9.0 MONITORING AND ADAPTIVE MANAGEMENT

Monitoring and adaptive management are key components of successful resource management plans in order to derive the greatest environmental benefit given limited agency resources. Incorporation of these strategies in the planning process will help ensure management actions identified in this State Plan are implemented and effective at achieving the intended goals and objectives for the benefit of sage-grouse. Adaptive management allows for information learned through monitoring to be integrated into iterative decision making that can be adjusted as outcomes from management actions become better understood (Williams et al. 2009). Management that does not achieve intended goals and objectives can be modified through adaptive management and contribute to the emerging understanding of management action response, sage-grouse habitat requirements, sage-grouse behavior, and sagebrush ecosystem processes.

Monitoring

Two main categories of monitoring will occur for the State Plan: 1) inventory monitoring and 2) management action monitoring. These are described below. Within each of these categories, additional concepts will need to be considered: short and long-term monitoring, monitoring at multiple scales (e.g., site, landscape), and, for management action monitoring, monitoring for implementation and for effectiveness.

Inventory monitoring assesses the status/extent/condition of sage-grouse populations (e.g., sage-grouse population trends over time), sage-grouse habitat (e.g., gain/loss of sage-grouse habitat over time), and of the threats to sage-grouse (as identified in the State Plan, e.g., how many acres of PJ encroachment are occurring each year). Inventory monitoring provides a quantified understanding of changes in condition and extent of sage-grouse populations, habitat, and threats over time and space, can help prioritize efforts, and can help evaluate success in meeting short and long-term goals and objectives. Many of the state and federal agencies already provide a level of inventory monitoring appropriate for the needs of the state plan and this will be incorporated into the state's monitoring plan- more detail is provided below.

This State Plan identified many management actions to address specific threats. Monitoring of management actions is necessary to ensure that individual actions are accomplishing what they are intended to do. The state will require that monitoring plans be developed for all management actions that occur under direction of the State Plan, including those intended to ameliorate threats outlined in Section 7.0. These plans will include monitoring for implementation and monitoring for effectiveness. Monitoring associated with the Conservation Credit System (see Section 8.0) is detailed in the Habitat Quantification Tool Scientific Methods Document1 {currently under development}.

[1] For more information please refer to The Habitat Quantification Tool Scientific Methods Document on the Sagebrush Ecosystem Program's Website: http://sagebrusheco.nv.gov/CCS/ConservationCreditSystem/

Management Action monitoring for implementation includes: 1) a brief description of the project and the work completed, 2) pre- and post-project photographs, 3) lessons learned during implementation, 4) discussion of impacts to uses and other resources, 5) recommendations on the implementation of future projects, 6) maintenance performed, and 7) accounting of expenditures.

Management Action monitoring for effectiveness can play a key role in demonstrating the accountability, success, and value of management investments. Effectiveness monitoring is designed to determine if the project is effective at meeting its biological and ecological goals and objectives. Project-scale effectiveness monitoring measures environmental parameters to ascertain whether management actions were effective in creating the desired change(s) in habitat conditions *and* species response. There are at least three important reasons to conduct project-scale effectiveness monitoring on a management action or a change in management: 1) to determine the biotic and abiotic changes resulting on, and adjacent to, the treatment area; 2) to determine if treatment and management actions were effective in meeting the objective(s); and 3) to learn from the management actions and to incorporate new knowledge in future treatment design.

The following concepts should be addressed in all monitoring plans:

- Identify the site conditions and the reasons for implementing management action(s) at the site.
- Set monitoring objectives and indicators – these should quantitatively or qualitatively evaluate the project objectives that will be used to evaluate project implementation and effectiveness in meeting objectives. Effectiveness in meeting objectives will need to be evaluated for both habitat changes and when appropriate and feasible, sage-grouse response.
- Identify anticipated site attribute changes in response to the management action, target values, and time frame under which changes are anticipated.
- Select monitoring sites and determine appropriate, effective methods. Include control or reference sites in method design. Baseline data on these will allow before, after, with, and without comparisons.
- Monitoring will be conducted for a minimum of three years or until management objects are met. If, as part of the treatment, grazing was restricted for a time period, post-treatment, monitoring should be conducted for three year following resumption of grazing practices. In addition, monitoring will be conducted at 10 years post-treatment as a follow-up for long-term monitoring.
- Monitoring plans will be prepared jointly between the project proponent and land management agency, with final approval from the land management agency. In addition, relevant stakeholders, such as permittees, should be involved in the development of plans and monitoring site selection.

