# Final Memo 4-C

## Northern Basin and Range and Snake River Plain Ecoregion Rapid Ecoregional Assessment

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# NORTHERN GREAT BASIN ECOREGION

## Rapid Ecoregional Assessment

**FINAL MEMORANDUM 4-c**

**December 2012**

This document was submitted for review and discussion to the Bureau of Land Management and does not reflect BLM policies or decisions

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# Acronyms

| | |
|---|---|
| ACEC | Area of Critical Environmental Concern |
| AFB | Air Force Base |
| AMT | Assessment Management Team |
| BLM | Bureau of Land Management |
| CA | Change Agent |
| CAFO | Concentrated Animal Feeding Operations |
| CE | Conservation Element |
| DOD | Department of Defense |
| DOE | Department of Energy |
| DOI | Department of Interior |
| DQE | Data Quality Evaluation |
| EI | Ecological Integrity or Intactness |
| EPA | Environmental Protection Agency |
| EPCA | Energy Policy Conservation Act |
| ESA | Endangered Species Act |
| ESRI | Environmental Studies Research Institute |
| FAA | Federal Aviation Administration |
| ft | feet |
| GIS | Geographic Information System |
| GSG | Greater Sage-Grouse |
| HMA | Herd Management Area |
| HUC | Hydrologic Unit Code |
| KEA | Key Ecological Attribute |
| km | kilometer |
| MIR | Middle Rockies |
| MTBS | Monitoring Trends in Burn Severity |
| MQs | Management Question |
| NAD | North American Datum |
| NADN | National Atmospheric Deposition Network |
| NAIP | National Agricultural Imagery Program |
| NGB | Northern Great Basin Ecoregion |
| NCA | National Conservation Areas |
| NDOW | Nevada Department of Wildlife |

| | |
|---|---|
| NEPA | National Environmental Policy Act |
| NHD | National Hydrographic Dataset |
| NHP | Natural Heritage Program |
| NISIMS | National Invasive Species Information Management System |
| NWI | National Wetlands Inventory |
| NWP | Northwestern Great Plains |
| OHV | Off-Highway Vehicle |
| PADS | Protected Areas Database |
| PPH | Preliminary Priority Habitat |
| PRISM | Parameter-elevation Regressions on Independent Slopes Model |
| REA | Rapid Ecoregional Assessment |
| RRT | Rolling Review Team |
| SAIC | Science Applications International Corporation |
| sq. km | square kilometers |
| SOW | Statement of Work |
| SDA | Specially Designated Area of Ecological and/or Cultural Value |
| TIGER | Topologically Integrated Geographic Encoding and Referencing |
| USDA | US Department of Agriculture |
| USFS | US Forest Service |
| USFWS | US Fish and Wildlife Service |
| USGS | US Geological Survey |
| VCC | Vegetation Condition Class |
| WAFWA | Western Association of Fish and Wildlife Agencies |
| WGA | Western Governors Association |
| WHRC | Woods Hole Research Center |
| WNV | West Nile Virus |

# 1. Introduction

The Northern Great Basin (NGB) Rapid Ecological Assessment (REA) is intended to characterize the current status (baseline conditions) and forecast the future condition of ecological resources in this ecoregion. Because it is not feasible to create an assessment of all of the individual ecological resources that are present in the ecoregion, such as species or ecosystems, conducting the REA involves selecting important, specific resource values throughout the ecoregion and carrying them through the assessment of change agent effects. This document presents the results of Phase I Task 4 of the REA, which specifically calls for the development of Work Plan. This REA Work Plan outlines the approach that will be used to complete the geoprocessing and analysis tasks (Phase 2) of the REA and the final REA document. The purpose of this document is to summarize decisions made at Assessment Management Team (AMT) Workshop 4 and provide as much detail as possible so that the AMT has a clear understanding of the datasets and models that will be used, the process and analysis that will be completed, and how the results will be measured and presented. Because the data collection task occurs after the REA work plan submittal, it is expected that some management questions (MQs), conservation elements (CEs), and change agents (CAs) may be dropped or altered based on data availability and quality. These decisions will be made by the AMT and be appropriately documented in the final REA document.

This memo is also intended to document data availability for CEs and CAs, management questions, modeling approaches and, most importantly, how Phase 2 of the REA will be completed. The AMT is comprised of resource specialists from the Bureau of Land Management (BLM) and other state, federal, and stakeholder scientists and planners. The US Geologic Survey (USGS) provides scientific peer review for the REA.

## 1.1 The Rapid Ecological Assessment Process

The BLM is currently evaluating a wide variety of environmental challenges to western ecosystems. Because these challenges transcend land ownership and administrative jurisdictions, they necessitate a landscape-scale approach to evaluation of these ecosystems. The REA process is the BLM's first step toward a broader initiative to systematically develop and incorporate landscape-scale information into the evaluation and management of public land resources.

REAs encompass an ecoregion to more fully understand ecological conditions and trends; natural and human influences; and opportunities for resource conservation, restoration, and development. They seek to identify important resource values and patterns of environmental change that may not be evident when managing smaller, local land areas. REAs describe and map areas of high ecological value. REAs then gauge the potential of these values to be affected by environmental CAs. REAs are called "rapid" assessments because they synthesize existing information, rather than conduct research or collect new data, and are generally completed within 18 months.

REAs are organized into various phases, with specific tasks in each phase (Table 1-1). Phase 1 is the pre-assessment, and includes four tasks including finalization of the MQs, CAs, and CEs that the REA will attempt to answer. In a departure from the order of tasks in previous REA efforts, Phase 1, Task 2 includes development of conceptual models to understand the process framework of the CEs. Geo-processing models, work-flows, and applied data tools will be developed under Phase 1, Task 3. The final task under Phase 1 will include the preparation of the REA Work Plan (Task 4).

***Table 1-1. REA Phases and Tasks***

| Phase | Task # | Product |
|---|---|---|
| I. Pre-assessment | 1 | Refine MQs (Complete) |
| | 2 | Identify, Evaluate, and Recommend Conceptual Models (Complete) |
| | 3 | Identify, Evaluate, and Recommend Geoprocessing Models, Methods, and Tools (Complete) |
| | 4 | **Prepare REA Work Plan (Subject of this Memo)** |
| II. Assessment | 1 | Compile and Generate Source Datasets (In Process) |
| | 2 | Conduct analyses and generate findings (In Process) |
| | 3 | Prepare REA report, maps, and supporting documents |

Phase 2 is the assessment itself, and includes an analysis of the data relative to the identified CAs and CEs, documentation of the results, which then will culminate into the REA document to guide BLM and other land managers in developing and prioritizing planning and management strategies.

## 1.2 Document Contents and Organization

This memo is divided into sections based on information needed to complete Phase 2 of the REA process. Section 2 presents the initial tasks 1 through 3 of Phase 1 of the REA. Section 3 gives a brief summary of the current list of CEs, CAs and MQs and Section 4 describes uncertainty and what value the REA products could provide. Section 5 describes subject matter expert review and what the Rolling Review Team functions will be. Section 6, 7, 8 and 9 discuss Phase 2 of the REA and what tasks still need to be completed.

Because the primary purpose of the final REA document (Phase 2 Task 3) is to answer MQs, Section 8 of this Work Plan takes a top down approach looking at each of the MQs. The AMT initially decided to adopt the MQs from the Central Basin and Range REA, and as such, each one here is evaluated as to whether a clear and concise approach can be decided upon to answer each MQ.

# 2. Overview of Tasks 1-3

## 2.1 Task 1 – Defining Management Questions, Change Agents and Conservation Elements

### 2.1.1 Management Questions

The Science Applications International Corporation (SAIC) team presented the screened list of 55 management questions (MQs) from the Scope of Work (SOW) to the AMT in the pre-workshop memo prior to Assessment Management Team (AMT) Workshop 1. However, it was determined at AMT Workshop 1 that the MQs developed for the adjacent and similar ecoregion, Central Basin and Range (CBR) Rapid Ecoregional Assessment (REA), would best represent the Northern Great Basin (NGB) as well as provide desirable consistency between the adjacent ecoregional assessments. The MQs from CBR were refined (i.e., rewording, removals, and additions) throughout that REA process; therefore were considered suitable as a starting point for the NGB. This set of MQs was discussed and further refined during the AMT Workshop and conference calls. In addition to CBR MQs, the NGB AMT determined that it was appropriate and necessary to include MQs related to grazing both as a change agent (CA) and conservation element (CE). As a result, eight additional grazing-focused MQs were developed and included in final Memo 1, for a total of 78 draft MQs.

The complete list of draft MQs from the final Memo 1 is presented in Appendix A. During AMT Workshop 4, the AMT went back over the MQs to better define wording and remove questions that will not be used in the REA. Appendix A provides a summary of AMT guidance on each revised MQ. The final updated MQ list (as of this memo) is presented in Section 3.1.

### 2.1.2 Change Agents

Successful completion of this REA will in part be based on a sound understanding of the ecoregional or landscape-scale CAs and their potential effects on ecological values throughout this ecoregion. CAs are natural or anthropogenic disturbances that influence the current and future status of CEs. Change agent effects can be positive or negative depending on the CE. The initial CAs for this ecoregion were outlined by the AMT in the SOW. The REA process focuses on regionally significant CAs that operate and impact on large scales, not on a site-by-site basis. SAIC included these CAs and consulted sources such as state wildlife action plans (SWAPs), existing literature on threats, and regional experts to develop the CAs described in Appendix B.

Historically, a variety of CAs in the NGB ecoregion included natural fire cycles, mining, hydrologic alteration, and grazing and other agricultural uses. More recently, the suppression of fire, urban development, energy resource development and infrastructure, recreation in natural areas, non-native species invasions, and the changes in climate patterns have played larger roles.

### 2.1.3 Conservation Elements

As noted in the Introduction, because it is not feasible to create an assessment of all of the individual ecological resources present within the ecoregion, such as species or ecosystems, conducting the REA involves selecting important, specific resource values and carrying them through the assessment of change agent effects. These selected resources are referred to as CEs and will be the objects of assessment that represent current condition and future status and trends. As stated in the REA SOW, "Conservation elements are the 'what' that are to be conserved and/or restored." The SOW further defines classes of CEs as species, ecosystems and landscapes, and scenery/special values recognized as warranting conservation/protection.

