

VI. CONSERVATION STRATEGY

The potential threats facing GrSG conservation in Colorado are diverse and abundant (see “Issues Potentially Affecting GrSG”, pg. 91). Existing local work groups have been identifying and addressing these on a local basis, in some cases for many years (see “Individual Populations: Status and Distribution”, pg. 60). It is intended that the strategies provided in this section provide enough detail for (1) topics that have not yet been addressed by existing local plans; and (2) GrSG population areas where no local plan yet exists. In addition, some of these strategies consider the cumulative, landscape-wide impacts to GrSG, something that is out of the scope of local plans. Managers should consult and implement appropriate strategies within this plan, and then should also read and apply strategies within the applicable local plan(s). In some cases, more detail will be offered by the local plans, and in other cases, this plan will be more specific. This approach will assure that both statewide issues and local conditions are recognized and addressed. Please refer to the goals of the CCP (pg. 2): this “Conservation Strategy” is designed to directly target most items on that list.

For many potential impacts, there isn’t adequate information to design as appropriately responsive GrSG management as managers would like. Rather, we must proceed in the face of uncertainty about the details of a given impact, though we know that the issue is, or will soon be, impacting GrSG populations (see “Adaptive Management”, pg. 3). The strategies are written with primarily a passive adaptive management approach in mind: multiple strategies recommend (1) monitoring of GrSG population and habitat response to management; (2) research to evaluate management and to improve the understanding of the causes of impacts and the possible solutions (which will ultimately also improve management); and (3) updating and improving management as necessary, based on feedback from (1) and (2). In addition, flexibility within this section allows for the innovation of a more active adaptive management program, if that becomes a priority (see “Adaptive Management”, pg. 3).

Each potential risk/issue has a separate accompanying strategy section, generally with the same title as the issue section (e.g., “Housing Development”). Refer to the associated “issue” section in the plan for additional background on each topic (see “Issues Potentially Affecting GrSG”, pg. 91). Exceptions to this are: (1) the strategy sections “Habitat Enhancement” and “Habitat Linkages” correspond, in part, to the issue section, “Habitat: Fragmentation, Quality, and Quantity”; and (2) strategy sections “Habitat Monitoring”, “Information, Communication, and Education”, “Population Monitoring”, and “Research” are important in multiple issues, and are not associated with any one in particular. The individual strategies/actions in each strategy section are grouped under separate “Objectives” (each “Objective” is designed to target a stated “Issue” within the topic).

Each numbered strategy has accompanying information regarding Responsible Parties (listed in alphabetical order), Timeline, and Cost. Definitions of acronyms used in “Responsible Parties” are in Appendix N. The “lead” responsible party(ies) refers to those who might: (1) initiate implementation of the given strategy; (2) provide key funding or technical assistance; (3) identify the specific

problem and bring it to the attention of other responsible parties; or (4) provide guidance from a biological perspective. If no lead is identified, all responsible parties are equally responsible for the strategy. The timeline generally refers to a “Complete by” date, unless otherwise stated. The cost is currently a best guess and should only be considered as a rough guide. The cost estimates represent new or additional costs, above and beyond current management. Full time equivalency costs (FTE) consider only the time required for the task from signatory agencies. There is obviously some overlap among topics/sections, such as “Energy and Mineral Development” and “Infrastructure”, and we tried to identify these where possible. For strategy sections that are relatively long, we provide an outline of how the issues and objectives are organized therein.

Two general topics that are of concern in almost every issue area are “Information, Communication, and Education”, and “Research”. We organized these strategies differently than the others, to address the numbered strategy similarities and redundancies among strategy sections. Thus, the original numbered strategy provided under an issue remains stated in that section, but a broader strategy is written in the “Information, Communication, and Education” or “Research” section, and is intended to cover the original individual strategy, along with others. This results in redundancy within the plan, but allows for completeness within each individual strategy section, which may be important in implementing the plan.

For example, this is a strategy in the “Grazing” section: “6.4.1.3 Develop an internet website through which local work groups can share information. Include a link from the CDOW website.” It is listed in that section, but the “Responsible Parties”, “Timeline” and “Cost” columns remain blank there. Instead, a strategy in the “Information, Communication, and Education” section reads: “12.3.2.1 Pursue all opportunities to support and facilitate the GrSG local work group process.” Strategy 6.4.1.3, and other related strategies from all issues sections are listed below 12.3.2.1. The “Responsible Parties”, “Timeline”, and “Cost” columns are then completed for the broader, overarching strategy 12.3.2.1. In some cases, the original numbered strategy *does* have responsible party, timeline, and cost, information, and a reference to that strategy is also included in a related “Information, Communication, and Education” numbered strategy.

Some of the strategies refer to tools for GrSG management, to be used in conjunction with the strategies, including (1) Appendix A, “GrSG Structural Habitat Guidelines”, (2) Appendix B, “GrSG Disturbance Guidelines” (3) Appendix C, “Habitat Monitoring Protocol”; (4) Appendix D, “Recommendations Regarding Plant Species for Use in GrSG Habitat Management and Restoration”, derived from Monsen (2005); (5) Appendix E, “Grazing Management Options”; (6) Appendix F, “Available Funding Opportunities for GrSG Conservation”; and (7) Appendix I, “Suggested Management Practices Applicable for Oil and Gas Development, within Lease Rights”.

Due to the short time frame provided for completion of this plan, prioritization of conservation strategies has not yet been accomplished. Within 6 months after the plan is signed, the signatory agencies will form an Implementation Team to embark on the

development of an implementation plan. The implementation plan will rank and prioritize the strategies according to importance to GrSG conservation in Colorado, within current budgetary and regulatory constraints. Prioritization will occur at both a statewide and population level, since not all the strategies in this plan are relevant to each population. The Implementation Team will meet with local work groups to gather input on strategies that are most applicable and time sensitive to GrSG conservation in their areas. This input will be considered during prioritization of strategies. The implementation plan will also establish a reporting timeline and process to gauge effectiveness of the CCP.

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1. Agricultural Conversion

Conversion of GrSG habitat to cropland, pasture, and hayland peaked in the 1960s and 1970s. Currently, very little native rangeland is being converted to cropland. Strategies should focus on developing programs that promote converting cropland back to native rangeland. Both private rangeland and cropland enrolled in the Conservation Reserve Program (CRP) provide, or have the potential to provide, habitat for GrSG. Strategies for these areas should focus on developing incentives to reduce the rate that rangeland and CRP are converted to other uses that are less desirable as GrSG habitat. Over the last 10-20 years, sagebrush has been slowly establishing in CRP lands and now provides some value as GrSG habitat. It is recommended to support re-enrollment of CRP lands in northwestern Colorado, and to encourage management of CRP lands to promote sagebrush establishment. For further discussion of this issue, see “Agricultural Conversion” issue, pg. 91.

ISSUE 1.1: Converted rangelands don’t provide adequate GrSG habitat.			
OBJECTIVE 1.1.1 Develop technologies and share information for establishing native vegetation suitable for GrSG habitat in CRP, cropland, and large monocultural non-native grass plantings. Encourage GrSG habitat restoration on private land.			
Conservation Strategy	Responsible Parties <small>(if there is a lead entity, it is in bold)</small>	Timeline	Cost
1.1.1.1 Evaluate past vegetation restoration applications in CRP, cropland, and large monocultural non-native grass plantings that may serve as GrSG habitat. Produce a report that documents these efforts. [See Research Strategy 21.1.2.1]	See Research Strategy 21.1.2.1		
1.1.1.2 Design, plant, evaluate, and report on field trials for establishing desired vegetation to serve as GrSG habitat in CRP, cropland, and large monocultural non-native grass plantings. [See Research Strategies 21.1.2.1 and 21.1.2.4]	See Research Strategies 21.1.2.1 and 21.1.2.4		
1.1.1.3 Arrange field trips for land managers to observe the results of different treatment methods in CRP, cropland, and large monocultural non-native grass plantings that may provide GrSG habitat.	BLM, CDOW, CSU Extension, LWGs, NRCS , Private Landowners	Begin by 2008	\$1,000
1.1.1.4 Purchase and maintain equipment necessary for restoration of GrSG habitat in CRP, cropland, and large monocultural non-native grass plantings.	BLM, CDOW, CSU Extension, NRCS , SCDs	2010 and ongoing	\$200,000
1.1.1.5 Work with FSA to insure CRP program policy supports improvement of enrolled land with developed technologies.	BLM, CDOW, LWGs, NRCS , Private Landowners, SCDs	2008 and ongoing	None

1.1.1.6 Help design and fund restoration projects (see “Habitat Enhancement” strategy, pg. 336 and Appendix F, “Available Funding Opportunities for GrSG Habitat Conservation”).	BLM, CDOW, LWGs, NRCS , Private Landowners, SCDs	Ongoing	\$200/acre
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ISSUE 1.2: Some CRP lands that are important to GrSG are not eligible for re-enrollment in the program, raising concern that those acres may no longer serve as GrSG habitat.			
OBJECTIVE 1.2.1: For CRP lands that are important to GrSG, pursue opportunities to keep the habitat intact for GrSG.			
Conservation Strategy	Responsible Parties <small>(if there is a lead entity, it is in bold)</small>	Timeline	Cost
1.2.1.1. CDOW and NRCS will work with FSA to have vacant/unknown, potential, and occupied GrSG habitat in Colorado designated as a priority area in the CRP. This will increase the probability that cropland will remain in CRP and will continue to serve as GrSG habitat.	CDOW , FSA, LWGs, NRCS	2008 and ongoing	0.25 FTE
1.2.1.2 When CRP lands become un-enrolled in the program, cooperating agencies will pool resources to offer monetary incentives to maintain those lands in similar condition as CRP and to provide GrSG habitat.	FSA, CDOW , NRCS, USFWS	2008-2015	\$100,000 annually

2. Disease and Parasites

WNV currently poses the most serious potential disease issue for GrSG populations. A looming risk is avian influenza, of which little is known. Outbreaks of other diseases or parasites are possible, but they have typically been localized and may be an issue for only the smallest GrSG populations. Efforts should be devoted to disease and parasite detection, as well as to the development of the appropriate management response if infection is detected in GrSG. In addition, more information is needed regarding our knowledge about GrSG diseases and parasites and the risk of transmission from other gallinaceous birds. For further discussion of this issue, see “Disease and Parasites” issue, pg. 95.

ISSUE 2.1: WNV is lethal to GrSG, has been detected in Colorado, and thus presents a risk to GrSG.			
OBJECTIVE 2.1.1: Minimize the occurrence and impact of WNV if it threatens GrSG populations.			
Conservation Strategy	Responsible Parties <small>(if there is a lead entity, it is in bold)</small>	Timeline	Cost
2.1.1.1 Monitor GrSG and other species (through ongoing projects) for presence of WNV in GrSG counties; coordinate this effort with other research and management activities.	CDOW , CDPHE, County Governments, LWGs	Ongoing	\$1,000/yr
2.1.1.2 To protect GrSG in localized areas where WNV has been detected, control mosquitoes through applications of appropriate EPA-regulated larvicides and/or adulticides.	CDOW, County Governments	As needed	Project - dependent
2.1.1.3 Continue to support investigation of GrSG susceptibility to, and inheritance of, immunity to WNV. [See Research Strategy 21.5.1.1]	See Research Strategy 21.5.1.1		
2.1.1.4 Determine the impact of wet conditions on mosquito production as it relates to the potential for catastrophic disease in GrSG. Determine the risk factors and potential of catastrophic disease in GrSG populations. [See Research Strategies 21.5.1.2 and 21.5.1.3]	See Research Strategies 21.5.1.2 and 21.5.1.3		

ISSUE 2.2: Diseases and/or parasites other than WNV have been shown to be lethal to, or to compromise the health of GrSG.			
OBJECTIVE 2.2.1: Minimize the occurrence and impact of diseases and/or parasites (other than WNV) if they threaten GrSG populations.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
2.2.1.1 If GrSG populations are infected with disease or parasites that threaten a population, (1) investigate, isolate, and control the source of disease or parasite; and (2) if possible, treat GrSG.	CDOW	As needed	Unknown
2.2.1.2 Investigate the possible need to conduct standard disease screening on all game birds before they are imported into Colorado or moved within GrSG range in Colorado.	CDOW , County Governments	As needed	0.25 FTE
2.2.1.3 Remain vigilant regarding the latest information and research regarding avian influenza and upland game birds.	CDOW	On going	Monitor as needed
2.2.1.4 Investigate the need to regulate intra- and inter-state movement of game birds by all parties.	CDOW , County Governments, LWGs	2008	0.5 FTE

3. Energy and Mineral Development

Rising energy prices and new technologies have recently led to an increased emphasis on developing domestic energy resources, many of which are located beneath sage-grouse habitat in the western United States, including Colorado. One result is a dramatic increase in oil and gas development over the past 6 years on federal lands. The Colorado Oil and Gas Commission (Colorado Oil and Gas Conservation Commission 2006) reported that approved Applications for Permits-to-Drill (APDs) increased 50% from 2004 to 2005 (from 2,915 to 4,373; Fig. 21, pg. 104), and permits in 2006 increased another 35% over 2005 (from 4,373 to 5,904; Fig. 21 [pg. 104]; Colorado Oil and Gas Conservation Commission 2007a). Early 2007 APD statistics suggest that the number approved in 2007 could reach 6,350 (Colorado Oil and Gas Conservation Commission 2007b). This increase in permits dwarfs that seen in the energy boom of the early 1980s (Fig. 21, pg. 104). As an example of how an increase in drilling will directly affect GrSG range, in Garfield County (PPR GrSG population), drilling permit totals more than tripled from 2003 (566 APDs) to 2006 (1,844 APDs; Colorado Oil and Gas Conservation Commission 2006, 2007a).

Research in Montana and Wyoming has indicated that traditional oil and gas stipulations designed to protect sage-grouse (primarily timing restrictions and no surface occupancy surrounding leks) are inadequate on a landscape scale (Lyon and Anderson 2003, Holloran 2005, Naugle et al. 2006a and 2006b). Current management was designed for, and still has validity in, areas of low intensity, dispersed development. However, other approaches are necessary to offset development of larger scale or higher intensity (see “Energy and Mineral Development: Preventing and/or Mitigating Impacts”, pg. 280). The energy and mineral strategies allow for implementation of current management, as well as incorporation of research and future management scenarios. We recognize the limitations of management options if an area is already leased. Lease status, topographic and geologic factors, and economic feasibility should all be considered when selecting and incorporating conservation measures. However, much progress can be made by working with industry and neighboring land owners to implement strategies on a voluntary basis.

The 2005 Energy Act (Energy Policy Act of 2005, H.R.6, Section 369) included an emphasis on the development of domestic energy sources, in particular oil shale. This legislation, along with higher oil prices and the advent of new oil shale in situ extraction techniques, has encouraged companies to pursue the development of oil shale resources. An important note, from the GrSG perspective, is the considerable overlap in potential resources for oil and gas drilling and oil shale extraction in Colorado.

Coal is also increasing in demand and use as an energy source. Coal production in the United States reached record levels in 2005 (Freme 2005). Demand for coal is expected to remain high due to continued economic expansion and elevated natural gas prices (Freme 2005). The largest coal reserves in the state also significantly overlap GrSG habitat and include significant portions of the NWCO and PPR populations. Coal reserves also overlap with potential oil, gas, and oil shale resources.

The primary potential risks to GrSG from energy and mineral development are: (1) direct disturbance, displacement, or mortality of grouse (this includes physiological stress to birds); (2) direct loss of habitat, or loss of effective habitat through fragmentation and reduced habitat patch size and quality; and (3) cumulative landscape-level impacts. While development impacts can occur quickly, timelines for effective enhancement and reclamation of GrSG habitats can be lengthy, depending on site capability and other factors. A potential for increases in invasive plant species is also mentioned here, but is addressed in more detail in the “Weeds” strategy, pg. 410. Impacts from infrastructure associated with energy and mineral development (e.g., powerlines, pipelines) is mentioned where relevant, but specific impacts are covered in more detail in the “Infrastructure” (pg. 369) and “Roads” (pg. 394) strategy sections. For further discussion of this issue, see “Energy and Mineral Development” issue, pg. 101.

Appendices related to energy and mining development are Appendix G, “Energy and Mining Leasing and Development Process”; Appendix H, “Literature Review: Oil and Gas Development Impacts on Prairie Grouse”; and Appendix I, “Suggested Management Practices Applicable for Oil and Gas Development, within Lease Rights”. For a discussion of the history of the “¼-mile buffer” frequently used in lease stipulations and recommended alternatives, see Appendix B, “GrSG Disturbance Guidelines”.

Some of the strategies here reflect current activities that are already taking place (e.g., strategies under Objective 3.1.1), many on a voluntary basis. (3) non-federal land (e.g. private or state), non-federal estate. Also note that there are 3 general situations that may occur in energy development, regarding land ownership and mineral development rights ownership (mineral estate): (1) federal land, federal estate; (2) “split-estate” where mineral and surface ownership are different (e.g., private land, federal mineral); and (3) non-federal land (e.g., private, state), non-federal estate. Ultimately, it would be best if all appropriate strategies were adopted across all 3 of these scenarios, but application on private estate is applied only on a voluntary basis.

A special case exists in the PPR population, which is small and isolated. Because of this, any level of energy development activity is likely to have significant adverse impacts on GrSG persistence. Virtually all energy leases in this area have been let, and the BLM has imposed stipulations on these leases to protect grouse, but nevertheless, there could be significant impact. This is a situation when innovative strategies may be needed (see Strategy 3.2.3.7), such as: (1) long-term habitat improvement/restoration efforts (e.g., piñon-juniper removal) for the local grouse population, so that more and better sage-grouse habitat exists after the period of highest development and disturbance associated with energy industry activities is completed (see Strategy 3.3.1.1); (2) completing development activities near this population as quickly as possible, to set the stage for population restoration efforts; and (3) pursuing stabilization and protection of GrSG populations off-site.

Outline of strategy organization (italics within Issues and Objectives refer to this outline)

Issue 3.1: Disturbance to GrSG

Objective 3.1.1: Current management, all industries except large-scale mining

Issue 3.2: Effects on GrSG habitat

Objective 3.2.1: Oil, gas, and small-scale mining of energy and mineral resources

Objective 3.2.2: Large-scale mining of energy and mineral resources

Objective 3.2.3: Cumulative impacts of all industries

Objective 3.2.4: Reclamation, all industries

Issue 3.3: How to improve on current management of industry development in GrSG habitat

Objective 3.3.1: Land management planning

Objective 3.3.2: Frameworks for voluntary participation

Objective 3.3.3: Adaptive management approach

Objective 3.3.4: Mitigation, both current and future

Issue 3.4: Research

Objective 3.4.1: Existing research

Objective 3.4.2: Determine effectiveness of existing stipulations and mitigation

Objective 3.4.3: Other needed research

Issue 3.5: Communication

Objective 3.5.1: Improve communication

ISSUE 3.1: Energy and mineral development within GrSG habitat may adversely affect the species through <i>disturbance, displacement, or direct mortality</i> .			
OBJECTIVE 3.1.1: Minimize <i>disturbance, displacement, or direct mortality of GrSG</i> during the construction, development, and production of <i>oil and gas resources and small-scale mining of energy and mineral resources</i> in Colorado (see Appendix B, “GrSG Disturbance Guidelines”).			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
3.1.1.1 Continue to avoid GrSG breeding and nesting seasons during oil and gas construction and drilling activities and small-scale mining in associated seasonal habitats (for seasonal habitat definitions refer to Appendix B: “GrSG Disturbance Guidelines”, or local conservation plans). To protect breeding habitat, negotiate appropriate Conditions of Approval (COAs) on federal estate or use voluntary application on private estates.	BLM, COGCC , County Governments, Industry, Private Landowners, SLB, USFS , USFWS	Ongoing	N/A
3.1.1.2 Restrict oil and gas development and production activities and small-scale mining during the GrSG lekking season within a buffer around leks (see Appendix B, “GrSG Disturbance Guidelines”; see also strategies 3.3.3.10 and 3.4.2.1). If this is not possible, limit activities near active sage-grouse leks during the breeding season to portions of the day after 9:00 a.m. and before 4:00 p.m. (for seasonal definitions refer to Appendix B: “GrSG Disturbance Guidelines”, or local conservation plans). Lek data are considered sensitive information by CDOW. Limit data distribution to the extent necessary for effective management.	BLM, COGCC , County Governments, Industry, Private Landowners, SLB, USFS , USFWS	Ongoing	N/A
3.1.1.3 Gate field and facility service roads or otherwise limit regular public access on field and facility service roads in GrSG range, consistent with landowner wishes and direction.	BLM, COGCC , County Governments, Industry, Private Landowners , SLB, USFS , USFWS	Ongoing	\$2500/gate and 0.1 FTE
3.1.1.4 Reduce noise impacts from compressor stations by locating stations at least 2,500 feet away from GrSG leks (or at an alternative distance as indicated by best available science: see Appendix B, “GrSG Disturbance Guidelines”; see also strategies 3.3.3.10 and 3.4.2.1), or by using decibel reduction equipment, on a site-by-site basis.	BLM, COGCC , County Governments, Industry , Private Landowners, SLB, USFS , USFWS,	Ongoing	\$1500/station and 0.1 FTE

3.1.1.5 For all geophysical exploration, conservation measures to avoid important GrSG seasonal habitat-use periods should be encouraged on private lands and incorporated on federal lands.	BLM, COGCC , County Governments, Industry, Private Landowners, SLB, USFS, USFWS	Ongoing	N/A
3.1.1.6 Encourage the use of technologies that reduce road traffic and daily visits to well pads to the extent possible in GrSG habitat (e.g., telemetric well monitoring, multi-phase pipeline gathering systems).	BLM, COGCC, County Governments, Industry , Private Landowners, SLB, USFS, USFWS	Ongoing	N/A

ISSUE 3.2: Energy and mineral development may adversely impact GrSG populations through <i>the loss, degradation, or fragmentation of existing GrSG habitats</i> .			
OBJECTIVE 3.2.1: Minimize the <i>loss, fragmentation, or degradation of existing GrSG habitat</i> during the planning and development of oil and gas resources and small-scale mining of energy and mineral resources in Colorado.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
3.2.1.1 Encourage the use of effective BMPs, as identified by BLM or other sources, in order to reduce habitat fragmentation and the long-term footprint of energy and mineral development in GrSG habitat, across all ownership boundaries (see Appendix I, “Suggested Management Practices Applicable for Oil and Gas Development within Lease Rights”).	BLM, COGCC , County Governments, Industry , Private Landowners, SLB, USFS, USFWS	Ongoing	N/A
3.2.1.2 On public lands, apply an NSO as a lease stipulation on new leases or as a COA on drilling permits around GrSG leks (see “GrSG Disturbance Guidelines”, Appendix B, and strategies 3.3.3.10 and 3.4.2.1). Encourage a similar approach on private lands.	BLM, COGCC , County Governments, Industry, Private Landowners, SLB, USFS, USFWS	Ongoing	N/A
3.2.1.3 Avoid surface disturbing activities (related to mining) within a buffer of GrSG leks (see Appendix B, “GrSG Disturbance Guidelines”; see also strategies 3.3.3.10 and 3.4.2.1). Locate surface-disturbing activities a minimum of 1,000 feet outside of riparian areas, or as far as practical and necessary to avoid influencing GrSG brood habitat function.	BLM, COGCC , County Governments, Industry, Private Landowners, SLB, USFS, USFWS	Ongoing	N/A

<p>3.2.1.4 If an energy or mineral development is planned in sagebrush habitats that are located within a 4-mile radius of a GrSG lek:</p> <ul style="list-style-type: none"> • within a 1-mile radius of the proposed ground-disturbing activity, any seasonal habitats that may be impacted should be delineated and field-validated in coordination with CDOW, BLM, USFS, or private biologists, prior to project location and design (see “Habitat Monitoring Strategy” [pg. 341] and Appendix C, “Sage-grouse Habitat Monitoring Protocol”). This is a priority for mapping only. Appropriate strategies should still apply within the 4-mile radius of the lek site. • coordinate responsibility across lease boundaries for mapping purposes and to assess cumulative effects • See “GrSG Disturbance Guidelines” (Appendix B) • Lek data are considered sensitive information by CDOW. Limit data distribution to the extent necessary for effective management. 	<p>BLM, CDOW, COGCC, County Governments, DRMS, Industry, LWGs, Private Landowners, SLB, USFS, USFWS</p>	<p>Ongoing</p>	<p>2.0 FTE</p>
<p>3.2.1.5 Encourage and/or offer to have biologists attend notice of staking on-site visits on private lands, as well as state and federal mineral estates, to locate well pads and roads where they will have the least impact on GrSG habitat.</p>	<p>BLM, CDOW, COGCC, County Governments, Industry, LWGs, Private Landowners, SLB, USFS, USFWS</p>	<p>Ongoing</p>	<p>2.0 FTE</p>
<p>3.2.1.6 Use directional drilling to minimize the impact to GrSG habitat where biologically significant GrSG habitats are involved, if such techniques are technically feasible and cost-effective.</p>	<p>BLM, COGCC, County Governments, Industry, Private Landowners, SLB, USFS, USFWS</p>	<p>Ongoing</p>	<p>N/A</p>
<p>3.2.1.7 Minimize pad size and other facilities to the smallest extent practical in GrSG habitat, consistent with safety (note: where directional drilling is used, larger pads are needed for multiple wells).</p>	<p>BLM, COGCC, County Governments, Industry, Private Landowners, SLB, USFS, USFWS</p>	<p>Ongoing</p>	<p>N/A</p>
<p>3.2.1.8 Limit facility footprint in sage-grouse habitat to that necessary for safe and effective development.</p>	<p>BLM, COGCC, County Governments, Industry, Private Landowners, SLB, USFS, USFWS</p>	<p>Ongoing</p>	<p>N/A</p>
<p>3.2.1.9 Plan and construct roads and pipelines to minimize duplication in GrSG habitat. Use existing roads and right-of-ways wherever possible, and design and construct all new roads to a safe and appropriate standard (no higher than necessary), to accommodate their intended use.</p>	<p>BLM, COGCC, County Governments, Industry, Private Landowners, SLB, USFS, USFWS</p>	<p>Ongoing</p>	<p>0.5 FTE</p>

3.2.1.10 Cooperate with county weed programs to control noxious weed infestations associated with oil and gas development disturbances in GrSG habitat (see also “Weeds” strategy, pg. 410).	BLM, CDOW, COGCC, County Governments, Industry, LWGs, NRCS, Private Landowners, SLB, USFS, USFWS	Ongoing	0.5 FTE
3.2.1.11 Incorporate BMPs to exclude wildlife from surface impoundments associated with oil and gas development.	BLM, CDOW, COGCC, Industry, Private Landowners, USFS, USFWS	2008	0.1 FTE

ISSUE 3.2: Energy and mineral development may adversely impact GrSG populations through the <i>loss, degradation, or fragmentation of existing GrSG habitats</i> .			
OBJECTIVE 3.2.2: Minimize the <i>loss, fragmentation, or degradation</i> of existing GrSG habitat during the planning and development of energy and mineral resources through <i>large-scale mining</i> in Colorado (including oil-shale development ¹).			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
3.2.2.1 Avoid GrSG seasonal habitats when siting large-scale mining operations and oil shale development, where possible (see Appendix B, “GrSG Disturbance Guidelines”).	BLM, County Governments, DRMS, Industry, Private Landowners, SLB, USFS, USFWS	Ongoing	N/A
3.2.2.2 Where GrSG habitats cannot be avoided when siting large-scale mining and oil shale development, mitigate impacts through strategies under Objective 3.3.4. See also “Off-site Mitigation of Impacts” discussion, pg. 287.	BLM, County Governments, DRMS, Industry, Private Landowners, SLB, USFS, USFWS	Ongoing	0.5 FTE
3.2.2.3 Encourage the use of effective BMPs, as identified by BLM or other sources, in order to reduce habitat fragmentation and the long-term footprint of energy and mineral development in GrSG habitat, across all ownership boundaries (see Appendix I, “Suggested Management Practices Applicable for Oil and Gas Development, within Lease Rights”).	BLM, County Governments, DRMS, Industry, Private Landowners, SLB, USFS, USFWS	Ongoing	N/A

<p>3.2.2.4 When an energy or mineral development is planned in sagebrush habitats that are located within a 4-mile radius of a GrSG lek:</p> <ul style="list-style-type: none"> seasonal habitats that may be impacted within a 1-mile radius of the proposed ground-disturbing activity should be delineated and field-validated in coordination with CDOW, BLM, or private biologists, prior to project location and design (see “Habitat Monitoring Strategy” [pg. 341] and Appendix C, “Sage-grouse Habitat Monitoring Protocol”). This is a priority for mapping only. Appropriate strategies should still apply within the 4 mile radius of the lek site. coordinate responsibility across lease boundaries for mapping purposes and to assess cumulative effects see Appendix B, “GrSG Disturbance Guidelines” Lek data are considered sensitive information by CDOW. Limit data distribution to the extent necessary for effective management. 	<p>BLM, CDOW, County Governments, DRMS, Industry, LWGs, Private Landowners, SLB, USFS, USFWS</p>	<p>Ongoing</p>	<p>2.0 FTE</p>
<p>3.2.2.5 For surface mining, above-ground facilities of underground mines, and oil shale development areas, minimize the area impacted and duration of impact on GrSG populations and habitat.</p>	<p>BLM, County Governments, DRMS, Industry, Private Landowners, SLB, USFS, USFWS</p>	<p>Ongoing</p>	<p>N/A</p>
<p>3.2.2.6 Limit facility footprint in sage-grouse habitat to that necessary for safe and effective development.</p>	<p>BLM, County Governments, DRMS, Industry, Private Landowners, SLB, USFS, USFWS</p>	<p>Ongoing</p>	<p>N/A</p>
<p>3.2.2.7 Cooperate with county weed programs to control noxious weed infestations associated with energy and mineral development disturbances in GrSG habitat (see “Weeds” strategy, pg. 410).</p>	<p>BLM, CDOW, County Governments, DRMS, Industry, NRCS, LWGs, Private Landowners, SLB, USFS, USFWS</p>	<p>Ongoing</p>	<p>0.5 FTE</p>

¹Regardless of the technique used for oil shale development, the spatial and temporal effects of oil shale development are expected to be similar to those of large-scale mines.

