meadow landform using a grid or transect.
5. Record parent material and groundwater dynamics for each core.
6. Map (using GPS) historic extent of meadow based on collected soil data.
7. Enter all GPS data into GIS database for future analysis.
8. This method is estimated to require approximately three days per meadow site.

Watershed Condition Framework protocol

Watershed Condition will be assessed using an interdisciplinary team approach and the Watershed Condition Framework process described in the following documents:

Deschutes and Ochoco National Forests and Crooked River Grassland. No date. *Watershed Condition Framework Datasets and Assumptions Used to Rate Subwatersheds on the Deschutes/Ochoco National Forests and Crooked River Grassland.* Unpublished document available from Forest Hydrologist, Deschutes and Ochoco National Forest and Crooked River National Grasslands.

Potyondy, J.P. and T.W. Geier. 2010. *Forest Service Watershed Condition Classification Technical Guide.* Washington, D.C.: USDA Forest Service. Available at: http://www.fs.fed.us/publications/watershed/watershed_classification_guide.pdf

USFS. 2011. *Watershed Condition Framework: A Framework for Assessing and Tracking Changes to Watershed Condition.* FS-977, May 2011. Washingtong, DC: USDA Forest Service. Available at: http://www.fs.fed.us/publications/watershed/Watershed_Condition_Framework.pdf

USFS-Region 6. 2011. *USFS-Region 6 Supplement to National Watershed Condition Classification Guide.* Interim Final. January 31, 2011. Portland, OR: USDA Forest Service, Region 6. Unpublished document available from Forest Hydrologist, Deschutes and Ochoco National Forest and Crooked River National Grasslands.

Water quality

Water quality and stream flow indicators will be monitored as described in:

Mork, L. 2014. *Whychus Creek Water Quality Status, Temperature Trends, and Stream Flow Restoration Targets.* Upper Deschutes Watershed Council, Bend, Oregon. 26 p.

Golden, B. 2013. *Whychus Creek Stream Flow*. Prepared for Upper Deschutes Watershed Council, Bend, Oregon. 11 p.

Road-stream interaction survey protocol

Hydrologically Connected Roads

1. Locate point of hydrologic connectivity to stream channel, lake or wetland (GPS – decimal degrees [naming convention for waypoints: road number-site number ex.4602-1hc]).
2. Record the contributing track of hydrologic connectivity if greater than 10 meters (GPS the length of road/ditch/rut/rill/gully connecting road to the stream).
3. Evidence of sediment contribution from roads in stream?
    a. Yes
    b. No
4. Estimate width, depth, and length of rills/ruts/gullies contributing sediment.
5. Brief description of hydrologic connectivity (ex. Road connected to stream via inside ditch/road surface ruts at the road crossing.).
6. Condition and trend of erosion/deposition:
    a. Condition is stable (not getting better or worse)
    b. Condition is improving
    c. Condition is deteriorating (accelerated erosion/deposition)
7. Photos (provide file name and file location)

Diversion Potential

1. Locate point of diversion potential (GPS – decimal degrees [naming convention for waypoints: road number-site number ex.4602-1dp]).
2. Record the potential track of diverted water if greater than 10 meters (GPS the length of the potential path of water from where it could be diverted from the stream to where it would return to a natural channel).
3. Briefly describe the route of potential diversion (ex. If culvert is blocked, water will travel 30 meters down the inside ditch of the road, cut across the road, and then travel down slope 75 meters before returning to the same channel.).
4. Evidence of water diversion occurring in the past?
    a. Yes
    b. No
5. Photo(s) (provide file name and file location)

Culvert Risk

1. Does the culvert seem to be properly sized for the channel (same width or larger than the active channel)?
    a. Yes
    b. No
2. Condition of inlet of the culvert:
    a. Open and in good condition
    b. Crushed or dented
    c. Accumulating debris (wood and/or bedload)

d. Other (describe)

3. Condition of outlet of the culvert:
    a. Open and in good condition
    b. Crushed or dented
    c. Accumulating debris (wood and/or bedload)
    d. Other (describe)
4. Culvert gradient v/s stream gradient:
    a. Culvert and stream gradient are approximately equal
    b. Culvert gradient is greater than stream gradient
    c. Culvert gradient is less than stream gradient
5. Is there evidence of active debris and/or bedload transport?
    a. Yes
    b. No
6. Approximate volume of fill that could be contributed to the stream if the crossing were to fail:
    a. <15 meters^3
    b. 15-30 meters^3
    c. >30 meters^3

Angular canopy density

Park, C., B. McCammon, and J. Braizer. 2008. *Changes to Angular Canopy Density from Thinning with Varying No Treatment Widths in a Riparian Area as Measured Using Digital Photography and Light Histograms.* Draft unpublished document **a**vailable from Forest Hydrologist, Deschutes National Forest.

Vegetation transects

Follow standard Deschutes National Forest methods.

Stream morphology surveys

Cross section, longitudinal profile, and sediment surveys will follow methods in:

Harrleson C.C., Rawlins C.L., Potyondy J.P. 1994. *Stream Channel Reference Sites: An Illustrated Guide to field Technique.* General Technical Report RM-245. Rocky Mountain Forest and Range Experiment Station, USDA Forest Service, Fort Collins, Colorado.

USDA Forest Service, Region 6. 2013. *Stream Inventory Handbook, Level I & II*. Version 2.13. Portland, Oregon: USDA Forest Service, Region 6. Available at: http://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5422991.pdf

Benthic macroinvertebrate surveys

Macroinvertebrates will be monitored as described in:

Mazzacano, C. 2013. *Effectiveness Monitoring in Whychus Creek: Benthic Macroinvertebrate Communities in 2005, 2009, and 2011-2013.* Prepared for Upper Deschutes Watershed Council, Bend, Oregon. 42 p.