Identification of the CEs included consideration of the following Core Ecological Values identified by BLM and discussed with the AMT. These Core Ecological Values include:

1. Native fish, wildlife, or plants of regional conservation concern (e.g., populations, species, or communities identified in state wildlife action plans [SWAPs]; species listed under the Endangered Species Act (ESA); species and communities identified through other agency/non-governmental organization assessments; etc.).
2. Regionally-important, terrestrial ecological features, functions, and services (e.g., large areas of native vegetation providing important cover, fiber, and forage; habitat strongholds and corridors; upland areas important for water quality or water supply; areas capable of significant carbon sequestration; etc.).
3. Regionally-important, aquatic ecological features, functions, and services (e.g., habitat strongholds and corridors; wetland, riparian, and other aquatic areas important for water quality, water supply, stream bank stability, flood control, and similar purposes).

### Coarse-filter Selection

Coarse-filter CEs will include all of the major ecosystem types that occur within the ecoregion, and should represent all of the predominant natural ecosystem functions and services in the ecoregion. The desired outcome of coarse-filter selection is to provide coverage for the vast majority of species that occur in the ecoregion. The AMT provided a list of coarse-filter CEs to be used for the NGB in the SOW. These are presented in Appendix C.

The selected suite of coarse-filter CEs encompasses the habitat requirements of most characteristic native species, and ecological functions and values in the region, described in detail in Section 3.3.1. As explained, careful selection of fine-filter species as CEs will ensure that resources of particular interest to the AMT and local agency managers, which may not be obvious within coarse-filter CEs, are included in the REA.

### Fine Filter Selection

The primary criterion for selecting fine-filter CEs is that they should be native species of regional management concern. Other guidance included focusing on species for which management by one BLM field office may affect management concerns of other BLM field offices (i.e., these species have trans-boundary management issues). CE species are not only surrogates for other species of concern, they should be of concern themselves. The following additional criteria reflect AMT workshop guidance and were used to refine the list of candidate fine-filter CEs:

- Appropriateness of the CE for answering MQs (e.g., vulnerability to CAs that can be readily measured or categorized in the REA);
- strong association with one or more coarse-filter CEs (e.g., species that require sagebrush habitat);
- association with a species group or assemblage being carried forward as a CE (e.g., fish species included in the cold water fish species assemblage); and
- lack of consensus among the AMT to carry the species forward as a fine-filter CE also affected fine-filter CE selections. Discussion points for not carrying a species forward included:
    - insufficient ecological knowledge;
    - not a landscape species;
    - not particularly susceptible to CAs covered in this REA; and/or
    - not of regional significance or strong agency concern throughout the ecoregion.

These criteria were used to refine the candidate list of fine-filter CEs in the SOW that will be carried forward in subsequent tasks of this REA. Appendix D provides the rationale and AMT guidance on including or eliminating CEs from the preliminary list of CEs. In some cases, for example, cold water fish species, individual species were combined into assemblages following discussion with AMT fisheries experts. The AMT also provided guidance on emphasizing life cycle stages for certain CEs based on their vulnerability to CAs at those times (e.g., migratory corridors for the golden eagle).

### 2.1.4 Conservation Elements for Future REA Consideration

During the course of review of SAIC's draft memos, some recommendations were made for consideration of species groups not listed as potential CEs in the SOW. USGS review of Memo 2 provided several recommendations for additional CEs in this REA. These groups include:

- Freshwater Mussels. A recent status review of several freshwater mussels (*Margaritifera falcata*, *Gonidea angulata*, and *Anodonta californiensis/Anodonta nuttalliana*) that inhabit the U.S. west of the Rocky Mountains indicates that severe declines have occurred in parts of the ranges of each of the species or species groups, and all three are of conservation concern (Xerces Society 2012). These are widely distributed species in western states, but have declined or have been extirpated from historically occupied sites in NGB. The Xerces Society reports state that there is a paucity of information on the biology and status of western freshwater mussels. These species are sedentary as adults and long-lived, and are sensitive to water quality changes, flow regime changes, water impoundments and diversion, loss of host fish, and introduction of non-native fish and invertebrates.
- Isolated endemic fish species. This group would include ESA-listed species such as Borax Lake Tui Chub (*Gila boraxobius*), Foskett Springs Speckled Dace (*Rhinichthys osculus ssp.)*, Hutton Tui Chub (*Gila bicolor ssp.*), and Warner Sucker (*Catostomus warnerensis*), and possibly other endemic species that have very limited distribution. These species are vulnerable to local land and water use impacts, drought, and predation by introduced species.
- Hydrobiid springsnails. This group includes species that occur in persistent aquatic habitats that are scattered throughout the Great Basin. Forty-two species of Great Basin springsnails have been petitioned for listing under the ESA. Threats include groundwater withdrawal, spring development, water quality, and non-native invasive species.

There is considerable uncertainty about aquatic species in this ecoregion including 1) uncertainty about the taxonomic status of many species; 2) incomplete surveys and unknown sampling biases; and, 3) inconsistent documentation among states or other institutions. Their distribution probably reflects hydrological connections that no longer exist, and cannot be easily modeled. At present, compiling data, some of which will likely not be geospatial or recent, from a number of potential sources would at best, result in an incomplete distribution layer with many significant data gaps. However, we recognize that aquatic taxa are among the most vulnerable groups in the ecoregion because water is a scarce resource, it is sensitive to human influences and exploited for development, and aquatic species have limited ability to move or adapt to these impacts. Therefore, this Work Plan calls attention to these groups in this work plan as important subjects for future REAs.

With respect to the freshwater mussels, there are important data gaps for these species, including their taxonomy, distribution, host fish species, and CA effects that would limit our ability to conduct a threat analysis at present. There are likely comparable data issues for isolated endemic fishes and springsnails.

Possible CE species with limited distribution or isolated habitats were discussed at AMT Workshop 1 and follow-up discussions. The AMT initially listed a non-specific warm-water fish assemblage CE in the

SOW, and SAIC suggested several species, but the AMT decided in Workshop 1 not to carry them forward as CEs because distribution mapping would be inadequate. The northern leatherside chub was also dropped as a CE because its range is limited. In general, the AMT selected widespread CEs for this assessment. Some occupy a broad range of habitats and they became species CEs because their requirements would not be adequately covered by the "umbrella" of a coarse filter CE. Other species that occur as isolated populations may be better suited to assessment using a habitat-focused surrogate CE, such as wetlands, seeps and springs. In addition, we think that threat analysis at the ecoregional scale would likely miss many localized impacts on these small populations, and would be more appropriate in a drill-down field office-level effort. However, we do have a management question (revised to ask "Where do spring snails occur?") that was discussed at Workshop 4, and we will attempt to document survey locations and occurrence data for spring snail occurrences. As a result, the authors suggest that freshwater mussels, isolated endemic fish and mollusk species be carried forward in the REA as species with limited data availability and other uncertainties at present that deserve consideration in future REAs.

USGS review of the CEs also focused on anadromous fishes, noting that the NGB historically supported runs of Chinook salmon, steelhead, and Pacific lamprey, and they have the potential to be restored if barriers to passage are removed. However, the AMT considered and eliminated Chinook, sockeye, summer steelhead, and Pacific lamprey as potential CEs in AMT Workshop 1 because they do not currently occur in the ecoregion and the timeframe for removing barriers and recolonization is unknown and would likely be outside the timeframe of the REA.

## 2.2 Task 2 – Conceptual Models

*Conceptual models are to be used* [in the context of this REA] *to (1) provide a science-based context as to how conservation elements interact with one another and how they may be driven to change by change agents; (2) identify if the manaugement questions are missing critical ecosystem attributes; (3) capture the best available understanding about ecological functioning and essential ecological attributes; and (4) depict the status (state) of conservation elements and the interactions among conservation elements and the change agents that drive ecological system (BLM 2011a).*

Natural systems are complex and many factors influence ecological processes. Conceptual models are useful for describing functional relationships among structure components of ecological systems (biotic, abiotic, and local- and landscape-level), and the effects of natural and human-influenced CAs (Miller *et al.* 2005). Well-constructed conceptual models provide a scientific framework and justification for the choice of indicators intended for use in assessing ecological integrity in landscape reporting units. Several types of conceptual models were considered for use in this REA, including control models and stressor models. Control models depict, in a mechanistic way, the actual controls, feedback, and interactions responsible for system dynamics (Gross 2003). Control models sometimes consist of sets of models that illustrate functional subsystems such as soils, fire, or nutrient flow. Stressor models depict relationships between stressors and ecosystem components, and often include indicators of the responses to stressors. Stressor models do not depict feedback and usually illustrate only a subset of system components (e.g., selected CEs in an REA). Since the purpose of these models is to illustrate sources of stress or disturbance in a system, and the responses of system components of interest, they generally do not present relationships in a mechanistic manner. Stressor models are an appropriate choice for CEs in this REA because they are better suited at illustrating the linkages between CAs and system components relied upon by the particular CE.

For the purposes of the REA, conceptual models should:

- provide scientific context and basis for answering MQs;
- be able to use reliable and available existing data;

- be easy to understand;
- meet REA constraints on schedule and cost; and
- be applicable and informative for BLM managers.

The following sections describe the current versions of conceptual models for fine-filter and coarse-filter CEs chosen for the NGB. For each fine-filter CE we present a system-level conceptual model that depicts the CE and the actions of CAs upon it, and if applicable, both on landscape and local scales.

### 2.2.1 Example Fine Filter Conservation Element: Greater Sage-grouse

#### Rationale for being a CE

As an example, the greater sage-grouse (GSG) is considered an umbrella species for sagebrush-associated vertebrates (Rowland *et al.* 2006, Hanser and Knick 2011). Indirect effects of sagebrush habitat loss, fragmentation, and degradation are thought to have caused the extirpation of the GSG from approximately 50 percent of its original range (Connelly and Braun 1997, Connelly *et al.* 2004, Schroeder *et al.* 2004), leading to a finding by the US Fish and Wildlife Service (USFWS) in 2010 that GSG warranted listing under the ESA.