ISSUE 3.2: Energy and mineral development may adversely impact GrSG populations through the <i>loss, degradation, or fragmentation of existing GrSG habitats</i> .			
OBJECTIVE 3.2.3: Minimize the <i>cumulative impacts of oil, gas, mining, and energy development</i> in GrSG habitat, in order to sustain viable GrSG populations in Colorado (see “Energy and Mineral Development: Preventing and/or Mitigating Impacts”, pg. 280).			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
3.2.3.1 Identify key GrSG areas located within potential energy development areas, to better address cumulative impacts to sage-grouse.	BLM, CDOW	2007	0.1 FTE
3.2.3.2 Maintain large blocks of undeveloped sagebrush habitat across the landscape. Locate facilities or design mitigation to maximize the size and continuity of undeveloped sagebrush habitat across the landscape.	BLM, CDOW , COGCC, County Governments, DRMS, Industry, LWGs, Private Landowners, SLB, USFS, USFWS	Ongoing	Unknown
3.2.3.3 Where production phase drilling and development may occur, require a plan that evaluates the impacts to sage-grouse from the entire field development, not just from individual well development. Include the need for additional infrastructure and/or communication towers (e.g., to facilitate remote monitoring) that should be considered during the land-use planning process (see also 3.2.3.6).	BLM , COGCC, County Governments, Industry, Private Landowners, SLB, USFS, USFWS	Ongoing	\$50,000
3.2.3.4 In GrSG habitat, cluster the development of roads, pipelines, electric lines, and other facilities, and use existing, combined corridors where possible (see “Infrastructure” [pg. 369] and “Roads” [pg. 394] strategies).	BLM , COGCC, County Governments, DRMS, Industry , Private Landowners, SLB, USFS, USFWS	Ongoing	N/A
3.2.3.5 Investigate opportunities and provide incentives for phased energy development in key GrSG habitats.	BLM, CDOW , COGCC, County Governments, Industry, LWGs, Private Landowners, SLB, USFS, USFWS	Ongoing	0.5 FTE
3.2.3.6 Identify key sage-grouse areas that are not already leased for energy and mineral development. Investigate and implement alternatives to leasing for energy and minerals in these areas.	BLM, CDOW , COGCC, County Governments, DRMS, Industry , LWGs, Private Landowners, SLB, USFS, USFWS	2007 and ongoing	1.0 FTE

<p>3.2.3.7 In areas or populations having intense energy development, encourage LWGs to aggressively pursue additional strategies, using an adaptive management approach, to address population sustainability (e.g., consult PVA analysis in CCP), including, but not limited to, the following options:</p> <ul style="list-style-type: none"> • options for increasing GrSG female survival • short duration of energy development and expedited reclamation • % habitat disturbance cap, habitat disturbance acreage cap, planned distribution of disturbance areas • innovative area development plans (e.g., refuge approach, mitigation/conservation credit approach; see “Energy and Mineral Development: Preventing and/or Mitigating Impacts”, pg. 280) • see also all strategies under Issue 3.3, “Habitat Enhancement” strategy section, discussion under “Population Augmentation” (pg. 224). 	<p>BLM, CDOW, COGCC, LWGs, Industry, Private Landowners</p>	<p>ASAP</p>	<p>N/A</p>
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<p>ISSUE 3.2: Energy and mineral development may adversely impact GrSG populations through the <i>loss, degradation, or fragmentation of existing GrSG habitats.</i></p>			
<p>OBJECTIVE 3.2.4: Ensure effective and rapid <i>reclamation</i> following <i>surface-disturbing activities</i> in GrSG habitats.</p>			
<p>Conservation Strategy</p>	<p>Responsible Parties (if there is a lead entity, it is in bold)</p>	<p>Timeline</p>	<p>Cost</p>
<p>3.2.4.1 Use early and effective reclamation techniques, including interim reclamation, to speed the return of disturbed areas to use by sage-grouse (see “Habitat Enhancement” strategy, pg. 336). Develop and implement performance-based reclamation standards.</p>	<p>BLM, CDOW, COGCC, County Governments, DRMS, Industry, LWGs, NRCS, Private Landowners, SLB, USFS, USFWS</p>	<p>Ongoing</p>	<p>N/A</p>
<p>3.2.4.2 Practice reclamation techniques that speed the recovery of pre-existing vegetation in GrSG habitat (e.g., brush-beating of sagebrush for site clearance, retention of topsoil with native seed).</p>	<p>BLM, CDOW, COGCC, County Governments, DRMS, Industry, LWGs, NRCS, Private Landowners, SLB, USFS, USFWS</p>	<p>Ongoing</p>	<p>\$20-100/ ac</p>

<p>3.2.4.3 Use reclamation seed mixes consisting of native bunchgrasses, forbs, and appropriate subspecies of big sagebrush in GrSG habitat. Avoid aggressive, non-native grasses, on a site-by-site basis (e.g., intermediate wheatgrass, pubescent wheatgrass, crested wheatgrass, smooth brome) in reclamation seed mixes (see Appendix D, “Recommendations Regarding Plant Species for Use in GrSG Habitat Management and Restoration”, and Monsen 2005).</p>	<p>BLM, CDOW, COGCC, County Governments, DRMS, Industry, LWGs, NRCS, Private Landowners, SLB, USFS, USFWS</p>	<p>Ongoing</p>	<p>\$100-200/ac</p>
<p>3.2.4.4 Structure reclamation soil profiling and re-vegetation seed mixes to create high quality sage-grouse habitat as quickly post-development as possible see Appendix D, “Recommendations Regarding Plant Species for Use in GrSG Habitat Management and Restoration” and Monsen 2005.</p>	<p>BLM, CDOW, COGCC, County Governments, DRMS, Industry, LWGs, NRCS, Private Landowners, SLB, USFS, USFWS</p>	<p>Ongoing</p>	<p>N/A</p>
<p>3.2.4.5 Identify and implement incremental habitat reclamation objectives in GrSG habitat.</p>	<p>BLM, CDOW, COGCC, County Governments, DRMS, Industry, LWGs, NRCS, Private Landowners, SLB, USFS, USFWS</p>	<p>Ongoing</p>	<p>0.5 FTE</p>
<p>3.2.4.6 Develop and implement an evaluation and monitoring process for meeting reclamation objectives in GrSG habitat, using standard monitoring criteria (see “Habitat Monitoring” strategy, pg. 341, and Appendix C, “Habitat Monitoring Protocol”).</p>	<p>BLM, CDOW, COGCC, County Governments, DRMS, Industry, LWGs, NRCS, Private Landowners, SLB, USFS, USFWS</p>	<p>Ongoing</p>	<p>1.0 FTE</p>
<p>3.2.4.7 Discuss options for making state reclamation standards for oil and natural gas development similar to those for mining.</p>	<p>BLM, COGCC, County Governments, DRMS, LWGs, Private Landowners</p>	<p>Begin in 2008</p>	<p>0.25 FTE</p>

ISSUE 3.3: <i>Current monitoring, mitigation, and management</i> may not be adequate to maintain, restore, or reclaim sage-grouse habitat and populations to the standards needed by sage-grouse.			
OBJECTIVE 3.3.1: During <i>land-use planning</i> , reduce the spatial and temporal influence of energy and mineral development, in both occupied and potentially suitable (but unoccupied) sage-grouse habitat (see “Energy and Mineral Development: Preventing and/or Mitigating Impacts”, pg. 280).			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
3.3.1.1 Use the best available and applicable information to expand the extent and to enhance the utility of habitats available for sage-grouse (while continuing to develop additional Colorado-specific research regarding GrSG habitat and habitat-use: see strategies 3.4.3.7 – 3.4.3.10; see also “Habitat Enhancement” strategy, pg. 336 and “Habitat Linkages” strategy, pg. 339).	BLM, CDOW , COGCC, County Governments, DRMS, Industry, LWGs, NRCS, Private Landowners, SLB, USFS, USFWS	Ongoing	N/A
3.3.1.2 Evaluate the existence and adequacy of energy and mineral development guidance in federal, state, county, and local work group plans within GrSG habitats, including leasing decisions. Federal policy allows for leasing decisions to be revisited through the land-use planning process when significant new scientific information becomes available (see Appendix G, “Energy and Mining Leasing and Development Background and Process”). Update guidance as needed.	BLM, CDOW , COGCC, County Governments, DRMS, Industry, LWGs, NRCS, Private Landowners, SLB, USFS , USFWS	By 2010	2.0 FTE
3.3.1.3 Inventory sage-grouse provisions in Resource Management Plans (RMPs). Ensure that RMP provisions for sage-grouse habitat are up-to-date.	BLM, CDOW, USFS	2008	0.1 FTE
3.3.1.4 Evaluate and implement specific mitigation and exception criteria during the land-use planning process in GrSG habitat. Attach the criteria to the lease as stipulations upon issuance.	BLM , CDOW, County Governments, LWGs, USFS	As LUPs are revised	0.5 FTE
3.3.1.5 Encourage counties to consider and implement sage-grouse conservation plan recommendations (local and statewide) when planning land-use, and when processing land-use permits.	BLM, CDOW, Counties , LWGs, NRCS, USFS, USFWS	Ongoing	0.1 FTE
3.3.1.6 Develop a map that reflects ownership of minerals and mineral potential in GrSG habitat in Colorado. Tabulate the acreage and identify blocks of areas with common mineral estate ownership.	BLM , CDOW, COGCC, DRMS, SLB, USFS	2008	0.5 FTE
3.3.1.7 Clarify energy development stipulations and where they apply in GrSG habitat.	BLM , CDOW, COGCC, DRMS, LWGs, USFS	Ongoing	0.1 FTE

3.3.1.8 Map energy development infrastructure within GrSG habitat to reflect current and historic development levels, patterns, and conditions (see also “Infrastructure” [pg. 369] and “Roads” [pg. 394] strategy sections.	BLM, CDOW, Industry , SLB, USFS, USFWS	Ongoing	2.0 FTE
3.3.1.9 Recommend setting bonds sufficient to ensure that appropriate GrSG habitat reclamation is met.	BLM, CDOW, COGCC , County Governments, DRMS , LWGs, SLB, USFS , USFWS	Ongoing	0.1 FTE
3.3.1.10 Write energy development guidelines that take into account a variety of site-specific situations in GrSG habitat. Implementation of these guidelines should be determined on a site-by-site basis within the landscape context.	BLM, CDOW , County Governments, LWGs, NRCS, USFS , USFWS	Ongoing	1.0 FTE
3.3.1.11 Consider private property owner concerns when developing guidelines for energy and mineral development on split estates in GrSG habitat.	BLM, CDOW , County Governments, LWGs, NRCS, USFS , USFWS	Ongoing	0.1 FTE
3.3.1.12 Require issue-specific monitoring plans and data reporting processes and standards for energy development projects in GrSG habitat.	BLM, CDOW, COGCC , County Governments, DRMS, Industry , Private Landowners, SLB, USFS , USFWS	Ongoing	N/A
3.3.1.13 Enforce and ensure compliance with conditions, stipulations, and reclamation for leases and permits in GrSG habitat.	BLM, CDOW, COGCC , County Governments, DRMS , SLB, USFS , USFWS	Ongoing	1.0 FTE/yr

ISSUE 3.3: <i>Current monitoring, mitigation, and management</i> may not be adequate to maintain, restore, or reclaim sage-grouse habitat and populations to the standards needed for sage-grouse.			
OBJECTIVE 3.3.2: Develop and implement a <i>framework that encourages voluntary participation</i> in sage-grouse conservation.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
3.3.2.1 Review the effectiveness of existing industry incentive programs in wildlife habitat in other states (e.g., Pinedale/Jonah field in Wyoming).	BLM , CDOW, Industry	2008	0.5 FTE
3.3.2.2 Develop incentives to encourage industry to implement beneficial development practices for GrSG, including restoration of old sites (energy development sites that have not been sufficiently reclaimed).	BLM , CDOW, COGCC, County Governments, DRMS , Industry, LWGs, SLB	2007, and ongoing	2 FTE and \$250,000/ yr

3.3.2.3 Encourage industry to incorporate new and less invasive technologies to develop energy and mineral resources in GrSG habitats (see also strategy 3.2.1.5).	BLM, CDOW, COGCC, County Governments, DRMS, Industry, LWGs, SLB	Ongoing	N/A
3.3.2.4 Conduct project design, review, and approval through a consultative process with industry, agencies, and others to assure that projects incorporate the most current sage-grouse data and development technology available.	BLM, CDOW, COGCC, County Governments, DRMS, Industry, LWGs, SLB	Ongoing	1.0 FTE/yr
3.3.2.5 Define the opportunities and/or limitations associated with directional drilling or other energy development technologies in GrSG habitat (e.g., geologic, topographic, cost/benefit).	BLM, CDOW, Industry	2008	N/A
3.3.2.6 Encourage operators to provide long-term financial commitments to support reclamation design, compliance, research, and monitoring in GrSG habitat.	BLM, CDOW, COGCC, County Governments, DRMS, Industry, LWGs, SLB	Ongoing	N/A
3.3.2.7 Locate site and design oil and gas facilities in cooperation with the operator and landowner to maximize opportunities for interim and long-term GrSG-oriented reclamation.	BLM, CDOW, COGCC, County Governments, Industry, LWGs, Private Landowners, SLB	Ongoing	2.0 FTE/yr

ISSUE 3.3: <i>Current monitoring, mitigation, and management</i> may not be adequate to maintain, restore, or reclaim sage-grouse habitat and populations to the standards needed for sage-grouse.			
OBJECTIVE 3.3.3: Develop an <i>adaptive management approach</i> to energy and mining development in GrSG habitat, based on monitoring and research.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
3.3.3.1 Develop and implement a valid monitoring plan to assess the impacts of energy and mineral development on sage-grouse.	BLM , CDOW, COGCC, County Governments, Industry, LWGs, Private Landowners, USFS , USFWS	2010 and Ongoing	2.0 FTE
3.3.3.2 Develop and implement a valid monitoring plan for reclamation activities in GrSG habitat (see “Habitat Monitoring” strategy, pg. 341 and Appendix C, “Habitat Monitoring Protocol”).	BLM , CDOW , COGCC, County Governments, DRMS, Industry, LWGs, Private Landowners, USFS , USFWS	2010 and Ongoing	2.0 FTE
3.3.3.3 Develop and implement a valid monitoring plan to assess GrSG habitat restoration and to measure success with respect to GrSG.	BLM , CDOW , COGCC, County Governments, DRMS, Industry, LWGs, Private Landowners, USFS , USFWS	2010 and ongoing	2.0 FTE

3.3.3.4 Use and refine existing vegetation and other map data to develop a better understanding of piñon-juniper/mountain shrub, industrial, agricultural, and urban encroachment on GrSG habitat.	BLM, CDOW, Industry, LWGs, NRCS, SLB, USFS, USFWS	2010	1.0 FTE
3.3.3.5 Use remote sensing and other techniques to determine the current state of fragmentation in GrSG habitat.	BLM, CDOW, Industry, LWGs, NRCS, SLB, USFS, USFWS	2010	1.0 FTE
3.3.3.6 Evaluate the adequacy and effectiveness of GrSG stipulations and BMPs related to mineral and energy development.	BLM, CDOW, COGCC, County Governments, DRMS, Industry, Private Landowners, USFS, USFWS	2015	\$250,000
3.3.3.7 Assess the compliance, consistency, implementation, and cost of stipulations and/or COAs with respect to GrSG management, and report results.	BLM, CDOW, COGCC, County Governments, DRMS, Industry, LWGs, SLB	Biennially	2.0 FTE
3.3.3.8 Continue to update and adjust BMPs to reflect monitoring and research results in GrSG habitats. Promote use of updated BMPs across land ownership boundaries.	BLM, CDOW, COGCC, County Governments, DRMS, Industry, Private Landowners, USFS, USFWS	Ongoing	0.5 FTE
3.3.3.9 Develop a mechanism to modify regulations or stipulations on federal mineral estates over time, based on monitoring and/or research results in GrSG habitat.	BLM, CDOW, USFS, USFWS	2007 and ongoing	1.0 FTE
3.3.3.10 Evaluate alternatives to a radial buffer approach in GrSG habitat, such as incorporating local topographic conditions or habitat communities for defining geometry (see Appendix B, “GrSG Disturbance Guidelines”).	BLM, CDOW, COGCC, County Governments, DRMS, Industry, Private Landowners, USFS, USFWS	2008	0.5 FTE

ISSUE 3.3: *Current monitoring, mitigation, and management may not be adequate to maintain, restore, or reclaim sage-grouse habitat and populations to the standards needed for sage-grouse.*

OBJECTIVE 3.3.4: *Develop and implement appropriate on- and off-site mitigation practices within GrSG habitat.*

Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
3.3.4.1 Define what constitutes meaningful mitigation to meet site- and/or issue-specific GrSG population and/or habitat objectives.	BLM, CDOW, Industry, LWGs, Private Landowners, NRCS, SLB, USFS, USFWS	2010	1.0 FTE

3.3.4.2 Wherever possible, incorporate site-specific COAs (on-site mitigation measures) on proposed operations in GrSG habitat, consistent with lease rights, or as negotiated with operators.	BLM, CDOW, COGCC, County Governments, DRMS, Industry Private Landowners, USFS, USFWS	Ongoing	N/A
3.3.4.3 Evaluate the need for near-site and/or off-site mitigation to maintain sage-grouse populations during oil and gas development and production and energy and mineral development through mining.	BLM, CDOW, LWGs, NRCS, SLB, USFS, USFWS	Ongoing	1 FTE
3.3.4.4 Determine whether sage-grouse will move to mitigation areas as mine and energy development sites develop in active habitat. [See Research Strategy 21.3.1.1]	See Research Strategy 21.3.1.1		
3.3.4.5 Identify potential locations where there may be opportunities for off-site mitigation for GrSG. Identify suitable mitigation practices within those areas (see also Strategy 3.3.4.9).	BLM, CDOW, LWGs, NRCS, USFS, USFWS	2010	1.0 FTE
3.3.4.6 Consider site capability and the timeline necessary to restore areas to suitable GrSG habitat, when determining which mitigation practices should be implemented on a site-by-site basis.	BLM, CDOW, COGCC, County Governments, DRMS, Industry, Private Landowners, USFS, USFWS	Ongoing	N/A
3.3.4.7 Conduct effective GrSG habitat enhancements (on- and off-site mitigation) in areas adjacent to or nearby energy development, in order to maintain sage-grouse population numbers (see “Habitat Enhancement” strategy, pg. 336).	BLM, CDOW, COGCC, County Governments, DRMS, Industry, Private Landowners, USFS, USFWS	Ongoing	\$50-400/ac
3.3.4.8 Complete mitigation measures prior to mine site development or expansion, or energy field development, where possible, to minimize sage-grouse population disruption.	BLM, COGCC, County Governments, DRMS, Industry, Private Landowners, USFS, USFWS,	Ongoing	N/A
3.3.4.9 Investigate, evaluate, and implement mitigation trust/banking opportunities where appropriate in GrSG habitat. Develop incentives to ensure that mitigation areas remain undeveloped until original habitats are fully recovered and populations are re-established.	BLM, CDOW, COGCC, DRMS, Industry, Land Trusts, Private Landowners, SLB, USFS, USFWS	Ongoing	1.0 FTE

ISSUE 3.4: Current <i>research and modeling</i> do not provide an adequate understanding of oil, gas, mining, and energy development impacts on GrSG in Colorado.			
OBJECTIVE 3.4.1: Evaluate <i>existing research and modeling efforts</i> for applicability to Colorado GrSG populations and habitat conditions.			
Conservation Strategy	Responsible Parties <small>(if there is a lead entity, it is in bold)</small>	Timeline	Cost
3.4.1.1 Evaluate existing research on energy and mining development impacts on GrSG regarding (1) its applicability to local situations; and (2) whether or not it has been peer-reviewed.	CDOW	Dec. 2008	\$20,000
3.4.1.2 Develop and update a modeling scenario and impacts assessment (regarding energy and mineral development) that considers (1) reclamation efforts and results; (2) long-term changes in GrSG habitat; and (3) the various stages of energy development (e.g., high-intensity, short-duration development vs. lower-intensity, longer-duration development). [See Research Strategies 21.1.1.2 and 21.1.2.3]	See Research Strategies 21.1.1.2 and 21.1.2.3		

ISSUE 3.4: Current <i>research and modeling</i> do not provide an adequate understanding of oil, gas, mining and energy development impacts on GrSG in Colorado.			
OBJECTIVE 3.4.2: Determine the <i>effectiveness of existing energy and mining development stipulations and mitigation</i> in minimizing impacts to GRSG.			
Conservation Strategy	Responsible Parties <small>(if there is a lead entity, it is in bold)</small>	Timeline	Cost
3.4.2.1 Through research, determine the effectiveness of energy and mining mitigation actions, stipulations, and BMPs in maintaining GrSG populations and/or habitat across the landscape. [See Research Strategy 21.3.1.1]	See Research Strategy 21.3.1.1		

ISSUE 3.4: Current <i>research and modeling</i> do not provide an adequate understanding of oil, gas, mining, and energy development impacts on GrSG in Colorado.			
OBJECTIVE 3.4.3: <i>Conduct research</i> necessary to answer specific questions regarding how mining and energy development are related to sustainability of GrSG populations in Colorado.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
3.4.3.1 Develop a timeline for implementation of research strategies (e.g., strategies 3.4.3.3 - 3.4.3.5; 3.4.3.7 – 3.4.3.10). [See Research Strategy 21.2.1.3]	See Research Strategy 21.2.1.3		
3.4.3.2 Increase funding to conduct needed research on mining, energy development, and GrSG in Colorado. [See Research Strategy 21.2.1.3]	See Research Strategy 21.2.1.3		
3.4.3.3 Investigate the specific factors affecting GrSG population parameters (e.g., causes of female and chick mortality, effects of noise on sage-grouse habitat use or avoidance, wind direction, and topography influence on noise impacts), and how they are influenced by energy development. [See Research Strategy 21.2.1.3]	See Research Strategy 21.2.1.3		
3.4.3.4 Design and implement a research program (regarding energy/mining and GrSG) so that the duration of data is sufficient to answer GrSG management questions. Recognize the need and timeline necessary to integrate research data and results into planning cycles. [See Research Strategy 21.2.1.3]	See Research Strategy 21.2.1.3		
3.4.3.5 Study, monitor, and attempt to quantify impacts to sage-grouse from oil and gas development and mining operations (e.g., intensity, duration, and timing elements of PVA). [See Research Strategy 21.2.1.3]	See Research Strategy 21.2.1.3		
3.4.3.6 Incorporate stakeholder concerns into current and future research designs for GrSG studies. [See Research Strategy 21.2.1.3]	See Research Strategy 21.2.1.3		
3.4.3.7 Quantify habitat fragmentation effects on GrSG. [See Research Strategy 21.1.1.1]	See Research Strategy 21.1.1.1		
3.4.3.8 Determine habitat loss thresholds for GrSG populations (i.e., how much habitat is needed to sustain a population). [See Research Strategy 21.1.1.1]	See Research Strategy 21.1.1.1		

<p>3.4.3.0 Identify the appropriate mix of sagebrush habitats and seral stages necessary for sustainable GrSG populations, consistent with site capabilities. [See Research Strategies 21.1.1.1 and 21.1.1.3]</p>	<p>See Research Strategies 21.1.1.1 and 21.1.1.3</p>
<p>3.4.3.10 Determine the sufficient minimum habitat patch size for GrSG, as it relates to habitat fragmentation. [See Research Strategy 21.1.1.1]</p>	<p>See Research Strategy 21.1.1.1</p>

<p>ISSUE 3.5: There is a <i>lack of communication among agencies, industry, and affected publics involved with mining and energy development</i>, resulting in misunderstanding and less effective management for GrSG.</p>			
<p>OBJECTIVE 3.5.1: <i>Improve communication among agencies, industry, and affected publics involved with mining and energy development, to facilitate improved trust, working relationships, planning, and more effective management of GrSG and their habitats.</i></p>			
<p style="text-align: center;">Conservation Strategy</p>	<p style="text-align: center;">Responsible Parties (if there is a lead entity, it is in bold)</p>	<p style="text-align: center;">Timeline</p>	<p style="text-align: center;">Cost</p>
<p>3.5.1.1 Develop a communication process to assist the energy industry to work with LWGs in planning energy activity on non-federal surface-owned leases. [See also Information, Communication, and Education Strategy 12.3.2.1]</p>	<p>CCI, CDOW, County Governments, DNR, Industry, LWGs, Private Landowners, SLB</p>	<p style="text-align: center;">2007</p>	<p style="text-align: center;">0.1 FTE</p>
<p>3.5.1.2 Present information and data about energy, mining, and GrSG so that it is readily understandable and accepted by stakeholders and the general public. [See also Information, Communication, and Education Strategy 12.2.1.3]</p>	<p>BLM, CDOW, Industry, LWGs, NRCS, SLB, USFS, USFWS</p>	<p style="text-align: center;">Ongoing</p>	<p style="text-align: center;">0.1 FTE</p>
<p>3.5.1.3 Share GrSG data among agencies, and with counties and industry to allow for better planning of mining and energy development, to minimize impacts to the species. Provide GrSG data to COGCC and DRMS to identify opportunities for coordination. Lek data are considered sensitive information by CDOW. Limit data distribution to the extent necessary for effective management. [See also Information, Communication, and Education Strategy 12.3.2.2]</p>	<p>BLM, CDOW, USFS, USFWS</p>	<p style="text-align: center;">Ongoing</p>	<p style="text-align: center;">0.1 FTE</p>

<p>3.5.1.4 Share energy development plans with agencies ASAP to facilitate improved planning, analysis, and management of GrSG within sagebrush habitats, recognizing confidentiality sensitivities. Lek data are considered sensitive information by CDOW. Limit data distribution to the extent necessary for effective management. [See also Information, Communication, and Education Strategy 12.3.2.2]</p>	<p>BLM, COGCC, DRMS, Industry</p>	<p>Ongoing</p>	<p>0.1 FTE</p>
<p>3.5.1.5 Encourage counties, LWGs, and private landowners to be involved in COGCC meetings in order to comment on well pad spacing densities, reclamation standards, and comprehensive planning within GrSG habitats. [See also Information, Communication, and Education Strategies 12.2.2.1 and 12.3.2.3]</p>	<p>BLM, CDOW, Industry, LWGs, NRCS, SLB, USFS, USFWS</p>	<p>Ongoing</p>	<p>0.1 FTE</p>
<p>3.5.1.6 Encourage open communication among companies to entertain opportunities to reduce impacts and/or maximize benefits to GrSG, at the local and landscape levels. [See also Information, Communication, and Education Strategy 12.3.2.3]</p>	<p>BLM, CDOW, Industry</p>	<p>Ongoing</p>	<p>0.1 FTE</p>
<p>3.5.1.7 Encourage oil, gas, and mining companies to participate on local GrSG work groups. [See Information, Communication, and Education Strategy 12.3.2.1]</p>	<p>See Information, Communication, and Education Strategy 12.3.2.1</p>		
<p>3.5.1.8 Promote regular communication and continual coordination among agencies, industry, LWGs, and counties to improve energy and mineral-related planning and management of GrSG. [See Information, Communication, and Education Strategy 12.3.2.3]</p>	<p>See Information, Communication, and Education Strategy 12.3.2.3</p>		
<p>3.5.1.9 Promote and provide regular opportunities for public involvement to improve energy and mineral planning as it relates to management of GrSG and GrSG habitat. [See also Information, Communication, and Education Strategy 12.2.2.1]</p>	<p>BLM, CDOW, County Governments, Industry, LWGs, NRCS, SLB, USFS, USFWS</p>	<p>Ongoing</p>	<p>N/A</p>
<p>3.5.1.10 Communicate to affected publics the need for energy and mineral production and the need to balance that development with GrSG requirements.</p>	<p>Industry, all stakeholders</p>	<p>Ongoing</p>	<p>N/A</p>
<p>3.5.1.11 Promptly and frequently update information related to energy and mineral development and GrSG to foster a better understanding of impacts to the species. [See also Information, Communication, and Education Strategy 12.3.2.2]</p>	<p>BLM, CDOW, County Governments, Industry, LWGs, NRCS, SLB, USFS, USFWS</p>	<p>Ongoing</p>	<p>0.5 FTE</p>

<p>3.5.1.12 Improve the understanding, sharing, and acceptance of research and modeling efforts regarding GrSG and mining/energy development. Ensure that current management, reclamation techniques, and appropriate BMPs are shared with contractors and consultants to improve on-the-ground implementation. [See also Information, Communication, and Education Strategies 12.3.1.1 and 12.3.2.2]</p>	<p>BLM, CDOW, USFS, USFWS</p>	<p>Ongoing</p>	<p>0.1 FTE</p>
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4. Fire and Fuels Management

Appropriate management of fire in GrSG sagebrush habitat is crucial to maintaining and restoring the health of sagebrush communities. Wildfire response planning, fire suppression, habitat rehabilitation following fire, the use of prescribed fire, and fuels treatments in and around GrSG habitat must be well planned and executed, using an interdisciplinary approach. Prescribed fire, if applied at an appropriate scale and with great caution, may be a viable tool to manage GrSG sagebrush habitat in some situations. Mechanical fuels treatments, when developed and implemented using an interdisciplinary approach, can also be very effective in meeting both fuel and fire objectives, as well as some GrSG habitat objectives. Rehabilitation and restoration measures following any fire may be essential to ensure that a healthy sagebrush community reestablishes following wildfire. Human safety is, as always, the highest priority with regard to wildfire suppression efforts. For further discussion of this issue, see “Fire and Fuels Management” issue, pg. 119.

Outline of Strategy Organization (italics within Issues and Objectives refer to this outline)

Issue 4.1: Fire and fuel treatments may impact GrSG

Objective 4.1.1: Wildfire – impacts to habitat

Objective 4.1.2: Prescribed burns and fuel treatments – impacts to habitat

Objective 4.1.3: All fire and fuel treatments – direct impacts to GrSG

Objective 4.1.4: Post-burn and –treatment habitat restoration

ISSUE 4.1: Wildfires, prescribed burns, and fuel treatments may adversely affect GrSG and their habitat.			
OBJECTIVE 4.1.1: Manage <i>wildfire</i> within sagebrush habitats to minimize <i>detrimental effects on GrSG habitat</i> .			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
4.1.1.1 Plan fire suppression response to potential wildfires in important GrSG habitat. Schedule annual coordination meetings and share fire response and GrSG seasonal habitat information with county, fire district, and federal fire fighting officials to plan and implement appropriate response to wildfires in these areas. Lek data are considered sensitive information by CDOW. Limit data distribution to the extent necessary for effective management.	BLM , CDOW, County Governments, CSFS, LWGs, Private Landowners, USFS, USFWS	Annually	0.5 FTE

<p>4.1.1.2 Train and use resource advisors to assist with considering sage-grouse conservation in prioritizing response to fire during multiple ignition episodes. Distribute sage-grouse information updates to fire dispatchers for initial attack planning. [See also Information, Communication, and Education Strategy 12.3.1.1]</p>	<p>BLM, CDOW, County Governments, CSFS, LWGs, USFS, USFWS</p>	<p>Training: annually; Updates: as needed</p>	<p>0.5 FTE</p>
<p>4.1.1.3 Burn-out/backfiring operations, dozer line construction, and other suppression activities in GrSG habitat should be conducted in a manner, and if possible in a location, that minimizes the loss of sagebrush, while still providing for public and fire crew safety.</p>	<p>BLM, CDOW, County Governments, CSFS, USFS, USFWS</p>	<p>As needed</p>	<p>Cost / Fire variable</p>
<p>4.1.1.4 Where practical, locate fire camps, staging areas, and helibases at least 2 miles away from GrSG leks, and preferably outside of GrSG habitat.</p>	<p>BLM, CDOW, County Governments, CSFS, USFS, USFWS</p>	<p>Annual discussion with FMOs</p>	<p>Cost/ Fire variable</p>
<p>4.1.1.5 Fire specialists and wildlife biologists should review and update area Wild Fire Management Plans in GrSG habitat every 5 years, or as necessary due to increased fire activity or risk.</p>	<p>BLM, CDOW, USFS, USFWS</p>	<p>Every 5 years</p>	<p>2.0 FTE</p>
<p>4.1.1.6 Manage habitat mosaics and fuel loads in and adjacent to GrSG habitats to minimize the possibility of catastrophic wildfires, while maintaining sage-grouse habitat quality (see Appendix A, “GrSG Structural Habitat Guidelines”).</p>	<p>BLM, CDOW, County Governments, CSFS, LWGs, Private Landowners, USFS, USFWS</p>	<p>Annually as crews available</p>	<p>\$25-100/acre, depending on treatment</p>
<p>4.1.1.7 Map all wildfire, prescribed burns, and fuel treatments in GrSG habitat within one year of occurrence, and develop a GIS layer of “vegetation modification” history (see “Habitat Monitoring” strategy, pg. 341; see also strategy 4.1.2.9). Track cumulative historic wildfire events under the umbrella of local fire management plans.</p>	<p>BLM, CDOW, USFS, USFWS</p>	<p>Annually</p>	<p>0.5 FTE</p>
<p>4.1.1.8 Conduct post-fire operation reviews/evaluations in areas where fires were large enough or intense enough to cause long-term degradation of GrSG habitat. The intent is to improve fire fighting priority setting, tactics, or resource availability in preparation for potential fires in sage-grouse habitat. The urgency of the review depends on when in the fire season the fire occurred, how typical or significant it was, and if there are clearly opportunities to identify and fix problems resulting from individual fires, and to learn important lessons.</p>	<p>BLM, CDOW, County Governments, CSFS, LWGs, NRCS, USFS, USFWS</p>	<p>Only as needed or warranted</p>	<p><\$10/acre</p>

4.1.1.9 At the wildland-urban interface bordering sagebrush habitats, increase public education and implement fuel reduction projects to reduce the risk of human-caused fires escaping into GrSG habitats (examples include pamphlets, news releases). [See also Information, Communication, and Education Strategy 12.2.1.3]	BLM , CDOW, County Governments, CSFS, LWGs, NRCS, USFS, USFWS	Annually and as needed during fire season	\$5,000
4.1.1.10 During annual training for fire fighting personnel, increase awareness of issues and potential impacts of fire and suppression activities in GrSG habitats. [See also Information, Communication, and Education Strategy 12.3.1.1]	BLM , CDOW, County Governments, CSFS, LWGs, USFS, USFWS	Annually	0.1 FTE

ISSUE 4.1: Wildfires, prescribed burns, and fuel treatments may adversely affect GrSG and their habitat.			
OBJECTIVE 4.1.2: Manage <i>prescribed burns and fuel treatments</i> within sagebrush to improve GrSG habitat where possible, and to minimize degradation, loss, and fragmentation of GrSG habitats.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
4.1.2.1 Use prescribed burning and mechanical fuels treatments at an appropriate scale (i.e., smaller is better) to maintain or improve the quality and quantity of GrSG habitats. Consider fire scale, seasonality, and moisture regime from a GrSG habitat management perspective (as well as air quality issues, as guided by state regulations) in planning prescribed burns (see “Habitat Enhancement Strategy” [pg. 336] and Monsen 2005).	BLM , CDOW, LWGs, USFS, USFWS	During project planning	Project - dependent
4.1.2.2 All prescribed burns or mechanical fuel treatments within sagebrush areas should have identified GrSG habitat objectives, and should consider existing sagebrush communities, site conditions, and site potential in treatment design (see “Habitat Enhancement Strategy” [pg. 336] and Monsen 2005).	BLM , CDOW, NRCS, USFS, USFWS	During project planning	Project - dependent