Acres and mapped location of invasive species

1. Identify total acres treated that year from FACTS database.
2. Produce a map that shows the location of known invasive plant sites. Use data in NRM Invasives Inventory. These are displayed as polygons. *NOTE: 1) total known acres changes each year; 2) CFLRA boundary expanded in 2013.*
3. On this map, overlay the locations of treated areas. (Data from NRM Invasives Treatment layer (i.e., FACTS database).

Invasive plant density

1. At each treatment site, conduct professional assessment of plant density pre- and post-treatment (method available from District Weed Coordinators). Use the Deschutes/Ochoco Invasive Plant Inventory Form (see next page) to collect site data, including area, percent of area infested, and approximate number of weeds at the site before and after treatments.
2. Enter pre-treatment inventory data into NRM Invasive Treatment Database; enter post-treatment data in NRM Invasive Treatment Database (FACTS).
3. Run a FACTS report to determine what sites were treated within the CFLRA and the percent efficacy (reduction in invasive plant density) reported for each site.
4. Sum the percent efficacy for all sites and divide by the total number of sites treated to get average efficacy for the DCFP landscape.

Strategic sampling for invasive plants

1. Conduct a pre-project survey during NEPA planning to identify existing invasive species sites recorded in FACTS in each treatment unit.
2. Conduct post-treatment strategic sampling in high probability areas (skid roads, landings, reconstructed/ decommissioned roads, etc.) that did not have existing (pre-treatment) invasive species sites.
3. For each newly discovered site, fill out the Deschutes/Ochoco NF Invasive Plant Inventory Form, noting unique conditions or site features and required mitigation measures in the comments section.
4. Record each EDRR site in NRM Invasive Plant Inventory Database.

Ochoco/Deschutes National Forest & Crooked River NG Invasive Species Inventory Field Form

Adapted from NRIS/FACTS Invasive Plant Data Recording Protocols *(* designates required fields)*

General Information

*Site ID:____________________	*Date:_________________ (MM/DD/YYYY)	New Site? Re-visit? (circle one)
*Examiner (Last, First, MI)		
*Region: *06* Forest:	*District:	*State: *OR*
*County:	*Ownership:	

Location

Site Location / Project Name: GPS File #	
*Legal Description T.________ R.________ Sec., ________ ¼ _______ ¼ _______ *Willamette Meridian*	
Latitude/Longitude:	
Elevation:	* Slope ___________%

Data Elements

(see back of form) *Species Code___________________	**Fractions of an acre (for reference):** 1 acre = 209' x 209' = 43,560 sq. ft.
Total Area (gross ac)_____________	0.25 acre = 104' x 104' = 10,816 sq. ft 0.1 acre = 66' x 66' = 4,356 sq. ft.
* Percent Infested ______________ (% of Total Area occupied by weeds, usually 100%. Percent infested ≠ canopy cover)	0.01 acre = 20.1' x 20.1' = 436 sq. ft. 0.001 acre = 6.1 x 6.6' = 43.6 sq. ft. 0.25 acre = 59' radius of a circle 0.1 acre = 37' radius of a circle 0.01 acre = 12' radius of a circle 0.001 acre = 4' radius of a circle
Distribution (Circle one) CL- Clumps (CL = more dense than SP) SP- Scattered Patchy SE- Scattered Even LI- Linear	
*Soil Texture (circle one): clay clay loam loam silt silt loam loamy sand sandy loam sand Is the soil saturated all or part of the year?___________________How many months?______________ Soil / Site Comments:____	
Site Type (circle one): administrative forest improved pasture rangeland right-of-way trail/trailhead campground irrigation ditch stream/river land/pond	
*Horizontal Distance to Water:___________*Feet* Vertical distance to Water:__________*Feet*	

Approximate number of weeds present _______________ Plants Stems

Phenology (circle all that apply): seedlings / rosettes / 1st year plants bolted / mature plants / previous yr seedheads

Plant Codes:

Bull thistle= CIVU	Houndstongue= CYOF	Orange hawkweed= HIAU	Ribbon grass = PHARP	Sulfur cinquefoil= PORE5
Canada thistle= CIAR4	Leafy spurge= EUES	Oxeye daisy = LEVU	Russian knapweed= ACRE3	Tansy ragwort= SEJA
Common mullein= VETH	Mediterranean sage= SAAE	Perennial pepperweed= LELA2	Scotch broom= CYSC4	Teasel= DIFU2
Dalmatian toadflax= LIDAD	Medusahead rye= TACA8	Poison hemlock= COMA2	Scotch thistle= ONAC	Yellow starthistle= CESO3
Diffuse knapweed= CEDI3	Morning glory= COAR4	Puncturevine= TRTE	Spotted knapweed= CEBI2	Yellow toadflax= LIVU2
	Musk thistle= CANU4	Reed canarygrass = PHAR3	St. Johnswort= HYPE	Whitetop= CADR

Treatment __________ (C–Cultural, H-Herbicide, B-Biological, N-None, M-Manual, ME-Mechanical)

Date ___________________ **Acres Treated** ___________ # Person Hours for Treatment _____________

Date ___________________ **Acres Treated** ___________ # Person Hours for Treatment _____________

Date Monitored ________________**Treatment Efficacy (%)** ________ **Examiner's Name**______________________

Site Comments and Directions: ____

____

____

____

____

____

SITE MAP N ↑

Desired Conditions and Scoring for National Reporting

In 2012, all projects funded under the Collaborative Forest Landscape Restoration Act were instructed to begin tracking and reporting ecological outcomes (i.e., conduct effectiveness monitoring) for their projects. Ecological Indicator Guidance provided by the USFS Washington Office directs CLFR projects to provide quantifiable desired condition outcome statements that reflect the initial project goals in their CFLR project proposal. Desired condition outcome statements are to be provided for each of the four ecological monitoring indicators – Fire Regime Restoration, Fish and Wildlife Habitat Condition, Watershed Condition, and Invasive Species Severity. Scoring for national reporting (Good, Fair, or Poor) is based on progress made toward these desired conditions.