#### Factors Related to the Distribution of the CE

The system model for GSG incorporates a life cycle model that indicates the major components of sagebrush ecosystems that are used during the course of the year (Connelly *et al.* 2011a) (Figure 2-1). There is considerable variation among populations with respect to migration distances, but some migratory populations move relatively large distances (often >20 kilometers [km]) between different seasonal habitats, and occupy large home ranges (>600 square kilometers [sq. km]). Life cycle components related to habitat (Connelly *et al.* 2011b) include: (1) Lek sites, which are typically located in natural or man-made openings within sagebrush communities. Sagebrush immediately surrounding lek sites (generally within 0.6 miles) is used for feeding, resting and cover from weather and security from predators when the birds are not on leks; (2) Nesting habitat, which requires a sagebrush canopy that provides cover from predation during the growing season; (3) Early brood-rearing habitat, which is characterized by the chicks' requirements for escape cover (sagebrush canopy) and food resources (primarily arthropods and forbs); (4) Summer and late brood-rearing, during which GSG may shift to areas that support green vegetation, such as riparian habitats, springs and seeps, and agricultural croplands, irrigated hayfields and high elevation meadows; (5) Winter habitat, in which the primary requirement is sagebrush exposed above the snow. Exposed sagebrush is used for feed and cover; GSG feed almost exclusively on sagebrush in the winter.

At the landscape scale, GSG require large, interconnected expanses of sagebrush ecosystems, with varying density and height of sagebrush cover, age, and moisture regimes (Doherty *et al.* 2008). Sagebrush steppe vegetation types are generally not considered resilient to frequent and substantial disturbance (Davies *et al.* 2009). Many semiarid systems are characterized by alternate stable states (vegetation conditions) resulting from different disturbance events, as described in greater detail in the coarse filter vegetation models (Section 2.3.1). Altering a native disturbance regime (e.g., fire frequency or grazing intensity) may drive a sagebrush community across a threshold to an alternate stable state (e.g., woodland). Because these details of transitions between sagebrush vegetation states are presented in a later section, they are not repeated in the GSG model. However, the GSG system model does indicate the relationships between the CAs that act upon the species' habitat needs.

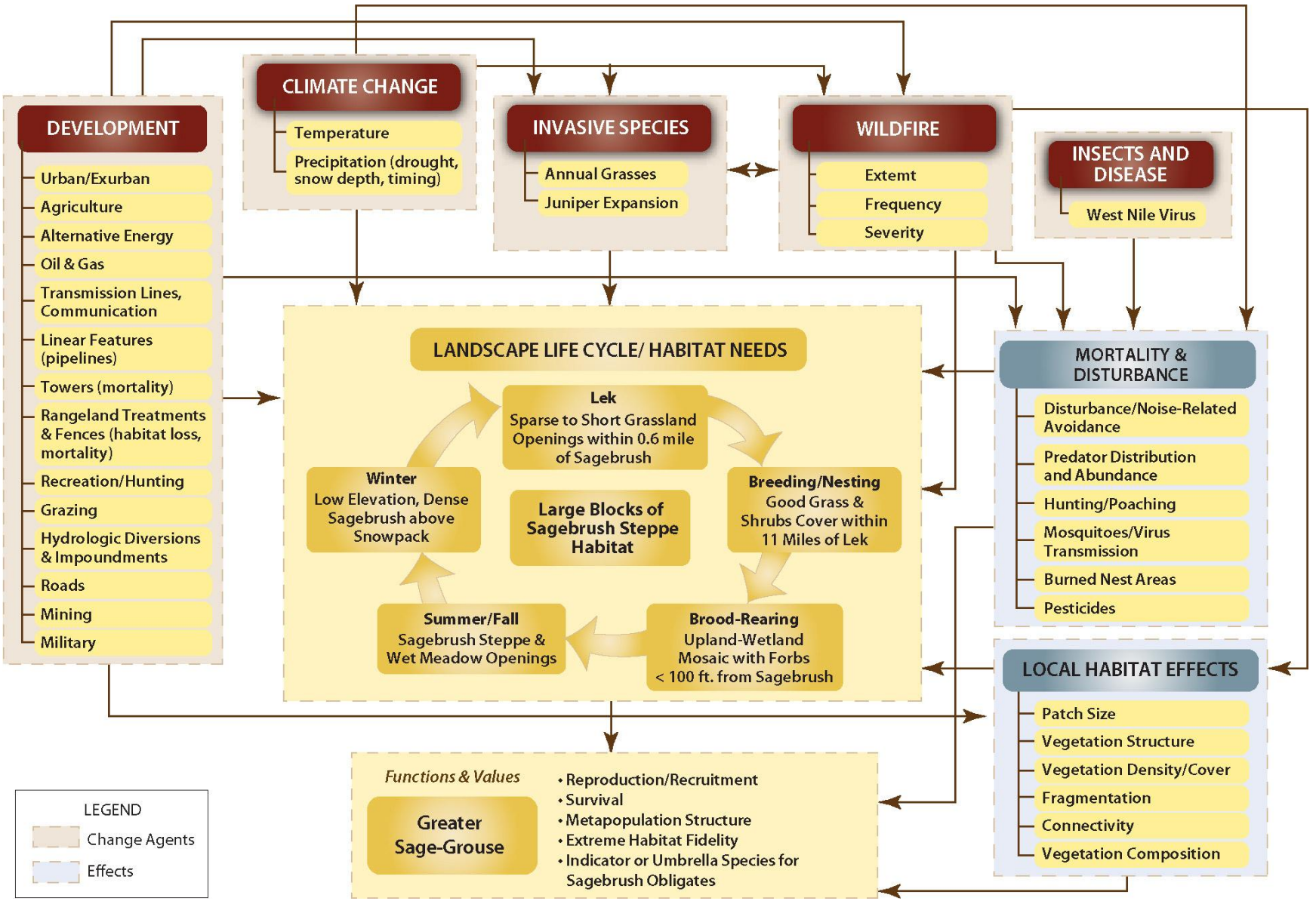


***Figure 2-1 Greater Sage-Grouse System Model***

## Key Change Agents

### *Development*

In the last few decades, developments including infrastructure expansion (e.g., roads, pipelines, and transmission lines), oil and gas exploration and development, mining, and establishment of wind farms in proximity to GSG leks, and in winter habitat, have directly reduced the amount of suitable habitat available for GSG, and introduced noise and human presence that may also have adverse effects (Hollaran 2005; Kaiser 2006; Aldridge and Boyce 2007; Doherty *et al.* 2008; Naugle *et al.* 2009; Harju *et al.* 2010). Livestock grazing may have positive or negative effects on GSG habitat. Grazing affects GSG habitat because livestock can deplete key understory forbs that are also consumed by GSG. Grazing can also have an effect on shrub cover, depending on the type of animal grazed and the season of grazing. Past grazing practices and some types of current grazing led or can lead to an increase in shrub cover by reducing competition for water and nutrients from the herbaceous layer. Prolonged grazing with cattle at high utilization levels and year-after-year grazing during the growing season has been shown to lead to increased shrub density and/or cover (Evers, 2010). Heavy utilization during severe drought can lead to a reduction in shrub cover (Evers 2010). Conversely, there is also evidence that grazing with sheep (and likely goats) in the early winter with sufficient snow cover can directly reduce shrub cover as the sheep focus on the shrub layer. Rangeland vegetation treatment practices formerly removed sagebrush, with adverse effects on GSG habitat, but current practices attempt to maintain adequate shrub cover while rejuvenating the understory component. Historic conversion of sagebrush to pasture, cropland or irrigated hayfields has been widely recognized as a dominant factor in the decline of GSG populations. Changes to the stand size or density of sagebrush, especially in winter habitat, reduce the suitability for GSG. On the landscape scale, reducing the land cover of sagebrush communities below 25 percent of a 30 km radius (i.e., the mean home range size) has been suggested as a strong predictor of GSG local extinctions (Aldridge *et al.* 2008) and landscapes with less than 60 percent are unlikely to have persisting GSG populations (Wisdom *et al.* 2011).

### *Climate Change, Wildfire, and Invasive Species*

Climate effects are expressed primarily as a range of suitable precipitation (Wisdom et al. 2011) and the frequency and duration of drought (Aldridge et al. 2008). Climate change will likely alter the atmospheric patterns that affect fire weather. Under natural conditions, fire return intervals long enough to maintain continued dominance of sagebrush in the shrub layer and low intensity fires promoted a mosaic of sagebrush-dominated communities that provided structural characteristics and species composition suited to the seasonal requirements of the greater sage-grouse for lekking, nesting, brood rearing, and winter survival. A warmer climate is expected to amplify the effects of drought and increase the number of days in a year with flammable fuels, (although in arid ecosystems increased drought may potentially reduce fuels) (McKenzie et al. 2011).

Invasive species occurrences and fire history are often linked, as shown in the coarse filter sagebrush model. On lower elevation, drier sites in the NGB ecoregion more frequent wildfires covering a larger extent have contributed to vegetation type conversion from Wyoming big sagebrush to invasive grass monocultures that increase fire extent and frequency (Crawford et al. 2004). Overall, fire extent is expected to increase in western rangelands (McKenzie et al. 2011).