<p>4.1.2.3 In xeric (dry) occupied and potential GrSG habitat, design prescribed burns that are small, irregular in shape, and that encourage natural reestablishment of the native plant community. For burns that are larger than 5 acres in xeric sites in occupied or potential GrSG habitat, encourage sagebrush rehabilitation with appropriate seed mixture (see “Habitat Enhancement” strategy, pg. 336 and Appendix D, “Recommendations Regarding Plant Species for Use in GrSG Habitat Management and Restoration”).</p>	<p>BLM, CDOW, NRCS, USFS, USFWS</p>	<p>As needed</p>	<p>Reseeding \$40 /acre</p>
<p>4.1.2.4 Avoid fire or mechanical fuel reduction treatments within GrSG habitat <i>in areas susceptible to invasion by cheatgrass or other invasive plant species</i>, except where they are part of a well-defined and aggressive restoration program (see “Habitat Enhancement” strategy, pg. 336).</p>	<p>BLM, CDOW, County Governments, CSFS, LWGs, NRCS, USFS, USFWS</p>	<p>As needed</p>	<p>N/A</p>
<p>4.1.2.5 In areas where sagebrush is limited on the landscape, avoid the use of prescribed fire and other sagebrush reduction projects in areas that currently meet GrSG breeding or winter habitat requirements (see “Habitat Enhancement” strategy, pg. 336 and Appendix B, “GrSG Disturbance Guidelines”).</p>	<p>BLM, CDOW, USFS, USFWS</p>	<p>During project planning</p>	<p>N/A</p>
<p>4.1.2.6 Protect sagebrush adjacent to riparian zones, meadows, lakebeds, and croplands that include important GrSG summer habitat.</p>	<p>BLM, CDOW, County Governments, CSFS, LWGs, NRCS, USFS, USFWS</p>	<p>During project planning</p>	<p>Project - dependent</p>
<p>4.1.2.7 To avoid introduction of noxious weeds in GrSG habitat, wash vehicles and heavy equipment for fires and mechanical fuel reduction treatments prior to arrival at a new location (see “Weeds” strategy, pg. 410).</p>	<p>BLM, CDOW, County Governments, CSFS, LWGs, USFS, USFWS</p>	<p>As needed</p>	<p>\$250/project</p>
<p>4.1.2.8 Consider recent drought events and their effects on GrSG habitat (e.g., understory vigor) when planning/implementing fire or fuel reduction treatment projects (see “Weather” strategy, pg. 408).</p>	<p>BLM, CDOW, NRCS, USFS, USFWS</p>	<p>During project planning</p>	<p>N/A</p>
<p>4.1.2.9 Map all burns and fuel treatments in GrSG habitat within one year of occurrence, and develop a GIS layer of “vegetation modification” history (see “Habitat Monitoring” strategy, pg. 341; see also strategy 4.1.1.7).</p>	<p>BLM, CDOW, NRCS, USFS, USFWS</p>	<p>Annually</p>	<p>0.25 FTE</p>

ISSUE 4.1: Wildfires, prescribed burns, and fuel treatments may adversely affect GrSG and their habitat.			
OBJECTIVE 4.1.3: Manage <i>wildfire, prescribed burns and fuel treatments</i> within sagebrush habitats to <i>minimize detrimental effects to GrSG populations</i> .			
Conservation Strategy	Responsible Parties <small>(if there is a lead entity, it is in bold)</small>	Timeline	Cost
4.1.3.1 Schedule prescribed burns and/or fuel treatment projects in sagebrush habitat to avoid, when possible, the GrSG seasonal use period for that area (e.g., breeding, winter; see also Appendix B “GrSG Disturbance Guidelines”).	BLM, CDOW, USFS, USFWS	During project planning	Project - dependent
4.1.3.2 When treating sagebrush areas to reduce fuels within 0.6 miles of a GrSG lek, maintain adequate canopy cover for sage-grouse (see “Breeding Habitat” in “GrSG Habitat Structural Guidelines”, Appendix A). Lek data are considered sensitive information by CDOW. Limit data distribution to the extent necessary for effective management.	BLM, CDOW, USFS, USFWS	During project planning	N/A

ISSUE 4.1: Wildfires, prescribed burns, and fuel treatments may adversely affect GrSG and their habitat.			
OBJECTIVE 4.1.4: Manage <i>post-burn/treatment sites</i> to maximize effective <i>restoration of GrSG habitat</i> .			
Conservation Strategy	Responsible Parties <small>(if there is a lead entity, it is in bold)</small>	Timeline	Cost
4.1.4.1 Monitor all wildfires or prescribed burns in the first 3 growing seasons post-fire, and then every 5-10 years for noxious or invasive weeds. Treat accordingly.	BLM , CDOW, County Governments, LWGs, NRCS, USFS, USFWS	As needed per fire event	Project-dependent
4.1.4.2 All wildfires or prescribed burns greater than 10 acres in size that are subject to cheatgrass invasion will be seeded with an appropriate seed mixture (i.e., avoid undesirable grass species; see Appendix D, “Recommendations Regarding Plant Species for Use in GrSG Habitat Management and Restoration” and Monsen 2005), to reduce the probability of cheatgrass establishment (see also “Habitat Enhancement” strategy, pg. 336).	BLM , CDOW, County Governments, LWGs, NRCS, USFS, USFWS	As needed per fire event	\$65-80 /acre

<p>4.1.4.3 Annually evaluate all recent wildfires and prescribed burns (greater than 10 acres), and reseed if necessary to achieve GrSG habitat objectives (see “Habitat Enhancement” strategy, pg. 336).</p>	<p>BLM, CDOW, County Governments, LWGs, NRCS, Private Landowners, USFS, USFWS</p>	<p>Annually</p>	<p>1.0 FTE</p>
<p>4.1.4.4 Ensure that GrSG habitat considerations are incorporated into restoration and burn rehabilitation plans. Use BMPs and grazing management alternatives (see Appendix E, “Grazing Management Options for GrSG”) for land management practices following wild and prescribed fire events (see also Monsen 2005, “Habitat Enhancement” [pg. 336], “Recreational Activities” [pg. 392] and ”Grazing” [pg. 329] strategies).</p>	<p>BLM, CDOW, County Governments, LWGs, NRCS, USFS, USFWS</p>	<p>During project planning</p>	<p>Project - Dependent</p>
<p>4.1.4.5 Evaluate the response of GrSG habitat (see “Habitat Monitoring” strategy, pg. 341) to all burns and mechanical fuel reduction treatments (be certain to consider the need for weed control in the area).</p>	<p>BLM, CDOW, NRCS, USFS, USFWS</p>	<p>Annually</p>	<p>\$10-15 /acre</p>
<p>4.1.4.6 Incorporate ecologically appropriate sagebrush seed into fire rehabilitation seed mixtures as often as possible in GrSG habitat (see Appendix D, “Recommendations Regarding Plant Species for Use in GrSG Habitat Management and Restoration”) and Monsen 2005.</p>	<p>BLM, CDOW, NRCS, USFS, USFWS</p>	<p>During re-seeding plan</p>	<p>\$2-5 /acre</p>
<p>4.1.4.7 Encourage and strongly support the development of production and storage facilities for native seed in Colorado, including native seed banks, for use in reclamation efforts (see “Habitat Enhancement” strategy 7.1.1.5). Emphasize the use of native plants following burns/treatments in GrSG habitat whenever possible.</p>	<p>BLM, CDOW, LWGs, NRCS, SCDs, USFS, USFWS</p>	<p>Annually</p>	<p>\$200,000/ year</p>
<p>4.1.4.8 When reseeded an area in GrSG habitat, use certified "weed-free" seeds (see “Habitat Enhancement” strategy 7.1.1.6 and “Weeds” strategy section, pg. 410).</p>			
<p>4.1.4.9 Rehabilitate firelines or trails caused by equipment use during fire fighting activities in GrSG habitat (see “Habitat Enhancement” strategy, pg. 336).</p>	<p>BLM, CDOW, County Governments, NRCS, USFS, USFWS</p>	<p>Post-fire</p>	<p>\$65-80 / acre</p>
<p>4.1.4.10 Identify and secure funding to support post-fire restoration efforts in GrSG habitat.</p>	<p>BLM, CDOW, County Governments, NRCS, USFS, USFWS</p>	<p>Annually</p>	<p>0.1 FTE</p>

5. Genetics

Oyler-McCance et al. (2005) documented the distribution of genetic variation across the entire range of GrSG. They found that isolation by distance has left an imprint on GrSG gene pools, and that local adaptation is a realistic possibility for the species that should be considered in decisions involving translocations. They argue that this genetic data used in conjunction with large-scale demographic and habitat data will provide an integrated approach to conservation efforts for GrSG. For Colorado, there appears to be a genetic line of demarcation (north to south) between Colorado GrSG populations, suggesting that if translocations are undertaken, birds should be moved north – south, and not east – west. The NP and NWCO populations are the largest GrSG populations in Colorado, and could serve as source populations if translocations to other populations are initiated. However, there is not current indication that any GrSG populations in Colorado are at risk from the genetic consequences associated with small populations. For further discussion of this topic, see “Genetics” in the Conservation Assessment [pg. 52] and “Genetics: Small Populations” issue [pg. 124].

ISSUE 5.1: Research has found that the genetic and geographic distances segregate Colorado greater sage-grouse populations into at least 2 clusters (Oyler-McCance et al. 2005), which should be considered in any potential transplant.

OBJECTIVE 5.1.1: Prevent the translocation of greater sage-grouse from the eastern part of the statewide distribution to the western part of the statewide distribution (or vice versa), to preserve unique genetic clusters.

Conservation Strategy	Responsible Parties <small>(if there is a lead entity, it is in bold)</small>	Timeline	Cost
5.1.1.1 Conduct additional genetic sampling and analysis in GrSG populations that have not had genetic samples collected (PPR, MWR, NWCO - Zone 4b), or increase samples in appropriate populations.	CDOW	5 years	\$5,000
5.1.1.2 If additional genetic testing indicates a genetic line of demarcation (north to south) between Colorado GrSG populations, all translocations should be north – south, and not east – west.	CDOW	Ongoing	None.

ISSUE 5.2: Small isolated populations of greater sage-grouse may have low genetic diversity, which may facilitate inbreeding depression.			
OBJECTIVE 5.2.1: Monitor genetic diversity within the smaller isolated populations of greater sage-grouse in Colorado.			
Conservation Strategy	Responsible Parties <small>(if there is a lead entity, it is in bold)</small>	Timeline	Cost
5.2.1.1 To monitor the genetic diversity and isolation of GrSG populations, obtain blood and other tissue samples as GrSG are captured for other purposes, and submit for DNA testing (see also strategy 8.2.1.4).	CDOW , University of Denver	By 2007 and ongoing	\$15,000/year for DNA analysis; other costs included in existing research projects
5.2.1.2 Continue to develop and refine, if it proves feasible, techniques to obtain DNA from sage-grouse fecal droppings so that genetic testing can be accomplished without capturing birds. [See Research Strategy 21.7.1.1]	See Research Strategy 21.7.1.1		

ISSUE 5.2: Small isolated populations of greater sage-grouse may have low genetic diversity, which may facilitate inbreeding depression.			
OBJECTIVE 5.2.2: Maintain genetic diversity present within individual Colorado populations of GrSG so that each small population contains 70% of the overall genetic diversity within Colorado (see also Issue 8.2, Objective 8.2.1).			
Conservation Strategy	Responsible Parties <small>(if there is a lead entity, it is in bold)</small>	Timeline	Cost
5.2.2.1 Increase genetic diversity (if found to be low) within small GrSG populations through augmentation with eggs, chicks, and/or adults.	CDOW	5 years	\$30,000
5.2.2.2 Develop and implement a genetic diversity monitoring plan and schedule for GrSG populations.	CDOW, Denver University/USGS	2010	\$1,000

6. Grazing

Herbivory is an integral part of sagebrush ecosystems in the West, and grazing by domestic and wild ungulates plays an important role in shaping and maintaining vegetative communities in sage-grouse range. The nature of the sage-grouse habitat (e.g., nesting, brood-rearing, wintering), the level of herbivory (e.g., light, moderate, or heavy stocking rates), and the ability of the vegetation to respond to herbivory, determine the degree to which grazing has adverse, neutral, or positive impacts on sage-grouse habitat. For these reasons, site-specific management direction should derive from these considerations.

Potential impacts of herbivory on sage-grouse and their habitat include (1) long-term effects of historic overgrazing on sagebrush habitat; (2) sage-grouse habitat changes due to domestic herbivory; (3) direct effects of domestic herbivores on sage-grouse, such as trampling of nests and eggs; (4) altered sage-grouse behavior due to presence of domestic herbivores; (5) impacts to sage-grouse and sage-grouse behavior from structures associated with grazing management; and (6) impacts to sage-grouse by wild herbivores.

Wise consideration of timing and stocking rates can be used to favorably alter vegetation and enhance sage-grouse habitat, including as a treatment for noxious weeds. Enough is known about GrSG habitat requirements to make reasonable recommendations to maintain and improve habitat. However, any effort to manage defoliation of vegetation must consider all herbivores, domestic and wild, grazers and browsers (and ideally, below-ground herbivores as well, such as small mammals). Developing grazing systems and management plans that would achieve desired vegetation composition and structure, including shrubs, forbs, and grasses, should benefit both GrSG and domestic and wild ungulates (for some suggested management options, see Appendix E, “Grazing Management Options for GrSG”). For further discussion of this issue, see “Grazing” issue, pg. 129.

Outline of strategy organization (italics within Issues and Objectives refer to this outline)

Issue 6.1: Lack of understanding of relationships among herbivory, GrSG populations, GrSG habitat

Objective 6.1.1: Research - herbivore direct effects on GrSG

Objective 6.1.2 Research - herbivory effects on GrSG habitat

Objective 6.1.3 Research – effects of GrSG habitat parameters on GrSG populations

Issue 6.2: Sagebrush - management of herbivores while considering GrSG habitat needs

Objective 6.2.1 Domestic herbivore management

Objective 6.2.2 Wild herbivore management

Issue 6.3 Funding and socioeconomic issues

Objective 6.3.1 Identify funding, prioritize projects

Objective 6.3.2 Address indirect costs of responsible GrSG management
 Issue 6.4 Lack of cooperation, communication, and respect among stakeholders
 Objective 6.4.1 Foster information sharing

ISSUE 6.1: There is a lack of understanding of the <i>relationships among herbivory, GrSG populations, and GrSG habitat</i> .			
OBJECTIVE: 6.1.1 Determine how <i>herbivores directly affect GrSG populations</i> .			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
6.1.1.1 Conduct a literature review of herbivores and their effects on sage-grouse. [See Research Strategy 21.2.1.1 ; see also http://sagemap.wr.usgs.gov/ for a recently completed literature review]	See Research Strategy 21.2.1.1		
6.1.1.2 Evaluate the effects of herbivores on GrSG (e.g., nest trampling, changes in GrSG behavior, also positive effects). [See Research Strategy 21.2.1.1]	See Research Strategy 21.2.1.1		

ISSUE 6.1: There is a lack of understanding of the <i>relationships among herbivory, GrSG populations, and GrSG habitat</i> .			
OBJECTIVE: 6.1.2 Determine how <i>herbivory affects GrSG habitat parameters</i> .			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
6.1.2.1 Conduct a literature review of grazing systems and their effects on the vegetation parameters important to sage-grouse. [See Research Strategy 21.1.2.2]	See Research Strategy 21.1.2.2		
6.1.2.2 Evaluate the effect of herbivores on the quality of sagebrush habitat (e.g., grass and forb abundance, diversity, and vegetative structure). [See Research Strategy 21.1.2.2]	See Research Strategy 21.1.2.2		
6.1.2.3 Provide incentives to private landowners to participate in research (e.g., strategy 6.1.1.2, 6.1.2.2) and monitoring actions (e.g., if a rancher is requested to rest a pasture for a research project). Develop grazing banks or help find other pasture to graze. Provide financial compensation such as fencing and water developments. [See Research Strategy 21.1.2.2]	See Research Strategy 21.1.2.2		

6.1.2.4 As results become available on research on herbivory and GrSG (e.g., strategy 6.1.1.2, 6.1.2.2), distribute them to local work groups. [See also Information, Communication, and Education Strategy 12.3.2.1 and Research Strategy 21.1.2.2]	BLM, CDOW, CSU Extension, NRCS, USFS	Ongoing	0.25 FTE
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ISSUE 6.1: There is a lack of understanding of the <i>relationships among herbivory, GrSG populations, and GrSG habitat</i> .			
OBJECTIVE 6.1.3: Determine how <i>GrSG populations respond to different habitat parameters</i> .			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
6.1.3.1 Conduct a literature review of how GrSG populations respond to different habitat parameters. [See Research Strategy 21.1.1.1]	See Research Strategy 21.1.1.1		
6.1.3.2 Determine the relationship of GrSG habitat parameters to sage-grouse productivity, demographics, and population viability. [See Research Strategies 21.1.1.1 and 21.1.1.3]	See Research Strategies 21.1.1.1 and 21.1.1.3		

ISSUE 6.2: The complexity and diversity of herbivory and management of herbivores in sagebrush communities presents challenges to meeting GrSG habitat needs.			
OBJECTIVE 6.2.1: <i>Manage domestic herbivory</i> to improve and maintain GrSG habitat and minimize conflicts between GrSG and other herbivores, while providing for sustainable agriculture.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
6.2.1.1 Identify GrSG seasonal habitat objectives for individual sites (dependent on site potential and environmental conditions; see Appendix A, “GrSG Structural Habitat Guidelines”).	BLM, CDOW, LWGs, NPS, NRCS, Private landowners, SLB, USFS, USFWS	Ongoing	Site-specific

<p>6.2.1.2 In cooperation with the local work groups, identify a specific menu of grazing management options (BMPs; for examples, see Appendix E, “Grazing Management Options”) that supports the local work group sage-grouse habitat objectives and will provide the flexibility needed for local site conditions; options should be compatible with the BLM’s “Standards for Public Land Health” and “Guidelines for Livestock Grazing Management” (http://www.blm.gov/co/st/en/BLM_Programs/grazing/rm_stds_guidelines.html), as well as the “GrSG Structural Habitat Guidelines” (Appendix A). Encourage application of BMPs on a landscape scale across ownership boundaries.</p>	<p>BLM, CSU Extension, LWGs, NRCS, SLB, USFS</p>	<p>Within next 2 years</p>	<p>0.25 FTE</p>
<p>6.2.1.3 Use livestock grazing management options on private lands, where possible, and on public lands, as developed by land management agencies or LWGs, that are consistent with achieving GrSG habitat objectives. Explore the use of vacant federal allotments through the land-use planning process and CRP, to provide flexibility in grazing options recommended to achieve GrSG habitat objectives.</p>	<p>BLM, CDOW, FSA, LWGs, NPS, NRCS, Private landowners, SLB, USFS, USFWS</p>	<p>Ongoing</p>	<p>Site-specific</p>
<p>6.2.1.4 Monitor the effectiveness of grazing management options. All stakeholders should be involved in the development of monitoring plans (see “Habitat Monitoring” strategy, pg. 341, and Appendix C, “Habitat Monitoring Protocol”).</p>	<p>BLM, CDOW, LWGs</p>	<p>Start within 5 years</p>	<p>\$50,000/yr</p>
<p>6.2.1.5 Use monitoring results (strategy 6.2.1.4) to adjust grazing management options (see “Adaptive Management”, pg. 3).</p>	<p>BLM, CDOW, FSA, LWGs, NPS, NRCS, Private landowners, SLB, USFS, USFWS</p>	<p>ASAP following monitoring results</p>	<p>Site-specific</p>
<p>6.2.1.6 Use results from research on grazing impacts on GrSG habitat and populations (strategies 6.1.1.2 and 6.1.2.2) to update and adjust grazing management options (see “Adaptive Management”, pg. 3).</p>	<p>BLM, CDOW, LWGs, Private landowners</p>	<p>Ongoing</p>	<p>0.5 FTE</p>
<p>6.2.1.7 Monitor (throughout the year as needed) GrSG habitat and total utilization (e.g., cattle, sheep, wild ungulates, wild horses, insects), and/or vegetation structure available during the important grouse use period, and adjust grazing management plans as necessary to achieve desired vegetation structure for GrSG. Monitoring protocol should provide data useful for determining if GrSG habitat and grazing objectives are being met (see Appendix C, “Habitat Monitoring Protocol”).</p>	<p>BLM, CDOW, LWGs, NRCS, Private Landowners, USFS</p>	<p>Ongoing</p>	<p>Site-specific</p>

6.2.1.8 Evaluate the effectiveness of grazing management options in achieving GrSG habitat objectives used at the local level. Use monitoring results to adjust management options (see “Adaptive Management”, pg. 3). It is critical for all stakeholders to be involved in the design of the monitoring plan.	BLM, CSU Extension, LWGs, NRCS, SLB, USFS	Within 5 years	1.25 FTE
6.2.1.9 Evaluate the effects of grazing management changes made for GrSG on maintaining sustainable agriculture.	BLM, CDOW, CSU Extension, LWG, NRCS, Private landowners,	On-going	.2 FTE

ISSUE 6.2: The complexity and diversity of herbivory and management of herbivores in sagebrush communities presents challenges to meeting GrSG habitat needs.			
OBJECTIVE 6.2.2: <i>Manage non-domestic herbivory</i> to maintain and improve GrSG habitat, while maintaining the economic benefits that are derived from wild ungulates.			
Conservation Strategy	Responsible Parties <small>(if there is a lead entity, it is in bold)</small>	Timeline	Cost
6.2.2.1 Encourage the consideration of specific sage-grouse habitat objectives when revising DAU plans for deer, elk, and pronghorn, particularly in revisions of big game population objectives.	BLM, CDOW, LWGs, USFS	Ongoing	0.25 FTE
6.2.2.2 Encourage the consideration of specific sage-grouse habitat objectives when revising BLM Wild Horse Herd Management Plans, where applicable.	BLM , CDOW, LWGs, USFS	Ongoing	0.1 FTE
6.2.2.2 Develop guidelines to influence wild ungulate distribution and utilization levels in order to achieve GrSG habitat objectives.	BLM, CDOW , LWGs, NPS, NRCS, Private landowners, SLB, USFS, USFWS	2009	Site-specific
6.2.2.3 Implement guidelines (where possible) to influence wild ungulate distribution and utilization levels in order to achieve GrSG habitat objectives.	BLM, CDOW , LWGs, NPS, NRCS, Private landowners, SLB, USFS, USFWS	2011 and ongoing	Site-specific

ISSUE 6.3: There is a need to recognize and address the funding and socioeconomic aspects of responsible GrSG conservation.			
OBJECTIVE 6.3.1: Identify funding sources for and prioritize individual projects for GrSG conservation.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
6.3.1.1 Identify potential funding sources for GrSG habitat conservation (see Appendix F, “Available Funding Opportunities for GrSG Habitat Conservation”).	CCP Steering Committee	2007	N/A
6.3.1.2 Assist local work groups in developing a process to evaluate management options and set priorities for funding habitat improvement projects.	CDOW, CSU Extension, LWG, NRCS, USFS, USFWS	As needed	0.25 FTE

ISSUE 6.3: There is a need to recognize and address the funding and socioeconomic aspects of responsible GrSG conservation.			
OBJECTIVE 6.3.2: Assist local work groups and communities with addressing the indirect economic costs of responsible GrSG conservation.			
6.3.2.1 Assist local work groups in developing procedures to conduct cost-benefit analyses of the economic impact of different grazing management options that benefit GrSG.	BLM, CDOW, CSU Extension, LWGs, NRCS, Universities, USFS, USFWS	Ongoing	\$200,000/yr
6.3.2.2 Identify opportunities to compensate landowners for the cost of implementation of management options and facilitating practices to benefit GrSG (e.g., grazing banks, conservation easements and other options).	BLM, CDOW, Land Trusts, NGO’s, USFS, USFWS,	2008 and ongoing	0.25 FTE
6.3.2.3 Provide funding to private landowners and land managers to implement grazing management options developed in strategy 6.2.1.2.	BLM, CDOW, Industry, NRCS, SLB, USFS, USFWS	Ongoing	\$500,000/yr
6.3.2.4 Conduct a cost-benefit analysis of the economic impact on local communities when planning for the management of the wild ungulates.	CDOW	As Needed	\$30,000
6.3.2.5 Continue support for HPP and game damage programs that address wild ungulate herbivory on private land.	CDOW	Ongoing	N/A

ISSUE 6.4: There is a lack of cooperation, communication, respect, and understanding among stakeholders in GrSG conservation.			
OBJECTIVE 6.4.1: Foster and facilitate sharing of information to improve communication, cooperation, and respect among stakeholders.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
6.4.1.1 Ensure that private land manager, permittees, conservation groups, and other interested publics are encouraged to be involved in land management planning (e.g., AMP planning, DAU plans) that involve sage-grouse habitats.	BLM, CDOW, LWGs, SLB, USFS, USFWS	Ongoing	None
6.4.1.2 Develop a public outreach/education program about domestic and wild grazing and GrSG needs (e.g., create a traveling display to be used at schools, county fairs). Be certain that part of the educational material identifies the contribution of landowners to sage-grouse conservation. [See Information, Communication, and Education Strategies 12.2.1.1, 12.2.1.2, 12.2.1.3, and 12.2.1.4]	See Information, Communication, and Education Strategies 12.2.1.1, 12.2.1.2, 12.2.1.3, and 12.2.1.4		
6.4.1.3 Develop an internet website through which local work groups can share information. Include a link from the CDOW website. [See Information, Communication, and Education Strategy 12.3.2.1]	See Information, Communication, and Education Strategy 12.3.2.1		
6.4.1.4 Establish controlled or regulated tours to impart an understanding of the various aspects of GrSG habitat. Be certain that part of the educational material identifies the contribution of landowners to sage-grouse conservation. Have a training and/or education program for the people who lead lek-viewing tours. [See Information, Communication, and Education Strategies 12.2.1.1, 12.2.1.2, 12.2.1.3, and 12.2.1.4]	See Information, Communication, and Education Strategies 12.2.1.1, 12.2.1.2, 12.2.1.3, and 12.2.1.4		
6.4.1.5 Develop elementary, middle, and high school curricula that include grazing and grouse management, to fit Colorado educational standards. [See Information, Communication, and Education Strategies 12.2.1.2 and 12.2.1.4]	See Information, Communication, and Education Strategies 12.2.1.2 and 12.2.1.4		

7. Habitat Enhancement

Habitat enhancement should be directed at specific and quantifiable ecological problems (Winward 2004, Monsen 2005). Projects should have specific and quantifiable goals. Some past and current projects have the goal of enhancing the herbaceous (grass and forb) understory in areas that already have sufficient structural characteristics, given the ecological status of the community. Expensive sagebrush manipulation projects that provide short-term herbaceous results should be viewed cautiously. Effort is best directed towards, for example, truly degraded sagebrush communities (e.g., breeding habitat that does not meet the “GrSG Structural Habitat Guidelines”, Appendix A), improving and/or creating riparian and wet meadow areas, reconstituting water tables by repairing down-cut banks, or piñon-juniper removal. Habitat improvement projects are expensive, often require extensive review, and are long-term in nature. It is important to schedule treatments and management actions in a manner that maintains adequate suitable habitat while other areas are recovering.

Three essential steps are suggested for designing habitat restoration projects for GrSG. The first step is to identify the sage-grouse seasonal habitat component in the project area that is lacking or needs improvement (see Appendix A, “GrSG Structural Habitat Guidelines”). For instance, good nesting habitat consists of live sagebrush with sufficient canopy cover and an adequate grass and forb understory. If it is documented or suspected that nest success is less than optimal, then improvement of the shrub overstory or herbaceous understory in delineated breeding habitat may require intervention.

The second step is to gain an understanding of the site characteristics (site potential and community identification) of the area needing improvement. Of primary importance is identification of the individual species or subspecies of sagebrush in the area. The SC strongly recommends using Winward (2004) to identify the taxonomy and distribution of sagebrush in Colorado. It is essential that this step is completed prior to further planning because the sagebrush species or subspecies naturally adapted to the site of interest will determine the suite of possible management actions for a successful treatment. Attempting to change community types (e.g., black sagebrush to Wyoming big sagebrush) is inadvisable (Monsen 2005). The vegetation, soils, and precipitation regimes of the treatment area need to be understood (Monsen 2005). For instance, basin big sagebrush communities normally occupy deeper soils with slightly higher soil moisture than sites dominated by Wyoming big sagebrush. Occurrence of silver sagebrush, black sagebrush, and low sagebrush is related to specific soil conditions (Winward 1983).

The third step is to select the appropriate management and remedial treatment measures that could be successfully applied to the site to assist in meeting treatment goals. Monsen (2005) provides a detailed manual addressing the myriad of issues associated with sagebrush community restoration. We recommend that, when planning a treatment, managers consult and apply Monsen (2005) to assist and guide in designing appropriate restoration options and application of techniques (e.g., timing of treatments, reestablishment

of sagebrush, seeding practicality, seedbed preparation). For examples of information provided in Monsen, see Appendix D, “Recommendations Regarding Plant Species for Use in GrSG Habitat Management and Restoration”.

ISSUE 7.1: Improper design or implementation of vegetation enhancement treatments may not meet habitat objectives and may lead to degraded GrSG habitats.			
OBJECTIVE 7.1.1: Conduct proper planning for vegetation, riparian, and wet meadow restoration and improvement projects that provide the structural habitat requirements in breeding, summer-fall, and winter sage-grouse habitats.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
7.1.1.1 Identify the sage-grouse habitat treatment objective(s) in a given population, sub-population, or population zone area, and review annually (see Appendix A, “GrSG Structural Habitat Guidelines”).	BLM, CDOW, LWGs, NRCS, Private Landowners, SLB, USFS, USFWS	When project is proposed	1 week FTE / project
7.1.1.2 Identify the ecological site characteristics and sagebrush species associated with the project area in GrSG habitat.	BLM, CDOW, LWGs, NRCS, Private Landowners, SLB, USFS, USFWS	When project is proposed	\$300/project
7.1.1.3 Consult Monsen (2005), and select appropriate treatment options suitable for the site characteristics and treatment objectives in GrSG habitat.	BLM, CDOW, LWGs, NRCS, Private Landowners, SLB, USFS, USFWS	During project planning	1 FTE week/project
7.1.1.4 Conduct pre-project planning for treatment areas in GrSG habitat (e.g., project design, necessary archaeological clearances, EAs).	BLM, CDOW, LWGs, NRCS, Private Landowners, SLB, USFS, USFWS	During project planning	\$25/acre for cultural clearances; \$50/acre for planning activities
7.1.1.5 Encourage and strongly support development of production and storage of native seed in Colorado, including native seed banks, for use in reclamation efforts in GrSG habitat (see also “Fire and Fuels Management” strategy 4.1.4.7.) Work cooperatively with the Uncompahgre Project (UP), Upper Colorado Environmental Plant Center (UCEPC), and other entities in the development and storage of native seed for restoration purposes.	BLM, CDOW, LWGs, NRCS, SCDs, SLB, UCEPC, UP, USFS, USFWS	Ongoing	\$200,000
7.1.1.6 When reseeding an area in GrSG habitat, use certified "weed-free" seeds (see “Fire and Fuels Management” strategy 4.1.4.8 and “Weeds” strategy section, pg. 410).	BLM, CDOW, LWGs, NRCS, SCDs, SLB, UCEPC, UP, USFS, USFWS	Ongoing	No additional cost

ISSUE 7.1: Improper design or implementation of vegetation enhancement treatments may not meet habitat objectives and may lead to degraded GrSG habitats.			
OBJECTIVE 7.1.2: Conduct and monitor restoration for improvement of the vegetation structural habitat requirements necessary for productive breeding, summer-fall, and winter sage-grouse habitats.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
7.1.2.1 Conduct pre-restoration monitoring using a recognized technique appropriate to measure the treatment objective(s) in GrSG habitat (see “Habitat Monitoring” strategy, pg. 3451 and Appendix C, “Habitat Monitoring Protocol”).	BLM, CDOW, LWGs, NRCS, Private Landowners, SLB, USFS, USFWS	During project planning	\$5/acre
7.1.2.2 Implement the appropriate treatment/restoration action(s) in GrSG habitat (Monsen 2005).	BLM, CDOW, LWGs, NPS, NRCS, Private Landowners, SLB, USFS, USFWS	Project – specific	\$100-\$500/acre depending upon treatment type
7.1.2.3 Monitor vegetation response to treatments in GrSG habitat using appropriate monitoring technique and timing for the treatment type (see “Habitat Monitoring” strategy, pg. 341 and Appendix C, “Habitat Monitoring Protocol”).	BLM, CDOW, LWGs, NPS, NRCS, Private Landowners, SLB, USFS, USFWS	Post-treatment + every 5 years	\$5/acre
7.1.2.4 Evaluate the effectiveness of vegetation enhancement treatments on GrSG. [See Research Strategy 21.1.2.1]	See Research Strategy 21.1.2.1		

8. Habitat Linkages

Using corridors to link isolated populations is often proposed as a conservation strategy for species in fragmented landscapes (Mann and Plummer 1995, Meffe and Carroll 1997, Rosenberg et al. 1997). It is assumed the habitat linkage will increase movement between populations and will decrease the probability of extinction of the species and genetic isolation of individual populations. We have defined GrSG linkages in Colorado as a heterogeneous landscape, within the historical range of GrSG, composed of isolated patches of landcover types frequently used by sage-grouse (for a list of landcover types see Table 34 [pg. 277]).