The DCFP has provided quantifiable desired condition outcome statements for landscape-scale goals described in its original proposal (and amended by the 2013 DCFP landscape expansion addendum). These are described below. Project-level goals, however, are defined in individual NEPA documents and not in the DCFP proposal. Projects implemented to date were developed before the national Ecological Indicator Guidance was available. Therefore, it is not possible for the DCFP to provide project-level desired condition outcome statements for the monitoring questions in this plan. However, project-scale monitoring results may be provided in narrative form to help interpret progress towards landscape-scale desired conditions.

For the five-year monitoring report, the DCFP will provide national reporting scores for each Ecological Indicator based on monitoring results from landscape-scale questions for which desired conditions were identified in the DCFP proposal (and amended by the 2013 DCFP landscape expansion addendum). Desired conditions and the scoring process are described below.

Fire Regime Restoration

The 2014 fire regime restoration score (Good, Fair, or Poor) for national reporting will be the average of the scores for 1L-1 and 1L-2.

1L-1. What is the change in acres of successional classes in each plant association group and ecological departure (condition class) of each Plant Association Group relative to its historic range of variability?

Baseline and desired conditions:

There are no desired conditions for forested habitat types (successional classes).

Desired condition outcome measures, based on baseline conditions for and planned treatments in each PAG, will be shown in the table below. These values will be determined by September 2014, using baseline model outputs and review of completed, current, and planned DCFP treatments. Responsible parties: Chris Zanger, Fire Research Analyst, The Nature Conservancy, Pete Caligiuri, Forest Ecologist, The Nature Conservancy, and Lori Blackburn, Forest Silviculturist, Deschutes National Forest.

To benefit the full suite of wildlife species native to the DCFP landscape, the majority of Plant Association Groups would be in LandFire vegetation condition class 1, indicating a low amount of departure from historic vegetation reference conditions. However, because DCFP treatments will affect less than 30% of the landscape, primarily in ponderosa pine and mixed conifer plant association groups, in some PAGs the desired condition is to maintain the current vegetation condition class.

Baseline and 5-year and 10-year desired condition outcome measures for vegetation condition class

Plant Association Group	VCC 1 0-33% departure				VCC 2 34-66% departure				VCC 3 67-100% departure			
	2009	5yr	10yr	15yr	2009	5yr	10yr	15yr	2009	5yr	10yr	15yr
Lodgepole Pine Dry												
Lodgepole Pine Wet												
Mixed Conifer Dry												
Mixed Conifer Wet												
Mountain Hemlock Dry												
Ponderosa Pine Dry												
Ponderosa Pine Moist												

Scoring for national reporting

Scoring values will be determined once the desired conditions have been set. Responsible parties: Chris Zanger, Fire Research Analyst, The Nature Conservancy, Pete Caligiuri, Forest Ecologist, The Nature Conservancy, and Lori Blackburn, Forest Silviculturist, Deschutes National Forest.

Good = Expected progress is being made toward Desired Conditions across ___ of the CFLR landscape area.

Fair= Expected progress is being made toward Desired Conditions across ___ of the CFLR landscape area.

Poor= Expected progress is being made toward Desired Conditions across ___ of the CFLR landscape area.

1L-2 What are the landscape-level effects of restoration treatments on fire behavior and forest resilience to fire within dry forest PAGs (ponderosa pine dry and wet, dry mixed conifer, and moist mixed conifer)?

Modeled baseline conditions, desired condition outcome measures, and scoring statements for national reporting will be completed by September 2014. Responsible parties: Pete Caligiuri, Forest Ecologist, The Nature Conservancy and Deana Wall, AFMO, Deschutes National Forest.

Fish and Wildlife Habitat Condition

The 2014 Fish and Wildlife Habitat Condition score (Good, Fair, or Poor) for national reporting will be the average of the scores for 2L-1 and 2L-2.

2L-1 What is the change in acres of forest types (successional classes) in each plant association group and ecological departure (condition class) of each Plant Association Group relative to its historic range of variability?

See desired conditions and scoring for 1L-1.

2L-2. What is the change in system road and system trail densities[1]?

Baseline condition: In January 2014, road density was 4.43 miles/square mile on the DCFP landscape (1418.28 miles of Forest Service 2, 3, 4, and 5 roads in 320.36 square miles[2] of national forest land).

Desired condition: As stated in the 2012 addendum to the DCFP's CFLR proposal, to reduce disturbance to most wildlife species on the DCFP landscape, 1.76% reduction in road density (25 miles mile of class 2, 3, 4, and 5 roads decommissioned or closed) will occur across 100% of the national forest land in the DCFP landscape by 2019.

Desired condition objectives:

Year	Total miles of road decommissioned	Road density (miles/square mile)	Percent reduction in road density since 2009
2009		4.43	N/A
2014	12.5	4.39	0.88
2019	25	4.34	1.76

Scoring for national reporting:

5.2 miles of roads were decommissioned on the DCFP landscape between 2010 and 2013. Adding the number of miles decommissioned in 2014 and calculating the new road density and percent reduction in road density on the landscape will determine scoring for the 5-year report.

Good= Expected progress is being made toward Desired Conditions across 80%-100% of the CFLR landscape area.

Fair= Expected progress is being made toward Desired Conditions across 50%-79% of the CFLR landscape area.

Poor= Expected progress is being made toward Desired Conditions across less than 50% of the CFLR landscape area.

[1] There are no desired conditions related to trail densities in the DCFP proposal.

[2] According to the 2013 DCFP proposal addendum, there are 205,028 acres of national forest land in the CFLR area.

Watershed Condition

Desired conditions and scoring for national reporting will be determined by September 2014 baseline Watershed Condition Framework values and an assessment of current, and planned DCFP treatments. Responsible parties: Jason Gritzner, Forest Hydrologist, Deschutes National Forest and Pete Caligiuri, Forest Ecologist, The Nature Conservancy.