The combined effects of climate change and the expansion of invasive annual species have resulted in wildfires now covering larger areas more frequently, reducing habitat quality and quantity for GSG (Connelly and Braun 1997, Connelly *et al.* 2000, Nelle *et al.* 2000, Fischer *et al.* 1996). In Wyoming big sage communities, invasion by annual grasses or weeds (e.g., cheatgrass, medusahead, ventenata) is the greatest threat, because these fuels increase the fire frequency from greater than 100 years to less than 10 years (Whisenant 1990). Increasing atmospheric $CO_2$ levels generally favor invasive species, including

cheatgrass, and cheatgrass has been shown to increase in flammability when grown under elevated atmospheric $CO_2$ concentrations (Blank *et al*. 2006). The predominant impacts of wildfire are expected to occur at the vegetation community level, as sagebrush sites shift from one state to another with changes in disturbance regimes. Evers (2010) suggested that under projected climate change, cooler and moister sagebrush communities (i.e., nesting and brood rearing habitat) would decrease substantially. Changes in fire severity (i.e., damage to aboveground and belowground organic matter) (Keeley 2009) are difficult to predict because both atmospheric conditions and finer-scale controls like topography play a role in determining the spatial pattern of fire severity, both for individual fires and for fire regimes in the aggregate (McKenzie et al. 2011). Ecosystem response to wildfire severity can be measured by changes in vegetation replacement, community structure, erosion, faunal recolonization, and other response variables (Keeley 2009).

Elsewhere fire suppression has promoted expansion of juniper woodland into mountain big sagebrush sites (Miller and Tausch 2001) which are now avoided by GSG. Tree establishment within sagebrush communities generally decreases forb availability due to moisture depletion (Crawford et al. 2000; Bates *et al.* 2000).

### *Mortality and Disturbance*

The GSG system model depicts CA effects related to direct mortality and disturbance. Direct loss of habitat was discussed under 'Development' above. In addition, GSG habitat adjacent to developed areas may be avoided by breeding GSG due to noise and disturbance, thereby further reducing suitable habitat availability in proximity to human developments (Holleran 2005; Doherty *et al.* 2008; Harju *et al.* 2010). Abandonment of GSG leks in response to power lines has been documented (Ellis 1987; Hall and Haney 1997; Braun 1998), presumably due to an increase in the number of raptors and ravens by offering them new or alternative nesting/perching structures (Gilmer and Wiehe 1977; Steenhof *et al.* 1993). Collision of GSG with transmission lines during flight is also a known source of mortality (Beck *et al.* 2006). Similar to power lines, collision with fencing has been shown to contribute to GSG mortality (Christiansen 2009, Gruver 2009) and wood fence posts may provide additional perches for avian predators. Predation has been shown to be a major cause of nest failure in poor habitats (Moynahan *et al.* 2007).

### *Disease*

West Nile virus (WNV), an important new source of mortality in GSG since its introduction in 1999, has the greatest potential for population-level effects among all parasites and infectious diseases identified in GSG (Christiansen and Tate 2011): WNV has been identified in GSG populations in 10 states and may result in persistent low-level mortality and possibly severe outbreaks leading to local and regional population declines (Walker and Naugle 2011). Its incidence is probably related to the increase in available surface water (breeding sites for the WNV mosquito vector) associated with energy development and livestock tanks and ponds.

## 2.3 Task 3 - GIS Process Models, Methods, and Tools

The purpose of the GIS process model is to detail the approach being recommended to take existing data and alter it to match the needs to the REA. The modeled process can be as simple as clipping an existing spatial layer to an ecoregion or as complex as using an inductive model such as Maxent (Phillips et al. 2006) which defines the extent of suitable habitat based on species occurrence data. Certain species that may not have region-wide datasets may rely on other modeling approaches such as Maxent to create a modeled suitable habitat across the ecoregion. Maxent is a presence-only data model using species observation and a series of environmental layers to try to predict the species suitable habitat. It is expected that occurrence data will be provided from each state's Natural Heritage Programs or Fish and Wildlife agencies to populate the models. Since many of the CEs will be modeled using existing established

datasets such as Western Association of Fish and Wildlife Agencies (WAFWA) for bighorn sheep or mule deer, simple Geographic Information System (GIS) process models will document the altering of the spatial layers for the REA (see Table 2.1-1). If needed, newer state data may be used to alter existing WAFWA data layers with approval of the AMT.

Every CE will have a GIS process model to document how each spatial layer was created. This serves two purposes: first, being a transparent way to show all of the processes that were used to derive the final layer; and secondly, a way to quickly repeat the process if a data layer is updated or the process needs to be altered. GIS process models will be created and delivered using ESRI's Modelbuilder as a required deliverable in the SOW. This module of ArcGIS (ArcGIS is a GIS software package) allows users to graphically depict the workflow of their analysis and save the workflow in individual models within toolboxes that are sharable with other users. One of the deliverables of later tasks is to deliver Modelbuilder models and toolboxes for each CE. This information will be used by the BLM National Operation Center's GIS team to quality assurance/quality control (QA/QC) the data layers being used in the REA.

### 2.3.1 Example Fine Filter CE GIS Process Model: Greater Sage-Grouse

#### Data Sources

The primary data source for GSG will be each state's preliminary priority habitat (PPH) data. This was downloaded from a BLM website provided by the National Operation Center, which is collecting the PPH data as part of a larger GSG initiative. As each state has recently reviewed or is in the process of reviewing the PPH data, it is expected that most of these layers will need to be updated during the REA timeframe. The GIS process model makes this a fairly simple task as long as each state keeps their attributes fairly similar so new datasets can be easily swapped out.

#### GIS Process Model

An example of the GIS process model for GSG can be viewed in Figure 2-2. Oregon, California, Idaho and Utah all provided their PPH data in shapefile format. The PPH data was then extracted, from the shapefiles (some states included other habitats such as Preliminary General Habitat [PGH] in the same layer) based on the attributes and the data was projected to the REA common project (Albers NAD 1983) and clipped (limited to the spatial extent) to the ecoregion. Nevada's PPH data was provided as a raster (grid of cells) therefore it was converted to polygons and PPH was extracted by attributes. Once the data was clipped and projected, it was merged to form one dataset, dissolved (to remove coincident boundaries such as state lines) and converted back to a raster for use in modeling key ecological attributes (KEAs) and CAs threat analysis.

#### Greater Sage-grouse Distribution in the Ecoregion

The final map showing the distribution of GSG PPH data for the NGB ecoregion can be viewed in Figure 2-3. Since this is a collection of data from multiple states, different methodologies have gone into defining the PPH. Reviewing Oregon's PPH shows that it appears to be based on buffered leks (similar to the Breeding Bird Density) as visualized as circular patterns in the PPH. Nevada has a large section on the border with Idaho that was listed as 'Areas to be Completed'. Overall most PPH data seems to match relatively well across state lines.