The effectiveness of a potential linkage will depend on the ability of GrSG to move among the isolated patches in a landscape (i.e., the relative "connectivity" of patches in a landscape; Taylor et al. 1993), which may be influenced by (1) the landscape composition; (2) configuration of the habitat patches; (3) distance between patches in the landscape (Dunning et al. 1992); and (4) the physical nature (land forms) of the landscape (Henein and Merriam 1990). The effectiveness of a potential linkage will also depend on the quality of the habitat in the isolated patches and the relative ability of sage-grouse to use (or move through) the surrounding unsuitable habitat. The effectiveness of linkages may also depend on predator behavior. The linear nature of corridors or the fragmented patches of habitat in a linkage may lead to greater predator foraging efficiency (Phillips et al. 2003).

We used GIS data to describe potential habitat linkages among GrSG populations ("inter-population linkages") in Colorado. In addition, we identified some linkages within populations ("intra-population linkages") that have experienced separation of smaller areas of occupied habitats from the larger population core (see "GrSG Habitat Linkages in Colorado", pg. 275). For further discussion of habitat fragmentation, see "Habitat: Fragmentation, Quality, and Quantity" issue section, pg.141.

ISSUE 8.1: Movement of GrSG is becoming increasingly limited by a reduction of suitable and available habitat linkages *within populations*.

OBJECTIVE 8.1.1: Maintain or reestablish linkages within populations where fragmentation and isolation of occupied habitats has occurred (e.g., NESR, NWCO populations).

Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
8.1.1.1 Within GrSG population areas, prioritize and refine mapped intra-population linkages that are most important to GrSG movements and dispersal.	BLM, CDOW , LWGs,	2008	0.1 FTE
8.1.1.2 In high priority GrSG intra-population linkages (see strategy 8.1.1.1), pursue opportunities to protect areas from permanent loss (e.g., management plans, easements, land exchanges, acquisitions).	BLM, CDOW, Land Trusts, Counties, Private Landowners, SLB, USFS	2009 and ongoing	\$200 - \$5,000/acre

8.1.1.3 In high priority GrSG intra-population linkages (see strategy 8.1.1.1), pursue opportunities for improving GrSG habitat (e.g., piñon-juniper removal, protection/enhancement of existing sagebrush communities; see “Habitat Enhancement” [pg. 336] and “Piñon – Juniper Encroachment” [pg. 382] strategies).	BLM, CDOW, LWGs, NRCS. Private Landowners, SLB, USFS	2009 and ongoing	\$100-\$500/acre depending upon treatment type
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ISSUE 8.2: Genetic interchange and movement of GrSG <i>between populations</i> may become increasingly limited by the lack of suitable linkages (see also Issue 5.2).			
OBJECTIVE 8.2.1: Pursue opportunities to develop and maintain linkages between GrSG populations.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
8.2.1.1 In linkage areas between GrSG populations, prioritize and refine mapped inter-population linkages that could offer GrSG movement opportunities and potential for genetic interchange. Address issues of isolated populations during the prioritization process.	BLM, CDOW , LWGs, USFS	2008	0.1 FTE
8.2.1.2 In high priority GrSG inter-population linkage areas (see strategy 8.2.1.1) that are on public lands, work to protect and improve habitat characteristics for GrSG (see “Habitat Enhancement” strategy, pg. 336).	CDOW, BLM , SLB, USFS	2009 and ongoing	0.25 FTE + \$100-\$500/acre
8.2.1.3 In high priority GrSG inter-population linkage areas (see strategy 8.2.1.1) that are on private lands, work with willing landowners to protect and enhance habitat characteristics for GrSG (e.g., management plans, conservation easements).	Counties, CDOW, Land trusts, LWGs, NRCS, Private Landowners	2010 and ongoing	\$200 - \$5,000/acre
8.2.1.4 Using results of population genetic testing (see Strategy 5.2.1.1), review prioritization of inter-population linkages.	CDOW , University of Denver	2007 and ongoing	\$15,000/year for DNA analysis; other costs included in existing research projects.

9. Habitat Monitoring

An adaptive management approach (pg. 3) is recommended for all actions designed to benefit sage-grouse habitat. As part of the adaptive management program, the results of habitat monitoring will allow managers to evaluate management success, refine management programs, and identify additional habitat management needs (see “Habitat Enhancement” strategy, pg. 336). To establish appropriate habitat monitoring, important sage-grouse habitat should be identified, habitat quality should be assessed, and changes in habitat should be monitored. For GrSG we will focus habitat monitoring at 2 scales: (1) the statewide (or landscape) scale; and (2) the local (local population or conservation plan) scale.

Statewide monitoring for GrSG will be based on the 2 state mapping and habitat assessment efforts described in the Conservation Assessment of this plan (see “GrSG Habitat Mapping Efforts”, pg. 58). Upon completion of the CCP, a more intensive CDOW mapping effort will be undertaken, primarily to further refine the current habitat categories (consistent with the refinement of GuSG habitat mapping in Colorado). Habitat definitions will be adjusted and new definitions will be incorporated into future CDOW mapping efforts to improve landscape-level habitat mapping efforts.

GrSG seasonal habitat should be mapped at the broad scale (see Strategy 9.1.1.9); until then, the following seasonal habitat definitions should be used:

Breeding Habitat: sagebrush communities delineated within 4 miles of an active strutting ground (lek) (see Appendix B, “GrSG Disturbance Guidelines”, for discussion). Breeding habitat includes active strutting grounds (leks), nesting habitat, and early brood-rearing habitat (Connelly et al. 2000c), and is usually in use from mid-March through late-June.

Summer – Fall Habitat: vegetation communities including sagebrush, agricultural fields, and wet meadows (Connelly et al. 2000c) that are within 4 miles of an active strutting ground (lek) (see Appendix B, “GrSG Disturbance Guidelines”, for discussion).

Winter Habitat: sagebrush areas (Connelly et al. 2000c) that have sufficient shrub height to be above winter snow cover (see Appendix B, “GrSG Disturbance Guidelines”, for discussion).

Local-scale (or project level) habitat monitoring quantifies vegetation structural characteristics and plant species diversity, and may serve to refine broader seasonal habitat mapping efforts. Ideal habitat conditions vary among different GrSG seasonal habitats such as breeding, summer - fall, and winter (see Appendix A, “GrSG Structural Habitat Guidelines”). Data from local habitat monitoring can

serve to (1) assess current vegetation conditions; (2) compare current vegetation conditions with established habitat guidelines; and (3) evaluate the short-term and/or long-term vegetation response to environmental changes or human-induced treatments (project effectiveness monitoring).

Local habitat monitoring and assessment efforts must be consistent so that information can be shared, compiled, and compared across the range of GrSG. Therefore, *minimum* data standards (as developed through the GuSG conservation planning effort) should be implemented when assessing occupied or potential sage-grouse habitat (see Appendix C, “Habitat Monitoring Protocol”. It is understood that local offices, agencies, and work groups may collect additional data (within budget and personnel constraints), to achieve specific monitoring objectives.

ISSUE 9.1: Information on the location and condition of current seasonal habitats for GrSG in Colorado may not be adequate to effectively manage, maintain, and/or improve those habitats.			
OBJECTIVE 9.1.1: On a statewide basis, identify and delineate current GrSG habitat and track future changes in habitat.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
9.1.1.1 Develop inventory technique(s) (in conjunction with similar efforts for GuSG) for searching “vacant/unknown” habitat areas for sage-grouse use. Techniques should: (1) determine grouse presence and/or use; and (2) assist in delineating and distinguishing between “suitable vacant” areas and “suitable unknown” areas (using GIS mapping).	CDOW	2008	0.25 FTE
9.1.1.2 In conjunction with efforts for GuSG, develop technique(s) to use in searching for new or previously unknown GrSG leks.	CDOW	2008	0.25 FTE
9.1.1.3 Survey and search vacant/unknown habitat for GrSG use and leks.	BLM, CDOW , LWGs, Private Landowners	2009 and ongoing	1.0 FTE
9.1.1.4 Update the CDOW habitat map using new GrSG habitat categories: “Suitable Occupied”, “Suitable Unknown”, “Suitable Vacant”, and “Potentially Suitable Habitat” *. Within the “Potentially Suitable Habitat” category, consider the relative restoration priority of each habitat area.	CDOW , BLM, LWGs, NRCS, SLB, USFS, USFWS	2008	\$10,000 and 0.5 FTE
9.1.1.5 Review and update statewide GrSG habitat-related mapping efforts.	BLM, CDOW	Every 10 years, or as necessary	\$5,000 and 0.25 FTE
9.1.1.6 In conjunction with GuSG efforts, delineate sagebrush communities by species and/or groups of species using GIS modeling techniques.	BLM, CDOW , NRCS, SLB, USFS, USFWS	2009	\$50,000 and 1 FTE

9.1.1.7 Develop and implement a process and standardized template for acquiring information on habitat projects, activities, and changes. Keep information requests with landowners focused and to a minimum.	CDOW, LWGs, NRCS, USFS, USFWS	2007	0.1 FTE
9.1.1.8 Create a central GIS database to track all sagebrush modification treatments and natural disturbances across GrSG range. This task will include database maintenance and updates.	BLM, CDOW, NRCS, USFS, USFWS	2009	\$10,000 and 0.25 FTE
9.1.1.9 Define GrSG seasonal habitats and map them into the GIS database. Incorporate GIS modeling techniques such as slope and aspect, observational data, and habitat assessment data into the seasonal habitat definitions.	BLM, CDOW, NRCS, USFS, USFWS	2008	\$50,000 and 0.5 FTE
9.1.1.10 Evaluate the amount and spatial arrangement of GrSG habitat in Colorado.	CDOW	2015	\$250,000 and 1 FTE
9.1.1.11 Develop a method of reporting and archiving data that facilitates evaluation of the effectiveness of management programs and how they meet the habitat objectives outlined in this plan.	CCP SC	2008	0.25 FTE

- * *Suitable Occupied Habitat:* Areas known to be used by sage-grouse within the last 10 years from the date of mapping. “Use” is defined as (1) radiotelemetry locations; (2) confirmed observations of grouse or grouse sign by reliable sources; or (3) documented use reported in unpublished reports or publications.
- Suitable Unknown Habitat:* Suitable and historic habitat adjacent to *Suitable Occupied Habitat*, where use by sage-grouse has not been documented but could occur. Habitat is similar to that within known occupied habitats.
- Suitable Vacant Habitat:* Sagebrush habitat within the historic range of sage-grouse that is not mapped as the above 2 categories (*Suitable Occupied* or *Suitable Unknown*).
- Potentially Suitable Habitat:* Habitat that is capable of producing sagebrush communities that could be occupied by sage-grouse, but would require a human- or non-human- induced perturbation. These areas have soils or other historic information (photos, maps, reports, etc.) indicating that sagebrush was the predominant cover type. These sites could include areas that have succeeded to non-sagebrush cover types (e.g., piñon-juniper).

ISSUE 9.1: Information on the location and condition of current seasonal habitats for GrSG in Colorado may not be adequate to effectively manage, maintain, and/or improve those habitats.			
OBJECTIVE 9.1.2: On a local basis, identify and delineate current GrSG habitat and track future changes in habitat.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
9.1.2.1 Use the standard sage-grouse habitat assessment protocol that was developed through the GuSG Rangeland Conservation Plan to assess GrSG habitat conditions (Appendix C, “Habitat Monitoring Protocol”), and compare results to the GrSG habitat structural guidelines (see Appendix A, “GrSG Habitat Structural Guidelines”). This protocol identifies which habitat variables should be measured (e.g., grass height) and which techniques should be used to measure them.	BLM, CDOW, LWGs, NRCS, SLB, USFS, USFWS	Ongoing	\$10/acre
9.1.2.2 Develop and implement habitat assessment training for LWGs, private landowners, and other land managers.	CDOW	2008	0.5 FTE
9.1.2.3 Obtain funding sources to support habitat monitoring implementation on a statewide basis for local GrSG populations. [See Research Strategy 21.1.1.1]	See Research Strategy 21.1.1.1		
9.1.2.4 Evaluate the impact of vegetation condition on GrSG populations.	CDOW	2015	250,000

10. Housing Development

Housing development in GrSG habitat results in permanent loss of habitat, degradation of remaining habitat from fragmentation, and indirect impacts from associated factors (e.g., roads, fencing, powerlines, increased human activity). Development may also facilitate the introduction of novel predators and noxious weeds. Colorado has been experiencing a significant increase in human population in recent years. This growth has resulted in conversion of agricultural lands to residential land-uses and encroachment of development onto nearby public lands (Theobald 2003). The GrSG populations with the highest current threat of impact from housing development are MP, MWR, NESR, and the east side of NWCO (Zone 4B). For further discussion and analysis of this topic, see “Housing Development” issue [pg. 144] and “Predicted Future Housing Development and GrSG Habitat Protection” [pg. 256]).

Where housing development is a likely threat in GrSG range, protections such as voluntary easements or fee-title acquisition of important habitats will be necessary to protect the land for the long-term. Maintaining sustainable rural economies (where traditional land-uses compatible with sage-grouse are profitable) can significantly reduce threats associated with subdivisions. Private property owners have a right to develop their land. Long-term and community-based planning to direct growth and development to appropriate areas, along with compensations for restrictions on developments in important areas, are the most efficient means to accomplish conservation.

Outline of Strategy Organization (italics within Issues and Objectives refer to this outline)

Issue 10.1: GrSG permanent habitat loss

Objective 10.1.1: Short-term strategies, in occupied habitats of 3 GrSG populations

Objective 10.1.2: Long-term strategies, in occupied habitats of all GrSG populations

Issue 10.2: Reduced GrSG habitat effectiveness (quality)

Objective 10.2.1: Short-term strategies, in occupied GrSG habitat, habitat fragmentation

Objective 10.2.2: Long-term strategies, in occupied and potential GrSG habitat, habitat fragmentation

Objective 10.2.3: Short-term strategies, invasive plants and contaminants

Objective 10.2.4: Long-term strategies, invasive plants and contaminants

Objective 10.2.5: Improve GrSG habitat in existing developments

Issue 10.3: Disturbance to GrSG

Objective 10.3.1: Reduce disturbance to GrSG

Issue 10.4: Planning of housing developments

Objective 10.4.1: Address GrSG needs in planning development

Issue 10.5: Increasing human water demand: changing water use

Objective 10.5.1: Address GrSG habitat needs in water use decisions

Objective 10.5.2: Provide for adequate water in GrSG habitat
Issue 10.6: Lack of awareness of GrSG
Objective 10.6.1: Educate public about GrSG

ISSUE 10.1: Housing development in sagebrush ecosystems results in <i>permanent loss of sage-grouse habitat</i> to residential and commercial uses.			
OBJECTIVE 10.1.1: <i>Short-term (5-year) within occupied sage-grouse range in MWR, MP, NESR, and Zone 4B of NWCO populations:</i> reduce the loss of seasonally important sage-grouse habitat (both public and private land) from housing development, including related commercial development and infrastructure (see “Infrastructure [pg. 369] and “Roads” [pg. 394] strategies).			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
10.1.1.1 Using GIS, identify occupied and seasonally important GrSG habitats and leks that are at highest risk of development (priority areas).	CDOW , County Governments	2008; update every 2 years	Negligible
10.1.1.2 Identify areas, within priority areas, for potential conservation actions to benefit GrSG (e.g., management plans, conservation easements, leases, Farm Bill programs, land exchanges, acquisition), and share this information with interested stakeholders.	BLM, CDOW , County Governments, Land Trusts, LWGs, NGOs, NRCS, USFS	2008 and ongoing	0.1 FTE
10.1.1.3 Incorporate benefits to sage-grouse into existing easements and management plans, as opportunities arise.	CDOW , Land Trusts, LWGs, NRCS, Private Landowners	2008 and ongoing	1 week FTE time/easement
10.1.1.4 Identify and pursue funding sources for protection of identified GrSG areas (identified in strategy 10.1.1.2), and encourage collaborative conservation funding opportunities.	BLM, CDOW , Land Trusts, LWGs, NGOs, NRCS, USFS, USFWS	2008 and ongoing	0.1 FTE
10.1.1.5 Within priority GrSG areas (strategy 10.1.1.1), set specific goals for the amount of habitat to protect from housing development.	BLM, CDOW , LWG , NGOs, Other Research Institutions, Universities, USFS, USFWS	2010; update every 3 years	2 meetings /work group
10.1.1.6 Pursue opportunities to protect identified GrSG areas (strategy 10.1.1.2) with interested landowners (e.g., land exchanges and acquisition, and management plans and easements that incorporate benefits to sage-grouse).	BLM, CDOW , Land Trusts, LWGs , NGOs, SLB, USFS, USFWS	2010 and ongoing	0.2 FTE / population
10.1.1.7 Establish a mechanism for tracking conservation easements that include protection for sage-grouse.	CDOW , County Governments, Land Trusts	2009	0.1 FTE

10.1.1.8 Investigate impacts of housing on GrSG, due to noise, pets, and increased activity. Use data to assist with planning and future housing development. [See Research Strategy 21.2.1.1]	See Research Strategy 21.2.1.1
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ISSUE 10.1: Housing development in sagebrush ecosystems results in <i>permanent loss of sage-grouse habitat</i> to residential and commercial uses.			
OBJECTIVE 10.1.2: <i>Long-term (6-15 years): within occupied range</i> , protect seasonally important sage-grouse habitat based on updated priority areas identified for protection from housing development and related commercial development and infrastructure (see “Infrastructure [pg. 369] and “Roads” [pg. 394] strategies).			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
10.1.2.1 Reevaluate and identify occupied and seasonally important sage-grouse habitats and leks that are at highest risk of development.	CDOW , County Governments	2015 and ongoing	0.25 FTE
10.1.2.2 For protection of identified GrSG areas (strategy 10.1.1.2), obtain funding from sources identified in strategy 10.1.1.4.	BLM, CDOW , GOCO, Land Trusts, NGOs, USFS, USFWS	2015 and ongoing	0.25 FTE
10.1.2.3 Protect identified GrSG areas (strategy 10.1.1.2) from housing development by continuing implementation of short-term actions (e.g., strategies 10.1.1.3 and 10.1.1.6), through voluntary agreements (e.g., conservation easements, leases) with willing landowners.	BLM, CDOW , County Governments, Land Trusts, LWGs, NGOs, federal agencies, USFS, USFWS	2015 and ongoing	\$200 - \$5,000/acre
10.1.2.4 Review, monitor, and update short-term actions (strategies 10.1.1.1 – 10.1.1.7).	BLM, CDOW , County Governments, Land trusts, LWGs, NGOs, USFS, USFWS	2015 and ongoing	0.1 FTE
10.1.2.5 Monitor and track land-use changes and infrastructure development in relationship to occupied and seasonally important GrSG habitats and leks (see “Infrastructure” strategy, pg. 369).	CDOW , County Governments, LWGs	2015 and ongoing	0.25 FTE

ISSUE 10.2: Housing development in occupied and potential sage-grouse range results in <i>reduced effectiveness (quality) of sage-grouse habitats</i> (e.g., reduced habitat patch size, increased habitat patch isolation, contaminant loading).			
OBJECTIVE 10.2.1: <i>Short-term (5 years): within occupied habitat, minimize future fragmentation of sage-grouse habitat from new housing development.</i>			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
10.2.1.1 Identify and map areas where new (proposed and potential) housing development could potentially fragment existing GrSG populations (in conjunction with strategy 10.1.1.1).	CDOW , County Governments, LWGs	2010	0.1 FTE
10.2.1.2 Monitor leks and other seasonally important sage-grouse habitat in jeopardy of fragmentation due to development.	BLM, CDOW , LWGs, NGOs, USFS	2008 and ongoing	0.1 FTE
10.2.1.3 Meet with land management agencies and local developers to address and recommend management actions to mitigate adverse fragmentation impacts to sage-grouse habitat. [See also Information, Communication, and Education Strategies 12.2.1.3 and 12.3.1.1]	BLM, CDOW, County Governments, Land Trusts, LWGs , Private Landowners, USFS, Utility Companies	2009 and ongoing	0.1 FTE
10.2.1.4 Create guidelines or recommendations to address the effects of habitat fragmentation (due to housing and related infrastructure) on sage-grouse populations.	BLM, CDOW , County Governments, LWGs, NGOs, USFS	2013	0.25 FTE
10.2.1.5 Discourage adverse impacts to sage-grouse habitat by conversion of sagebrush lands to ‘park space’ in developments (e.g., lawns, golf courses). Encourage natural, native landscaping to reduce water consumption and conversion of sagebrush habitats.	Counties, CDOW, County Governments, LWGs, Private Landowners	Ongoing	0.25 FTE

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ISSUE 10.2: Housing development in occupied and potential sage-grouse range results in <i>reduced effectiveness (quality) of sage-grouse habitats</i> (e.g., reduced habitat patch size, increased habitat patch isolation, contaminant loading).			
OBJECTIVE 10.2.2: <i>Long-term</i> (6-15 years): <i>within occupied and potential habitat, minimize future fragmentation</i> of sage-grouse habitat resulting from new housing development.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
10.2.2.1 Conduct research to determine (1) sage-grouse habitat patch size and configuration needs; and (2) fragmentation impacts on GrSG movements and population isolation. [See Research Strategy 21.1.1.1]	See Research Strategy 21.2.1.1		
10.2.2.2 Prioritize sage-grouse habitat areas (including from a statewide perspective) to protect from or to reduce impacts from habitat fragmentation due to housing and related development.	BLM, CDOW , County Governments, Developers, Land Trusts, LWGs , NGOs, USFS, USFWS	2015 and ongoing	1 meeting /working group/year; 0.1 FTE
10.2.2.3 Encourage local governments to develop land-use recommendations or guidelines to reduce GrSG habitat fragmentation from housing and related development (see also strategy 10.2.1.3).	CDOW , County Governments, Land Trusts, LWGs , NGOs	2015and ongoing	0.1 FTE
10.2.2.4 Develop predictive models to monitor and assess impacts of habitat fragmentation in sage-grouse habitat. [See Research Strategy 21.1.1.1]	See Research Strategy 21.1.1.1		
10.2.2.5 Where housing development is occurring in or near sagebrush habitat, encourage underground utilities to reduce raptor perches and the potential for wire-strikes by GrSG (see “Infrastructure” strategy, pg. 369).	County Governments, LWGs , Utility Companies	ongoing	0.1 FTE

ISSUE 10.2: Housing development in occupied and potential sage-grouse range results in <i>reduced effectiveness (quality) of sage-grouse habitats</i> (e.g., reduced habitat patch size, increased habitat patch isolation, contaminant loading).			
OBJECTIVE 10.2.3: <i>Short-term</i> (5 years): <i>in sage-grouse habitat, minimize the introduction of invasive plants and contaminants</i> resulting from housing development.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
10.2.3.1 Identify potential contaminants associated with housing developments (e.g., household chemicals, fertilizers, sediments) that could impact sage-grouse.	CDOW , CDPHE	Complete by 2009	0.1 FTE

<p>10.2.3.2 Develop informational materials regarding the impacts of invasive plants and contaminants on sage-grouse (see “Weeds” strategy, pg. 410). [See Information, Communication, and Education Strategy 12.2.1.1]</p>	<p>See Information, Communication, and Education Strategy 12.2.1.1</p>		
<p>10.2.3.3 Recommend seed-mix guidelines that are beneficial to sage-grouse (see Appendix D, “Recommendations Regarding Plant Species for Use in GrSG Habitat Management and Restoration” and “Habitat Enhancement” strategy, pg. 336). [See also Information, Communication, and Education Strategy 12.3.1.1]</p>	<p>CDOW, County Governments, CSU Extension, Developers, Land Trusts, LWGs, NGOs, NRCS, Private Landowners</p>	<p>2008 and ongoing</p>	<p>0.1 FTE</p>
<p>10.2.3.4 Recommend management and revegetation techniques to decrease noxious and invasive weeds in disturbed areas of GrSG habitat (see “Habitat Enhancement [pg. 336] and “Weeds” [pg. 410] strategies). [See also Information, Communication, and Education Strategy 12.3.1.1]</p>	<p>BLM, CDOW, County Governments, CSU Extension, Developers, NRCS, Utility Companies</p>	<p>2008 and ongoing</p>	<p>0.1 FTE</p>

<p>ISSUE 10.2: Housing development in occupied and potential sage-grouse range results in <i>reduced effectiveness (quality) of sage-grouse habitats</i> (e.g., reduced habitat patch size, increased habitat patch isolation, contaminant loading).</p>			
<p>OBJECTIVE 10.2.4: <i>Long-term</i> (6-15 years): in sage-grouse habitat, <i>prevent the introduction of invasive plants and contaminants</i> resulting from housing development.</p>			
<p style="text-align: center;">Conservation Strategy</p>	<p style="text-align: center;">Responsible Parties (lead agency is in bold)</p>	<p style="text-align: center;">Timeline</p>	<p style="text-align: center;">Cost</p>
<p>10.2.4.1 Encourage local governments to formally adopt revegetation requirements (including seed type recommendations beneficial for sage-grouse, strategy 10.2.3.3) for sites disturbed by housing development and related infrastructure (see Appendix D, “Recommendations Regarding Plant Species for Use in GrSG Habitat Management and Restoration”).</p>	<p>CDOW, City Governments, County Governments CSU Extension, Land Trusts, LWGs, NRCS</p>	<p>2015and ongoing</p>	<p>0.25 FTE</p>
<p>10.2.4.2 Develop and implement ongoing outreach program for homeowners (e.g., workshops, brochures) regarding the potential effects of noxious/invasive weeds, fuels management, and contaminants on GrSG. [See Information, Communication, and Education Strategies 12.2.1.1 and 12.2.1.3]</p>	<p>See Information, Communication, and Education Strategies 12.2.1.1 and 12.2.1.3</p>		

ISSUE 10.2: Housing development in occupied and potential sage-grouse range results in <i>reduced effectiveness (quality) of sage-grouse habitats</i> (e.g., reduced habitat patch size, increased habitat patch isolation, contaminant loading).			
OBJECTIVE 10.2.5: <i>Increase sage-grouse habitat effectiveness (quality) in existing developed areas.</i>			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
10.2.5.1 Reduce fragmentation of sage-grouse habitat by encouraging low-impact siting of roads and utilities, as opportunities arise in existing developed areas (see “Infrastructure [pg. 369] and “Roads” [pg. 394] strategies).	BLM, CDOW , City Governments, County Governments, LWGs, Private Landowners, USFS, Utility Companies	2015 and ongoing	0.1 FTE
10.2.5.2 Prioritize areas for increasing sage-grouse habitat effectiveness (quality) within and adjacent to existing developments.	BLM, CDOW , County Governments, Land Trusts, LWGs , Private Landowners, USFS	2015 and ongoing	1 week/ population

ISSUE 10.3: Housing development increases human presence, pets, and activities that <i>disturb sage-grouse</i> behavior, potentially affecting survival and reproduction in sage-grouse populations. The effects may extend for some distance beyond actual housing structures.			
OBJECTIVE 10.3.1: Reduce disturbance to GrSG that is associated with human presence and activities, including pets, resulting from housing development.			
Conservation Strategy	Responsible Parties (lead agency is in bold)	Timeline	Cost
10.3.1.1 Recommend seasonal closures or restrictions on recreational uses on public lands within sage-grouse habitat, in areas in close proximity to housing developments (see “Recreational Activities” strategy, pg. 392).	BLM , CDOW, USFS	2009 and ongoing	0.1 FTE
10.3.1.2 Work with local governments to encourage homeowner associations and individual homeowners to adopt and enforce pet control measures in and near sage-grouse habitat.	CDOW, County Governments, LWGs	2009 and ongoing	0.25 FTE
10.3.1.3 Incorporate information about the impacts of human disturbance on sage-grouse in other outreach efforts to homeowners (see Issue 10.6). Include information on effects of open garbage on GrSG through an increase in some predators (e.g., skunks and raccoons). [See Information, Communication, and Education Strategy 12.2.1.3]	See Information, Communication, and Education Strategy 12.2.13]		

ISSUE 10.4: Sage-grouse habitat is not recognized by current regulatory frameworks for <i>pre-planning for housing development</i> and mitigation of impacts on private lands.			
OBJECTIVE 10.4.1: Incorporate sage-grouse habitat conservation into <i>land-use planning decisions</i> .			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
10.4.1.1 Provide information to local, state, and federal governments on sage-grouse habitat requirements and the status, location, and possible effects of different land-uses (including right-of-way and inholding access across public lands and land trades) on sage-grouse. Include discussion of issues and state statute regarding 35-acre parcels and estate taxes, and the need for additional incentives for large landowners to not develop lands. Analyze statutes for unforeseen impacts on sage-grouse (e.g., 3-mile annex annually, “leapfrogging” of cities). Discourage disposal of public lands in sage-grouse habitat. [See also Information, Communication, and Education Strategies 12.2.1.3 and 12.3.1.1]	BLM, CDOW , Cities, County Governments, Land Trusts, LWGs, SLB, USFS	Ongoing	0.25 FTE
10.4.1.2 Work with county planners and commissioners to develop and modify land-use and zoning plans to protect sage-grouse habitats (e.g., cluster development, density credits, special zoning overlay districts, development rights transfers). Provide updated GrSG GIS layers to county governments, as data become available.	CDOW , LWGs, Land Trusts	Ongoing	0.5 FTE

ISSUE 10.5: <i>Increasing water demand</i> resulting from local and statewide population growth (housing development) can lead to <i>changes in water use within sagebrush habitat</i> , including altered streamflow, transfer of water rights, reduction of irrigated habitats, and inundation at storage sites.			
OBJECTIVE 10.5.1: <i>Mitigate the impacts to and/or protect seasonally important sage-grouse habitat from increasing domestic water development.</i>			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
10.5.1.1 Identify areas of overlap between seasonally important sage-grouse habitat and aquatic and riparian ecosystems.	CDOW	2009 and ongoing	0.1 FTE

10.5.1.2 Stay informed about and provide input regarding Colorado Water Conservation Board actions regarding water rights or uses that might affect sage-grouse habitat, referring to areas identified in strategy 10.5.1.1 (e.g., get on mailing list, attend hearings).	BLM, CDOW , County Governments, LWGs, NGOs, USFS	As Needed	0.1 FTE
10.5.1.3 Work with water development interests to seek avoidance of, changes to, or mitigation for water projects that could affect sage-grouse.	BLM, CDOW , County Governments, LWGs, NGOs, USFS	As Needed	3 meetings/ project
10.5.1.4 If a large reservoir project appears likely near sage-grouse habitat, consider the potential impacts to sage-grouse from indirect effects such as recreation, real estate development, and road realignment.	BLM, CDOW , County Governments, LWGs, NGOs, USFS, Water Conservation Districts	As Needed	0.1 FTE
10.5.1.5 During regional and statewide water planning efforts provide information on relationships between sage-grouse habitat and water uses.	BLM, CDOW , County Governments, LWGs, NGOs, USFS, Water Conservation Districts	As Needed	0.1 FTE

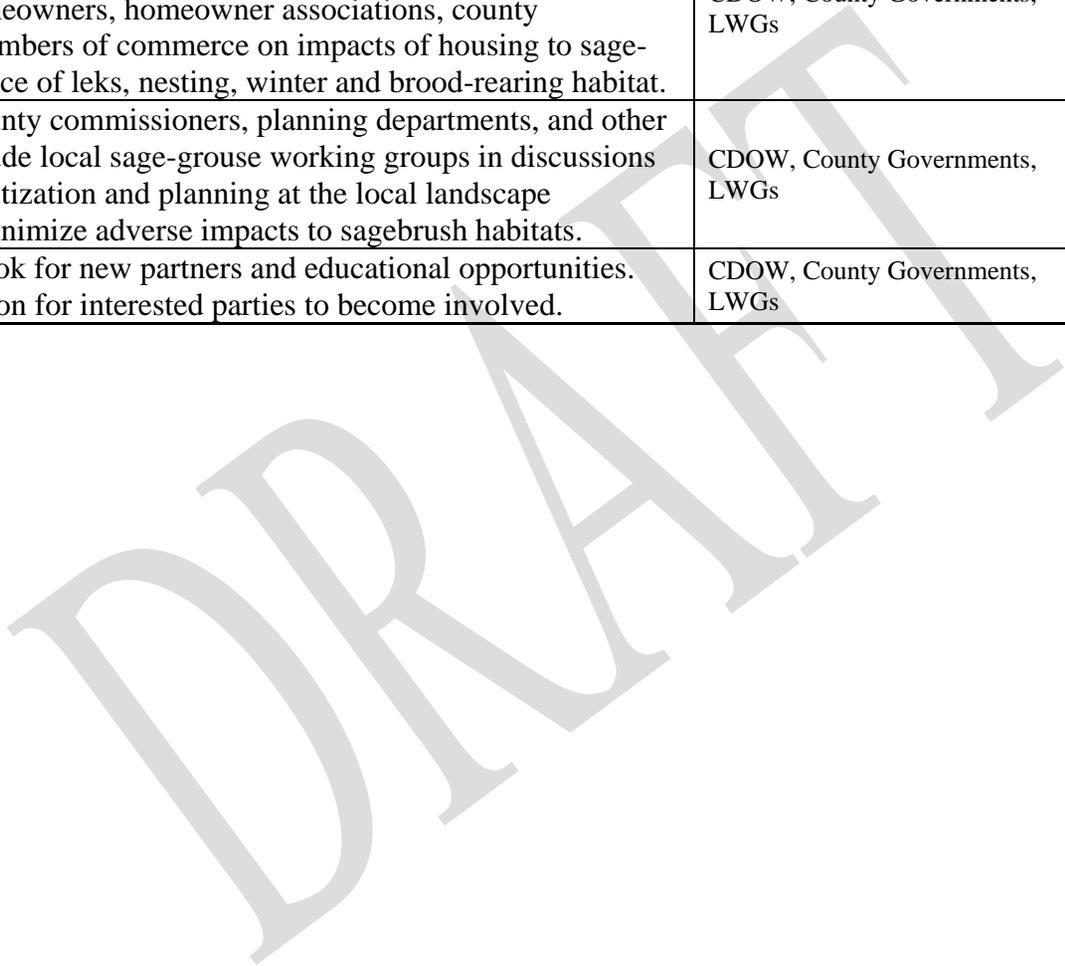
ISSUE 10.5: *Increasing water demand* resulting from local and statewide population growth (housing development) can lead to *changes in water use within sagebrush habitat*, including altered streamflow, transfer of water rights, reduction of irrigated habitats, and inundation at storage sites.