Invasive Species Severity

The 2014 Invasive Species Severity score (Good, Fair, or Poor) will be based on the percent of the landscape treated and the percent of reduction in invasive species severity on the treated acres, as described below. This score is determined using monitoring data from questions 4L-1a and 4L-2.

4L-1a. How many acres of high priority invasive plant infestations are treated across the DCFP landscape?
4L-2. What is the average percent reduction in invasive plant density across all treated areas?

Desired condition:

According to the 2013 addendum to the DCFP proposal, there will be 9,800 acres of invasive plant treatments on the CFLR landscape from 2009-2019. This represents 4.8% of the landscape.

According to the Deschutes National Forest Invasive Species EIS, the desired average restoration performance outcome is 80% reduction in invasive plant density across all treatments.

Desired condition outcome statements:

2.4% of the landscape was restored by reducing invasive species severity to meet desired conditions by 2014.

4.8% of the landscape was restored by reducing invasive species severity to meet desired conditions by 2019.

Scoring for national reporting:

As stipulated in the 2012 national Ecological Indicator Guidance document, scoring for Good, Fair, and Poor ratings is:

Good (Low Severity) = Treatment activities conducted to meet the Desired Conditions result in an **average** restoration performance outcome of 90-100% across all invasive species treatment activities within the CFLR Landscape Area over the life of the CFLR landscape. The **actual** number of acres restored is at least 90% of the **planned** number of acres restored across the entire CFLR Landscape Area.

Fair = Treatment activities conducted to meet the Desired Conditions result in an **average** restoration performance outcome of 70%-89% across all invasive species treatment activities within the CFLR Landscape Area over the life of the CFLR landscape. The **actual** number of acres restored is 70%-89% of the **planned** number of acres restored across the entire CFLR Landscape Area.

Poor = Treatment activities conducted to meet the Desired Conditions result in an **average** restoration performance outcome of 0%-69% across all invasive species treatment activities within the CFLR Landscape Area over the life of the CFLR landscape. The **actual** number of acres restored is less than 70% of the **planned** number of acres restored across the entire CFLR Landscape Area.

Interpreting and Using Results

In addition to meeting the national requirement to track and report progress toward desired conditions, the purposes of this ecological monitoring plan include informing adaptive management and building trust and common ground. Achieving these purposes requires more than collecting and analyzing monitoring results: monitoring reports that simply summarize data or critique performance are not conducive to improving management decisions. On the other hand, an evaluation process that includes multiparty review and interpretation of monitoring results can identify practices that best achieve desired outcomes and produce concrete, actionable results that feed directly into planning and management decisions (Patton 2008).

Interpreting results

The majority of the questions in this plan will be answered using effectiveness monitoring, which provides data on project outcomes, as opposed to project implementation measures. However, most effectiveness monitoring methods, including the methods in this plan, do not definitively determine whether or not observed outcomes were caused by project activities. Without using more robust, research-level methods, it is not possible to definitively state, for example, whether changes in forest successional classes or habitat types were due to DCFP project activities or natural disturbances. Similarly, water quality and aquatic habitat changes may be due to upstream conditions or any of a number of other factors. There are several vectors for invasive plant introduction and spread on the DCFP landscape, notably extensive recreational use.

There is, however, considerable information available to help interpret monitoring results. Project administrators and operators and field monitoring crews are particularly important sources for identifying unexpected conditions or activities that may have influenced outcomes. DCFP monitoring sub-committee members can share observations from multiparty monitoring field reviews and restoration sub-committee members bring information from research synthesis and joint learning field trips. In addition, ecological research and monitoring conducted elsewhere on the Deschutes National Forest and in Central Oregon can provide important context for interpreting trends on the DCFP landscape.

Informing practice

Periodic, collective review of monitoring results to identify practical applications of lessons learned can help monitoring teams, agencies, and collaborative groups avoid the frustration of time and money invested in monitoring that does not get used (Moote 2013). In the case of the DCFP, this review would include agency decisionmakers and DCFP steering committee members as well as people responsible for data collection and analysis. This group can evaluate monitoring results and create a record of agreed-upon actions items based on their assessment of the monitoring results. The collective review process also strengthens working relationships, which are important to maintaining agreements and implementing changes.

Recommended process

Data interpretation and annual monitoring reports are largely the responsibility of the DCFP monitoring sub-committee and DNF program managers, who compile and analyze data, interpret results, develop an annual monitoring report, and recommend management actions based on their findings. The challenge is finding the time to interpret and evaluate monitoring results and then identify and apply change mechanisms. To address this challenge, the DNF and DCFP steering committee may choose to adopt the following process:

1. *Technical review:* DNF program managers, key data collection and analysis individuals, and the DCFP sub-committee monitoring coordinator meet in September or October to:
   - Share and interpret monitoring results, identifying cross-cutting findings and identifying external factors that may have influenced;
   - Highlight findings to be shared with larger stakeholder group and decisionmakers.

2. *Multi-stakeholder review:* DCFP monitoring sub-committee and DNF decisionmakers meet in October to:
   - Review monitoring results presented by DNF program managers and the DCFP monitoring sub-committee;
   - Discuss implications for future planning and management and recommend changes to improve outcomes.

3. *Annual monitoring report:* By the end of December, the DCFP monitoring sub-committee and DCFP staff, with input from DNF program managers, write an annual monitoring report.

4. *Formal written recommendations*: By the end of January, DCFP monitoring sub-committee makes formal written recommendations for revised planning and/or management actions to the DCFP steering committee for review, approval, and submission to DNF line officers.

5. *Monitoring plan review and revision:* By the end of February, the monitoring sub-committee reviews the 2014 DCFP monitoring plan and Appendix to determine which monitoring questions should be measured in the coming year.