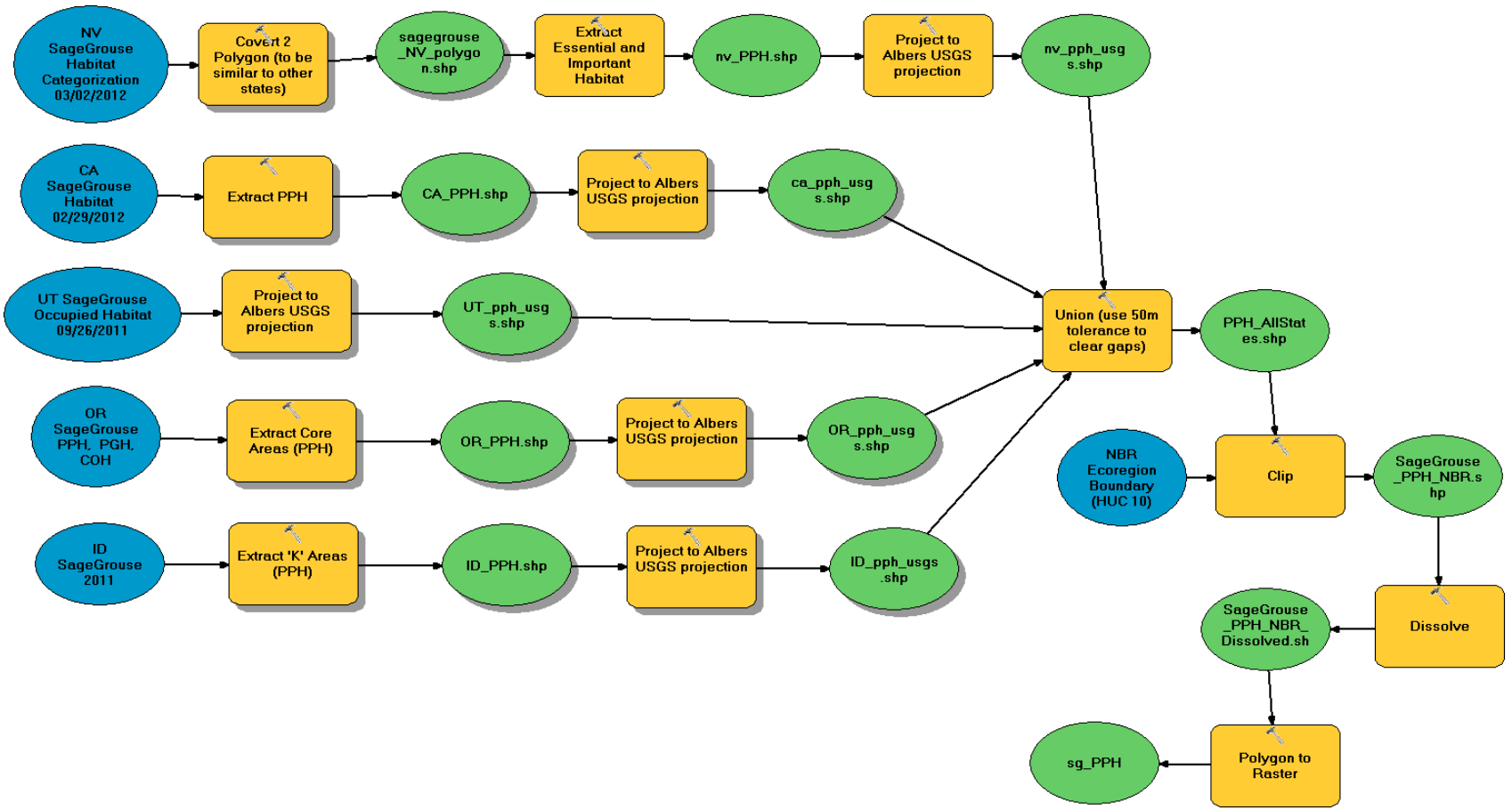


***Figure 2-2 GIS Process Model for Merging State PPH layers***

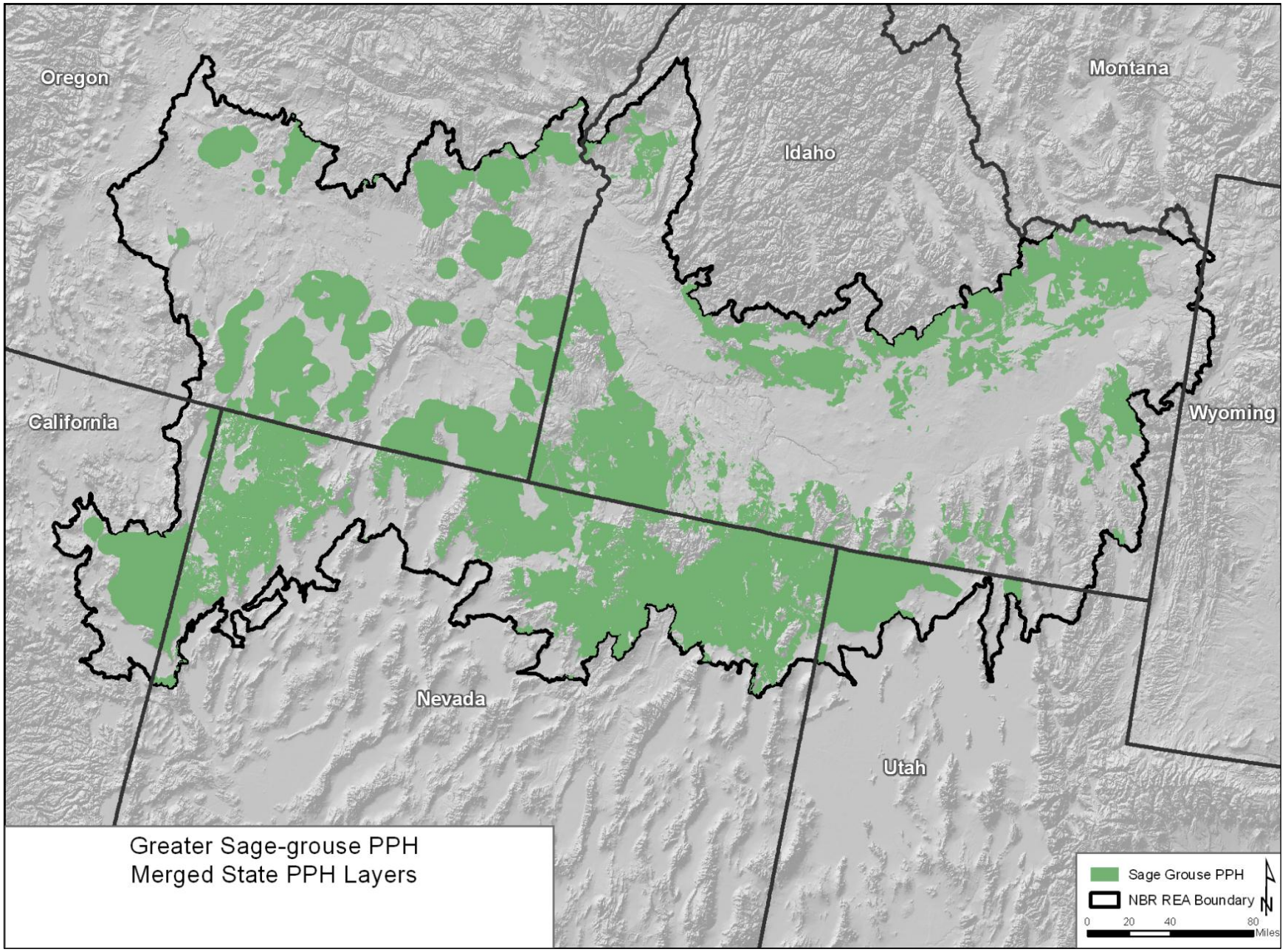


***Figure 2-3 Greater Sage-Grouse Preliminary Priority Habitat in the NGB Ecoregion***

# 3. Current Status of Management Questions, Change Agents, and Conservation Elements

## 3.1 Management Questions

Current management questions (MQs) for the NGB are listed in Table 3-1. We have highlighted several MQs that were dropped from the original list during AMT (Assessment Management Team) Workshop 4, and other MQs that were not addressed at the workshop and still require AMT attention. This list will be updated in the Final Memo 4 to reflect pending decisions. The original and current Management Questions for this REA are listed in Appendix A, along with an explanation of AMT guidance that led to the changes. The rationale for dropping MQs is also provided in Section 8.4, in which we discuss the details of how we will answer each MQ.

The AMT also considered a classification system for MQs at Workshop 4, with the intention of assigning each to one of three tiers that correspond to the level of data inputs, GIS processing, and management implications associated with each question.

Tier 1 questions are the lowest level of questions that involve presentation of basic data describing where conservation elements (CEs) or change agents (CAs) are located. These questions will be posed for all of the CEs and CAs in the assessment in order to depict their distribution or location. An example of a Tier 1 question is MQ 42: Where are current locations of development CAs? We would need to answer this MQ for each of the development CAs (e.g., mining, urban development, etc.).

Tier 2 questions focus on identifying where conflicts occur between a CE and the CAs. This is the intersections of CE distributions and CA effects. An example of a Tier 2 question is MQ 45: Where do current locations of CEs overlap with development CAs?

Tier 3 questions are the highest-level questions in which we ask about the significance of the CA risks identified by the Tier 2 analyses or management implications of the Tier 2 MQs. An example of a Tier 3 question is MQ 44: Where do development CAs cause significant loss of ecological integrity? As discussed in Workshop 4, other Tier 3 MQs are more explicit in asking for a measure of the effect of CAs (e.g., a gradient of intensity of effects).

## 3.2 Change Agents

The current list of CAs can be viewed in Table 3-2. Some of the main missing items relate to pumped storage, hydro impoundments, hydro diversions, recreation, and rangeland treatments. The Western Regional Partnership (WRP) has information on military use of lands in the ecoregion and are awaiting access to view what information may reside there. BLM's Rangeland Treatment Database should contain some information on Rangeland Treatments but the spatial nature of the data is still unknown.

### *Table 3-1. Management Questions for the NGB*

| MQ # | MQ Group | Revised Management Question | Tier |
|---|---|---|---|
| **Questions Related to Conservation Elements (CEs)** | | | |
| 1 | Species | What is the currently occupied habitat or modeled suitable habitat for each species CE? | 1 |
| 2 | Species | Where are the areas of greatest and least collective impact of existing CAs on occupied habitat or modeled suitable habitats of species CEs? | 3 |
| 3 | Species | Where are the connectivity corridors identified by the WGA landscape integrity dataset? | 1 |
| 4 | Species | Where are the areas of greatest and least collective impact of existing CAs on connectivity corridors identified in MQ3? | 3 |
| 5 | Species | Where are species CEs whose current locations or suitable habitats overlap with the potential future distribution of CAs (other than climate change)? | 2 |
| 6 | Species | Given current and anticipated future locations of CAs, which habitat areas remain as opportunities for habitat enhancement/ restoration? | 3 |
| 7 | Species | Where are potential areas to restore connectivity for landscape species and species assemblage CEs, based on current locations of CAs? | 3 |
| 8 | Species | Where will landscape species and species assemblage CEs (not including white sturgeon and cave bat species, and limited to winter and/or summer range for mule deer, pronghorn winter range) experience climate outside their current climate envelope? | 2 |
| 9 | Native Plant Communities | Where are coarse filter CE vegetative communities located? | 1 |
| 10 | Native Plant Communities | Where are intact (i.e., minimally disturbed by human activities) coarse filter CE vegetative communities located? | 2 |
| 11 | Native Plant Communities | Where will existing and potential future CAs (aside from climate change) affect current communities? | 2 |
| 12 | Native Plant Communities | Where will current locations of these communities experience significant deviations from normal climate variation? | 2 |
| ~~13~~ | ~~Terrestrial Sites of High Biodiversity~~ | ~~Where are sites identified as having high biodiversity characteristics? Which designated sites are protected?~~ | |
| ~~14~~ | ~~Terrestrial Sites of High Biodiversity~~ | ~~Where will CAs (aside from climate change) potentially affect sites of high biodiversity?~~ | |
| ~~15~~ | ~~Terrestrial Sites of High Biodiversity~~ | ~~Where will locations of these high biodiversity sites experience significant deviations from normal climate variation?~~ | |
| 16 | Aquatic High Biodiversity Sites | Where do spring snails occur? | 1 |
| ~~17~~ | ~~Aquatic High Biodiversity Sites~~ | ~~Where are areas representing unique aquatic lineages or assemblages or other areas of high aquatic biodiversity (considering both local [alpha] and regional [beta or gamma] diversity)?~~ | ~~2~~ |
| ~~18~~ | ~~Aquatic High Biodiversity Sites~~ | ~~Where will these aquatic high biodiversity sites (as defined in MQ 17) be potentially affected by CAs (aside from climate change)?~~ | ~~2~~ |
| ~~19~~ | ~~Aquatic High Biodiversity Sites~~ | ~~Where will current locations of these aquatic high biodiversity sites (as defined in MQ 17) experience significant deviations from normal climate variation?~~ | ~~2~~ |
| 20 | SDAs | Where are specially designated areas of ecological and/or cultural value? | 1 |
| 21 | Wild Horse and Burro Management Areas | Where are the current wild horse and burro Herd Management Areas (HMAs)? | 1 |
| 22 | Wild Horse and Burro Management Areas | Where will CAs (excluding climate change) overlap HMAs, under each time scenario? | 2 |