See resources listed at end of this section for development on monitoring plans.

Adaptive Management

Adaptive management as it relates to sage-grouse and their habitat is a structured, iterative process of robust decision making in the face of uncertainty, with an aim to reduce uncertainty over time through continued monitoring. Because adaptive management is based on a learning system, it improves long term management outcomes. The challenge in using the adaptive management approach lies in finding the correct balance between gaining knowledge to improve management in the future and achieving the best short-term outcomes based on current knowledge (Allan and Stankey 2009).

> "An adaptive management approach involves exploring alternatives ways to meet management objectives, predicting the outcomes of alternatives based on the current state of knowledge, implementing one or more of these alternatives, monitoring to learn about the impacts of management actions, and then using the results to update knowledge and adjust management actions" (Williams et al. 2009).

Adaptive management takes monitoring to the next level by establishing, prior to implementation, a framework from which an iterative implementation and learning process can be instituted. Adaptive management implements "learning by doing" and provides flexibility to act in the face of uncertainty.

The following are additional steps to monitoring that need to be addressed to successfully implement adaptive management (Adapted from Williams et al. 2009):

- Identify and record potential drivers of change in the system, threats to the system, and opportunities for beneficial actions. These should be incorporated in the model of response for each management action.
- Development of "models" or hypotheses of the expected response and rationale.
- Development of how management actions should be adjusted following results from monitoring (this should include a set of potential alternatives to management based on the outcome of specific monitoring, allowing for flexibility while based on best available science~~triggers that identify what monitoring~~ results~~ will trigger what management actions~~).
- Implementation of iterative adjustments to management actions following implementation of actions and results of monitoring, following the process outlined in previous bullet.
- Project and management plans have to incorporate the ability to change methods when monitoring of the projects or management actions provides indication or when new science from research or other monitoring project emerges.

Consideration of when adaptive management is appropriate:

- Decision making must be able to be made in an iterative process
- Monitoring data must be available to decision makers
- It is not appropriate when risks associated with learning based-decision making are too high (i.e., if risk of management action is unknown and worst case scenario has

irreversible consequences) in comparison to the risks of not doing so (i.e., the consequences of doing nothing).

See resources listed at end of this section for development on adaptive management plans.

Incorporation of Monitoring and Adaptive Management into the State Plan

A multi-scale monitoring approach is necessary as sage-grouse are a landscape species and conservation is scale dependent to the extent that management actions are implemented within or across seasonal habitats to benefit populations. The state needs to track the extent of threats to sage-grouse (e.g., fire, pinyon-juniper encroachment, etc.), through inventory monitoring, as well as the efforts to manage the threats (e.g., number of acres of pinyon-juniper treated), through management action monitoring, to be able to effectively manage for the species and understand progress in goals and objectives outlined in this plan. Many of the components of inventory monitoring are already being monitored by state and federal agencies. The SETT will work to compile annual monitoring reports that provide a synopsis of these monitoring efforts and metrics relevant to the state plans goals and objectives. The state will engage with stakeholders responsible for these components to facilitate when possible and ensure monitoring occurs. For components that are not currently under purview of agencies, the SETT will work to engage relevant stakeholders to develop a monitoring program. The SETT will develop a comprehensive database to store all monitoring information which will be accessible to the public.

To meet the need for the management action monitoring requirement, all management actions overseen by the SEP will develop monitoring plans following guidance provided in this section. If participating in projects developed by BLM/USFS, NDOW, NDA, NDF, or other agencies, projects should include similar aspects to those outlined here, if not all. As well, all management actions should be reviewed and those appropriate for the adaptive management process should additionally develop an adaptive management plan in coordination with the monitoring plan.

Table XX presents the components (sage-grouse threats, habitat, and populations) that will be monitored to be able to better understand the level of threat to sage-grouse and sagebrush ecosystems and what can be done to respond to the threat for sage-grouse. Elements for inventory monitoring and management action monitoring are outlined as well as the relevant agencies from which monitoring information will be gathered. Monitoring information will be collected across the extent of SGMA and provided at the site, landscape, PMU and state levels and by core, priority, and general management areas. In addition, known changes in extent between years will be documented and total extent of treatments will be summarized.