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Appendix: Questions Considered But Not Selected for Monitoring in 2014

Appendix contents

The following monitoring questions were identified and discussed by the DCFP monitoring sub-committee and working groups in 2013 and winter 2014. These questions were not priorities for monitoring in 2014, but were retained for further consideration. Some of them, including several of the Fish and Wildlife Habitat monitoring questions, will likely be high-priority monitoring questions for the DCFP in future years. Each question and a summary of the working groups' rationales for and against monitoring it are provided below, followed by a draft monitoring protocol. It is expected that the DCFP monitoring sub-committee will revisit these questions in winter 2014-2015, after the 5-year monitoring report has been completed, and determine whether any should be added to the working monitoring plan.

Fire Regime Restoration monitoring questions

1L3. What are the priority treatment areas that need future re-treatment and maintenance to achieve desired fire behavior conditions over time?

Fuels reduction projects have a lifespan in terms of treatment efficacy, and then need re-treatment or maintenance to maintain the fuels reduction benefits. It may be important 10 years or more after initial treatment to evaluate where and how much of previously treated areas should be prioritized for future re-treatment or maintenance. Although this question may help locate priority areas for future re-treatment or maintenance, this is not an effectiveness monitoring question because it will not help evaluate the effectiveness of current and future CFLR investments in the landscape. Also, as it is difficult to control for the many factors that affect fuels conditions, results may not be as useful as expected.

1P4. To what extent are treatments reducing overall forest density and shifting overstory species composition (e.g., white fir-dominant stands) to older, larger, more fire-tolerant species (primarily ponderosa pine within the DCFP landscape) in dry and moist mixed conifer PAGs?

Forest density and species composition change are important and of interest to the DCFP based on their relevance to forest ecological resilience. Research from Central Oregon indicates that this question is particularly relevant in dry and moist mixed conifer PAGs, where changes in density and shifts in species composition in the absence of fire is most pronounced. Because of the high cost of field-based monitoring and uncertainties in emerging science on appropriate reference conditions for species composition, this is not a priority question for monitoring in 2014. However, it may be revisited for a pilot project or using photo points to track general trends in stand density and composition. It could also be the focus of future research synthesis and field evaluations by the DCFP. This is not a priority monitoring question for 2014, but may be explored through joint fact-finding (science synthesis) and field-based collaborative learning.

1P5. What is the change in relative stand density?

Stand density is an easily understood metric that is useful for communicating treatment effects. It relates to both restoring the natural fire regime and reducing the risk of uncharacteristic fire. It also relates to other aspects of forest resilience, including insects and disease resistance. Canopy closure and canopy bulk density are included as inputs into the fire behavior model that will be used to answer question 1P1. These two metrics can be used to describe changes in relative stand density or other more commonly used metrics such as stand density index (SDI) can be inferred from them. These metrics can be reported as part of the monitoring results for question 1P1, so stand density will not be monitored separately.

1P6. What is the change in canopy base height?

Canopy base height is also a useful metric for communication, with a little explanation. It is one measure that demonstrates whether or not treatments are increasing resistance to passive or active crown fire in forest stands at the project level. CBH is estimated as an input to fire behavior models, so can be extracted from the data compiled to answer question 1P1.

1P7. Are treatments effectively restoring a more heterogeneous spatial pattern consistent with HRV in dry forest type stands (i.e., clump and gap/opening size, abundance, and distribution)?

This question is important for wildlife habitat, watershed condition, and fire behavior. According to scientific synthesis on the importance of spatially heterogeneous stand pattern (from Churchill et al. 2013),

> “irregular tree patterns, large openings, and resulting variation in surface fuels inhibit the spread of crown fire and perpetuate variable post-fire patterns (Beaty and Taylor, 2007; Pimont et al., 2011; Stephens et al., 2008), analogous to strategic placement of fuel treatments at larger spatial scales (Finney et al., 2007). Heterogeneous stand structures impede the buildup of epidemic insect outbreaks by disrupting pheromone plumes and breaking up the continuity of susceptible species, as well as age and size classes (Fettig et al., 2007). Similarly, openings create barriers to the spread of dwarf mistletoes and fungal pathogens (Goheen and Hansen, 1993; Hawksworth et al., 1996; Shaw et al., 2005). Likewise, openings and frequent disturbances facilitate periodic tree regeneration in dry forests (Boyden et al., 2005; Sánchez Meador et al., 2009), which is thought to be partly responsible for high levels of local genetic diversity of trees (Linhart et al., 1981; Hamrick et al., 1989). … In addition, the contrasting light, moisture, and soil nutrient environments in heterogeneous stands increase understory plant abundance and diversity (Dodson et al., 2008; Moore et al., 2006).”

However, there is little agreement on what gaps and openings are desired in any given situation, and therefore it is not possible to ask this as an effectiveness monitoring question. Due to the lack of cost-effective and reliable methods, and disagreement over the desired distribution of clumps or openings, this question will not be considered for monitoring in 2014. However, this is an important issue for the DCFP to continue exploring through collaborative learning and should be addressed by the restoration sub-committee for prescription development, by the implementation sub-committee after treatments are marked, and during multiparty monitoring field reviews for post-implementation monitoring.

1P8. What is the change in legacy tree mortality/vigor?

This question directly addresses a common goal of forest restoration: to support retention of large and old trees on the landscape. It is not directly related to fire regime restoration. This question is of particular concern to the environmental community and other stakeholders concerned that some restoration treatments could be adversely affecting legacy trees. Similarly, setting forest structure on a trajectory to maintain and develop late-successional stands is a major DCFP goal. When interpreting data, it is important to recognize that research conducted elsewhere on legacy tree response to restoration treatments suggests that a number of factors affect tree response, and these must be taken into account. In some cases, there is no detectable benefit to the tree, but lack of decline may reflect a positive response to treatment. The number of factors driving response and vigor may make it hard to draw conclusions, and sampling for statistically significant results is not feasible. Since there is little legacy structure on the DCFP landscape and monitoring legacy trees would be costly, this question would only be monitored on a pilot project basis in areas of special concern. For 2014, this question will not be monitored but is prioritized for ongoing learning and knowledge building through collaborative discussion of relevant research and field trips to treatment sites with legacy trees.