### *Table 3-1. Management Questions for the NGB*

| MQ # | MQ Group | Revised Management Question | Tier |
|---|---|---|---|
| **Questions Related to Change Agents (CAs)** | | | |
| 23 | Wild Horse and Burro Management Areas | Where will HMAs experience significant deviations from normal climate variation? | 2 |
| 24 | Grazing (livestock) CE | Where are the current livestock grazing allotments? | 1 |
| 25 | Grazing (livestock) CE | Where will CAs (excluding climate change) overlap grazing allotments under each time scenario? | 2 |
| 26 | Grazing (livestock) CE | Where will grazing allotments experience significant deviations from normal climate variation? | 2 |
| 27 | Vulnerable Soils | Where are vulnerable (e.g., erodible, slickspot) soil types within the ecoregion? | 1 |
| 28 | Vulnerable Soils | Where will vulnerable soil types overlap with CAs (aside from climate change) under each time scenario? | 2 |
| 29 | Vulnerable Soils | Where will current vulnerable soil types experience significant deviations from normal climate variation? | 2 |
| 30 | Surface/Subsurface Water | Where are current natural and man-made surface water resources, and which are perennial, seasonal, ephemeral, spatially intermittent, etc.? | 1 |
| 31 | Surface/Subsurface Water | What is the natural variation of monthly discharge and monthly base flow for streams and rivers? | 1 |
| ~~32~~ | ~~Surface/Subsurface Water~~ | ~~Where are the likely recharge areas within a HUC?~~ | ~~1~~ |
| ~~33~~ | ~~Surface/Subsurface Water~~ | ~~Where will the recharge areas (relating to aquatic CEs) identified in MQ 32 potentially be affected by CAs?~~ | ~~2~~ |
| 34 | Aquatic Ecological Function and Structure | What is the condition (ecological integrity) of aquatic CEs? | 2 |
| 35 | Fire | What is the frequency, size, and distribution of wildfire on the landscape? | 1 |
| 36 | Fire | What areas now have (high, medium, low) potential for fire based on fuels composition (e.g., invasive plants, uncharacteristically dense sagebrush)? | 2 |
| 37 | Fire | Where are areas that in the future will have high potential for fire? | 2 |
| 38 | Invasive Species | What is the current distribution of invasive species included as CAs? | 1 |
| 39 | Invasive Species | What is the relative abundance or intensity of effect of invasive species included as CAs (dominant/non-dominant, presence/absence, or not detected)? | 3 |
| 40 | Invasive Species | Focusing on the distributions of terrestrial and aquatic CEs that are significantly affected by invasive species, which areas have restoration potential? | 3 |
| 41 | Invasive Species | Given current patterns of occurrence and expansion of the invasive species included as CAs, what is the potential future distribution of these invasive species? | |
| 42 | Development | Where are current locations of development CAs? | 1 |
| 43 | Development | Where are areas of planned or potential development CAs? | 1 |
| 44 | Development | Where do development CAs cause significant loss of ecological integrity? | 3 |
| 45 | Development | Where do current locations of CEs overlap with development CAs? | 2 |
| 46 | Recreation | Where are areas with significant recreational use? | 1 |
| 47 | Recreation | Where have designated recreation areas, such as for off-highway vehicle (OHV) use, affected CEs and invasive species? | 2 |
| 48 | Recreation | Where are other areas of likely high OHV use [as determined by modeling] that may affect CEs and invasive species? | 2 |
| 49 | Oil, Gas, and Mining Development | Where are the current locations of oil, gas, and mineral extraction? | 1 |

## *Table 3-1. Management Questions for the NGB*

| MQ # | MQ Group | Revised Management Question | Tier |
|---|---|---|---|
| **Questions Related to CAs (continued)** | | | |
| 50 | Oil, Gas, and Mining Development | Where will locations of oil, gas, and mineral extraction potentially exist by 2025? | 1 |
| 51 | Oil, Gas, and Mining Development | Where are the areas of potential future locations of Oil, Gas, and Mining (including gypsum) development (locatable, salable, and fluid and solid leasable minerals)? | 2 |
| 52 | Oil, Gas, and Mining Development | Where do locations of current CEs overlap with areas of potential future locations of non-renewable energy development? | 3 |
| 53 | Renewable Energy Development | Where are the current locations of renewable energy development (solar, wind, geothermal, transmission)? | 1 |
| 54 | Renewable Energy Development | Where are the areas identified by the National Renewable Energy Laboratory (NREL) as potential locations for renewable energy development? | 1 |
| 55 | Renewable Energy Development | Where are the areas of low renewable and non-renewable energy development that could potentially mitigate impacts to CEs from potential energy development? | 3 |
| 56 | Renewable Energy Development | Where do current locations of CEs overlap with areas of potential future locations of renewable energy development (MQ 65)? | 3 |
| 57 | Renewable Energy Development | Where will locations of renewable energy [development] potentially exist by 2025? | 2 |
| 58a | Groundwater Extraction and Transportation | Where are areas with current groundwater extraction? | 1 |
| 58b | Groundwater Extraction and Transportation | Where are the areas of potential future change in groundwater extraction? | 2 |
| ~~59~~ | ~~Groundwater Extraction and Transportation~~ | ~~What is the present distribution of municipal and agricultural water use of groundwater resources in relation to the distribution of aquatic CEs?~~ | |
| 60 | Groundwater Extraction and Transportation | Where are the aquatic CEs showing degraded ecological integrity from existing groundwater extraction? | 3 |
| ~~61~~ | ~~Surface Water Consumption and Diversion~~ | ~~Where are current surface water diversions?~~ | ~~1~~ |
| 62 | Surface Water Consumption and Diversion | Where are the areas of potential future change in surface water diversion? | 2 |
| 63 | Surface Water Consumption and Diversion | Where are the CEs showing degraded ecological integrity from existing surface water diversion? | 3 |
| 64 | Climate Change: Terrestrial Resource Issues | Where will changes in climate be greatest relative to normal climate variability? | 2 |
| 65 | Climate Change: Terrestrial Resource Issues | Given anticipated climate shifts and the direction shifts in climate envelopes for CEs, where are potential areas of significant change in extent such as ecotones? | 3 |
| 66 | Climate Change: Terrestrial Resource Issues | Where are vegetation CEs that will experience significant deviations from normal climate variation? | 2 |

***Table 3-1. Management Questions for the NGB***

| MQ # | MQ Group | Revised Management Question | Tier |
|---|---|---|---|
| **Questions Related to CAs (continued)** | | | |
| 67 | Climate Change: Terrestrial Resource Issues | Where are wildlife CE habitats that will experience significant deviations from normal climate variation? | 2 |
| 68 | Climate Change: Aquatic Resource Issues | Where will aquatic CEs experience significant deviations from historic climate variation that potentially could affect the hydrologic and temperature regimes of these aquatic CEs? | 2 |
| 69 | Military Constrained Areas | Where are areas of Department of Defense and Department of Energy use? | 1 |
| 70 | Atmospheric Deposition | Where are areas affected by atmospheric deposition of pollutants, as represented specifically by nitrogen deposition, acid deposition, and mercury deposition? | 1 |
| 71 | Livestock Grazing | Where is structure of vegetation CEs affected by livestock grazing? | 2 |
| 72 | Livestock Grazing | Where can livestock grazing be used to reduce wildfire risk in areas with herbaceous fuel loads and proximity to high-probability ignition locations (roads, train tracks, lightning etc.)? | 3 |
| 73 | Livestock Grazing | Where will livestock grazing have the potential to increase fire frequency as a result of increased cover of annual grasses (high, medium, low)? | 3 |
| 74 | Livestock Grazing | Where are areas in the landscape with various (low, medium, high) levels of resilience to livestock grazing (based upon ecological site and existing vegetation)? | 3 |
| 75 | Livestock Grazing | Where has the landscape been modified for purposes of livestock grazing and management (sagebrush elimination, fences, plantings, water sources, etc.)? | 2 |
| ~~76~~ | ~~Livestock Grazing~~ | ~~What areas of the landscape are low density vs. high density livestock grazed (streams, water developments, corrals, steep slopes, etc.)?~~ | ~~2~~ |
| ~~77~~ | ~~Livestock Grazing~~ | ~~Where are areas best suited to potential livestock cattle and sheep grazing based on environmental factors (such as slope, aspect, water availability, wild ungulate grazing)?~~ | ~~3~~ |
| ~~78~~ | ~~Livestock Grazing~~ | ~~Where do grazing areas have the highest potential to increase invasive and/or noxious species occurrences?~~ | ~~3~~ |

*Note:* Strikethrough indicates that the MQ is removed from consideration (see Section 8.4).

***Table 3-2. Refinement of Change Agents for the NGB***

| Change Agents (CAs) | Primary Dataset | Source | Status | Additional Dataset | Comments |
|---|---|---|---|---|---|
| **Wildfire** | GeoMAC, MTBS | DOI (Multi Agency) | Acquired | MODIS Fire Detection, Sagemap (USGS) | Updates Downloadable |
| **Climate Change** | USGS/Hostetler | USGS/ Oregon State U. | Acquired except for 2000-2009 | PRISM | |
| **Development:** | | | | | |
| **Energy:** *Note:* some of the CAs in this category, e.g., solar energy, may not be significant developments (current or future) but will be carried through subsequent REA tasks in order to evaluate datasets. | | | | | |
| Oil & Gas | Oil and Gas Wells | BLM | Acquired except for OR | EPCA data | |
| Wind Energy | Permitted Wind Energy Areas | BLM | Acquired | Wind Turbine Locations (FAA), Wind Potential (NREL) | |
| Geothermal Energy | Geothermal Mine Claims | BLM | Acquired | Geothermal Potential Areas | |
| Solar Energy | Permitted Solar Energy Areas | BLM | Acquired | Solar Energy Potential (NREL) | |
| Pumped Storage | TBD | | | | |
| Non-transportation Linear Features | Transmission Lines | Global Energy | Acquired | | |
| Urban | US Census 2010 | US Dept of Commerce | Available for download | | |
| Mining | MRDS | USGS | Acquired | State data from ID and OR | |
| Transportation | TIGER Roads 2010 | US Dept of Commerce | Acquired | | |
| Recreation | TBD | | | | |
| Agriculture | Cropland Data Layer 2011 | US Dept of Agriculture | Acquired | LANDFIRE | |
| Hydro Diversions | TBD | | | | |
| Hydro Impoundments | TBD | | | | |
| Military and other Federal Land | TBD | Western Regional Partnership | Pending Access to Data | Protected Areas Database (USGS) | Need permission to access their datasets |
| Rangeland Treatments | TBD | BLM | | | |
| **Invasives:** | | | | | |
| Cheatgrass | NISIMS | BLM | Acquired | State Weed Data | |
| Medusahead | NISIMS | BLM | Acquired | State Weed Data | |
| Other Exotic Grasses | NISIMS | BLM | Acquired | State Weed Data | |
| Exotic Forbs | NISIMS | BLM | Acquired | State Weed Data | |
| Juniper Expansion | LANDFIRE, REGAP | USGS | Acquired | | Not sure if expansion can be identified. |