OBJECTIVE 10.5.2: *Promote adequate water distribution and flow* in sage-grouse brood-rearing habitat.

Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
10.5.2.1 Work with willing landowners and public agencies to keep water rights tied to existing uses in local areas in GrSG habitat. Explore incentives to accomplish this task, including filing objections with the water court on any change of use.	CDWR, LWGs, NGOs	As Needed	0.25 FTE
10.5.2.2 Work with willing landowners to develop or maintain GrSG brood-rearing habitat, or replace lost or impacted habitats.	CDOW, LWGs, NRCS, USFWS	As Needed	Project Specific

ISSUE 10.6: There is a <i>lack of awareness of sage-grouse</i> on the part of planners, developers, housing residents, and state decision makers, resulting in land management decisions that impact sage-grouse (habitat loss, habitat degradation, and disturbance to sage-grouse; see also strategy 10.3.1.3).			
OBJECTIVE 10.6.1: <i>Increase the awareness of sage-grouse conservation</i> among land-use planners and developers, and housing residents.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
10.6.1.1 Compile existing information and guidelines pertaining to housing development-associated impacts on sage-grouse.	CDOW , County Governments, Land Trusts, LWGs, NGOs	2009	0.1 FTE
10.6.1.2 Develop key messages, focused on different types of development (e.g., high or low density rural housing, clustering), to include in informational materials about GrSG (strategy 10.6.1.3). [See Information, Communication, and Education Strategies 12.2.1.1 and 12.2.1.3]	See Information, Communication, and Education Strategies 12.2.1.1 and 12.2.1.3		
10.6.1.3 Prepare and distribute informational materials about sage-grouse to land-use planners, developers, landowners, realtors, utility companies, and housing residents. Conduct outreach program to get materials to second homeowners and 35-acre ranchette owners. [See Information, Communication, and Education Strategies 12.2.1.1 and 12.2.1.3]	See Information, Communication, and Education Strategies 12.2.1.1 and 12.2.1.3		
10.6.1.4 Develop and implement an ongoing outreach program for homeowners regarding housing development impacts on sage-grouse (e.g., provide workshops and information on the potential effects of fuels management, noxious weeds, and pets on sage-grouse). Contact homeowner associations and landowner cooperatives. [See Information, Communication, and Education Strategies 12.2.1.1 and 12.2.1.3]	See Information, Communication, and Education Strategies 12.2.1.1 and 12.2.1.3		
10.6.1.5 Encourage local agencies, landowners, groups, and interested parties to gain local representatives' support of decisions regarding sage-grouse conservation actions.	LWGs, NGOs	As needed	Negligible
10.6.1.6 Install sage-grouse information signs (e.g., road crossing signs, kiosks) where appropriate.	BLM, CDOT, CDOW , LWGs, SLB, USFS, USFWS	As needed	Project - Dependent

<p>10.6.1.7 Promote and expand the “Guide to Rural Living” to include the impacts of housing, pets, lawns, and other housing-associated issues on sage-grouse. Work with homeowners, homeowner associations, county commissioners, and chambers of commerce on impacts of housing to sage-grouse and the importance of leks, nesting, winter and brood-rearing habitat.</p>	<p>CDOW, County Governments, LWGs</p>	<p>2009 and ongoing</p>	<p>\$5,000</p>
<p>10.6.1.8 Encourage county commissioners, planning departments, and other planning groups to include local sage-grouse working groups in discussions regarding housing prioritization and planning at the local landscape (population) level, to minimize adverse impacts to sagebrush habitats.</p>	<p>CDOW, County Governments, LWGs</p>	<p>2008 and ongoing</p>	<p>\$2,000</p>
<p>10.6.1.9 Continually look for new partners and educational opportunities. Develop a central location for interested parties to become involved.</p>	<p>CDOW, County Governments, LWGs</p>	<p>ongoing</p>	<p>No distinct cost</p>



11. Hunting

The first sport harvest season for GrSG in Colorado was established in 1877 (Rogers 1964), and GrSG hunting continues today. There is much debate about (1) whether or not sport harvest of GrSG is additive or compensatory to over-winter mortality; and (2) what an appropriate harvest rate is for GrSG populations. In addition, although current GrSG populations can sustain hunting, it is not clear how quickly the current harvest management system might respond to declines in population.

In order to apply a specific harvest rate each year, managers need to be able to annually estimate fall population levels, and to adjust annual harvest. To date, the available techniques to estimate fall populations do not exist. For further discussion, see “Hunting” issue, pg. 146.

ISSUE 11.1: There is a perception that GrSG populations are not thriving, and therefore sport hunting is inappropriate.			
OBJECTIVE 11.1.1: Influence the perception about the status of GrSG populations by providing accurate information about GrSG populations, their management, and the sustainability of sport hunting.			
Conservation Strategy	Responsible Parties <small>(if there is a lead entity, it is in bold)</small>	Timeline	Cost
11.1.1.1 Inventory all existing education and awareness materials regarding GrSG population status and management (e.g., brochures, posters). [See Information, Communication, and Education Strategies 12.2.1.1 and 12.2.1.2]	See Information, Communication, and Education Strategies 12.2.1.1 and 12.2.1.2		
11.1.1.2 Conduct initial and annual reviews of information and all materials regarding GrSG. Review for accuracy and information gaps, and produce new materials if necessary. [See Information, Communication, and Education Strategy 12.2.1.1]	See Information, Communication, and Education Strategy 12.2.1.1		
11.1.1.3 Develop an integrated communication strategy about upland bird sport hunting to inform and educate the non-hunting public about sport hunting. [See Information, Communication, and Education Strategies 12.2.1.1 and 12.2.1.3]	See Information, Communication, and Education Strategies 12.2.1.1 and 12.2.1.3		
11.1.1.4 Encourage and coordinate with LWGs to initiate articles in local newspapers and electronic media about their activities and successes with GrSG. [See Information, Communication, and Education Strategy 12.3.2.1]	See Information, Communication, and Education Strategy 12.3.2.1		

ISSUE 11.2: There is a lack of credible research on the theories of additive and compensatory mortality and sport harvest of GrSG.			
OBJECTIVE 11.2.1: Foster and support the research and the collection of data to gain knowledge about additive and compensatory mortality thresholds and sport harvest in GrSG.			
Conservation Strategy	Responsible Parties <small>(if there is a lead entity, it is in bold)</small>	Timeline	Cost
11.2.1.1 Initiate experimental field research designed to specifically address the issue of compensatory and additive mortality and GrSG. Collaborate with other westerns states that hunt GrSG. [See Research Strategy 21.6.1.1]	See Research Strategy 21.6.1.1		

ISSUE 11.3: There is concern regarding the quality of GrSG hunter and harvest information.			
OBJECTIVE 11.3.1: Foster and support the collection accurate information on hunters and GrSG harvest.			
Conservation Strategy	Responsible Parties <small>(if there is a lead entity, it is in bold)</small>	Timeline	Cost
11.3.1.1 Identify and implement more effective techniques to collect GrSG hunter statistics.	CDOW , LWGs	2009	0.5 FTE
11.3.1.2 Evaluate the efficacy of implementing a required free permit, a sage-grouse stamp, a limited sage-grouse license, and/or an improved phone survey for GrSG hunters.	CDOW , LWGs	2009	0.5 FTE
11.3.1.3 Using local communities and LWG, provide educational materials to ensure that hunters accurately identify sage-grouse in the field. [See also Information, Communication, and Education Strategy 12.3.1.1]	LWGs , CDOW	2008	0.1 FTE
11.3.1.4 Evaluate, and if needed, improve the wing receipt (wing barrel) program and assess its accuracy for reporting GrSG harvest statistics.	CDOW , LWGs, USFWS (Arapaho NWR)	2009	0.5 FTE
11.3.1.5 Educate hunters about the importance of wing receipt data and harvest reports in GrSG management. [See Information, Communication, and Education Strategy 12.3.1.1]	See Information, Communication, and Education Strategy 12.3.1.1		

ISSUE 11.4: There is concern regarding the relationship between the GrSG hunting public and landowners.			
OBJECTIVE 11.4.1: Foster and support a strong relationship between the GrSG hunting public and landowners.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
11.4.1.1 Encourage GrSG hunters to participate in LWG and statewide plan implementation.	CDOW, CWF, LWGs	Ongoing	0.1 FTE
11.4.1.2 Contact hunting groups and organizations (e.g., sportsmen’s councils) to encourage participation in sage-grouse conservation. [See Information, Communication, and Education Strategy 12.2.2.1]	See Information, Communication, and Education Strategy 12.2.2.1.		

ISSUE 11.5: There is a concern that the CDOW’s system for annually setting GrSG hunting regulations (e.g., season length, bag limits, open/closed areas) cannot adapt and respond quickly enough to potential changes in GrSG populations.			
OBJECTIVE 11.5.1: Develop a system for adjusting season lengths, bag limits, and areas of closure or re-opening that is rigorous, predictable, and responsive to changes in sage-grouse populations.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
11.5.1.1 Develop a biologically-based adaptive GrSG statewide harvest management system that responds to the current LWG trigger systems to close or open areas to GrSG hunting.	CDOW, LWGs	2010	0.5 FTE
11.5.1.2 Implement an intensive monitoring system of GrSG population and harvest to refine the adaptive harvest model periodically, to affect season length and bag limit.	CDOW, LWGs	2010	0.5 FTE
11.5.1.3 Consider reducing the length of the sage-grouse falconry season to eliminate overlap with the GrSG strutting season (i.e., March).	CDOW , Colorado Hawking Club	By 2012	No additional cost

12. Information, Communication, and Education

Effective communication, information sharing, and education are key to the success of any conservation effort. The need for efforts in these areas is clearly stated in many of the strategy sections that address other issues affecting GrSG in Colorado. This section presents broad strategies, each designed to address particular concerns that are common among the other strategy sections. Paramount to this topic is the need for central coordination of communication and information sharing, to ensure consistency in facts, data, education, management, and research regarding GrSG. Facilitating the local work group process is critical to the success of strategies in the plan, and this section focuses, in part, on that process.

In this section we recommend establishing a GrSG information, communication, and education program, including creating a position and hiring a statewide coordinator for the program. The strategies listed here are essentially a list of tasks and responsibilities that would fall under this program. Numbered strategies from other sections that relate to “Information, Communication, and Education” are referenced below numbered strategies in this section. For example, the “Grazing” section contains this strategy: “6.4.1.3 Develop an internet website through which local work groups can share information. Include a link from the CDOW website.” It is listed in the Grazing section, but the “Responsible Parties”, “Timeline” and “Cost” columns remain blank there. Instead, strategy 12.3.2.1 in the Information/Communication/Education section reads: “12.3.2.1 Pursue all opportunities to support and facilitate the GrSG local work group process.” Strategy 6.4.1.3, and other related strategies from all issues sections are listed below 12.3.2.1. The “Responsible Parties”, “Timeline”, and “Cost” columns are then completed for the broader, overarching Information strategy 12.3.2.1. This organizational approach results in redundancy within the plan, but allows for completeness within each individual strategy section, which may be important in implementing the plan.

In some cases, however, the responsible party, timeline, and cost, information remains in the original numbered strategy section (e.g., Grazing). This is because the responsibility for that action rests primarily with personnel outside the proposed GrSG Education and Communication Program. The reference to that strategy is still included in this section so that the information program is well-informed about all strategies related to the information topic.

Outline of Strategy Organization (italics within Issues and Objectives refer to this outline)

Issue 12.1 Need for information and education central coordination

Objective 12.1.1 Establish GrSG information, communication, education program

Issue 12.2 General public and those not involved in GrSG conservation need information

Objective 12.2.1 Inform general public and those not involved in GrSG conservation

Objective 12.2.2 Involve general public and those not already involved in GrSG conservation

Issue 12.3 Those already involved in GrSG conservation: need for data sharing, information dissemination, better communication

Objective 12.3.1 Provide information and training to those involved in GrSG conservation

Objective 12.3.2 Facilitate local work group process, data sharing, communication among those involved in GrSG conservation

ISSUE 12.1: There is no central coordination for developing and disseminating accurate and consistent information statewide about GrSG status, requirements, management, and conservation.			
OBJECTIVE 12.1.1: Establish a GrSG information, communication, and education program designed to coordinate statewide efforts as well as to enable local work groups to complete their communication and information strategies. Program duties would include (but would not be limited to) responsibilities regarding (1) communications among groups, industry, and stakeholders; (2) training opportunities for all involved in GrSG conservation in Colorado; and (3) national sage-grouse strategy implementation and network.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
12.1.1.1 Identify and earmark funding resources to cover personal services and operating expenses for an interagency statewide sage-grouse education and communication coordinator .	BLM, CDOW , LWGs, NRCS, USFS, USFWS	2008	\$500
12.1.1.2 Recruit and hire an interagency statewide sage-grouse education and communication coordinator and assign tasks to this person across institutional and local work group boundaries (ombudsman, interagency, independent).	BLM, CDOW , LWGs, NRCS, USFS, USFWS	2008	\$80,000 - \$100,000
12.1.1.3 Assign tasks to the sage-grouse education and communication program, including all strategies under Objective 12.2.1.	BLM, CDOW , LWGs, NRCS, USFS, USFWS	2008 budget process	\$1,000

ISSUE 12.2: The <i>general public and groups that are not already involved with or interested in GrSG conservation</i> have a lack of information and understanding about the species' requirements, management, and conservation.			
OBJECTIVE 12.2.1: Inform and educate the general public and those not already involved with GrSG conservation about the species' requirements, management, and conservation.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
12.2.1.1 Gather information and develop programs for informing groups (those not already involved in GrSG conservation) whose activities may potentially impact GrSG and/or their habitat about the species' requirements, management, and conservation. Facilitate similar ongoing informational programs.	BLM, CDOW , LWGs, USFS	2009	\$5,000

<i>FROM GRAZING STRATEGY SECTION:</i>			
6.4.1.2 Develop a public outreach/education program about domestic and wild grazing and GrSG needs (e.g., create a traveling display to be used at schools, county fairs). Be certain that part of the educational material identifies the contribution of landowners to sage-grouse conservation. [Also under 12.2.1.2, 12.2.1.3, and 12.2.1.4]			
6.4.1.4 Establish controlled or regulated tours to impart an understanding of the various aspects of GrSG habitat. Be certain that part of the educational material identifies the contribution of landowners to sage-grouse conservation. Have a training and/or education program for the people who lead lek-viewing tours. [Also under 12.2.1.2, 12.2.1.3, and 12.2.1.4]			
<i>FROM HOUSING DEVELOPMENT STRATEGY SECTION:</i>			
10.2.3.2 Develop informational materials regarding the impacts of invasive plants and contaminants on sage-grouse.			
10.2.4.2 Develop and implement ongoing outreach program for homeowners (e.g., workshops, brochures) regarding the potential effects of noxious/invasive weeds, fuels management, and contaminants on GrSG. [Also under 12.2.1.3]			
10.6.1.2 Develop key messages, focused on different types of development (e.g., high or low density rural housing, clustering), to include in informational materials about GrSG (strategy 10.6.1.3). [Also under 12.2.1.3]			
10.6.1.3 Prepare and distribute informational materials about sage-grouse to land-use planners, developers, landowners, realtors, utility companies, and housing residents. Conduct outreach program to get materials to second homeowners and 35-acre ranchette owners. [Also under 12.2.1.3]			
10.6.1.4 Develop and implement an ongoing outreach program for homeowners regarding housing development impacts on sage-grouse (e.g., provide workshops and information on the potential effects of fuels management, noxious weeds, and pets on sage-grouse). Contact homeowner associations and landowner cooperatives. [Also under 12.2.1.3]			
<i>FROM HUNTING STRATEGY SECTION:</i>			
11.1.1.1 Inventory all existing education and awareness materials regarding GrSG population status and management (e.g., brochures, posters). [Also under 12.2.1.2]			
11.1.1.2 Conduct initial and annual reviews of information and all materials regarding GrSG. Review for accuracy and information gaps, and produce new materials if necessary.			
11.1.1.3 Develop an integrated communication strategy about upland bird sport hunting to inform and educate the non-hunting public about sport hunting. [Also under 12.2.1.3]			
<i>FROM RECREATIONAL ACTIVITIES STRATEGY SECTION:</i>			
19.1.2.3 Develop and distribute educational material on (1) general GrSG biology, and (2) the potential harmful effects of recreational activities on GrSG breeding, nesting, and winter areas. Distribute to recreational groups, tourists, pet owners, private landowners, and lek viewers. [Also under 12.2.1.3]			
12.2.1.2 Gather information and develop programs for informing school groups about GrSG requirements, management, and conservation.	BLM, CDOW, LWGs, USFS	2009	\$10,000
<i>FROM GRAZING STRATEGY SECTION:</i>			
6.4.1.2 Develop a public outreach/education program about domestic and wild grazing and GrSG needs (e.g., create a traveling display to be used at schools, county fairs). Be certain that part of the educational material identifies the contribution of landowners to sage-grouse conservation. [Also under 12.2.1.1, 12.2.1.3, and 12.2.1.4]			
6.4.1.4 Establish controlled or regulated tours to impart an understanding of the various aspects of GrSG habitat. Be certain that part of the educational material identifies the contribution of landowners to sage-grouse conservation. Have a training and/or education program for the people who lead lek-viewing tours. [Also under 12.2.1.1, 12.2.1.3, and 12.2.1.4]			

<p>6.4.1.5 Develop elementary, middle, and high school curricula that include grazing and grouse management, to fit Colorado educational standards. [Also under 12.2.1.4]</p> <p><i>FROM HUNTING STRATEGY SECTION:</i></p> <p>11.1.1.1 Inventory all existing education and awareness materials regarding GrSG population status and management (e.g., brochures, posters). [Also under 12.1.1.1]</p>			
<p>12.2.1.3 Present, and facilitate presentation of, information about GrSG requirements, management, and conservation to groups (those not already involved in GrSG conservation) whose activities may impact the species and/or its habitat.</p>	<p>BLM, CDOW, LWGs, USFS</p>	<p>2009</p>	<p>\$100/group</p>
<p><i>FROM ENERGY AND MINERAL DEVELOPMENT STRATEGY SECTION:</i></p> <p>3.5.1.2 Present information and data about energy, mining, and GrSG so that it is readily understandable and accepted by stakeholders and the general public.</p>			
<p><i>FROM FIRE AND FUELS MANAGEMENT STRATEGY SECTION:</i></p> <p>4.1.1.9 At the wildland-urban interface bordering sagebrush habitats, increase public education and implement fuel reduction projects to reduce the risk of human-caused fires escaping into GrSG habitats (examples include pamphlets, news releases).</p>			
<p><i>FROM GRAZING STRATEGY SECTION:</i></p> <p>6.4.1.2 Develop a public outreach/education program about domestic and wild grazing and GrSG needs (e.g., create a traveling display to be used at schools, county fairs). Be certain that part of the educational material identifies the contribution of landowners to sage-grouse conservation. [Also under 12.2.1.1, 12.2.1.2, and 12.2.1.4]</p>			
<p>6.4.1.4 Establish controlled or regulated tours to impart an understanding of the various aspects of GrSG habitat. Be certain that part of the educational material identifies the contribution of landowners to sage-grouse conservation. Have a training and/or education program for the people who lead lek-viewing tours. [Also under 12.2.1.1, 12.2.1.2, and 12.2.1.4]</p>			
<p><i>FROM HOUSING DEVELOPMENT STRATEGY SECTION:</i></p> <p>10.2.1.3 Meet with land management agencies and local developers to address and recommend management actions to mitigate adverse fragmentation impacts to sage-grouse habitat. [Also under 12.3.1.1]</p>			
<p>10.2.4.2 Develop and implement ongoing outreach program for homeowners (e.g., workshops, brochures) regarding the potential effects of noxious/invasive weeds, fuels management, and contaminants on GrSG. [Also under 12.2.1.1]</p>			
<p>10.3.1.3 Incorporate information about the impacts of human disturbance on sage-grouse in other outreach efforts to homeowners (see Issue 10.6). Include information on effects of open garbage on GrSG through an increase in some predators (e.g., skunks and raccoons).</p>			
<p>10.4.1.1 Provide information to local, state, and federal governments on sage-grouse habitat requirements and the status, location, and possible effects of different land-uses (including right-of-way and inholding access across public lands and land trades) on sage-grouse. Include discussion of issues regarding 35-acre parcels and estate taxes, and the need for additional incentives for large landowners to not develop lands. Analyze statutes for unforeseen impacts on sage-grouse (e.g., 3-mile annex annually, “leapfrogging” of cities). Discourage disposal of public lands in sage-grouse habitat. [Also under 12.3.1.1]</p>			
<p>10.6.1.2 Develop key messages, focused on different types of development (e.g., high or low density rural housing, clustering), to include in informational materials about GrSG (strategy 10.6.1.3). [Also under 12.2.1.1]</p>			
<p>10.6.1.3 Prepare and distribute informational materials about sage-grouse to land-use planners, developers, landowners, realtors, utility companies, and housing residents. Conduct outreach program to get materials to second homeowners and 35-acre ranchette owners. [Also under 12.2.1.1]</p>			

<p>10.6.1.4 Develop and implement an ongoing outreach program for homeowners regarding housing development impacts on sage-grouse (e.g., provide workshops and information on the potential effects of fuels management, noxious weeds, and pets on sage-grouse). Contact homeowner associations and landowner cooperatives. [Also under 12.1.1.1]</p>			
<p><i>FROM HUNTING STRATEGY SECTION:</i></p>			
<p>11.1.1.3 Develop an integrated communication strategy about upland bird sport hunting to inform and educate the non-hunting public about sport hunting. [Also under 12.2.1.1]</p>			
<p><i>FROM INFRASTRUCTURE STRATEGY SECTION:</i></p>			
<p>13.5.1.1 Present information and data about infrastructure development and GrSG so that it is readily understandable and accepted by stakeholders and the general public. [Also under 12.3.1.1]</p>			
<p>13.5.1.8 Communicate to affected publics the need for infrastructure development and the need to balance that with GrSG requirements.</p>			
<p><i>FROM LEK VIEWING STRATEGY SECTION:</i></p>			
<p>14.1.1.5 Educate the GrSG viewing public about ethical viewing and photography of GrSG (e.g., provide information in viewing guides, internet sites focused on bird watching, brochures).</p>			
<p>14.1.1.6 Educate commercial bird watching tour guides and photographers about ethical GrSG lek-viewing protocol.</p>			
<p><i>FROM PESTICIDES STRATEGY SECTION:</i></p>			
<p>15.3.1.1 Conduct local field trips to observe the results of different herbicide treatment methods in GrSG habitat.</p>			
<p><i>FROM PREDATION STRATEGY SECTION:</i></p>			
<p>18.1.1.1 Actively provide accurate information to the general public and stakeholders to improve their understanding about the relationship between predation and GrSG. [Also under 12.3.1.1]</p>			
<p><i>FROM RECREATIONAL ACTIVITIES STRATEGY SECTION:</i></p>			
<p>19.1.2.3 Develop and distribute educational material on (1) general GrSG biology, and (2) the potential harmful effects of recreational activities on GrSG breeding, nesting, and winter areas. Distribute to recreational groups, tourists, pet owners, private landowners, and lek viewers. [Also under 12.2.1.1]</p>			
<p>19.1.2.5 Provide information and signage at areas where management actions relating to GrSG are in effect (e.g., designated trails, seasonal closures).</p>			
<p>19.1.2.6 On land that is important to GrSG, encourage private and public land managers to manage human recreation activities to benefit sage-grouse (e.g., during the breeding season, on winter range). Provide incentives to landowners, is possible. [Also under 12.3.1.1]</p>			
<p><i>FROM WEATHER STRATEGY SECTION:</i></p>			
<p>22.2.2.3 Educate the public and agencies on management that affects riparian and wet meadow areas used by GrSG. [Also under 12.3.1.1]</p>			
<p><i>FROM WEEDS STRATEGY SECTION:</i></p>			
<p>23.2.1.5 Keep land managers informed of the latest technology in habitat restoration techniques for weed-infested areas in GrSG habitat by providing periodic technology transfer workshops. [Also under 12.3.1.1]</p>			
<p>23.3.1.3 Organize and participate in annual workshops with all land managers to identify the most threatening weed problems in GrSG habitat, and to prioritize efforts for control. [Also under 12.3.1.1]</p>			
12.2.1.4 Present, and facilitation presentation of, information about GrSG requirements, management, and conservation to school groups.	BLM, CDOW, LWGs, USFS	2009	\$100/group

<p><i>FROM GRAZING STRATEGY SECTION:</i> 6.4.1.2 Develop a public outreach/education program about domestic and wild grazing and GrSG needs (e.g., create a traveling display to be used at schools, county fairs). Be certain that part of the educational material identifies the contribution of landowners to sage-grouse conservation. [Also under 12.2.1.1, 12.2.1.2, and 12.2.1.3]</p>
<p>6.4.1.4 Establish controlled or regulated tours to impart an understanding of the various aspects of GrSG habitat. Be certain that part of the educational material identifies the contribution of landowners to sage-grouse conservation. Have a training and/or education program for the people who lead lek-viewing tours. [Also under 12.2.1.1, 12.2.1.2, and 12.2.1.3]</p>
<p>6.4.1.5 Develop elementary, middle, and high school curricula that include grazing and grouse management, to fit Colorado educational standards. [Also under 12.2.1.2]</p>

<p>ISSUE 12.2: The general public and groups that are not already involved with or interested in GrSG conservation have a lack of information and understanding about the species’ requirements, management, and conservation.</p>			
<p>OBJECTIVE 12.2.2: Encourage the general public and groups not already concerned with GrSG conservation to become involved in the process.</p>			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
<p>12.2.2.1 Focusing on the general public and those not already involved with GrSG conservation, facilitate communication with and pursue opportunities to engage them in the conservation process.</p>	<p>BLM, CDO, LWGs, USFS</p>	<p>2010</p>	<p>\$5,000/yr</p>
<p><i>FROM ENERGY AND MINERAL DEVELOPMENT STRATEGY SECTION:</i> 3.5.1.5 Encourage counties, LWGs, and private landowners to be involved in COGCC meetings in order to comment on well pad spacing densities and comprehensive planning within GrSG habitats. [Also under 12.3.2.3]</p>			
<p>3.5.1.9 Promote and provide regular opportunities for public involvement to improve energy and mineral planning as it relates to management of GrSG and GrSG habitat.</p>			
<p><i>FROM HUNTING STRATEGY SECTION:</i> 11.4.1.2 Contact hunting groups and organizations (e.g., sportsmen’s councils) to encourage participation in sage-grouse conservation.</p>			
<p><i>FROM INFRASTRUCTURE STRATEGY SECTION:</i> 13.5.1.7 Promote and provide regular opportunities for public involvement to improve infrastructure planning as it relates to management of GrSG and GrSG habitat.</p>			

ISSUE 12.3: There is a need to facilitate communication, data sharing, and information dissemination among <i>those already involved with GrSG conservation.</i>			
OBJECTIVE 12.3.1: Facilitate information dissemination among those already involved with GrSG conservation.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
12.3.1.1 Provide accurate and timely information and training opportunities (and facilitate the same) to those already involved in GrSG conservation. Facilitate ongoing efforts in these areas.	BLM, CDOW , LWGs, USFS	Annually beginning in 2008	\$10,000/yr
<i>FROM ENERGY AND MINERAL DEVELOPMENT STRATEGY SECTION:</i>			
3.5.1.12 Improve the understanding, sharing, and acceptance of research and modeling efforts regarding GrSG and mining/energy development. Ensure that current management, reclamation techniques, and appropriate BMPs are shared with contractors and consultants to improve on-the-ground implementation. [Also under 12.3.2.2]			
<i>FROM FIRE AND FUELS MANAGEMENT STRATEGY SECTION:</i>			
4.1.1.2 Train and use resource advisors to assist with considering sage-grouse conservation in prioritizing response to fire during multiple ignition episodes. Distribute sage-grouse information updates to fire dispatchers for initial attack planning.			
4.1.1.10 During annual training for fire fighting personnel, increase awareness of issues and potential impacts of fire and suppression activities in GrSG habitats.			
<i>FROM HOUSING DEVELOPMENT STRATEGY SECTION:</i>			
10.2.1.3 Meet with land management agencies and local developers to address and recommend management actions to mitigate adverse fragmentation impacts to sage-grouse habitat. [Also under 12.2.1.3]			
10.2.3.3 Recommend seed-mix guidelines that are beneficial to sage-grouse.			
10.2.3.4 Recommend management and revegetation techniques to decrease noxious and invasive weeds in disturbed areas of GrSG habitat.			
10.4.1.1 Provide information to local, state, and federal governments on sage-grouse habitat requirements and the status, location, and possible effects of different land-uses (including right-of-way and inholding access across public lands and land trades) on sage-grouse. Include discussion of issues regarding 35-acre parcels and estate taxes, and the need for additional incentives for large landowners to not develop lands. Analyze statutes for unforeseen impacts on sage-grouse (e.g., 3-mile annex annually, “leapfrogging” of cities). Discourage disposal of public lands in sage-grouse habitat. [Also under 12.2.1.3]			
<i>FROM HUNTING STRATEGY SECTION:</i>			
11.3.1.3 Using local communities and LWG, provide educational materials to ensure that hunters accurately identify sage-grouse in the field.			
11.3.1.5 Educate hunters about the importance of wing receipt data and harvest reports in GrSG management.			
<i>FROM INFRASTRUCTURE STRATEGY SECTION:</i>			
13.5.1.1 Present information and data about infrastructure development and GrSG so that it is readily understandable and accepted by stakeholders and the general public. [Also under 12.2.1.3]			

13.5.1.10 Improve the understanding, sharing, and acceptance of research and modeling efforts regarding GrSG and infrastructure development. Ensure that current management, reclamation techniques, and appropriate BMPs are shared with contractors and consultants to improve on-the-ground implementation. [Also under 12.3.2.2]
<i>FROM PESTICIDES STRATEGY SECTION:</i>
15.3.1.1 Conduct local field trips to observe the results of different herbicide treatment methods in GrSG habitat.
<i>FROM PREDATION STRATEGY SECTION:</i>
18.1.1.1 Actively provide accurate information to the general public and stakeholders to improve their understanding about the relationship between predation and GrSG. [Also under 12.2.1.3]
18.3.1.9 Educate interested publics regarding which management actions are most biologically effective in increasing reproductive success in GrSG populations.
<i>FROM RECREATIONAL ACTIVITIES STRATEGY SECTION:</i>
19.1.2.6 On land that is important to GrSG, encourage private and public land managers to manage human recreation activities to benefit sage-grouse (e.g., during the breeding season, on winter range). Provide incentives to landowners, if possible. [Also under 12.2.1.3]
<i>FROM WEATHER STRATEGY SECTION:</i>
22.2.2.3 Educate the public and agencies on management that affects riparian and wet meadow areas used by GrSG. [Also under 12.2.1.3]
<i>FROM WEEDS STRATEGY SECTION:</i>
23.2.1.5 Keep land managers informed of the latest technology in habitat restoration techniques for weed-infested areas in GrSG habitat by providing periodic technology transfer workshops. [Also under 12.2.1.3]
23.3.1.3 Organize and participate in annual workshops with all land managers to identify the most threatening weed problems in GrSG habitat, and to prioritize efforts for control. [Also under 12.2.1.3]

ISSUE 12.3: There is a need to facilitate communication, data sharing, and information dissemination among <i>those already involved with GrSG conservation</i> .			
OBJECTIVE 12.3.2: Promote and facilitate the local work group process, as well as communication and data sharing among those already involved with GrSG conservation.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
12.3.2.1 Pursue all opportunities to support and facilitate the GrSG local work group process, including professional facilitation of work group meetings, as requested by LWGs.	BLM, CDOW , LWGs, USFS	2007 and ongoing	\$26,000/yr
<i>FROM ENERGY AND MINERAL DEVELOPMENT STRATEGY SECTION:</i>			
3.5.1.1 Develop a communication process to assist the energy industry to work with LWGs in planning energy activity on non-federal surface-owned leases.			
3.5.1.7 Encourage oil, gas, and mining companies to participate on local GrSG work groups.			