Fish and Wildlife Habitat Condition monitoring questions

2L-6. What is the change in acres of mixed conifer dry forest habitat at the landscape scale? 2P-10. What is the change in acres of mixed conifer dry forest habitat at the project scale?

This habitat type is important for species such as the northern goshawk. Answering this question at the landscape scale will build understanding of broad changes this habitat type, which is less well understood than the ponderosa pine forest type. Monitoring results may be used by line officers to inform future project planning, and by collaborative members and partners to build common ground about the efficacy of restoration treatments to restore this forested habitat**.** In future, monitoring this question at the project level will inform adaptive management and build common ground by helping the DCFP and DNF evaluate how project activities are affecting the extent of this habitat type within each NEPA project area. This question is low priority for monitoring in 2014 because the only mixed conifer dry forest habitat treated on the DCFP landscape in the first five years of this CFLR project were on the West Tumbull project. West Tumbull was planned prior to the CFLRA award and was exclusively a fuels reduction project with no desired condition related to forested habitat conditions. Because mixed conifer forest habitat types are important to the DCFP, this will likely become a high priority question in future.

2L-7. What is the change in acres of mixed conifer dry late-successional forest habitat at the landscape scale?? 2P-11. What was the change in acres of mixed conifer dry late-successional forest habitat at the project scale?

Mixed conifer dry late-successional forest habitat is important for species such as Williamson's sapsucker. The rationale for monitoring this question is the same as for 2L-6.

2L-8. What is the change in acres of mixed conifer wet late-successional forest habitat at the landscape scale? 2P-12. What is the change in acres of mixed conifer wet late-successional forest habitat at the project scale?

This habitat type is important to species such as pileated woodpecker, marten, and spotted owl. Although mixed conifer wet late-successional forest habitat is important to the DCFP, as of 2014 none has been treated on the landscape as of January 2014, so this is a low priority question in 2014. Because mixed conifer forest habitat types are important to the DCFP, this will likely become a high priority question in future.

2L-9. What is the change in acres of mature lodgepole pine forest habitat at the landscape scale? 2P-13. What is the change in acres of mature lodgepole pine forest habitat at the project scale?

Mature lodgepole pine forest habitat is important to species such as black-backed woodpecker and three-toed woodpecker. Priority for monitoring this question in 2014 is low because DCFP treatments in lodgepole pine forest type do not align with restoring the historical condition, which includes intense stand-replacement fire. For this reason, lodgepole pine forest restoration has been a low priority for the DCFP and relatively few acres have been treated on the landscape.

2L-10. What is the change in number and location of beaver activity areas at the landscape scale? 2P-14. What is the change in number and location of beaver activity areas at the project scale?

Beaver are a species of concern on this landscape, and are considered important to climate change mitigation because their dams help retain water on the landscape. This is also a watershed condition monitoring question. Tracking beaver activity will inform future planning. Depending on the methods used, monitoring beaver activity areas could also build scientific knowledge of beaver activity on the landscape. Informal (opportunistic) surveys will cost very little, but formal surveys, which would provide more useful results, are estimated to cost $10,000 every 5 years or up to $2,000 per project. This question is low priority because it focuses on a single species and beaver restoration is not a direct goal of the DCFP, although some projects are restoring beaver forage in riparian areas.

2L-11. What is the change in acres of post-wildfire habitat?

Post-wildfire habitat is important to some species of special interest on the DCFP landscape, including the Black-backed woodpecker and Lewis' woodpecker. Information on changes in post-wildfire habitat may build common ground by providing information on existing post-fire habitat and stimulating discussion of different perspectives on desired post-fire habitat conditions. Answering this question is estimated to cost $4,000 every 5 years. It is a low priority for monitoring in 2014 because there are no historical reference data to help determine a desired condition. Also, no current DCFP projects aim to increase or decrease acres of post-wildfire habitat, so this is not an effectiveness monitoring question for existing DCFP projects.

2P-15. What is the change in acres and improvement of aspen and hardwood habitat?

Aspen and hardwoods are important to many wildlife species, and aspen are declining on the DCFP landscape due to conifer encroachment, changes in hydrology, and ungulate grazing. Answering this question will address a DCFP goal: aspen and hardwood habitats are of particular interest to the DCFP. It also will build common ground and inform adaptive management by helping the DNF and DCFP evaluate how projects are affecting the extent of these habitat types within project areas. The estimated cost for pre- and post-project implementation Wildhab analysis plus soil profiles is $4,000 per project. Although monitoring aspen and hardwood restoration is high priority for the DCFP, in 2014 the only project to date with significant aspen and hardwood treatments is Glaze Meadow, and treatments on the Glaze Meadow project are not yet complete.

2P-16. In prescribed burns, what is the number of acres in each tree mortality level?

Prescribed fires may meet fuel objectives but undermine silvicultural, wildlife, soil, or visual objectives. Monitoring this questions would build common ground by standardizing assessment of the range of prescribed fire severity and its effects on management outcomes. However, currently there are no reliable metrics or methods developed for answering this question and it is a low priority for the monitoring sub-committee.

2P-17. What is the change in gap size, abundance, and distribution in ponderosa pine and dry mixed conifer forests?

Creating more gaps and openings at a range of sizes in ponderosa pine forest and dry mixed conifer plant association groups is a major element of the DCFP goal to increase spatial heterogeneity in dry forest types. This question is also important to watershed condition and fire regime restoration monitoring. See further discussion under 1P-7.

2P-18.What is the change in understory plant species composition in each plant association group?

Increasing forb and understory abundance and diversity is critical to improving habitat for many wildlife species and is a goal of the DCFP. This question meets all of the DCFP criteria for monitoring question selection: it would address a DCFP goal, build scientific knowledge, build common ground, inform adaptive management, and inform future planning. Recognizing the high cost of conducting plot-based field monitoring (estimated at $35,000 per project), however, the monitoring sub-committee recommends seeking outside funding to pilot understory monitoring on one project and that it be piloted on a NEPA project that contains many different habitat types. Although understory abundance and diversity is of critical importance, this question was not prioritized for monitoring in 2014 because neither funding nor agreed-upon methods were available. A related question about understory plant cover will be monitored in 2014 using photo points. See question 1P2/2P9 in the 2014 monitoring plan.