***Table 3-2. Refinement of Change Agents for the NGB***

| Change Agents (CAs) | Primary Dataset | Source | Status | Additional Dataset | Comments |
|---|---|---|---|---|---|
| Russian olive, tamarisk and other Invasive Woody Plants | NISIMS | BLM | Acquired | State Weed Data | |
| Aquatic Invasives | Nonindigenous Aquatic Species Program | USGS | Acquired | State Weed Data | |
| **Grazing:** | | | | | |
| Livestock | Grazing Allotments | BLM | Acquired | USFS Grazing Allotments, Domestic Sheep Overlap with Bighorn Sheep | Still require USFS grazing allotments. |
| Wild Horses & Burros | Wild Horse and Burro Herd Management Areas | BLM | Acquired | | |

## 3.3 Conservation Elements

### 3.3.1 Coarse Filter

The current list of coarse filter CEs can be viewed in Table 3-3. Most of the data sources have been identified for these CEs except for groundwater, cottonwood galleries, and wetlands. For groundwater, the USGS Base Flow Index was recommended and downloaded. Regional or state data on groundwater varied greatly between the states. Idaho and Nevada had some well records available but the accuracy and timeliness of the data varied. Cottonwood galleries are difficult to pick up on most remotely sensed vegetation classifications since they tend to be narrow in width following streams and rivers. There were some possible modeling approaches using ReGAP, using aerial imagery to map cottonwood stands, or a combination of both. The use of these methodologies over a large ecoregion may be too detailed for an REA. The National Wetlands Inventory (NWI) has digital data on most of the ecoregion except for parts of Idaho and Utah. Both states do have wetland mapping that can be used to fill in the gaps if needed. At AMT Workshop 4, it was mentioned that the Great Northern Landscape Conservation Cooperative (GNLLC) was working with wetlands and may have a dataset that covers the ecoregion.

### 3.3.2 Fine Filter

The current list of fine filter CEs can be viewed in Table 3-4. Some of the CE's have already had data secured for them such as mule deer, greater sage-grouse, bighorn sheep and the fisheries related CEs. The other CEs are still in the process of finding and attempting to acquire the data. Some are being held up by data sharing agreements or determining what permissions need to be granted to pass the data along. There are some studies that are in the process of wrapping up that hopefully will be available for this REA. In particular is the Range-wide Assessment for Redband trout, which will hopefully be completed by August 2012. Pronghorn is one big game species that data gaps have been identified. Currently Oregon and California have no pronghorn habitat/range mapping. Pygmy rabbit has some data from the USFWS that is a compilation of records up to 2008, but no spatial data has been received. The USGS is compiling eagle observations in a larger west-wide effort that could be used for golden eagle and bald eagle CEs. Since the data is coming from multiple sources there could be a variety of access constraints that will need to be dealt with to use this dataset.

### *Table 3-3. Coarse-Filter Conservation Elements Chosen for the NGB Ecoregion*

| Conservation Elements (CEs) | Primary Dataset | Source | Status | Additional Dataset | Comments |
|---|---|---|---|---|---|
| ***Regionally Important Terrestrial Ecological Features, Functions, and Services*** (e.g., large areas of native vegetation providing important cover, fiber, and forage; habitat strongholds and corridors; upland areas important for water quality or water supply; areas capable of significant carbon sequestration (CS); etc.) | | | | | |
| Sagebrush | NWReGAP/ Southwest ReGAP/ LANDFIRE | USGS | Acquired | | Sagebrush will be broken down into three categories Wyoming/Basin big sagebrush, Mountain big sagebrush, and Low sagebrush types to the extent these can be discerned by combining categories used in the NW and SW ReGAP and LANDFIRE datasets |
| Salt desert shrub | NWReGAP/ Southwest ReGAP/ LANDFIRE | USGS | Acquired | | |
| Utah and Western Juniper | NWReGAP/ Southwest ReGAP/ LANDFIRE | USGS | Acquired | | |
| Aspen | NWReGAP/ Southwest ReGAP/ LANDFIRE | USGS | Acquired | | |
| Other Conifer | NWReGAP/ Southwest ReGAP/ LANDFIRE | USGS | Acquired | | |
| Vulnerable soils | STATSGO | NRCS | Acquired | | |
| ***Regionally Important Aquatic Ecological Features, Functions, and Services*** (e.g., habitat strongholds and corridors; wetland, riparian, and other aquatic areas important for water quality, water supply, stream bank stability, flood control, and similar purposes) | | | | | |
| Perennial stream/rivers | NHD | USGS | Acquired | | |
| Springs/seeps | NHD | USGS | Acquired | | |
| Wetlands | NWI Wetlands | USFWS | Acquired | State Wetlands Mapping | Not all areas of the ecoregion mapped with NWI Wetlands. |
| Open water habitat | NHD | USGS | | | |
| Cottonwood galleries | TBD | | | | |
| Riparian habitat | NWReGAP/ Southwest ReGAP/ LANDFIRE | USGS | | | |
| Groundwater | Base Flow Index | USGS | Acquired | | Limited State Data that is current |
| ***Specially Designated Areas of Ecological and/or Cultural Value*** | | | | | |
| Specially Designated Areas of Ecological and/or Cultural Value (All categories) | Protected Areas Database | USGS | Acquired | Wild Rivers | |
| Wild Horse and Burro Herd Management Areas | Wild Horse and Burro Herd Management Areas | BLM | Acquired | | |

### *Table 3-4. Fine-Filter Conservation Elements Chosen for the NGB Ecoregion*

| Conservation Elements (CEs) | Primary Dataset | Source | Status | Additional Dataset | Comments |
|---|---|---|---|---|---|
| ***Regionally Important Terrestrial Ecological Features, Functions, and Services*** (e.g., large areas of native vegetation providing important cover, fiber, and forage; habitat strongholds and corridors; upland areas important for water quality or water supply; areas capable of significant carbon sequestration (CS); etc.) | | | | | |
| Mule Deer | WAFWA and NV State | WAFWA and NV State | Acquired | | Update WAFWA with NV data. |
| Greater Sage-grouse | State Preliminary Priority Habitat (PPH) | State Data | Acquired | Breeding Bird Density (BLM) | Some states still updating PPH data. |
| Golden Eagle | USFWS | Compiled from many sources | | | Working with Mark Fuller to access their compiled data. |
| Bald Eagle | USFWS | Compiled from many sources | | | Working with Mark Fuller to access their compiled data. |
| Pygmy Rabbit | TBD | | | | Received a pdf of data from USFWS. |
| Bighorn Sheep | WAFWA 2011 | WAFWA | Acquired | | |
| Pronghorn | UT, ID, NV State Data | | | | Data Gap for CA and OR. |
| Bull Trout | Critical Habitat and 5 Year Assessment | USFWS | Acquired | | |
| Cold water fish assemblage | Streamnet, various Range-Wide Assessments | Various (Oregon State, USFWS, USFS) | Some data Acquired | | Redband range-wide assessment hoping to be done in August 2012 |
| White Sturgeon | Streamnet | various | Acquired | | |
| Bats | TBD | | | | Need help with data sharing agreement. |
| Spotted Frog | TBD | | | | State Natural Heritage Programs likely sources, GeoBob Data from BLM from OR. |

# 4. Uncertainty and Value of Outputs

## 4.1 Uncertainty

Uncertainty can arise from datasets, modeling methods or decisions made by the Assessment Management Team (AMT) during the Rapid Ecological Assessment (REA). Communicating the uncertainty is one of the most important aspects of the final REA document. Readers of the document need to know what assumptions, limitations or quality of datasets were used in the analysis so they can review the results with full disclosure. To fully explain the uncertainty in the REA document, uncertainty will be addressed in several locations. A section in the final REA document will be devoted to discussing uncertainty but since not everyone will read that section, the conservation element (CE) or change agent (CA) packages will also fully document any uncertainty related to that CE or CA. Since mapping products produced only have so much space for legends and ancillary data, fully documenting all the limitations in using the maps or uncertainty is always practical. A note will be placed on maps reminding the reader to review the section on uncertainty in the CE/CA package.

## 4.2 Value of Outputs

The quality of the REA can really be determined by products it creates and the ability for land managers to use them as part of their decision making process. The management questions (MQs) really drive the focus of the REA to provide answers beyond where are the CEs and CAs. Section 8.3 in this memo will go through the MQs to describe what will be done to try to answer the questions. The CE and CA packages that will be put into the appendix of the final REA document will contain:

- Rationale for inclusion in the REA,
- Conceptual Model and detailed information about the ecology (CE only),
- MQs that pertain to that CE or CA,
- Datasets used for this CE/CA,
- GIS Processing Models,
- Uncertainty or limitations to be considered for this CE/CA based on the available data and modeling approaches chosen by the AMT and Subject Matter Experts (SMEs), and
- Maps and synthesis providing answers for each of the MQs.