Additional monitoring components may be identified in the future for inclusion in the annual monitoring report (above and beyond those monitoring components listed in Table XX). As additional threats to sage-grouse are identified, components should be included in the inventory monitoring and management action monitoring to better assess and understand the severity of threat and the progress in ameliorating the threat.

In addition to the annual monitoring report and database, the state of Nevada will develop a methods document for monitoring plans and adaptive management plans that provide recommended, standardized protocols and methods for objective based monitoring that are consistent with other land jurisdictions and agencies, including BLM, USFS, NDOW, and others. ~~the Habitat Assessment Framework (Stiver et al. 2010). These methods outlined will be consistent with those developed for the HQT and for the EIS.~~

Table XX. Inventory and management action monitoring for the State Plan

Monitoring Component	Agency/Entity	Inventory Monitoring Elements	Management Action Monitoring E
Sage-grouse Parameters			
Sage-grouse habitat	NDOW, BLM, USFS, SETT CCS	• Land Health Assessments (BLM) (site, landscape, and state scale) • Resource Implementation Protocol for Rapid Assessment Matrices (USFS) [[Waiting to hear from USFS if this is the appropriate name]] • Sagebrush landscape cover (BLM EIS)[2] (landscape scale) • CCS- functional aces lost due to debit projects, functional acres gained due to credit projects (concept of no net unmitigated loss)	• Treatment conducted and effect treatments (these would be trea included in subsequent monitori components, e.g., meadow resto
Sage-grouse populations	NDOW, BLM, USGS	• Lek, lek cluster, PMU counts, populations and trends[1] (all scales) • Telemetry data collection (site to landscape scale- project dependent)	• At this point, the state plan does management actions directly inf grouse numbers. Management outlined directly affect habitat a affect populations.
Threat			
Fire	BLM, USFS, NDF, NDOW[3]	• Number of fire starts per year • Number and size of fires in each vegetation community, and resistance and resilience classes	• Number of fires "successfully" su (<1,000 acres) • Number of catastrophic fires • Fuels management treatments (effectiveness of treatments)

[1] Scale of Management Action Monitoring is dependent on management action details specified in Section 7.0

[2] As part of the Greater Sage-grouse Northern California and Nevada Sub-regional EIS/LUPA, the BLM/USFS have developed a Monitoring Framework (Appendix E of that document) that outlines monitoring for habitat loss, habitat degradation, and population trend (in coordination with NDOW) at the 1st, 2nd, and 3rd order scale (Stiver et al. 2010).

[3] NDOW is engaged with BLM on post –fire treatment monitoring and provides monitoring in conjunction with these agencies post ES&R efforts.

Monitoring Component	Agency/Entity	Inventory Monitoring Elements	Management Action Monitoring I
			• Rehabilitation efforts for each fi (implementation and effectiven treatments) • Document coordination efforts t efficient and effective fire pre-su suppression management
Cheatgrass	SETT will coordinate with researchers to determine extent BLM, USFS, NDOW, Nevada Cheatgrass Action Team	• Extent (spatial distribution, acres, and density of invasion)	• Treatments conducted and effec treatments (includes restoration efforts to improve resilience/res •
Noxious weeds[1] Medusahead (*Taeniatherum caput-medusae*) Hoary cress (*Cardaria draba*) Russian knapweed (*Acroptilon repens*) Leafy spurge (*Euphorbia esula*) Other weeds Red Brome (*Bromus rubens*) Rattlesnake chess (*Bromus briziformis*) Halogeton (*Halogeton gomeratus*) Purple mustard (*Chorispora*	NDA , NDOW, University of Nevada Cooperative Extension, and SETT	• Extent (spatial distribution, acres, and density of invasion) •	• Treatments conducted and effec treatments

[1] Weed species in Nevada identified as having, generally, greatest impact to sage-grouse habitats (S. Espinosa, personal communication). [[Waiting to hear if Robert Little, Brad Schultz, orKent McAdoo have any additional input]]