<i>FROM GRAZING STRATEGY SECTION:</i>			
6.1.2.4 As results become available on research on herbivory and GrSG (e.g., strategy 6.1.1.2, 6.1.2.2), distribute them to local work groups. [Also under Research Strategy 21.1.2.2]			
6.4.1.3 Develop an internet website through which local work groups can share information. Include a link from the CDOW website.			
<i>FROM HUNTING STRATEGY SECTION:</i>			
11.1.1.4 Encourage and coordinate with LWGs to initiate articles in local newspapers and electronic media about their activities and successes with GrSG.			
<i>FROM INFRASTRUCTURE STRATEGY SECTION:</i>			
13.5.1.5 Encourage infrastructure companies to participate in local GrSG work groups. [Also under 12.3.2.3]			
<i>FROM PREDATION STRATEGY SECTION:</i>			
18.3.1.6 Establish an annual meeting to coordinate reporting of LWG progress towards implementation of predation management strategies (in both local and statewide conservation plans), and to encourage communication among LWGs regarding predation management.			
<i>FROM WEEDS STRATEGY SECTION:</i>			
23.1.1.2 Inform local work groups of identified invasive weed problems in GrSG range.			
12.3.2.2 Among those already involved in GrSG conservation, facilitate and promote sharing of data relevant to GrSG management and conservation.	BLM, CDOW, Industry, LWGs, USFS	2007	\$2,000/yr
<i>FROM ENERGY AND MINERAL DEVELOPMENT STRATEGY SECTION:</i>			
3.5.1.3 Share GrSG data among agencies, and with counties and industry to allow for better planning of mining and energy development, to minimize impacts to the species. Provide GrSG data to COGCC and DRMS to identify opportunities for coordination. Lek data are considered sensitive information by CDOW. Limit data distribution to the extent necessary for effective management.			
3.5.1.4 Share energy development plans with agencies ASAP to facilitate improved planning, analysis, and management of GrSG within sagebrush habitats, recognizing confidentiality sensitivities. Lek data are considered sensitive information by CDOW. Limit data distribution to the extent necessary for effective management.			
3.5.1.11 Promptly and frequently update information related to energy and mineral development and GrSG to foster a better understanding of impacts to the species.			
3.5.1.12 Improve the understanding, sharing, and acceptance of research and modeling efforts regarding GrSG and mining/energy development. Ensure that current management, reclamation techniques, and appropriate BMPs are shared with contractors and consultants to improve on-the-ground implementation. [Also under 12.3.1.1]			
<i>FROM INFRASTRUCTURE STRATEGY SECTION:</i>			
13.5.1.2 Share GrSG data among agencies, and with counties and industry to allow for better planning of infrastructure development to minimize impacts to the species.			
13.5.1.3 Share infrastructure development plans with agencies ASAP to facilitate improved planning, analysis, and management of GrSG within sagebrush habitats, recognizing confidentiality sensitivities.			
13.5.1.9 Promptly and frequently update information related to infrastructure development and GrSG to foster a better understanding of impacts to the species.			
13.5.1.10 Improve the understanding, sharing, and acceptance of research and modeling efforts regarding GrSG and infrastructure development. Ensure that current management, reclamation techniques, and appropriate BMPs are shared with contractors and consultants to improve on-the-ground implementation. [Also under 12.3.1.1]			

<i>FROM WEEDS STRATEGY SECTION:</i>			
23.3.1.2 Inform local weed program managers of all pest management plans developed within GrSG range.			
12.3.2.3 Promote and facilitate communication among those already involved in the GrSG conservation process.	BLM, CDOW, Industry, LWGs, USFS	2007	\$5,000/yr
<i>FROM ENERGY AND MINERAL DEVELOPMENT STRATEGY SECTION:</i>			
3.5.1.5 Encourage counties, LWGs, and private landowners to be involved in COGCC meetings in order to comment on well pad spacing densities and comprehensive planning within GrSG habitats. [Also under 12.2.2.1]			
3.5.1.6 Encourage open communication among companies to entertain opportunities to reduce impacts and/or maximize benefits to GrSG, at the local and landscape levels.			
3.5.1.8 Promote regular communication and continual coordination among agencies, industry, LWGs, and counties to improve energy and mineral-related planning and management of GrSG.			
<i>FROM INFRASTRUCTURE STRATEGY SECTION:</i>			
13.5.1.4 Encourage open communication between companies to entertain opportunities to reduce impacts and/or maximize benefits to GrSG.			
13.5.1.5 Encourage infrastructure companies to participate in local GrSG work groups. [Also under 12.3.2.1]			
13.5.1.6 Promote regular communication and continual coordination among agencies, industry, LWGs, and counties to improve infrastructure-related planning and management of GrSG.			

13. Infrastructure

This section addresses the potential impacts to GrSG from the infrastructure associated with various types of human development, including housing, energy, and minerals. Infrastructure refers to utility corridors, wind turbines, communication towers, and fences. Roads are addressed in a separate section (see “Roads” strategy, pg. 394). In this strategy, utility corridors are defined as pipelines, and power, phone, and cable lines. It is understood that economic and technical feasibility are considerations when implementing infrastructure strategies. The plan assumes there will be differences in potential impacts to GrSG resulting from the size, design, and location of powerlines, wind turbines, communication towers and other infrastructure. Strategies should be selected and implemented on a site specific-basis depending on project and habitat characteristics.

The primary infrastructure issues for GrSG are increased risk of predation, collision mortality of and disturbance to birds, and the introduction and spread of invasive weeds. Elevated structures of various types may provide perch sites for raptors that prey on grouse, possibly resulting in increased predation. The presence of paths cleared under powerlines, that fragment previously contiguous habitat, may change the behavior of terrestrial predators by providing easy travel lanes into sagebrush habitat. Construction of new infrastructure, and maintenance and/or use activities could disrupt the behavior of nearby GrSG. Direct mortality of grouse from collisions with overhead power and telephone lines has been documented (Borell 1939, Ligon 1951, J. Stiver, University of Nebraska, personal communication). Roads provide an avenue for the spread of exotic plants (U.S. Bureau of Land Management 1999), and powerline or pipeline corridors could also do so.

Although habitat loss does occur when infrastructure is constructed in GrSG habitat, it is generally distributed as linear or small patch changes in habitat, so the total amount of habitat lost is minimal. The wide distribution of these smaller habitat disturbances does, however, fragment formerly intact habitat and may result in the impacts mentioned, such as an increase in predation risk and invasive weeds. For further discussion of this topic, see “Infrastructure” issue, pg. 160.

Outline of strategy organization (italics within Issues and Objectives refer to this outline)

13.1 All infrastructure, excluding fences: predation risks

13.1.1 Minimize predation risks

13.2 All infrastructure, excluding fences: disturbance to and mortality of GrSG, and habitat fragmentation

13.2.1 Minimize direct impacts to GrSG and fragmentation of habitat

13.3 Fences

13.3.1 Fences: minimize impacts

13.4 Infrastructure impacts not well understood

13.4.1. Research

13.5 Lack of communication

13.5.1 Improve communication

ISSUE 13.1: Utility corridors or other structures (excluding fences: see Issue 13.3) may increase opportunities for predation on GrSG in an area.			
OBJECTIVE 13.1.1: Minimize the potential of increased predation pressure on GrSG as a result of human infrastructure (see also “Predation” strategy, pg. 386).			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
<p>13.1.1.1 Where technically and economically feasible, locate <i>new</i> utility corridors, communication towers, wind turbines, and other above-ground facilities outside GrSG seasonal habitats (as per “GrSG Disturbance Guidelines”, Appendix B, with particular attention to lek sites. (Lek data are considered sensitive information by CDOW. Limit data distribution to the extent necessary for effective management.)</p> <p>Where this is not feasible, consider the following options:</p> <ul style="list-style-type: none"> • route <i>new</i> utility corridors and locate new surface facilities as far from key habitat sites (e.g., leks) as possible • use topographic relief to reduce predator perch potential when designing <i>new</i> utility corridors and facilities • encourage utility burial when feasible where key habitat sites (e.g., leks) cannot be avoided for <i>new</i> utilities 	<p>BLM, CDOW, County Governments, Industry, LWGs, Private Landowners, SLB, USFS</p>	Ongoing	0.1 FTE
<p>13.1.1.2 Design <i>new</i> powerlines and other above-ground facilities to minimize use of the structures by avian predators. Install appropriate perch deterrents where appropriate, in consultation with CDOW.</p>	<p>BLM, CDOW, County Governments, Industry, LWGs, Private Landowners, SLB, USFS</p>	Ongoing	1.0 FTE, \$25,000 per project
<p>13.1.1.3 Encourage retrofitting of <i>existing</i> powerlines and other overhead structures (e.g., communication towers, wind turbines) to deter raptor perching where utility corridors impact GrSG seasonal habitats. Prioritize areas identified in need of retrofitting. Encourage burial of the utility where predation effects are high, predation cannot be otherwise mitigated, and/or key habitat sites (e.g., leks) are involved. All design and location recommendations should be based on the most current science.</p>	<p>BLM, CDOW, County Governments, Industry, LWGs, Private Landowners, SLB, USFS</p>	Ongoing	1.0 FTE, \$25,000 per project

<p>13.1.1.4 In <i>new</i> pipeline construction, encourage reclamation practices that reduce predator effectiveness in the pipeline corridor. To reduce the linear habitat effect of pipelines, consider reclamation and management techniques including:</p> <ul style="list-style-type: none"> • feathering edges of vegetation cleared along the line • planting of sagebrush patches within the right of way • bridging the pipeline clearing with sagebrush patches at appropriate intervals • use least surface disturbing technique suitable for necessary development 	<p>BLM, CDOW, County Governments, Industry, LWGs, Private Landowners, SLB, USFS</p>	<p>Ongoing</p>	<p>0.1 FTE</p>
<p>13.1.1.5 Encourage the use of vegetation establishment techniques in <i>existing</i> pipeline corridors to reduce predator effectiveness.</p>	<p>BLM, CDOW, County Governments, Industry, LWGs, Private Landowners, SLB, USFS</p>	<p>Ongoing</p>	<p>0.1 FTE</p>
<p>13.1.1.6 Coordinate the location and design of utility corridors and sage-grouse species conservation efforts with management of other species within occupied GrSG habitat.</p>	<p>BLM, CDOW, County Governments, Industry, LWGs, Private Landowners, SLB, USFS, FWS</p>	<p>Ongoing</p>	<p>Site-specific</p>

<p>ISSUE 13.2: Utility corridors, wind turbines, communication towers (including those associated with remote monitoring of oil and gas development), or other structures may increase the potential for <i>disturbance to or direct mortality of GrSG</i>, and may <i>adversely impact GrSG habitats</i></p>			
<p>OBJECTIVE 13.2.1: Minimize (1) the <i>direct adverse impacts</i> on GrSG; and (2) <i>fragmentation of GrSG habitat</i> resulting from the development of infrastructure related to mineral, utility, energy, and housing development (see also “Energy and Mineral Development” [pg. 300], “Housing Development” [pg. 345], and “Roads” [pg. 394] strategies).</p>			
<p>Conservation Strategy</p>	<p>Responsible Parties (if there is a lead entity, it is in bold)</p>	<p>Timeline</p>	<p>Cost</p>
<p>13.2.1.1 Identify and map <i>existing</i> utility corridors, wind turbines, communication towers, and designated utility corridors in GrSG habitat.</p>	<p>BLM, CDOW, County Government, Industry, LWGs, Private Landowners, SLB, Industry, USFS</p>	<p>Begin by 2007</p>	<p>0.5 FTE</p>

<p>13.2.1.2 For placement of <i>new</i> utility corridors or other infrastructure, GrSG seasonal habitats should be mapped, prioritized, and avoided where possible. If seasonal habitats are not mapped, prioritize the areas to avoid by using the buffers described in “GrSG Habitat Disturbance Guidelines”, Appendix B. Consider land tenure options such as land exchanges or easements to minimize conflicts with leks and other key seasonal habitats.</p>	<p>BLM, CDOW, County Governments, Industry, LWGs, Private Landowners, SLB, USFS</p>	<p>Ongoing</p>	<p>2.0 FTE</p>
<p>13.2.1.3 Cluster development of <i>new</i> roads, utility corridors, and other infrastructure facilities and use existing, combined corridors, ROWs, or previously disturbed areas, where possible. Place new structures and infrastructure outside of key GrSG seasonal habitats (see “GrSG Disturbance Guidelines”, Appendix B) whenever possible to minimize loss and fragmentation of habitat. Use the least surface-disturbing technique suitable for necessary development. Balance the benefits of clustered developments against the potential impact of wider disturbed corridors on GrSG movements. Consider road closures and/or signing following development.</p>	<p>BLM, CDOW, County Governments, Industry, LWGs, Private Landowners, SLB, USFS</p>	<p>Ongoing</p>	<p>0.1 FTE</p>
<p>13.2.1.4 Encourage the appropriate marking of structures and/or altering tower features to minimize GrSG collisions with wind turbines, communication towers, powerlines, other overhead structures, and associated guy wires, in areas near leks and other important seasonal GrSG habitat (see “GrSG Disturbance Guidelines”, Appendix B).</p>	<p>BLM, CDOW, County Governments, Industry, LWGs, Private Landowners, SLB, USFS</p>	<p>Ongoing</p>	<p>0.1 FTE</p>
<p>13.2.1.5 Cooperatively plan construction and routine maintenance of utility corridors, wind turbines, or other infrastructure to avoid critical periods and sensitive areas, where technically and economically feasible. Emergency maintenance and repairs are not subject to any timing restrictions.</p>	<p>BLM, CDOW, County Governments, Industry, LWGs, Private Landowners, SLB, USFS</p>	<p>Ongoing</p>	<p>0.1 FTE</p>
<p>13.2.1.6 Encourage effective off-site mitigation (see descriptive process in “Energy” strategy, Objective 3.3.4), when infrastructure impacts cannot be mitigated or avoided on site.</p>	<p>BLM, CDOW, Industry, LWGs, SLB, USFS, USFWS</p>	<p>Ongoing</p>	<p>0.25 FTE</p>

<p>13.2.1.7 Where GrSG habitat disturbances occur that require reclamation or habitat restoration, the potential vegetation community should be identified (Winward 2004) and a diverse seed mixture of native shrubs, grasses, and forbs should be used where ever possible (see Appendix D, “Recommendations Regarding Plant Species for Use in GrSG Habitat Management and Restoration”, Monsen 2005, and “Habitat Enhancement” strategy, pg. 336).</p>	<p>BLM, CDOW, County Governments, Industry, LWGs, Private Landowners, SLB, USFS</p>	<p>Ongoing</p>	<p>0.1 FTE</p>
<p>13.2.1.8 Use early and effective reclamation techniques, including interim reclamation, to speed the return of disturbed areas to use by sage-grouse. Develop and implement performance-based reclamation standards that include coordinated weed management. Recognize that reclamation and/or weed control are continual and long-term efforts.</p>	<p>BLM, CDOW, COGCC, County Governments, DRMS, Industry, LWGs, NRCS, Private Landowners, SLB, USFS, USFWS</p>	<p>Ongoing</p>	<p>N/A</p>
<p>13.2.1.9 Recommend setting bonds sufficient to ensure that appropriate GrSG habitat reclamation is met.</p>	<p>BLM, CDOW, COGCC, DRMS, LWGs, SLB, USFS, USFWS</p>	<p>Ongoing</p>	<p>0.1 FTE</p>
<p>13.2.1.10 Enforce and ensure compliance with conditions, stipulations, and reclamation for leases and permits in GrSG habitat.</p>	<p>BLM, CDOW, COGCC, County Governments, DRMS, SLB, USFS, USFWS</p>	<p>Ongoing</p>	<p>1.0 FTE/yr</p>
<p>13.2.1.11 Evaluate the need for restoration of previously reclaimed infrastructure sites. Prioritize areas in need of additional restoration efforts and identify potential funding sources.</p>	<p>BLM, CDOW, Industry, LWGs, Private Landowners, SLB, USFS, USFWS</p>	<p>Ongoing</p>	<p>0.1 FTE</p>
<p>13.2.1.12 Coordinate the location and design of utility corridors and sage-grouse species conservation efforts with management of other species within occupied GrSG habitat.</p>	<p>BLM, CDOW, County Governments, Industry, LWGs, Private Landowners, SLB, USFS, USFWS</p>	<p>Ongoing</p>	<p>0.1 FTE</p>

ISSUE 13.3: *Fences* may adversely affect GrSG and their habitats.

OBJECTIVE 13.3.1: Minimize the potential for adverse impacts of *fences* on GrSG.

Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
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<p>13.3.1.1 GrSG seasonal habitats should be mapped prior to fence construction, in coordination with CDOW. When feasible, <i>new</i> fences should not be placed within a buffer around active leks (see Appendix B, “GrSG Disturbance Guidelines”). Lek data are considered sensitive information by CDOW. Limit data distribution to the extent necessary for effective management.</p>	<p>BLM, CDOW, LWGs, Private Landowners, SLB, USFS</p>	<p>Ongoing</p>	<p>0.5 FTE</p>
<p>13.3.1.2 If fences are constructed within the recommended buffer for leks (see Appendix B, “GrSG Disturbance Guidelines”), or within other known GrSG seasonal habitats where significant collision issues are identified through LWGs, consider the following options to minimize the possibility of GrSG collisions:</p> <ul style="list-style-type: none"> • place fences to use topographic features to minimize the possibility of GrSG collisions • clearly mark fences in strategic locations for increased visibility • discourage the use of net-wire fencing to allow easier movement of grouse under fences, where feasible • if fences are needed for seasonal livestock use, consider using let-down fences that can be put down during times of non-use 	<p>BLM, CDOW, LWGs, Private Landowners, SLB, USFS</p>	<p>Ongoing</p>	<p>0.1 FTE</p>
<p>13.3.1.3 Timing of fence construction on public land should be scheduled according to the GrSG seasonal habitat in the area and the timing guidelines provided in Appendix B, “GrSG Disturbance Guidelines”.</p>	<p>BLM, CDOW, SLB, USFS</p>	<p>Ongoing</p>	<p>N/A</p>
<p>13.3.1.4 Minimize the width of cleared areas along fences to reduce predator effectiveness.</p>	<p>BLM, CDOW, LWGs, Private Landowners, SLB, USFS</p>	<p>Ongoing</p>	<p>N/A</p>
<p>13.3.1.5 Where habitat disturbances occur that require reclamation or habitat restoration, the potential vegetation community should be identified (Winward 2004) and a diverse seed mixture of native shrubs, grasses, and forbs should be used wherever possible (see Appendix D, “Recommendations Regarding Plant Species for Use in GrSG Habitat Management and Restoration”, Mosen 2005, and “Habitat Enhancement” strategy, pg. 336).</p>	<p>BLM, CDOW, LWGs, Private Landowners, SLB, USFS</p>	<p>Ongoing</p>	<p>0.1 FTE</p>

13.3.1.6 In consultation with permittees or private landowners, relocate or redesign site-specific segments of <i>existing</i> fences where significant adverse effects on GrSG have been documented, as opportunities arise, to reduce the impacts to GrSG. Identify potential funding sources to assist private landowners in modifying or marking existing fences.	BLM , CDOW, LWGs, Private Landowners, SLB , USFS	Ongoing	0.1 FTE, \$5000 per project
13.3.1.7 Minimize duplication of fences, and facilitate the removal of abandoned fences within GrSG habitat.	BLM , CDOW, LWGs, NRCS, Private Landowners , SLB , USFS	Ongoing	0.1 FTE

ISSUE 13.4: Effects of human infrastructure on GrSG are poorly understood.			
OBJECTIVE 13.4.1: Evaluate and quantify the effects of human infrastructure on GrSG.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
13.4.1.1 Evaluate the impact of utility corridors, communication towers, wind turbines and other infrastructure on predator effectiveness and resulting effects on GrSG populations. [See Research Strategy 21.4.1.3]	See Research Strategy 21.4.1.3		
13.4.1.2 Evaluate the impacts of utility corridors on GrSG habitats (i.e., fragmenting effects on habitat). [See Research Strategy 21.1.2.3]	See Research Strategy 21.1.2.3		
13.4.1.3 Evaluate the impacts of communication towers, wind turbines, and associated infrastructure on GrSG (both disturbance impacts and habitat fragmentation impacts). [See Research Strategies 21.1.2.3 and 21.2.1.2]	See Research Strategies 21.1.2.3 and 21.2.1.2		
13.4.1.4 Evaluate the impact of fences on GrSG populations (both disturbance impacts and habitat fragmentation impacts), and identify options to minimize those impacts. [See Research Strategies 21.1.2.3 and 21.2.1.2]	See Research Strategies 21.1.2.3 and 21.2.1.2		
13.4.1.5 Develop effective methods to mark various types of infrastructure to increase visibility and minimize sage-grouse collisions. [See Research Strategy 21.2.1.2]	See Research Strategy 21.2.1.2		

ISSUE 13.5: There is a lack of communication among agencies, industry, and affected publics involved with human infrastructure development, resulting in misunderstanding and less effective management for GrSG.			
OBJECTIVE 13.5.1: Improve communication among agencies, industry, and affected publics involved with human infrastructure development, to facilitate improved trust, working relationships, planning, and more effective management of GrSG and their habitats.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
13.5.1.1 Present information and data about infrastructure development and GrSG so that it is readily understandable and accepted by stakeholders and the general public. [See also Information, Communication, and Education Strategies 12.2.1.3 and 12.3.1.1]	BLM, CDOW, Industry , LWGs, NRCS, SLB, USFS, USFWS	Ongoing	0.1 FTE
13.5.1.2 Share GrSG data among agencies, and with counties, private landowners, and industry to allow for better planning of infrastructure development to minimize impacts to the species. Lek data are considered sensitive information by CDOW. Limit data distribution to the extent necessary for effective management. [See also Information, Communication, and Education Strategy 12.3.2.2]	BLM, CDOW , USFS, USFWS	Ongoing	0.1 FTE
13.5.1.3 Share infrastructure development plans with agencies ASAP to facilitate improved planning, analysis, and management of GrSG within sagebrush habitats, recognizing confidentiality sensitivities. Lek data are considered sensitive information by CDOW. Limit data distribution to the extent necessary for effective management. [See also Information, Communication, and Education Strategy 12.3.2.2]	BLM, Industry	Ongoing	0.1 FTE
13.5.1.4 Encourage open communication among companies to entertain opportunities to reduce impacts and/or maximize benefits to GrSG. [See also Information, Communication, and Education Strategy 12.3.2.3]	BLM, CDOW, Industry	Ongoing	0.1 FTE
13.5.1.5 Encourage infrastructure companies to participate in local GrSG work groups. [See Information, Communication, and Education Strategies 12.3.2.1 and 12.3.2.3]	See Information, Communication, and Education Strategies 12.3.2.1 and 12.3.2.3		
13.5.1.6 Promote regular communication and continual coordination among agencies, industry, LWGs, and counties to improve infrastructure-related planning and management of GrSG. [See Information, Communication, and Education Strategy 12.3.2.3]	See Information, Communication, and Education Strategy 12.3.2.3		

<p>13.5.1.7 Promote and provide regular opportunities for public involvement to improve infrastructure planning as it relates to management of GrSG and GrSG habitat. [See also Information, Communication, and Education Strategy 12.2.2.1]</p>	<p>BLM, CDOW, County Governments, Industry, LWGs, NRCS, SLB, USFS, USFWS</p>	<p>Ongoing</p>	<p>N/A</p>
<p>13.5.1.8 Communicate to affected publics the need for infrastructure development and the need to balance that with GrSG requirements. [See Information, Communication, and Education Strategy 12.2.1.3]</p>	<p>See Information, Communication, and Education Strategy 12.2.1.3</p>		
<p>13.5.1.9 Promptly and frequently update information related to infrastructure development and GrSG to foster a better understanding of impacts to the species. [See also Information, Communication, and Education Strategy 12.3.2.2]</p>	<p>BLM, CDOW, County Governments, Industry, LWGs, NRCS, SLB, USFS, USFWS</p>	<p>Ongoing</p>	<p>0.5 FTE</p>
<p>13.5.1.10 Improve the understanding, sharing, and acceptance of research and modeling efforts regarding GrSG and infrastructure development. Ensure that current management, reclamation techniques, and appropriate BMPs are shared with contractors and consultants to improve on-the-ground implementation. [See also Information, Communication, and Education Strategies 12.3.1.1 and 12.3.2.2]</p>	<p>BLM, CDOW, USFS, USFWS</p>	<p>Ongoing</p>	<p>0.1 FTE</p>

14. Lek Viewing

It has been suggested that lek viewing may have an adverse impact on GrSG during the lekking season by interfering with normal lek behavior, though definitive research on the topic is limited. An obvious disturbance would be to flush birds from the lek, which could hypothetically affect individuals and/or a population. Sage-grouse are frequently flushed off leks by predators and respond to this disturbance in various ways. Human disturbance, particularly if it is additive to disturbance by predators, could reduce the time the lek is active and reduce its size (by lowering attendance by “subordinate” males).

Although the impacts of human observers on lek behavior has not been clearly demonstrated, it has been found that vehicle disturbance and high-volume traffic is disruptive to GrSG (Mattise 1995, Trombulak and Frissell 2000). Leks that can be viewed from the road or a parking area may be vulnerable to vehicle traffic disturbance, if the viewing experience is not managed properly.

Lek viewing is a popular spring activity for many bird watchers. Lek viewing can also be a positive influence on sage-grouse, as they can provide educational benefits as well as economic incentives to maintain sage-grouse habitats. There is a need to manage this demand for viewing activity appropriately to benefit the grouse and the local communities. Lek locations need to be treated as “sensitive information; i.e., they should not be published in books or on the internet, but they need to be available to appropriate agency or private consultant biologists for planning purposes. For further discussion, see “Lek Viewing” issue, pg. 160.

ISSUE 14.1: The disturbance from lek viewing may be impacting the breeding success of GrSG.			
OBJECTIVE 14.1.1: Minimize disturbance to GrSG at leks while allowing for public viewing of lek activity.			
Conservation Strategy	Responsible Parties <small>(if there is a lead entity, it is in bold)</small>	Timeline	Cost
14.1.1.1 Develop and implement a lek-viewing protocol for guidance in managing lek-viewing activities to minimize the impacts to GrSG. Include activities such as monitoring visitors to leks, and providing an opportunity for the public to view leks without disturbing the birds (e.g., lease of private property, signs, viewing blinds, defining parking areas).	CDOW, LWGs	2008	Negligible
14.1.1.2 Develop public lek-viewing areas in consultation with CDOW and land management agencies to minimize disturbance to GrSG. Encourage local communities to develop and implement a managed lek-viewing opportunity.	BLM, CDOW, County Governments, LWGs	2008	\$8000/site

14.1.1.3 Manage lek viewing on developed sites to minimize the impacts to GrSG. Encourage managed lek-viewing (using protocols) on private lands as a revenue source for landowners, or provide incentives, if possible.	BLM, CDOW, LWGs, Private Landowners	2008	0.1 - 0.25 FTE/site
14.1.1.4 Limit the number of managed lek viewing sites for each GrSG population, and encourage the public to use developed sites. Encourage agencies to develop a remote lek-viewing opportunity (e.g., “webcam”).	BLM, CDOW, LWGs, Private Landowners	2008	0.1 FTE and \$500/site /year
14.1.1.5 Educate the GrSG viewing public about ethical viewing and photography of GrSG (e.g., provide information in viewing guides, internet sites focused on bird watching, brochures). [See Information, Communication, and Education Strategy 12.2.1.3]	See Information, Communication, and Education Strategy 12.2.1.3		
14.1.1.6 Educate commercial bird watching tour guides and photographers about ethical GrSG lek-viewing protocol. [See Information, Communication, and Education Strategy 12.2.1.3]	See Information, Communication, and Education Strategy 12.2.1.3		
14.1.1.7 Encourage local volunteers (e.g., Audubon Society, Chambers of Commerce) to help with lek counts to increase educational opportunities.	CDOW	2008	
14.1.1.8 Evaluate the impact of lek viewing on GrSG. [See Research Strategy 21.2.1.5]	See Research Strategy 21.2.1.5		
14.1.1.9 Treat lek locations as “sensitive information”, i.e. not published on the web or in books. Lek locations need to be available for planning purposes to appropriate agency or private consultant biologists.	BLM, CDOW, LWGs, NRCS, SLB, USFS, USFWS	2007	None.
14.1.1.10 Monitor and quantify the effects of viewing on lek attendance patterns. [See Research Strategy 21.2.1.5]	See Research Strategy 21.2.1.5		

15. Pesticides

This section addresses pesticide use in an agricultural context; pesticides associated with housing developments are covered in the “Housing Development” strategy section (see pg. 345). Conservation strategies for agricultural pesticide use should focus on educating agricultural producers and cooperators about the potential impacts of pesticide applications on sage-grouse. *Insecticide* use in occupied GrSG habitat is limited, so the focus should be on the use of *herbicides* to control sagebrush. The importance of herbicide treatment type, timing, and location relative to GrSG habitats should be emphasized. Strategies should include efforts to update knowledge on methods of herbicide treatments that can minimize adverse impacts to and/or enhance GrSG habitat. For further discussion, see “Pesticides” issue, pg. 166.

ISSUE 15.1: Some herbicide use recommendations for sagebrush treatment in GrSG habitat are obsolete.			
OBJECTIVE 15.1.1: Update recommendations on sagebrush herbicide treatment methods that reduce adverse impacts to and/or improve GrSG habitat.			
Conservation Strategy	Responsible Parties <small>(if there is a lead entity, it is in bold)</small>	Timeline	Cost
15.1.1.1 Conduct research on the effects of various herbicide treatments on GrSG habitat. [See Research Strategy 21.1.2.1]	See Research Strategy 21.1.2.1		
15.1.1.2 Using an interagency team approach, develop recommendations for methods of sagebrush herbicide treatments that reduce adverse impacts to and/or improve GrSG habitat.	BLM, CDOW, LWGs, NRCS, USFS, USFWS	2008	0.5 FTE

ISSUE 15.2: Sagebrush herbicide treatment methods that have fewer adverse impacts to GrSG habitat can be more expensive than traditional methods.			
OBJECTIVE 15.2.1: Encourage the use of non-traditional sagebrush herbicide treatments that have fewer adverse impacts to GrSG habitat.			
Conservation Strategy	Responsible Parties <small>(if there is a lead entity, it is in bold)</small>	Timeline	Cost
15.2.1.1 Provide monetary incentives to promote the use of non-traditional herbicide treatments where appropriate in GrSG habitat (see “Habitat Enhancement” strategy, pg. 336).	CDOW , NRCS, USFWS	Ongoing	\$25-40/acre

ISSUE 15.3: Land managers are not informed about the various herbicide treatment methods and associated impacts to GrSG habitat.			
OBJECTIVE 15.3.1: Inform land managers about sagebrush herbicide treatment methods and the associated impacts to GrSG habitat.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
15.3.1.1 Conduct local field trips to observe the results of different herbicide treatment methods in GrSG habitat. [See also Information, Communication, and Education Strategies 12.2.1.3 and 12.3.1.1]	CDOW, CSU Extension, LWGs, NRCS, Private Landowners	2008	\$1,000
15.3.1.2 Provide technical assistance to land managers regarding herbicide treatment design and application methods that minimize adverse impacts to GrSG habitat.	BLM, CDOW, NRCS, USFWS, USFS	2008	0.25 FTE

ISSUE 15.4: Insecticide used for Mormon cricket control has the potential to impact GrSG.			
OBJECTIVE 15.4.1: Avoid using Mormon cricket treatments that are harmful to GrSG.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
15.4.1.1 Provide information on (1) important GrSG areas to avoid; (2) best timing for applications; and (3) least toxic methods of control, to aerial applicators of insecticides used to control Mormon crickets.	CDOW, CSU Extension	Ongoing	No additional cost.

16. Piñon-Juniper Encroachment

Loss of habitat within GrSG range in Colorado can be attributed in some areas to piñon-juniper expansion and encroachment into sagebrush communities. In addition to loss of habitat, conversion of shrub-steppe communities to piñon-juniper results in alterations in habitat suitability for wildlife (Miller et al. 1999). Commons et al. (1999) reported that Gunnison sage-grouse avoid piñon-juniper areas during breeding and summer periods. A similar study on GrSG has not been done, but field observations suggest such avoidance also occurs with GrSG.