2P-19. What is the change in density of all system and user-created roads and trails?

Roads and trails affect virtually all wildlife species. This information can be used by DCFP and DNF to build common ground and inform future management by identifying 1) the extent of roads and trails—including non-system, user-created roads and trails—in the project area and 2) the potential effects of both motorized and non-motorized roads and trails on functional habitat and habitat quality. Road and trail system information may be particularly useful when overlayed with other data, such as core habitat areas. Depending on the monitoring methods used, answering this question may also provide feedback for adaptive management. There are currently no methods for monitoring for user-created roads and trails, which is estimated to cost $15,000 to $20,000 per project. Recognizing the high cost of surveying for non-system, user-created roads and trails, the monitoring sub-committee recommends piloting this monitoring question on a single project. Priority for monitoring in 2014 is moderate. This is not an effectiveness monitoring question that will inform adaptive management, reliable monitoring methods have not yet been developed, and answering this question will likely require additional fundraising. However, this is a relatively high priority question for the monitoring sub-committee.

Watershed Condition monitoring questions

3P-5. What is the change in total system road and trail density in each DCFP project area?

Road and trails have a range of impacts on watershed function, both terrestrial and aquatic. System roads and trails is a terrestrial indicator within the WCF assessment, so having spatial monitoring data regarding road and trail density will improve WCF evaluation process. This question was not selected for monitoring in 2014 because there have been relatively few road closures to date on DCFP projects.

3P-6. What is the change in total system road and trail density in riparian zones and sensitive land types in each DCFP project area?

Road and trails have a range of impacts on watershed function, both terrestrial and aquatic. However, not all roads and trails have equal impact on watershed function, and roads/trails in riparian zones and sensitive land types in particular have greater impact on aquatic ecosystem health. System road and trail density is therefore a proxy for aquatic impacts and is used as terrestrial indicator within the WCF assessment. This question was not selected for monitoring in 2014 because there have been relatively few road closures to date on DCFP projects.

3P-7. What are the changes in soil productivity in each DCFP project area?

Soils are a critical driver of forest vegetation communities and site productivity. Understanding inherent soil productivity and its relationship to site and restoration objectives, as well as changes to soil productivity resulting from restoration could be an important dimension of future project planning, objectives, and implementation. Also, soil productivity is a key issue for environmental groups, so monitoring it could help trust that the DCFP and DNF are taking upland soil conditions into account on CFLR treatments.

Invasive species severity monitoring questions

4P-2. For each NEPA project, was an invasive plant risk assessment completed and what were the required mitigations?

Prevention of new infestations is critical and meets defined restoration goals. Assessing project risk and identifying prevention measures is an important action to reduce invasive plant introduction and spread. This question is of interest because it would address resilience against new invasions rather than invasive species invasions themselves. However, it is an implementation and not an effectiveness monitoring question.

Draft monitoring protocol for potential future monitoring questions

	Question	Metrics	Methods	Data Source(s)	Data Management	Monitoring Schedule	Responsible Party	Product s
1L-3	What are the priority treatment areas that need future re-treatment and maintenance to achieve desired fire behavior conditions over time?	Size (acres) and location of high priority areas for maintenance or return treatment	Possibly treatment optimization model (TOM) component of FlamMap. (Also see Ager)	TBD	TBD	Year 10 (2019), Year 15 (2024)	TBD	TBD
1P-4	To what extent are treatments reducing overall forest density and shifting overstory species composition (e.g., white fir-dominant stands) to older, larger, more fire-tolerant species (primarily ponderosa pine within the DCFP landscape) in dry and moist mixed conifer PAGS?	Qualitative comparison of research findings and field observations on the DCFP landscape.	Collaborative learning through literature review, expert presentations, and multiparty field reviews	research synthesis, presentations, field reviews	TBD	Pre- and post-NEPA project implementation	TBD	TBD
1P-5	What is the change in relative stand density?	options: trees per acre, basal area, stand density index, canopy closure, canopy bulk density	infer SDI from canopy closure and canopy bulk density or use field-based plot data or possibly photo points to measure trees per acre or basal area	Fire behavior model input data; field survey	TBD	Pre- and post-NEPA project implementation	TBD	TBD
1P-6	What is the change in canopy base height?	feet/meters from ground to crown	estimated from FVS modeled exercise used as input to fire behavior modelss	extracted from fire behavior models	TBD	Pre- and post-NEPA project implementation	TBD	TBD

		Metrics	Methods	Data Source(s)	Data Management	Monitoring Schedule	Responsible Party	Products
1P-7	Are treatments effectively restoring more heterogeneous spatial pattern consistent with HRV in dry forest type stands (i.e. clump and gap/opening size, abundance, and distribution)?	size, number, and location of gaps	Collaborative learning through research review, presentations, and field reviews; Research methods similar to Derek Churchill et al., Youngblood; Cooper	research synthesis; field reviews; Field surveys; Aerial photography or LiDAR	TBD	Pre- and post-NEPA project implementation	TBD	TBD
1P-8	What is the change in legacy tree mortality/vigor?	qualitative comparison of research findings and DCFP field observations; tree ring width	Collaborative learning through research review, presentations, and field reviews. See Ashland Forest Restoration method (for field-based plot sampling)	research synthesis, presentations, field reviews	TBD	Pre- and post-NEPA project implementation	TBD	TBD
2L-6 & 2P-10	What is the change in acres of mixed conifer dry forest habitat?	PAG; Seral Stage; Structure Class; Tree Density	WildHab modeling of forest habitat structural components required by northern goshawk	USFS: DNF PAG data; 2010 GNN data; DecAid Habitat Type; Viable Model data; FACTS	DNF GIS database	2L-6: Year 10, Year 15; 2P-10: pre- and post-NEPA project implementation	DNF Forest Wildlife Biologist	Mapped and tabular results
2L-7 & 2P-11	What is the change in acres of mixed conifer dry late-successional forest habitat?	PAG; Seral Stage; Structure Class; Tree Density	WildHab modeling of forest habitat structural components required by Williamson's sapsucker	USFS: DNF PAG data; 2010 GNN data; DecAid Habitat Type; Viable Model data; FACTS	DNF GIS database	2L-7: Year 10, Year 15; 2P-11: pre- and post-NEPA project implementation	DNF Forest Wildlife Biologist	Mapped and tabular results