Monitoring Component	Agency/Entity	Inventory Monitoring Elements	Management Action Monitoring I
tenella)			
Pinyon juniper encroachment	BLM, USFS, NDF, NDOW, SETT, all stakeholders (including researchers at University of Nevada, Reno, and USGS)	• Extent (spatial distribution, acres, and density of invasion)	• Treatments conducted and effec treatments
Predation	NDOW, Wildlife Services, NDA, and SETT,	• Baseline data collected prior to treatments- data will likely be site specific, not SGMA wide (road kill inventories, raven counts, habitat parameters, etc.)	• Treatments conducted and effec treatments • Documentation of coordination city counties, landfills waste mar livestock owners, research on pe nest deterrent technology
WHB populations	BLM, USFS	• HMA/WHBT populations • Extent of resources damaged by WHB • Understand their timing of use on wetland resources • Trend monitoring regarding maintenance of a thriving natural ecological balance for adjusting AML (BLM 2010)	• Gathers conducted • Treatments conducted and effec treatments
Livestock grazing	BLM, USFS, permitees and stakeholders	• Allotment standards and guidelines • Dates of use and/or intensity of use by allotment • Monitoring of attainment of management objectives (Swanson et al. 2006)	• Documentation of changes in ma prescriptions to improve manag appropriate
Anthropogenic disturbances	SETT, BLM, USFS, other federal agencies, all stakeholders	• CCS- functional aces lost due to debit projects, functional acres gained due to credit projects (concept of no net unmitigated loss) • Surface acres impacted • Indirect acres impacted • Identification of existing infrastructure that	• Management actions to mitigati anthropogenic disturbances will for under the appropriate threat habitat and in reporting will be r projects. • Documentation of implementati

Monitoring Component	Agency/Entity	Inventory Monitoring Elements	Management Action Monitoring I
		could be retrofitted, as appropriate (inclusion on the list does not require retrofitting, simply identifying the opportunity)	Specific Consultation Based Desi
Recreation and OHVs	SETT, BLM, USFS, Commission on Off-Highway Vehicles and other stake holders	• Permitted activities • Extent of authorized and unauthorized recreational trails and facilities	• Treatments conducted to restor impacted by recreational activiti effectiveness of treatments • Documentation of coordination recreational groups
Weather Variability	NOAA, DRI, State Climatologist, NRCS Water and Climate Center, USGS BLM, USFS, and other stakeholders	• U.S. Drought Monitor • Hydrologic Report • Climate data records (current and historic)	• Tracking changes in managemer to weather variability
Land Ownership	All agencies	• Tracking of land ownership changes	• Tracking of how changes in man actions due to land ownership a

Existing monitoring and adaptive management plans and methods

There are several key plans and methods that have been developed for use in Nevada and across the range of the sage-grouse. These should be referenced in the development of resource objectives, management action monitoring plans, and adaptive management plans. The following are recommended for consideration in the State Plan:

Monitoring

Swanson, S, Ben, B, Rex, C, Bill, D, Gary, B, Gene, F, James, L, Gary, M, Valerie, M, Barry, P, Paul, T, Diane, W and Duane, W.2006. Nevada rangeland monitoring handbook. Second Edition. Educational Bulletin 06-03. University of Nevada Cooperative Extension, Natural Resources Conservation Service, Bureau of Land Management, U.S. Forest Service. USA. 84 pp. Available at: https://www.unce.unr.edu/publications/files/ag/2006/eb0603.pdf

Stiver, S.J., E.T. Rinkes, and D.E. Naugle. 2010. Sage-grouse Habitat Assessment Framework. U.S. Bureau of Land Management. Unpublished Report. U.S. Bureau of Land Management, Idaho State Office, Boise, Idaho. Available at: http://sagemap.wr.usgs.gov/docs/rs/SG%20HABITAT%20ASESSMENT%202010.pdf

Bureau of Land Management. 2010 Wild Horses and Burros Management Handbook. H-4700-1. Available at: http://www.blm.gov/pgdata/etc/medialib/blm/wo/Information_Resources_Management/policy/blm_handbook.Par.11148.File.dat/H-4700-1.pdf

BLM AIM Strategy

Toevs, G.R., J.W. Karl, J.J. Taylor, C.S. Spurrier, M. Karl, M.R. Bobo, and J.E. Herrick. 2011. Consistent Indicators and Methods and a Scalable Sample Design to Meet Assessment, Inventory, and Monitoring Information Needs Across Scales. Rangelands: 14-20.