Piñon-juniper encroachment into occupied GrSG habitat in Colorado is most significant in the NESR, NWCO, and PPR populations. In the NESR population, piñon-juniper encroachment is in the Eagle zone of the population. Piñon-juniper treatment is listed as a conservation action in the NESR local plan (NESRCP 2004) and has been identified as a priority for CDOW biologists. The NWCO population has the largest areas of piñon-juniper communities, primarily in the western part of the occupied habitat (Fig. 30, pg. 172). In the Piceance Basin portion of the PPR population area many of the ridge tops are relatively flat, and due to heavy piñon-juniper encroachment, sagebrush has become more of an understory to piñon-juniper than a predominant community type. Piñon-juniper encroachment is also occurring in potential habitats associated with the PPR area. For further discussion, see “Piñon-juniper Encroachment” issue, pg. 169.

ISSUE 16.1: In some areas of Colorado, loss of GrSG habitat can be attributed to piñon-juniper expansion and encroachment into sagebrush communities.			
OBJECTIVE 16.1.1: Reduce the encroachment of piñon-juniper in those portions of NESR, NWCO, and PPR GrSG populations identified in Fig. 30, pg. 172.			
Conservation Strategy	Responsible Parties <small>(if there is a lead entity, it is in bold)</small>	Timeline	Cost
16.1.1.1 For each of the 3 GrSG populations, prioritize areas (Fig. 30, pg. 172) where removal of piñon-juniper to enhance GrSG habitat is needed (see “Habitat Enhancement” strategy, pg. 336). Focus should be on sites having appropriate characteristics (e.g., soil characteristics, sagebrush understory; also review historic photos) to support sagebrush communities, due to increased probability of success and reduction in cost. Identify options, schedules, and funding opportunities for specific projects.	BLM, CDOW, LWGs, NPS, NRCS, SLB, USFS, USFWS	2008	0.1 FTE
16.1.1.2 Identify ecological site characteristics and sagebrush species (Winward 2004) associated with GrSG habitat project areas identified in strategy 16.1.1.1 (Monsen 2005).	BLM, CDOW, LWG, NPS, NRCS, Private Landowners, SLB, USFS, USFWS	2008 and ongoing	\$300/project

16.1.1.3 Conduct pre-project planning (e.g., necessary archaeological clearances, EAs) and pre-restoration monitoring for sites selected for treatment in GrSG habitat in strategy 16.1.1.1.	BLM , CDOW, LWGs, NPS, NRCS, Private Landowners, SLB, USFS , USFWS	Begin 2008, and ongoing	\$25/acre for cultural clearances; \$50/acre for planning activities
16.1.1.4 Implement appropriate treatment/restoration action(s) (Monsen 2005) for selected sites (identified in strategy 16.1.1.1) in GrSG habitat, as funding/personnel levels allow. Treatment options include, but are not limited to: prescribed fire, mechanical treatments (such as roller chopping, hydro-axing, or chaining), and reseeded, if necessary.	BLM , CDOW, LWGs, NPS, NRCS, Private Landowners, SLB, USFS , USFWS	Begin 2008 and ongoing	\$150-500/acre; depends on equipment type used and if site is reseeded
16.1.1.5 Monitor vegetation response to treatments in GrSG habitat (implemented in strategy 16.1.1.4), and evaluate treatment success (Monsen 2005).	BLM , CDOW, LWGs, NPS, NRCS, Private Landowners, SLB, USFS , USFWS	Post-treatment	\$5/acre
16.1.1.6 Reseed if necessary in areas treated in GrSG habitat (strategy 16.1.1.4), to reestablish understory shrubs and herbs using methods outlined in Monsen (2005). See also Appendix D, “Recommendations Regarding Plant Species for Use in GrSG Habitat Management and Restoration”.	BLM , CDOW, LWGs, NPS, NRCS, Private Landowners, SLB, USFS , USFWS	Ongoing	\$100-300/acre
16.1.1.7 Re-treat areas in GrSG habitat (identified in strategy 16.1.1.1), as necessary, to control re-invading trees.	BLM , CDOW, LWGs, NPS, NRCS, Private Landowners, SLB, USFS , USFWS	Post-treatment, every 5-10 years	\$80/acre

ISSUE 16.2: In some areas of Colorado, loss of GrSG habitat can be attributed to piñon-juniper expansion and encroachment into sagebrush communities.			
OBJECTIVE 16.2.1: Refine and regularly update mapping of piñon-juniper encroachment areas within occupied and potential GrSG habitat in all populations.			
Conservation Strategy	Responsible Parties <i>(if there is a lead entity, it is in bold)</i>	Timeline	Cost
16.2.1.1 Re-evaluate and update (for accuracy and currency) existing maps of piñon-juniper distribution in GrSG habitat (Fig. 30, pg. 172).	BLM, CDOW , LWGs, NPS, NRCS, SLB, USFS, USFWS	Every 5 years or as needed	0.5 FTE

17. Population Monitoring and Targets

Current methods of estimating GrSG population size from lek counts make many unsupported assumptions (see “Lek Counts and Population Estimation”, pg. 42). Research to address these assumptions and establish a more precise estimate is needed. To reduce the assumptions made in estimating populations and identifying population targets, we use only adult male population estimates and targets.

The male population targets in this plan are based on current male population estimates and potential habitat conditions (see “Colorado GrSG Population Targets”, pg. 237). Habitat conditions and availability are expected to change over time, necessitating the need for reevaluation of population targets. In addition, population targets should be modified as knowledge of GrSG behavior and use of landscape features improves.

ISSUE 17.1: It is important to assess GrSG population size and trends, but current methods of estimating population size from lek counts make many unsupported assumptions.

OBJECTIVE 17.1.1: Assess GrSG population size and trends and provide for the long-term monitoring of GrSG.

Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
17.1.1.1 Maintain consistent current GrSG lek count protocols (include searching for new leks), but use research results to establish protocols for future population monitoring and record keeping, including mechanisms to assure consistent implementation and reporting. [See also Research Strategy 21.8.1.1]	BLM, CDOW , LWGs	Ongoing	No additional cost
17.1.1.2 Consider and implement conservation actions to achieve the GrSG male population targets outlined in this plan (see “Colorado GrSG Population Targets”, pg. 237).	BLM, CDOW , Counties, LWGs, NRCS, USFS, USFWS	Ongoing	Specific to individual conservation strategies
17.1.1.3 Develop statistically defensible methods to estimate GrSG population size and/or trends. [See Research Strategies 21.8.1.1, 21.8.1.2, 21.8.1.3, and 21.8.1.5]	See Research Strategies 21.8.1.1, 21.8.1.2, 21.8.1.3, and 21.8.1.5		
17.1.1.4 Coordinate with private landowners to gain access to expand GrSG lek search areas.	CDOW	Ongoing	0.25 FTE
17.1.1.5 Develop a single, statewide, standardized lek data base for all Colorado GrSG population, and update data annually.	CDOW	2007 and update annually	0.25 FTE

ISSUE 17.2: Population targets are based on current population estimates and potential habitat conditions, but habitat conditions and availability are expected to change over time.			
OBJECTIVE 17.2.1: Reevaluate population targets as habitat conditions change and knowledge increases with regards to GrSG behavior and population dynamics.			
Conservation Strategy	Responsible Parties <small>(if there is a lead entity, it is in bold)</small>	Timeline	Cost
17.2.1.1 Use adaptive management approach (see pg. 3) to re-evaluate current population targets.	CDOW	2010	0.25 FTE

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18. Predation

Predation is frequently cited as a major cause of mortality in sage-grouse (Bergerud 1988a, Schroeder et al. 1999, Connelly et al. 2000c). However, whether predation affects the fluctuations and viability of sage-grouse populations has never been investigated (Connelly and Braun 1997, Connelly et al 2000c, Schroeder and Baydack 2001). Schroeder and Baydack (2001) suggest that nest predators, in particular, may have an important impact on sage-grouse population dynamics, given the high variation in nest success. Nest predation may be higher, more variable, and have a greater impact on small, fragmented populations. Predation may be an important factor in juvenile mortality, but nutrition, habitat quality, and environmental conditions also affect juvenile mortality (Pyle and Crawford 1996, Sveum et al. 1998a). The PVA analysis in this plan indicates that female juvenile mortality is one of the parameters that has the greatest impact on GrSG population growth rates (see “Population Viability Analysis”, pg, 210). For further discussion of this topic, see “Predation” issue, pg. 173.

Before a predator control program is implemented, it is recommended that research be conducted to: (1) evaluate the demographic status of GrSG populations; (2) eliminate other contributing factors to population fluctuations (e.g., drought or disease); (3) address the behavioral and spatial interactions of predators and sage-grouse; (4) identify the extent of predation pressures and contributing predator community; and (5) evaluate the role of predation on the long-term viability of sage-grouse populations.

The development of an effective predator management program is problematic given the complexity of the ecological and socioeconomic consequences, lack of reliable information, and public resistance to lethal predator control (Messmer et al. 1999), as well as conflicting state and federal regulations. However, predator control may be necessary under some circumstances for GrSG populations that are small, isolated and/or fragmented. In these cases, a predator control program should be designed for a specific GrSG population, since the relevant predator community will likely vary for each population. An integrated program that includes both intensive and extensive (lethal and nonlethal) predator control methods may be the most effective, but will likely be costly. Predator control may be valid only if nest success and/or female (or brood) survival is exceptionally low. The population viability analysis indicates a higher extinction probability for populations with <30 breeding males (see results for MWR population, Appendix K, “Population Viability Analysis Report”, pg. K-14).

ISSUE 18.1: Public misunderstanding of the role of predation in GrSG populations can make GrSG predation management challenging.			
OBJECTIVE 18.1.1: Improve the public’s understanding of the role of predation on GrSG populations.			
Conservation Strategy	Responsible Parties <small>(if there is a lead entity, it is in bold)</small>	Timeline	Cost
18.1.1.1 Actively provide accurate information to the general public and stakeholders to improve their understanding about the relationship between predation and GrSG. [See Information, Communication, and Education Strategies 12.2.1.3 and 12.3.1.1]	See Information, Communication, and Education Strategies 12.2.1.3 and 12.3.1.1		

ISSUE 18.2: Information is lacking on the role of predation on GrSG populations.			
OBJECTIVE 18.2.1: Conduct research and monitoring to investigate the role of predation on GrSG populations in Colorado.			
Conservation Strategy	Responsible Parties <small>(if there is a lead entity, it is in bold)</small>	Timeline	Cost
18.2.1.1 Conduct a thorough review of the existing literature on the relationship between predation and GrSG populations and habitat. [See Research Strategy 21.4.1.1]	See Research Strategy 21.4.1.1		
18.2.1.2 Establish a process to develop GrSG predation research priorities within Colorado, and encourage innovative and progressive research questions. [See Research Strategy 21.4.1.1]	See Research Strategy 21.4.1.1		
18.2.1.3 Document and monitor current predator population levels in GrSG habitat. [See Research Strategy 21.4.1.1]	See Research Strategy 21.4.1.1		
18.2.1.4 Evaluate relationships among GrSG predator species, including how GrSG predator species population levels change relative to each other. [See Research Strategy 21.4.1.2]	See Research Strategy 21.4.1.2		
18.2.1.5 Investigate and evaluate the natural variability in GrSG predator populations. [See Research Strategy 21.4.1.2]	See Research Strategy 21.4.1.2		
18.2.1.6 Investigate the effects of predation on all GrSG life stages. [See Research Strategy 21.4.1.1]	See Research Strategy 21.4.1.1		

18.2.1.7 Investigate the influence of GrSG habitat on predation rates. [See Research Strategy 21.4.1.3]	See Research Strategy 21.4.1.3
18.2.1.8 Investigate how predation rates on GrSG are influenced by the natural temporal and spatial variability in sagebrush ecosystems (e.g., plant age class, fire intervals). [See Research Strategy 21.4.1.3]	See Research Strategy 21.4.1.3
18.2.1.9 Investigate the quantity of habitat (i.e., patch size) needed to sustain GrSG. [See Research Strategies 21.1.1.1 and 21.4.1.3]	See Research Strategies 21.1.1.1 and 21.4.1.3
18.2.1.10 Investigate how invasive weed species impact predation rates on GrSG. [See Research Strategy 21.4.1.3]	See Research Strategy 21.4.1.3
18.2.1.11 Investigate the influence of habitat quality (e.g., nutrition, forb/insect quality and quantity) on GrSG chick vulnerability to predation. [See Research Strategies 21.1.1.1 and 21.1.1.3]	See Research Strategies 21.1.1.1 and 21.1.1.3
18.2.1.12 Evaluate the impact of infrastructure, powerlines, roads, and fences on predation rates in GrSG populations. [See Research Strategy 21.4.1.3]	See Research Strategy 21.4.1.3
18.2.1.13 Investigate the roles of and relationships between native and non-native predators in the sagebrush ecosystem. [See Research Strategy 21.4.1.2]	See Research Strategy 21.4.1.2
18.2.1.14 Evaluate whether vegetation treatments improve GrSG habitat in a way that affects GrSG population parameters, such as nest success. [See Research Strategy 21.1.2.1]	See Research Strategy 21.1.2.1

ISSUE 18.2: Information is lacking on the role of predation on GrSG populations.			
OBJECTIVE 18.2.2: Secure funding for research on predation and GrSG populations.			
Conservation Strategy	Responsible Parties <small>(if there is a lead entity, it is in bold)</small>	Timeline	Cost
18.2.2.1 Identify funding sources for research on predation and GrSG. [See Research Strategy 21.4.1.1]	See Research Strategy 21.4.1.1.		
18.2.2.2 Secure funding for research on predation and GrSG. [See Research Strategy 21.4.1.1]	See Research Strategy 21.4.1.1		

ISSUE 18.3: Although predation has always occurred in GrSG populations, general increases in numbers or types of predators may affect sage-grouse population numbers.			
OBJECTIVE 18.3.1: Encourage timely, innovative GrSG predation management strategies (including adaptive predator management and monitoring), to assist in achieving GrSG population targets (see “Colorado GrSG Population Targets”, pg. 237).			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
18.3.1.1 Identify appropriate types of predator control for GrSG populations and coordinate potential actions locally and regionally.	APHIS, CDA, CDOW, LWGs	2008	0.5 FTE
18.3.1.2 Implement GrSG predator control, as necessary and appropriate and coordinate activities locally and regionally.	APHIS, BLM, CDOW, County Governments, LWGs,	2009	3.0 FTE
18.3.1.3 When applying predation management techniques, abide by existing laws, including: <ul style="list-style-type: none"> • Colorado Amendment 14 • Bald and Golden Eagle Protection Act • Migratory Bird Treaty Act 	APHIS, CDOW, USFWS	As needed	No cost
18.3.1.4 Design an effective and consistent monitoring program to determine if predation management actions are achieving desired results in GrSG populations.	BLM, CCA, CDOW , CFB, CREA, LWGs, SRM	ASAP	1.0 FTE
18.3.1.5 Work with implementing parties to ensure that GrSG predation management monitoring results are reported.	BLM, CCA, CDOW , CFB, CREA, Industry, LWGs, SRM	As needed	0.5 FTE
18.3.1.6 Establish an annual meeting to coordinate reporting of LWG progress towards implementation of predation management strategies (in both local and statewide conservation plans), and to encourage communication among LWGs regarding predation management. [See Information, Communication, and Education Strategy 12.3.2.1]	See Information, Communication, and Education Strategy 12.3.2.1		
18.3.1.7 Encourage and allow risk-taking (e.g., experimental predator control in limited areas) so that implementers and collaborators have the flexibility to conduct adaptive GrSG predation management.	APHIS, CDOW	Ongoing	No Cost
18.3.1.8 Report predation management strategy results to GrSG steering committee.	LWGs	Annually	No cost

18.3.1.9 Educate interested publics regarding which management actions are most biologically and cost-effective in increasing reproductive success in GrSG populations. [See Information, Communication, and Education Strategy 12.3.1.1]	See Information, Communication, and Education Strategy 12.3.1.1
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ISSUE 18.4: Funding is needed to support predation strategies (in both local plan and statewide GrSG conservation plans).			
OBJECTIVE 18.4.1: Identify and secure the funding needed to implement predation strategies (in both local plan and statewide GrSG conservation plans).			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
18.4.1.1 Identify potential funding sources for predation management strategies.	CDOW , NRCS, USFWS	2007	N/A
18.4.1.2 Secure funding for predation management strategies.	BLM, CDOW, Industry, LWGs, Private Landowners, NRCS, USFS, USFWS	2007	0.5 FTE
18.4.1.3 Develop a process to allocate funding for LWG predation strategies.	CDOW	2007	0.5 FTE
18.4.1.4 LWGs identify local plan funding needs and submit proposals within funding process framework (see strategy 18.4.1.3).	CDOW, LWGs	2007 and annually	0.25 FTE

ISSUE 18.5: Special consideration regarding the implementation of predator management may be required in small isolated GrSG populations.			
OBJECTIVE 18.5.1: Protect GrSG small populations from excessive predation when populations (3-year average) fall to either of 2 “trigger” levels: (1) below 25 birds in the spring breeding population; or (2) to 25% of the long-term average goal for the population.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
18.5.1.1 Identify relevant predator species within local GrSG populations that meet the established trigger(s).	BLM, CDOW, LWGs, Other Research Institutions, Universities, USFS, USFWS	2009	\$200,000 / population

18.5.1.2 Determine age-specific mortality and identify relative risks from avian and mammalian predation within local GrSG populations meeting the described trigger(s).	BLM, CDOW, LWGs, Other Research Institutions, Universities, USFS, USFWS	2009	\$200,000. / population
18.5.1.3 Evaluate whether predator management aimed at a specific predator species is an effective management tool that increases production and recruitment of sage-grouse in local populations that meet the established trigger(s).	BLM, CDOW, LWGs, Other Research Institutions, Universities, USFS, USFWS	2009	\$400,000 / population
18.5.1.4 If predator control is likely to be effective, then develop and implement predator management strategies designed for specific GrSG population that is in accordance with CDOW and federal regulations and policies.	BLM, CDOW, LWGs, Other Research Institutions, Universities, USFS, USFWS	2009	Cost varies by project

19. Recreational Activities

Several GrSG local work groups in Colorado have identified recreational activities as a potential issue for GrSG (NPCP 2001, MPCP 2001, NESRCP 2004). Risks to GrSG from recreational activities include potential disturbances from humans (and their pets), resulting from activities such as hiking, biking, camping, photography, use of off-road vehicles, and snowmobiling. However, the relative impact of these potential disturbances has never been examined. Recreational activities such as lek viewing and hunting are addressed in separate strategy sections. Recreation facilities and infrastructures (e.g., kiosks, restrooms, trailheads) are to be considered in the “Infrastructure” strategy section (pg. 369). For further discussion, see “Recreational Activities” issue, pg. 181.

ISSUE 19.1: Recreational activities may cause a potential impact to GrSG.			
OBJECTIVE 19.1.1: Use experimentally designed studies to evaluate the cause and effect of recreational activity on the productivity and population viability of GrSG.			
Conservation Strategy	Responsible Parties <i>(if there is a lead entity, it is in bold)</i>	Timeline	Cost
19.1.1.1 Evaluate the effect of recreational activities on GrSG mating behavior. [See Research Strategy 21.2.1.5]		See Research Strategy 21.2.1.5	
19.1.1.2 Evaluate the effect of recreational activities on GrSG nesting and brood-rearing success. [See Research Strategy 21.2.1.5]		See Research Strategy 21.2.1.5	
19.1.1.3 Evaluate the effect of recreational activities on GrSG winter flocks. [See Research Strategy 21.2.1.5]		See Research Strategy 21.2.1.5	
19.1.1.4 Evaluate the effect of recreational activities on recruitment and long-term population dynamics of GrSG. [See Research Strategy 21.2.1.5]		See Research Strategy 21.2.1.5	

ISSUE 19.1: Recreational activities may cause a potential impact to GrSG.			
OBJECTIVE 19.1.2: Minimize the potential adverse impacts of recreational activities on GrSG (see “GrSG Disturbance Guidelines”, Appendix B).			
Conservation Strategy	Responsible Parties <i>(if there is a lead entity, it is in bold)</i>	Timeline	Cost
19.1.2.1 Minimize, where possible, the impacts to sage-grouse when designing or modifying recreational roads or trails.	BLM, CDOW, County Governments, DPOR, LWGs, Private Landowners, USFS	Ongoing	Project-specific

19.1.2.2 On publicly-owned properties, pets (this excludes working dogs) should be on-leash or restricted from areas within important GrSG breeding habitat (mid-March – June).	BLM, CDOW, SLB, USFS, USFWS	2007	Negligible
19.1.2.3 Develop and distribute educational material on (1) general GrSG biology, and (2) the potential harmful effects of recreational activities on GrSG breeding, nesting, and winter areas. Distribute to recreational groups, tourists, pet owners, private landowners, and lek viewers. [See Information, Communication, and Education Strategies 12.2.1.1 and 12.2.1.3]	See Information, Communication, and Education Strategies 12.2.1.1 and 12.2.1.3		
19.1.2.4 Identify and map areas of high recreational use within GrSG habitat for use in guiding management decisions.	BLM, CDOW, LWGs, USFS	2008	0.1 FTE
19.1.2.5 Provide information and signage at areas where management actions relating to GrSG are in effect (e.g., designated trails, seasonal closures). [See Information, Communication, and Education Strategy 12.2.1.3]	See Information, Communication, and Education Strategy 12.2.1.3		
19.1.2.6 On land that is important to GrSG, encourage private and public land managers to manage human recreation activities to benefit sage-grouse (e.g., during the breeding season, on winter range). Provide incentives to landowners, if possible. [See also Information, Communication, and Education Strategies 12.2.1.3 and 12.3.1.1]	BLM, CDOW, County Governments LWGs, Private landowners, USFS	Ongoing	Negligible
19.1.2.7 Advocate for increased monitoring and enforcement of existing recreational regulations where conflicts with GrSG have been identified.	BLM, CDOW, County Governments, LWGs, Private Landowners	Ongoing	Negligible
19.1.2.8 Promote the development of a realistic and enforceable travel management plan on public lands to protect GrSG lek, nesting, brood rearing, and winter habitats.	BLM, CDOW, County Governments, LWGs, SLB, USFS	As plans are developed	0.25 FTE
19.1.2.9 When existing recreational roads and trails conflict with GrSG habitat requirements, consider management options (within authorities) such as seasonal use restrictions, closure, removal, speed limits and realignment (administrative uses may be allowed).	BLM, CDOW, County Governments, LWGs, Private Landowners, SLB, USFS	As needed.	Negligible
19.1.2.10 Restrict off-highway vehicles (OHV) to on-trail or on-road use on public lands during the nesting season in occupied GrSG breeding habitat.	BLM, CDOW, County Governments, LWGs, SLB, USFS,	As needed.	0.1 FTE

20. Roads

Roads may have multiple impacts on wildlife in terrestrial ecosystems, including (1) increased mortality from collision with vehicles; (2) changes in behavior; (3) loss and alteration of habitat; (4) spread of exotic species; and (5) increased human access, resulting in facilitation of additional alteration and use of habitats by humans (Jackson 2000, Trombulak and Frissell 2000).

There is not much research regarding any of the potential impacts of roads on GrSG. Potential changes in GrSG behavior may have a significant impact on populations (see “Energy and Mineral Development” issue section, pg. 101), especially if traffic volume and disturbance to grouse is high. Collisions with vehicles may cause individual sage-grouse mortality, but these collisions have not been demonstrated to have a significant effect on GrSG populations. For further discussion on this topic, see “Roads” issue (pg. 183) and “GrSG Habitat Loss: Roads in Colorado” (pg. 272).

ISSUE 20.1: Roads may impact GrSG populations by direct mortality, behavioral changes, spread of exotic plants, fragmentation of habitat, and by providing additional human access to formerly remote areas.			
OBJECTIVE 20.1.1: Minimize the potential for adverse impact of roads on GrSG and their habitat (see “GrSG Disturbance Guidelines”, Appendix B).			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
20.1.1.1 Identify, categorize (e.g., 2-track, gravel, unpaved, paved), and map roads in GrSG range. Maintain a current GIS roads datalayer.	BLM, CDOT, CDOW, County Governments, NPS, USFS	Ongoing	\$20/mile (FTE Costs) +\$10,000 (Equipment)
20.1.1.2 For placement of new roads, GrSG seasonal habitats should be mapped and avoided whenever possible. If seasonal habitats are not yet mapped, construction should be avoided within the buffers described in the “GrSG Disturbance Guidelines” (Appendix B).	BLM, CDOW, County Governments, Industry, LWGs, NPS, Private Landowners, SLB, USFS	During road planning phase	Varies by project.
20.1.1.3 Timing of road building and road maintenance activities should be modified according to the GrSG seasonal habitat in the area and the timing guidelines provided in Appendix B.	BLM, CDOW, County Governments, Industry, LWGs, Private Landowners, SLB, USFS	During road Planning phase	0.1 FTE
20.1.1.4 Where opportunities arise, manage existing roads to minimize disturbance to leks or other seasonal habitats, particularly breeding habitat. Employ seasonal closures, permanent closures, rerouting of existing roads, or other measures, as deemed locally appropriate.	BLM, CDOW, County Governments, Industry, LWGs, Private Landowners, SLB, USFS	Annually	Varies by type of management.

20.1.1.5 If new local or unpaved roads are constructed within GrSG seasonal habitats, encourage appropriate governing authorities to restrict speed limits as specified by the “GrSG Disturbance Guidelines”, Appendix B).	BLM, CDOW, County Governments, Industry, LWGs, NPS, Private Landowners, SLB, USFS	During road planning phase	0.1 FTE
20.1.1.6 New roads should not be constructed within 0.6 miles of leks (see “GrSG Disturbance Guidelines”, Appendix B). If this is impractical, roads should be placed to avoid line-of-sight between strutting males and road/associated traffic. Lek data are considered sensitive information by CDOW. Limit data distribution to the extent necessary for effective management.	BLM, CDOW, County Governments, NPS, SLB, USFS	During road planning phase	Varies by project
20.1.1.7 On federal land, consider GrSG habitat when determining allocation designations for user-created routes. This should be done when developing activity or LUP level Travel Management Plans.	BLM, USFS, USFWS	During travel mgmt. plan phase	N/A
20.1.1.8 If habitat disturbance that will require habitat restoration occurs in conjunction with building, maintaining, or reclaiming roads, the potential vegetation community needs to be identified (Winward 2004) and a diverse seed mixture of native shrubs, grasses, and forbs should be used (see Appendix D, “Recommendations Regarding Plant Species for Use in GrSG Habitat Management and Restoration”, Monsen 2005, and “Habitat Enhancement” strategy, pg. 336).	BLM, CDOT, CDOW, County Governments, Industry, NPS, Private Landowners, SLB, USFS	Immediately following disturbance	Project specific
20.1.1.9 Prevent and control the spread of noxious and invasive weeds in disturbed areas associated with roads (see “Weeds” strategy, pg. 4130).	BLM, CDOT, CDOW, County Governments, SLB, USFS	Ongoing	\$40-\$100/acre
20.1.1.10 Evaluate the effects of road placement and traffic levels on GrSG. [See Research Strategies 21.1.2.3 and 21.2.1.2]	See Research Strategies 21.1.2.3 and 21.2.1.2		

21. Research

This section is a summary of research needs related to GrSG. Specific research questions have been identified within many of the other strategy sections (e.g., Energy and Mineral Development, Grazing). Using these specific questions as a basis, we have identified broader research topics that (1) are important to understanding GrSG populations and habitat; and (2) lead to more effective GrSG management.

Research is a topic that is of concern in almost every issue area. We organized this strategy section differently than the others, to address similarities and redundancies among the numbered strategies in different strategy sections. Under each numbered research strategy, we have listed all (if any) related specific research questions that were identified in other strategy sections. Thus, the original numbered strategy provided under an issue remains stated in that section, but a broader strategy is written in the “Research” section, and is intended to cover the original individual strategy, along with others. The “Responsible Parties”, “Timeline”, and “Cost” columns are completed for the broader, overarching research strategy, but remain blank in the supporting, related strategies from other strategy sections.

For example, “Research” strategy 21.1.1.3 reads, “Evaluate the effect(s) of vegetation “quality” (e.g., vegetation structure, sagebrush canopy height and cover, forb and grass height, diversity, and abundance, nutrition available to GrSG) on sage-grouse productivity, adult survival, and population dynamics.” Related strategies from all issues sections are listed below 21.1.1.3, including a strategy from the “Grazing” section: “6.1.3.2 Determine the relationship of GrSG habitat parameters to sage-grouse productivity, demographics, and population viability.” The “Responsible Parties”, “Timeline”, and “Cost” columns are completed for strategy 21.1.1.3, but not for strategy 6.1.3.2 in the “Grazing” strategy section. This organizational approach results in redundancy within the plan, but allows for completeness within each individual strategy section, which may be important in implementing the plan.

This list of research strategies is meant only to illustrate where information is needed for GrSG. An effective management program will require research studies that incorporate an adaptive management approach. Acquired scientific information should be integrated into the implementation of research and management plans, which should be revised and updated as necessary. Obviously there are more research needs listed than time, money, and personnel can achieve in the near-term. Prioritization of these research strategies, along with other strategies, will occur in the implementation plan to be completed after this plan is signed.

Outline of Research Strategy Organization (italics within Issues and Objectives refer to this outline)

Issue 21.1: Effects on GrSG of (1) Habitat quality and quantity; and (2) human-controlled impacts in GrSG habitat

Objective 21.1.1: Impacts of habitat quality and quantity on GrSG

Objective 21.1.2: Impacts of human-controlled activities on GrSG habitat

Issue 21.2: Effects of human-controlled activities on GrSG behavior and demographics.

Objective 21.2.1: Impacts of various human-controlled activities on GrSG behavior, and the resulting implications for GrSG populations.

Issue 21.3: Effectiveness of current measures designed to protect GrSG from energy and mineral development impacts

Objective 21.3.1: Determine effectiveness of the measures designed to protect GrSG from the potential adverse impacts of energy and mineral development, and related infrastructure.

Issue 21.4: Impacts of predation on GrSG

Objective 21.4.1: Examine the effect(s) of predation on GrSG behavior and population dynamics.

Issue 21.5: Potential impacts of West Nile Virus on GrSG

Objective 21.5.1: Investigate the potential impacts of WNV on GrSG

Issue 21.6: Theories of additive and compensatory mortality and hunting of GrSG.

Objective 21.6.1: Investigate additive and compensatory mortality thresholds and sport harvest in GrSG.

Issue 21.7: Small isolated populations of greater sage-grouse may have low genetic diversity, which may facilitate inbreeding depression.

Objective 21.7.1: Monitor genetic diversity within the smaller isolated populations of greater sage-grouse in Colorado.

Issue 21.8: Population estimation methods are imprecise

Objective 21.8.1: Conduct research to establish a more precise population estimate method

ISSUE 21.1: It is not well understood how GrSG population dynamics and sustainability are impacted by (1) the quality and quantity of GrSG habitat; and (2) human-controlled activities in GrSG habitat.

OBJECTIVE 21.1.1: Evaluate the effects of habitat quality and quantity on (1) GrSG behavior; and (2) the dynamics and sustainability of GrSG populations.