	Question	Metrics	Methods	Data Source(s)	Data Management	Monitoring Schedule	Responsible Party	Products
2L-8 & 2P-12	What is the change in acres of mixed conifer wet late-successional forest habitat?	PAG, Seral Stage, Structure Class; Density for Pileated woodpeckert and marten, NRF acres for spotted owl	Wildhab modeling of forest structural components required by pileated woodpecker, marten, and northern spotted owl (using NRF layer for spotted owl)	DNF PAG data - USFS; 2010 GNN data - USFS; DecAid Habitat Type - USFS;	DNF GIS database	2L-8: Year 10, Year 15; 2P-12: pre- and post- NEPA project implementation	DNF Forest Wildlife Biologist	Mapped and tabular results
2L-9 & 2P-13	What is the change in acres of mature lodgepole pine forest habitat?	PAG; Seral Stage; Structure Class; Tree Density	WildHab modeling of forest habitat structural components required by black-backed woodpecker and three-toed woodpecker	USFS: DNF PAG data; 2010 GNN data; DecAid Habitat Type; Viable Model data; FACTS	DNF GIS database	2L-9: Year 10, Year 15; 2P-13: pre- and post- NEPA project implementation	DNF Forest Wildlife Biologist	Mapped and tabular results
2L-10 & 2P-14	What is the change in number and location of beaver activity areas?	Beaver sign (chews, slides, dams/lodges, scat, tracks, sightings)	Informal surveys or formal stream surveys by foot documenting evidence of beaver activity	Field surveys	TBD	2L-10: Year 10, Year 15; 2P-14: pre-and post- NEPA project implementation	DNF Forest Wildlife Biologist	Mapped and tabular results
2L-11	What is the change in acres of post-wildfire habitat?	acres of post-wildfire habitat stratified by fire severity and by snag density	DedAid and Wildhab modeling of post-fire habitat structure and quality required by black-backed woodpecker and Lewis' woodpecker	USFS: DNF PAG data; 2010 GNN data; DecAid Habitat Type; Viable Model data; FACTS	DNF GIS database	Year 10, Year 15	DNF Forest Wildlife Biologist	

		Metrics	Methods	Data Source(s)	Data Management	Monitoring Schedule	Responsible Party	Products
2P-15	What is the change in acres and improvement of aspen and hardwood habitat?	GIS aspen layer, hardwood & aspen info. from on-site soil survey (soil profile assessment, soil description, water table info., historic occurrences)	WildHab modeling of forest habitat structural requirements of Red-breasted sapsucker and Red-naped sapsucker, soil survey,field site assessment and soil survey, photo points. Other site-specific monitoring methods may be selected during NEPA planning	TBD (for WildHab: DNF GIS aspen layer and various vegetation layers; PAG data; 2010 GNN data)	DNF GIS database	Pre- and post-implementation of relevant NEPA projects	DNF Forest Wildlife Biologist and Forest Soil Scientists	Mapped and tabular results
2P-16	In prescribed burns, what is the number of acres in each tree mortality level?	TBD. May include high, medium, and low fire severity scores.	TBD.	field surveys	TBD	Pre- and post-NEPA project implementation	TBD	Mapped and tabular results
2P-17	What is the change in gap size, abundance, and distribution in ponderosa pine and mixed conifer dry forests?	TBD	TBD	TBD	TBD	Pre- and post-NEPA project implementation	TBD	Mapped and tabular results
2P-18	What is the change in understory plant species composition each PAG within one pilot project area?	TBD, may include percent cover, plant species diversity and abundance, etc.	TBD: Understory vegetation survey plots measuring understory species composition and percent cover	TBD	TBD	Pre- and post-NEPA project implementation	TBD	Mapped and tabular results
2P-19	What is the change in density of all system and user-created roads and trails?	Miles per square mile	TBD	TBD	TBD	Pre- and post-NEPA project implementation	TBD	TBD

	Question	Metrics	Methods	Data Source(s)	Data Management	Monitoring Schedule	Responsible Party	Products
3-P5	What is the change in total system road and trail density in each DCFP project area?	Miles of class 1-5 roads and system trails per square mile	GIS analysis of system road and trail density	USFS – DNF system road and trail GIS data	DNF GIS database	Pre-and post-NEPA project implementation	DNF Forest Hydrologist, DNF Transportation Planner	Mapped and Tabular results
3-P5	What is the change in total system road and trail density in riparian zones and sensitive land types in each DCFP project area?	Miles of Class 1-5 roads and trails/square mile in riparian zones and sensitive land types as defined by DNF	GIS analysis of system road and trail density	USFS – DNF system road and trail GIS data	DNF GIS database	Pre-and post-NEPA project implementation	DNF Forest Hydrologist, DNF Transportation Planner	Mapped and Tabular results
3-P7	What are the changes in soil productivity in each DCFP project area?	TBD	Not developed at this time, but ongoing discussion within USFS R6 and DNF.	TBD	TBD	Pre- and post-NEPA project implementation	DNF Forest Hydrologist	Mapped and tabular results
4-P2	For each NEPA project, was an invasive plant risk assessment completed and what were the required mitigations?	List of mitigation measures	TBD	TBD	TBD	Annual	DNF Invasive Plant Manager	Narrative report

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