Toevs, G.R., J.J. Taylor, C.S. Spurrier, W.C. MacKinnon, and M.R. Bobo. 2011. Bureau of Land Management Assessment, Inventory, and Monitoring Strategy: For Integrated Renewable Resources Management. Department of the Interior, Bureau of Land Management, National Operations Center, Denver, CO. Available at: http://www.blm.gov/pgdata/etc/medialib/blm/wo/Information_Resources_Management/policy/ib_attachments/2012.Par.53766.File.dat/IB2012-080_att1.pdf

BLM AIM Monitoring Methods

Herrick, J.E., J.W. Van Zee, K.M. Havstad, L.M. Burkett, and W.G. Whitford. 2009. Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems. Volume I: Quick Start. Department of Agriculture, Agricultural Research Service, Jornada Experimental Range, Las Cruces, NM. Available at:

http://www.ntc.blm.gov/krc/uploads/281/Monitoring%20Manual%20for%20Grassland, %20Shrubland%20and%20Savanna%20Ecosystems%20Vol.%20I_Quick%20Start.pdf

Herrick, J.E., J.W. Van Zee, K.M. Havstad, L.M. Burkett, and W.G. Whitford. 2009. Monitoring Manual for Grassland, Shrubland and Savanna Ecosystems. Volume II: Design, Supplementary Methods and Interpretation. Department of Agriculture, Agricultural Research Service, Jornada Experimental Range, Las Cruces, NM. Available at: http://www.ntc.blm.gov/krc/uploads/281/Monitoring%20Manual%20for%20Grassland, %20Shrubland%20and%20Savanna%20Ecosystems%20Vol.%20.II.pdf

Adaptive Management

Williams, B. K., R. C. Szaro, and C. D. Shapiro. 2009. Adaptive Management: The U.S. Department of the Interior Technical Guide. Adaptive Management Working Group, U.S. Department of the Interior, Washington, DC. Available at: http://www.doi.gov/initiatives/AdaptiveManagement/TechGuide.pdf

Cooperative monitoring

The state of Nevada recognizes the value of monitoring as well as the time and effort required to do so. Given limiting staffing and resources of agencies, the SETT will encourage and facilitate cooperative monitoring by interested stakeholders. The BLM has established a cooperative monitoring agreement for grazing allotment permitees to help conduct rangeland health assessments on their permitted allotments (See Attachment XXX). In compilation of the first annual monitoring report and through discussions with stakeholders, the SETT will work to develop similar cooperative monitoring agreements for additional resources with additional agencies and will facilitate development of such to meet the needs for training and quality control.

See resources below for monitoring guides for ranchers and other stakeholders.

Oregon Cattlemen's Association (2014). Oregon Resources Monitoring Guide: The Rancher's Guide to Improved Grazing.

Peterson, Eric. 2010. Implementing a Cooperative Permittee Monitoring Program. Sublette County Extension. University of Wyoming Cooperative Extension Service. B-1169. 28 pp. Available at: http://www.wyoextension.org/agpubs/pubs/B1169.pdf _____

Swanson, S, Ben, B, Rex, C, Bill, D, Gary, B, Gene, F, James, L, Gary, M, Valerie, M, Barry, P, Paul, T, Diane, W and Duane, W.2006. Nevada rangeland monitoring handbook. Second Edition. Educational Bulletin 06-03. University of Nevada Cooperative Extension, Natural Resources Conservation Service, Bureau of Land Management, U.S. Forest Service. USA. 84 pp. Available at: https://www.unce.unr.edu/publications/files/ag/2006/eb0603.pdf

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Allan C. and G. H. Stankey. 2009. Adaptive Environment Management: a practitioner's guide. Dordrecht Publisher, Netherlands. ISBN 978-90-2710-8.

Bureau of Land Management. 2010 Wild Horses and Burros Management Handbook. H-4700-1. Available at: http://www.blm.gov/pgdata/etc/medialib/blm/wo/Information_Resources_Management/policy/blm_handbook.Par.11148.File.dat/H-4700-1.pdf

Swanson, S, Ben, B, Rex, C, Bill, D, Gary, B, Gene, F, James, L, Gary, M, Valerie, M, Barry, P, Paul, T, Diane, W and Duane, W.2006. Nevada rangeland monitoring handbook. Second Edition. Educational Bulletin 06-03. University of Nevada Cooperative Extension, Natural Resources Conservation Service, Bureau of Land Management, U.S. Forest Service. USA. 84 pp. Available at: https://www.unce.unr.edu/publications/files/ag/2006/eb0603.pdf

Williams, B. K., R. C. Szaro, and C. D. Shapiro. 2009. Adaptive Management: The U.S. Department of the Interior Technical Guide. Adaptive Management Working Group, U.S. Department of the Interior, Washington, DC.