Conservation Strategy	Responsible Parties <small>(if there is a lead entity, it is in bold)</small>	Timeline	Cost
21.1.1.1 Evaluate how the amount (i.e., “patch size”), configuration, and composition of GrSG habitat affect (1) sage-grouse behavior (e.g., movement and dispersal); (2) species distribution; (3) productivity; (4) population dynamics; and (5) population sustainability. Map and analyze landscape metrics (e.g., edge density, fragmentation, heterogeneity, fractal dimension), using the most reliable and current GIS data and examine the spatial and temporal correlation with sage-grouse population dynamics. Evaluate the potential for dispersal of individuals into currently unoccupied suitable habitat.	BLM, CDA, CDOW, Industry, LWGs, NGOs, NRCS, Other Research Institutions, Private Landowners, SLB, Universities, USFS, USFWS, USGS, WAFWA	Begin by 2010	\$2,250,000 / yr, + \$130,000 + 0.1 FTE

<i>FROM ENERGY AND MINERAL DEVELOPMENT STRATEGY SECTION:</i>			
3.4.3.8 Quantify habitat fragmentation effects on GrSG.			
3.4.3.9 Determine habitat loss thresholds for GrSG populations (i.e., how much habitat is needed to sustain a population).			
3.4.3.10 Identify the appropriate mix of sagebrush habitats and seral stages necessary for sustainable GrSG populations, consistent with site capabilities. [Also under 21.1.1.3]			
3.4.3.11 Determine the sufficient minimum habitat patch size for GrSG, as it relates to habitat fragmentation.			
<i>FROM GRAZING STRATEGY SECTION:</i>			
6.1.3.1 Conduct a literature review of how GrSG populations respond to different habitat parameters.			
6.1.3.2 Determine the relationship of GrSG habitat parameters to sage-grouse productivity, demographics, and population viability. [Also under 21.1.1.3]			
<i>FROM HABITAT MONITORING STRATEGY SECTION:</i>			
9.1.2.3 Evaluate the impact of vegetation condition on GrSG populations.			
<i>FROM HOUSING DEVELOPMENT STRATEGY SECTION:</i>			
10.2.2.1 Conduct research to determine (1) sage-grouse habitat patch size and configuration needs, and (2) fragmentation impacts on GrSG movements and population isolation.			
<i>FROM PREDATION STRATEGY SECTION:</i>			
18.2.1.9 Investigate the quantity of habitat (i.e., patch size) needed to sustain GrSG. [Also under 21.4.1.3]			
18.2.1.11 Investigate the influence of habitat quality (e.g., nutrition, forb/insect quality and quantity) on GrSG chick vulnerability to predation. [Also under 21.1.1.3]			
21.1.1.2 Develop a spatially-explicit population model that incorporates current estimates (with appropriate estimates of temporal and spatial variation) of demography and movement in order to evaluate the relative effects of changing land-uses on GrSG populations.	CCP SC, CDOW, NGOs, Other Research Institutions, Universities	Begin by 2009	0.1 FTE
<i>FROM ENERGY AND MINERAL DEVELOPMENT STRATEGY SECTION:</i>			
3.4.1.2 Develop and update a modeling scenario and impacts assessment (regarding energy and mineral development) that considers (1) reclamation efforts and results; (2) long-term changes in GrSG habitat; and (3) the various stages of energy development (e.g., high-intensity, short-duration development vs. lower-intensity, longer-duration development). [Also under 21.1.2.3]			
<i>FROM HOUSING DEVELOPMENT STRATEGY SECTION:</i>			
10.2.2.4 Develop predictive models to monitor and assess impacts of habitat fragmentation in sage-grouse habitat.			
21.1.1.3 Evaluate the effect(s) of vegetation “quality” (e.g., vegetation structure, sagebrush canopy height and cover, forb and grass height, diversity, and abundance, nutrition available to GrSG) on sage-grouse productivity, adult survival, and population dynamics.	BLM, CDA, CDOW, Industry, LWGs, NRCS, Private Landowners, SLB, Universities, USFS, USFWS, USGS	Begin by 2012	\$250,000 / yr + \$100,000
<i>FROM ENERGY AND MINERAL DEVELOPMENT STRATEGY SECTION:</i>			
3.4.3.10 Identify the appropriate mix of sagebrush habitats and seral stages necessary for sustainable GrSG populations, consistent with site capabilities. [Also under 21.1.1.1]			

<p><i>FROM GRAZING STRATEGY SECTION:</i> 6.1.3.2 Determine the relationship of GrSG habitat parameters to sage-grouse productivity, demographics, and population viability. [Also under 21.1.1.1]</p>
<p><i>FROM PREDATION STRATEGY SECTION:</i> 18.2.1.11 Investigate the influence of habitat quality (e.g., nutrition, forb/insect quality and quantity) on GrSG chick vulnerability to predation. [Also under 21.1.1.1]</p>

ISSUE 21.1: It is not well understood how GrSG population dynamics and sustainability are impacted by (1) the quality and quantity of GrSG habitat; and (2) human-controlled activities in GrSG habitat.

OBJECTIVE 21.1.2: Evaluate human-controlled impacts on GrSG habitat, and the resulting implications for GrSG populations.

Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
21.1.2.1 Examine the effects of different habitat treatments on the quality, quantity, and configuration of GrSG habitat, and the responses of GrSG populations.	BLM, CDA, CDOW, LWGs, NRCS, Private Landowners, UCEPC, USFS, USFWS, USGS	Begin by 2015	\$200,000 / yr + \$305,000
<p><i>FROM AGRICULTURAL CONVERSION STRATEGY SECTION:</i> 1.1.1.1 Evaluate past vegetation restoration applications in CRP and cropland that may serve as GrSG habitat. Produce a report that documents these efforts.</p>			
<p>1.1.1.2 Design, plant, evaluate, and report on field trials for establishing desired vegetation to serve as GrSG habitat in CRP and cropland. [Also under 21.1.2.4]</p>			
<p><i>FROM HABITAT ENHANCEMENT STRATEGY SECTION:</i> 7.1.2.4 Evaluate the effectiveness of vegetation enhancement treatments on GrSG.</p>			
<p><i>FROM PESTICIDES STRATEGY SECTION:</i> 15.1.1.1 Conduct research on the effects of various herbicide treatments on GrSG habitat.</p>			
<p><i>FROM PREDATION STRATEGY SECTION:</i> 18.2.1.14 Evaluate whether vegetation treatments improve GrSG habitat in a way that affects GrSG population parameters, such as nest success.</p>			
21.1.2.2 Evaluate the effects of varying grazing management practices (domestic and wild ungulates) on the quality of GrSG habitat (e.g., grass and forb abundance, diversity, and vegetation structure).	BLM, CDOW, CSU Extension, LWGs, NAGP, NRCS, Universities, USFS, WAFWA	Begin by 2015	\$200,000/ yr + \$30,000 + 0.25 FTE
<p><i>FROM GRAZING STRATEGY SECTION:</i> 6.1.2.1 Conduct a literature review of grazing systems and their effects on the vegetation parameters important to sage-grouse.</p>			
<p>6.1.2.2 Evaluate the effect of herbivores on the quality of sagebrush habitat (e.g., grass and forb abundance, diversity, and vegetative structure).</p>			

6.1.2.3 Provide incentives to private landowners to participate in research (e.g., strategy 6.1.1.2, 6.1.2.2) and monitoring actions (e.g., if a rancher is requested to rest a pasture for a research project). Develop grazing banks or help find other pasture to graze. Provide financial compensation such as fencing and water developments.			
6.1.2.4 As results become available on research on herbivory and GrSG (e.g., strategy 6.1.1.2, 6.1.2.2), distribute them to local work groups. [Also under Information, Communication, and Education Strategy 12.3.2.1]			
21.1.2.3 Evaluate the impacts of infrastructure, energy, and mineral development (including reclamation efforts following development), on the quality, quantity, and configuration of GrSG habitat.	CDOW, CCP SC, LWGs, Universities	Begin by 2015	\$800,000 + 6.0 FTE
<i>FROM ENERGY AND MINERAL DEVELOPMENT STRATEGY SECTION:</i>			
3.4.1.2 Develop and update a modeling scenario and impacts assessment (regarding energy and mineral development) that considers (1) reclamation efforts and results; (2) long-term changes in GrSG habitat; and (3) the various stages of energy development (e.g., high-intensity, short-duration development vs. lower-intensity, longer-duration development). [Also under 21.1.1.2]			
<i>FROM INFRASTRUCTURE STRATEGY SECTION:</i>			
13.4.1.2 Evaluate the impacts of utility corridors on GrSG habitats (i.e., fragmenting effects on habitat).			
13.4.1.3 Evaluate the impacts of communication towers, wind turbines, and associated infrastructure on GrSG (both disturbance impacts and habitat fragmentation impacts). [Also under 21.2.1.2]			
13.4.1.4 Evaluate the impact of fences on GrSG populations (both disturbance impacts and habitat fragmentation impacts) and identify options to minimize those impacts. [Also under 21.2.1.2]			
<i>FROM ROADS STRATEGY SECTION:</i>			
20.1.1.10 Evaluate the effects of road placement and traffic levels on GrSG. [Also under 21.2.1.2]			
21.1.2.4 Evaluate the potential impact of (and techniques for) converting CRP to sagebrush habitat on sage-grouse distribution and population viability.	CDOW, LWGs, NRCS, Private Landowners, Universities, UCEPC, USFS	Begin by 2010	\$100,000
<i>FROM AGRICULTURAL CONVERSION STRATEGY SECTION:</i>			
1.1.1.2 Design, plant, evaluate, and report on field trials for establishing desired vegetation to serve as GrSG habitat in CRP and cropland. [Also under 21.1.2.1]			

ISSUE 21.2: It is not well-understood how GrSG behavior and demographics are impacted by human-controlled activities.				
OBJECTIVE 21.2.1: Evaluate the <i>impact of various human-controlled activities on GrSG behavior</i> , and the resulting implications for GrSG populations.				
	Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
	21.2.1.1 Evaluate the impact of agricultural and residential development on the behavior, distribution, demography, and population dynamics of sage-grouse.	BLM, CDOW, Universities	Begin by 2020	\$250,000/yr for 3 yrs

<i>FROM GRAZING STRATEGY SECTION:</i>			
6.1.1.1 Conduct a literature review of herbivores and their effects on sage-grouse.			
6.1.1.2 Evaluate the effects of herbivores on GrSG (e.g., nest trampling, changes in GrSG behavior, also positive effects).			
<i>FROM HOUSING DEVELOPMENT STRATEGY SECTION:</i>			
10.1.1.8 Investigate impacts of housing on GrSG, due to noise, pets, and increased activity. Use data to assist with planning and future housing development.			
21.2.1.2 Evaluate the effect of powerlines, fences, roads, and other human infrastructure on the behavior, distribution, demography, and population dynamics of sage-grouse.	CDOW, LWGs, Universities	Begin by 2015	\$800,000 and 6.0 FTE
<i>FROM INFRASTRUCTURE STRATEGY SECTION:</i>			
13.4.1.3 Evaluate the impacts of communication towers, wind turbines, and associated infrastructure on GrSG (both disturbance impacts and habitat fragmentation impacts). [Also under 21.1.2.3]			
13.4.1.4 Evaluate the impact of fences on GrSG populations (both disturbance impacts and habitat fragmentation impacts), and identify options to minimize those impacts [Also under 21.1.2.3]			
13.4.1.5 Develop effective methods to mark infrastructure for visibility to minimize sage-grouse collisions.			
<i>FROM ROADS STRATEGY SECTION:</i>			
20.1.1.10 Evaluate the effects of road placement and traffic levels on GrSG. [Also under 21.1.2.3]			
21.2.1.3 Evaluate the impact of energy development on the behavior, distribution, demography, and population dynamics of sage-grouse. Include: (1) how specific factors affecting population parameters are influenced by energy development; and (2) the relative impact of specific aspects of oil and gas development (e.g., intensity, duration, and timing elements in PVA [see pg. 199]). Recognize the need and timeline necessary to integrate research data and results into energy development planning cycles.	BLM, CDOW, Industry, LWGs, NRCS, SLB, Universities, USFS, USFWS	Begin by 2020	\$2,000,000 / yr + 0.5 FTE
<i>FROM ENERGY AND MINING DEVELOPMENT STRATEGY SECTION:</i>			
3.4.3.1 Develop a timeline for implementation of research strategies (strategies 3.4.3.3 - 3.4.3.5; 3.4.3.7 – 3.4.3.10).			
3.4.3.2 Increase funding to conduct needed research on mining, energy development, and GrSG in Colorado.			
3.4.3.4 Investigate the specific factors affecting GrSG population parameters (e.g., causes of female and chick mortality), and how they are influenced by energy development.			
3.4.3.5 Design and implement a research program (regarding energy/mining and GrSG) so that the duration of data is sufficient to answer GrSG management questions. Recognize the need and timeline necessary to integrate research data and results into planning cycles.			
3.4.3.6 Study, monitor, and attempt to quantify impacts to sage-grouse from oil and gas development and mining operations (e.g., intensity, duration, and timing elements of PVA).			
3.4.3.7 Incorporate stakeholder concerns into current and future research designs for GrSG studies.			

21.2.1.4 Evaluate the effect of mining development on the behavior, distribution, demography, and population dynamics of sage-grouse.	CDOW, Universities	Begin by Dec. 2008	\$200,000 /yr for 3 yrs and 1 FTE
21.2.1.5 Evaluate the effect of recreational activities (e.g., lek viewing, hiking, camping, off-road vehicles, etc.) on the behavior, distribution, demography, and population dynamics of sage-grouse.	CDOW, Other Research Institutions, Universities	Begin by 2020	\$200,000 / yr
<i>FROM LEK VIEWING STRATEGY SECTION:</i>			
14.1.1.8 Evaluate the impact of lek viewing on GrSG.			
14.1.1.10 Monitor and quantify the effects of viewing on lek attendance patterns.			
<i>FROM RECREATIONAL ACTIVITIES STRATEGY SECTION:</i>			
19.1.1.1 Evaluate the effect of recreational activities on GrSG mating behavior.			
19.1.1.2 Evaluate the effect of recreational activities on GrSG nesting and brood-rearing success.			
19.1.1.3 Evaluate the effect of recreational activities on GrSG winter flocks.			
19.1.1.4 Evaluate the effect of recreational activities on recruitment and long-term population dynamics of GrSG.			

ISSUE 21.3: The effectiveness of current measures designed to protect GrSG from the impacts of energy and mineral development is not well understood.			
OBJECTIVE 21.3.1: Determine the effectiveness of the various programs and approaches designed to protect GrSG from the potential adverse impacts of energy and mineral development, and related infrastructure.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
21.3.1.1 Determine the effectiveness of energy and mining mitigation actions, reclamation, existing stipulations, and BMPs in protecting GrSG habitat and populations.	BLM, CDOW , Universities	Begin by 2010	\$750,000 / yr
<i>FROM ENERGY AND MINERAL DEVELOPMENT STRATEGY SECTION:</i>			
3.3,4,4 Determine whether sage-grouse will move to mitigation areas as mine and energy development sites develop in active habitat.			
3.4.2.1 Through research, determine the effectiveness of energy and mining mitigation actions, stipulations, and BMPs in maintaining GrSG populations and/or habitat across the landscape.			

21.3.1.2 Determine the effectiveness of stipulations, restrictions, and guidelines designed to protect GrSG populations and habitat from the potential adverse impacts of infrastructure (e.g., powerlines, wind turbines, roads).	APHIS, BLM, CDA, CDOW, CSU Extension, Industry, LWGs, NRCS, Private Landowners, USFS, USFWS, USGS	Begin by 2010	Conduct in conjunction with other research
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ISSUE 21.4: The impacts of predation on GrSG are not well understood.			
OBJECTIVE 21.4.1: Examine the effect(s) of predation on GrSG behavior and population dynamics.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
21.4.1.1 Determine age-specific mortality (especially for chick and adult females, as per the PVA sensitivity analysis [see pg.206]) and identify the relative risks from avian and mammalian predation within local GrSG populations.	APHIS, BLM, CDA, CDOW, CSU Extension, Industry, LWGs, NRCS, Private Landowners, USFS, USFWS, USGS	Begin by 2010	\$600,000 / yr + 2.0 FTE
<i>FROM PREDATION STRATEGY SECTION:</i>			
18.2.1.1 Conduct a thorough review of the existing literature on the relationship between predation and GrSG populations and habitat.			
18.2.1.2 Establish a process to develop GrSG predation research priorities within Colorado, and encourage innovative and progressive research questions.			
18.2.1.3 Document and monitor current predator population levels in GrSG habitat.			
18.2.1.6 Investigate the effects of predation on all GrSG life stages.			
18.2.2.1 Identify funding sources for research on predation and GrSG.			
18.2.2.2 Secure funding for research on predation and GrSG.			
21.4.1.2 Implement research to better understand the behavioral and spatial interactions of GrSG predators with prey and other predator species.	APHIS, BLM, CDA, CDOW, Private Landowners, Universities, USFWS, USGS	Begin by 2015	\$600,000 / yr
<i>FROM PREDATION STRATEGY SECTION:</i>			
18.2.1.4 Evaluate relationships among GrSG predator species, including how GrSG predator species population levels change relative to each other.			
18.2.1.5 Investigate and evaluate the natural variability in GrSG predator populations.			
18.2.1.13 Investigate the roles of and relationships between native and non-native predators in the sagebrush ecosystem.			

<p>21.4.1.3 Evaluate the large-scale effects of landscape structure (e.g., composition and configuration of landcover types) and small-scale effects (e.g., perch site availability, vegetation structure, and predator exclosures) on GrSG predator-prey interactions.</p>	<p>APHIS, BLM, CDA, CDOW, Industry, Private Landowners, Universities, USFWS, USGS</p>	<p>Begin by 2015</p>	<p>\$100,000 / yr</p>
<p><i>FROM INFRASTRUCTURE STRATEGY SECTION:</i> 13.4.1.1 Evaluate the impact of utility corridors, communication towers, wind turbines and other infrastructure on predator effectiveness and resulting effects on GrSG populations.</p>			
<p><i>FROM PREDATION STRATEGY SECTION:</i> 18.2.1.7 Investigate the influence of GrSG habitat on predation rates.</p>			
<p>18.2.1.8 Investigate how predation rates on GrSG are influenced by the natural temporal and spatial variability in sagebrush ecosystems (e.g., plant age class, fire intervals).</p>			
<p>18.2.1.9 Investigate the quantity of habitat (i.e., patch size) needed to sustain GrSG. [Also under 21.1.1.1]</p>			
<p>18.2.1.10 Investigate how invasive weed species impact predation rates on GrSG.</p>			
<p>18.2.1.12 Evaluate the impact of infrastructure, powerlines, roads, and fences on predation rates in GrSG populations.</p>			
<p>21.4.1.4 Evaluate whether predator control aimed at specific predator species is an effective management tool that increases production and recruitment of sage-grouse in local populations.</p>	<p>APHIS, BLM, CDA, CDOW, CSU Extension, Industry, LWGs, NRCS, Private Landowners, Universities, USFS, USFWS, USGS</p>	<p>Begin by 2015</p>	<p>\$300,000/ year</p>
<p>21.4.1.5 Evaluate the spatial and temporal interactions between different trophic levels (e.g., predators and prey) and between similar trophic levels (e.g., examine the impact of grazing by deer and elk on the quality of sagebrush habitats and its effect on sage-grouse behavior and productivity).</p>	<p>APHIS, BLM, CDA, CDOW, CSU Extension, Industry, LWGs, NRCS, Private Landowners, Universities, USFS, USFWS, USGS</p>	<p>Begin by 2015</p>	<p>\$500,000/ year</p>

<p>ISSUE 21.5: WNV is lethal to GrSG and has been detected in Colorado, but few details are known about its potential impact on GrSG.</p>			
<p>OBJECTIVE 21.5.1: Investigate the potential impacts of WNV on GrSG populations in Colorado.</p>			
<p style="text-align: center;">Conservation Strategy</p>	<p style="text-align: center;">Responsible Parties <i>(if there is a lead entity, it is in bold)</i></p>	<p style="text-align: center;">Timeline</p>	<p style="text-align: center;">Cost</p>
<p>21.5.1.1 Determine the level of susceptibility to WNV and survival patterns of each GrSG age and sex class. Examine whether sage-grouse can develop immunity to WNV and whether the immune response can be inherited</p>	<p>CDOW, NWRC, Other Research Institutions, Universities</p>	<p>Ongoing</p>	<p>\$50,000/yr</p>

<i>FROM DISEASE STRATEGY SECTION:</i> 2.1.1.3 Continue to support investigation of GrSG susceptibility to, and inheritance of, immunity to WNV.			
21.5.1.2 Examine the spatial interaction of mosquito species that are the main vectors of the virus (e.g., <i>Culex tarsalis</i> and <i>C. pipiens</i>) with seasonal habitat use by GrSG (e.g., evaluate whether sage-grouse are more likely to be exposed to the virus in relatively wetter brood-rearing habitat than in lekking and nesting habitats).	CDOW, Other Research Institutions, Universities	Begin by 2010	\$100,000/yr
<i>FROM DISEASE STRATEGY SECTION:</i> 2.1.1.4 Determine the impact of wet conditions on mosquito production as it relates to the potential for catastrophic disease in GrSG. Determine the risk factors and potential of catastrophic disease in GrSG populations. [Also under 21.5.1.3]			
21.5.1.3 Examine the potential impact of WNV on GrSG population dynamics and viability.	CDOW, Other Research Institutions, Universities	Ongoing	Conducted with current research
<i>FROM DISEASE STRATEGY SECTION:</i> 2.1.1.4 Determine the impact of wet conditions on mosquito production as it relates to the potential for catastrophic disease in GrSG. Determine the risk factors and potential of catastrophic disease in GrSG populations. [Also under 21.5.1.2]			

ISSUE 21.6: There is a lack of credible research on the theories of additive and compensatory mortality and sport harvest of GrSG.			
OBJECTIVE 21.6.1: Foster and support the research and the collection of data to gain knowledge about additive and compensatory mortality thresholds and sport harvest in GrSG.			
Conservation Strategy	Responsible Parties <small>(if there is a lead entity, it is in bold)</small>	Timeline	Cost
21.6.1.1 Initiate experimental field research designed to specifically address the issue of compensatory and additive mortality and GrSG. Collaborate with other western states that hunt GrSG.	CDOW	Begin 2008, Continue 5 - 10 years	200,000/yr.
<i>FROM HUNTING STRATEGY SECTION:</i> 11.2.1.1 Initiate experimental field research designed to specifically address the issue of compensatory and additive mortality and GrSG. Collaborate with other westerns states that hunt GrSG.			

ISSUE 21.7: Small isolated populations of greater sage-grouse may have low genetic diversity, which may facilitate inbreeding depression.			
OBJECTIVE 21.7.1: Monitor genetic diversity within the smaller isolated populations of greater sage-grouse in Colorado.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
21.7.1.1 Continue to develop and refine, if it proves feasible, techniques to obtain DNA from sage-grouse fecal droppings so that genetic testing can be accomplished without capturing birds.	CDOW, Universities	Ongoing	\$25,000
<i>FROM GENETICS STRATEGY SECTION:</i> 5.2.1.2 Continue to develop and refine, if it proves feasible, techniques to obtain DNA from sage-grouse fecal droppings so that genetic testing can be accomplished without capturing birds.			

ISSUE 21.8: Current methods for monitoring trends in GrSG populations and for estimating GrSG population size from lek counts make many unsupported assumptions.			
OBJECTIVE 21.8.1: Conduct research to establish reliable and effective methods for monitoring GrSG population trends and estimating population size.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
21.8.1.1 Develop and evaluate protocols for the inventory and monitoring of GrSG populations and to evaluate factors that influence the population ecology of GrSG.	CDOW, Universities	Begin by 2010	\$200,000/year
<i>FROM POPULATION MONITORING STRATEGY SECTION:</i> 17.1.1.1 Maintain consistent current GrSG lek count protocols (include searching for new leks), but use research results to establish protocols for future population monitoring and record keeping, including mechanisms to assure consistent implementation and reporting.			
17.1.1.2 Develop statistically defensible methods to estimate GrSG population size and/or trends.			
21.8.1.2 Evaluate whether GrSG lek counts can be calibrated and measurements of accuracy and precision can be assessed using mark-resight or sightability models.	CDOW, Universities	Begin by 2010	In conjunction with 21.8.1.1
<i>FROM POPULATION MONITORING STRATEGY SECTION:</i> 17.1.1.2 Develop statistically defensible methods to estimate GrSG population size and/or trends.			

21.8.1.3 Evaluate alternative methods for estimating GrSG population abundance (e.g., line transects or DNA fingerprinting using fecal samples).	CDOW, Universities	Ongoing	\$50,000/ year
<i>FROM POPULATION MONITORING STRATEGY SECTION:</i> 17.1.1.2 Develop statistically defensible methods to estimate GrSG population size and/or trends.			
21.8.1.4 Determine the causes of mortality in different GrSG age and sex classes and the consequences for population dynamics.	APHIS, BLM, CDA, CDOW, CSU Extension, Industry, LWGs, NRCS, Private Landowners, Universities, USFS, USFWS, USGS	Begin by 2015	\$200,000/ year
21.8.1.5 Examine the correlation (and time lag) between the variation in annual GrSG productivity and subsequent lek counts and its impact on the precision of population estimates.	BLM, CDA, CDOW, CSU Extension, Industry, LWGs, NRCS, Private Landowners, Universities, USFS, USFWS, USGS	Begin by 2010	In conjunction with 21.8.1.3 & 21.8.1.4
<i>FROM POPULATION MONITORING STRATEGY SECTION:</i> 17.1.1.2 Develop statistically defensible methods to estimate GrSG population size and/or trends.			
21.8.1.6 Refine the population viability assessment of GrSG based on more accurate and precise estimates of demographic parameters.	BLM, CDA, CDOW, CSU Extension, Industry, LWGs, NRCS, Private Landowners, Universities, USFS, USFWS, USGS,	Ongoing	Data is collected with other research

22. Weather

Weather patterns within GrSG range in Colorado can be unpredictable and extreme. The variability and irregular nature of severe weather can pose problems to wildlife managers, and one severe winter or dry spring may impact populations for many years. Weather is one factor that cannot be controlled and generally cannot be planned for by wildlife managers. The primary weather issue that can be anticipated is drought. Managers can mitigate for dry periods with strategically placed water developments and other management planning. For further discussion, see “Weather” issue, pg. 186.

ISSUE 22.1: There is a need to understand weather impacts on GrSG survivability and reproduction.			
OBJECTIVE 22.1.1: Investigate GrSG responses to drought and wet conditions.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
22.1.1.1 Review the literature and existing data regarding whether drought, precipitation, or temperature extremes during specific times of the year have a negative or positive effect on GrSG survivability and reproduction. Also search the literature regarding the effect of climatic conditions on insect and forb availability, as it pertains to the survivability of GrSG broods.	CDOW, Other Research Organizations, Universities	2009	0.25 FTE

ISSUE 22.2: There is a need to address drought impacts on GrSG survivability and reproduction.			
OBJECTIVE 22.2.2: Manage GrSG habitats in anticipation of drought conditions.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
22.1.2.1 Develop springs, wells, and other water sources, in appropriate GrSG areas, to provide reliable water and forb/insect production during drought conditions. Consider appropriate fencing to protect these areas for sage-grouse use.	BLM, CDOW, NRCS, Private Landowners, USFWS	2006 and ongoing	\$10,000 /project
22.1.2.2 Manage invasive species in riparian, wet meadow, and uplands in GrSG range to improve the water table (see “Weeds” strategy, pg. 410).	BLM, CDOW, County Governments, NRCS, Private Landowners, USFWS	2006 and ongoing	\$50-150/acre

<p>22.2.2.3 Educate the public and agencies on management that affects riparian and wet meadow areas used by GrSG. [See Information, Communication, and Education Strategies 12.2.1.3 and 12.3.1.1]</p>	<p>See Information, Communication, and Education Strategies 12.2.1.3 and 12.3.1.1</p>		
<p>22.2.2.4 In areas experiencing sagebrush mortality due to drought, adjust grazing practices, prescriptive fire, and/or vegetation management to minimize additive impacts on GrSG (see “Fire and Fuels Management” [pg. 321], “Grazing” [pg. 329] and “Habitat Enhancement” [pg. 336] strategy sections).</p>	<p>BLM, CDOW, Private Landowners, USFWS</p>	<p>As needed.</p>	<p>0.1 FTE</p>
<p>22.2.2.5 Encourage land managers to reduce herbivory, and adjust prescriptive fire and/or vegetation management during times of drought.</p>	<p>BLM, CDOW, Private Landowners, USFWS</p>	<p>As needed.</p>	<p>0.1 FTE</p>
<p>22.2.2.6 Develop grass banks for livestock producers to graze during extreme drought conditions (see “Grazing” strategy, pg. 329).</p>	<p>BLM, CDOW, LWGs, NRCS, Private Landowners, SLB, USFS, USFWS</p>	<p>2007 and ongoing</p>	<p>\$12-16/AUM</p>
<p>22.2.2.7 Review agency policies and practices to explore adjusting agency policy (if deemed necessary) for the benefit of selected GrSG habitats during drought conditions.</p>	<p>BLM, CDOW, USFWS</p>	<p>2007 and ongoing</p>	<p>0.1 FTE</p>

23. Weeds: Noxious and Invasive Plants

Noxious and invasive weeds may impact rangeland health in much of GrSG range in Colorado (see weeds threats section for definition of noxious weeds). Invasive and/or noxious weeds have become established in some GrSG occupied habitats, altering the suitability of the habitat for GrSG. Once these plants become established they are difficult to control and restoration of native plant diversity is difficult. The most effective method of control is preventing establishment by systematic scouting, taking actions to prevent spreading weed seeds, and treatment when infestations are small. When infestations are located, quick action using the most effective and environmentally acceptable treatments is needed. An Integrated Pest Management approach that utilizes alternatives such as grazing (cultural) and biological treatments should be emphasized. All land management agencies and private land owners should coordinate and develop Integrated Pest Management plans that involve periodic scouting, identify effective methods of control, and can be applied on a landscape scale across property boundaries. For further discussion, see “Weeds” issue, pg. 187.

ISSUE 23.1: There is a lack of information on invasive weed distribution in GrSG range in Colorado.			
OBJECTIVE 23.1.1: Gather and share information regarding the distribution of noxious and invasive weeds in GrSG range.			
Conservation Strategy	Responsible Parties <small>(if there is a lead entity, it is in bold)</small>	Timeline	Cost
23.1.1.1 Continue to cooperatively identify, map, and monitor undesirable noxious and invasive weed invasions that occur within GrSG habitat.	BLM, CDOW, County Governments, LWGs, NPS, NRCS, SCDs, SLB, USFS	Ongoing	\$200,000/yr
23.1.1.2 Inform local work groups of identified invasive weed problems in GrSG range.	BLM, CDOW, County Governments, NPS, NRCS, SCDs, SLB, USFS	Ongoing	0.25 FTE

ISSUE 23.2: Within GrSG habitat, noxious and invasive weeds may adversely impact GrSG habitat.			
OBJECTIVE 23.2.1: Minimize the impacts of noxious and invasive weeds on GrSG habitat.			
Conservation Strategy	Responsible Parties (if there is a lead entity, it is in bold)	Timeline	Cost
23.2.1.1 Prevent new damaging invasions of noxious and invasive weeds in GrSG habitat. This refers to both new infestations of known weedy species and future infestations of as-yet-unidentified weed species. Coordinate efforts across property boundary lines.	BLM, CDOW, County Governments, LWGs, NPS, NRCS, SCDs, SLB, USFS, USFWS	Ongoing	Project-specific (\$) and 0.5 FTE/county
23.2.1.2 Conduct local workshops emphasizing the prevention of new weed infestations. Include topics on cleaning equipment and vehicles including recreational equipment, minimizing ground disturbance, and spread of seeds.	BLM, CDOW, County Government , Industry, LWGs, NRCS, SCDs, SLB, USFS, USFWS	2008	.1 FTE
23.2.1.3 Treat all new and existing noxious weed infestations. Treatments may include biological controls, cultural controls such as grazing (see “Grazing” strategy, pg. 329), chemical controls and any other method considered safe and effective. Coordinate efforts across boundary lines. See “Habitat Enhancement” strategy, pg. 336.	BLM, CDOW, County Governments, LWGs, NPS, NRCS, SCDs, SLB, USFS, USFWS	Ongoing	Project – specific (\$) and 0.5 FTE (County)
23.2.1.4 Monitor the effectiveness of treatments of noxious and invasive weeds in GrSG habitat.	BLM, CDOW, County Governments, LWGs, NPS, NRCS, SCDs, SLB, USFS, USFWS	Ongoing	0.5 FTE/county
23.2.1.5 Keep land managers informed of the latest technology in habitat restoration techniques for weed-infested areas in GrSG habitat by providing periodic technology transfer workshops. [See also Information, Communication, and Education Strategies 12.2.1.3 and 12.3.1.1]	BLM, CDOW, County Governments, LWGs, NRCS, USFS	Every 5 years starting in 2008	\$50,000 / workshop

ISSUE 23.3: Within GrSG habitat, there is a need for information sharing and coordination among weed managers.			
OBJECTIVE 23.3.1: Improve communication and coordination among those involved with weed and pest management within GrSG range.			
Conservation Strategy	Responsible Parties <small>(if there is a lead entity, it is in bold)</small>	Timeline	Cost
23.3.1.1 The local weed program manager or other entities will keep a database of all lands with developed weed management plans, within occupied GrSG habitat.	BLM, CDOW, County Governments, LWGs, NPS, NRCS, SCDs, SLB, USFS	Ongoing	0.5 FTE
23.3.1.2 Inform local weed program managers of all pest management plans developed within GrSG range.	BLM, CDOW, County Governments, LWGs, NPS, NRCS, SCDs, SLB, USFS	Ongoing	See strategy 23.2.1.1.
23.3.1.3 Organize and participate in annual workshops with all land managers to identify the most threatening weed problems in GrSG habitat, and to prioritize efforts for control. [See also Information, Communication, and Education Strategies 12.2.1.3 and 12.3.1.1]	BLM, CDOW, County Governments, Industry, LWGs, NRCS	Ongoing	\$5,000/yr and 0.25 FTE

ISSUE 23.4: There is a lack of funding for developing integrated weed management plans, and for application of weed control treatments.			
OBJECTIVE 23.4.1: Identify and provide funding for land managers to scout, map, develop management plans for, and apply treatments to address invasive and noxious weeds.			
Conservation Strategy	Responsible Parties <small>(if there is a lead entity, it is in bold)</small>	Timeline	Cost
23.4.1.1 Encourage land management agencies and industry to fund integrated weed management programs in GrSG range.	BLM, CDOW, County Governments, Industry, LWGs, NRCS, SLB, USFS	On-going	0.25 FTE
23.4.1.2 Develop a list of funding opportunities for invasive and noxious weed management.	LWGs, NRCS	2007	0.25 FTE