# 5. Subject Matter Expert Review

Subject Matter Experts (SMEs) play a key role in ensuring that the Rapid Ecological Assessments (REA) reflects the best available data and modeling processes suitable for each conservation element (CE) and change agent (CA). SMEs will be added to Rolling Review Teams (RRTs) comprised of SAIC scientists, SAIC GIS personnel, Assessment Management Team member(s) and other subject matter experts from the Department of Interior or state agencies. To ensure consistency amongst the different RRTs, the number of lead SAIC scientists will be maintained to only a few individuals. This should ensure that there is a common approach, or framework, used amongst the different RRTs and that one RRT does not stray too far from the rest. It is expected that the USGS, as peer reviewers, will have personnel participate in RRTs.

RRTs will consist of 3 one hour conference calls to give recommendations on preliminary results, modeling techniques, a path forward for finalizing the analysis for each CE or CA and determining if the MQs are answered by the analysis.

The main function of the RRT will be to:

- Review datasets being used for analysis,
- Review Key Ecological Attributes (KEAs) for each CE,
- Provide feedback on how to weight KEAs (if necessary),
- Give input on how to score the results (bins for poor, fair, good),
- Give recommendations on suitable future time frame for analyzing CAs effects on CEs, and
- To determine if the approaches are consistent with other similar efforts such as the WGA's Crucial Habitats, neighboring REAs or other state initiatives.

# 6. Schedule for Phase 2 of the REA

Phase 2 of the Rapid Ecological Assessment (REA) process begins with compiling and generating datasets, conducting the analysis and generating the findings, and finally the assembly of the final REA document. Interweaved with these remaining three tasks is the input and review by the Rolling Review Teams (RRTs). To give the RRTs a chance to provide some review and input into the REA work plan, the following is a proposed schedule for Phase 2 of the REA.

Submittal of RRT analysis packages: to include conservation element (CE) or change agent (CA) specific data types (not necessarily source) required for analysis, conceptual model if appropriate, rationale for inclusion and narrative of key elements, and GIS process models if available (**within 2-3 weeks of REA Draft Work Plan submittal**).

RRT Meeting 1: Agenda will be provided- discussion should focus on: relationship between official management question and subject CA/CE; value of specific data types to answer management questions (MQs) for subject CA/CE; preliminary discussions on data sources and capture plan, preliminary discussion on key ecological attributes (KEAs) and literature sources (**within 1 week of previous task**).

Finalize Work Plan Submittal: Comments will be requested for the pre-Final Work Plan submittal and will be addressed as part of the Final deliverable. Non-concurrence comments will be discussed in AMT calls (**within 4 weeks of Draft Work Plan**).

RRT Meeting 2: Discussion should focus on KEA tables, literature identified/reviewed, focused data source coordination and, if possible, presentation of some "test cases" providing preliminary outputs based on previously identified KEAs (**within 2-3 weeks of RRT Meeting 1**).

Proposed AMT webinar presenting RRT approaches and accomplishments to date (SAIC led): Estimated 2 hours **(within 2 weeks of Meeting 2)**.

Phase 2, Task 1 - Data Gap/Data Quality submittal: Document will present data collection efforts to date and include requisite discussion on confidence and quality following BLM requirements **(within 2 weeks following webinar)**.

RRT Meeting 3: Discussion should focus on concluding remarks or comments related to KEA tables, literature basis, approach to analysis and processing (**within 2-3 weeks of RRT Meeting 2**).

Phase 2, Task 2 AMT Meeting: Approach to analysis (based on RRTs) will be presented to AMT for final coordination and discussion. Materials will be provided in advance and will represent all research and analysis efforts to date. This meeting should focus on fine tuning; prior webinar will serve as an opportunity for general AMT to provide feedback to RRTs on analysis to date (**within 3 weeks of RRT Meeting 3**).

Submittal of Draft Final REA document: including analysis packages as well as preliminary document sections (intro, history, definitions, etc.) **(within 3 weeks of AMT Meeting)**.

Phase 2 Task 3 AMT Meeting: Discuss overall document and analysis **(within 2 weeks of Draft Final Document submittal)**.

Pre-final comments received: (**within 2 weeks of AMT Meeting**).

Final Deliverable: (**within 2 weeks of comments received**).

# 7. Phase 2 Task 1 – Compile and Generate Source Datasets

The data collection task was moved to Phase 2 of the Rapid Ecological Assessment (REA) process, in previous REAs it was in Phase 1, Task 2 near the beginning of the process. Moving this task back benefited the REA process by allowing the focus to be on the relative merits of a whether a conservation element (CE), change agent (CA) or management question (MQ) should be included without regards to data availability. The challenge to moving this task forward is that the REA work plan will be written not knowing if there is data for the ecoregion, if it will be available (if still in process) or once received if it will be at a high enough quality to actually use. In an attempt to resolve this problem, data collection actually began back in the initial tasks of the REA. The most efficient way to identify data was to use the Assessment Management Team (AMT) to identify data contacts and start the process of contacting and acquiring data as soon as possible. The data collection can take a lot of time as one is often referred to someone else, personnel in the field or on travel, data sharing agreements that need to be signed, etc. Since the ecoregion is made up of many states, a lot of the datasets we might receive may be state data only and there may be data gaps for certain states that don't track that species. One example of this would be pronghorn. Currently Oregon and California don't have any pronghorn spatial data while Nevada, Utah, and Idaho have some ranges defined.

## 7.1 Data Quality Evaluation

The REA process requires that relevant spatial data be identified and evaluated for accuracy prior to implementation of use for the modeling to be completed as part of Phase 2, Task 2. The purpose of this evaluation is to ensure that the data used in the modeling process is appropriate to derive a suitable outcome in the analysis stage. The goal of the evaluation process is to determine the best datasets available from public and private entities, and to provide results that could be replicated among all states within the Northern Great Basin (NGB).

A large number of datasets have been acquired and data acquisition and evaluation is anticipated to continue through to Phase 2, Task 2 of the BLM REA process. Geospatial data will be evaluated using a multi-stage approach (Figure 7-1). After completing a comprehensive data search, geospatial analysts perform a standard data evaluation, identify gaps within the data, and document associated weaknesses of the individual datasets. Each dataset is compared and documented for quality and usability against the 11 BLM criteria identified from the 2008 Department of Interior (DOI) Data Quality Management Guide.

The most basic and initial approach to data evaluation will be the import of data into GIS. ArcGIS will be used to evaluate all spatial data. The data will be opened and viewed in ArcGIS to determine the geographic extent, coverage and scale of the data relative to the ecoregion extent. Spatial accuracy and extent of coverage will be determined through the use of two specific established GIS datasets. Data will then be compared against imagery that is readily available through Environmental Studies Research Institute (ESRI). This imagery exists at a scale suited for use as a comparative model of spatial accuracy. In addition to the imagery, SAIC accessed ESRI StreetMap data, which features high quality street layers in the form of vector data. Combining the StreetMap data with the ESRI imagery layer will provide a high quality spatially referenced display of a base map on which to view and assess the quality of spatial features. The combination of both base map layers enables the GIS analysts to compare acquired dataset features relative to vegetation, topography, linear man-made features, and other pertinent datasets, enabling an objective method of analysis.

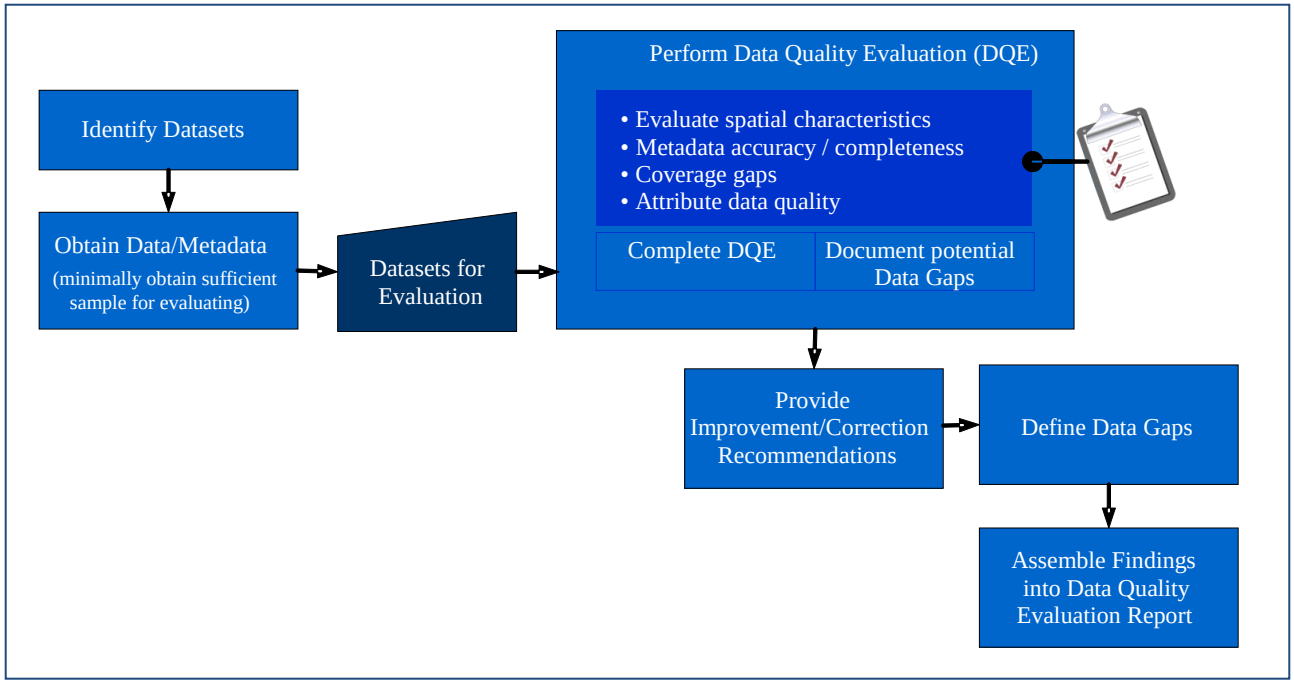


***Figure 7-1. Data Quality Evaluation Process***

In addition to observable spatial accuracy, attribute tables were evaluated to determine if attribute information is relevant for that particular dataset. The level of detail associated with the attributes varies widely among the various data sources. For example, species occurrence data from one source could contain attribute information such as county location, frequency, population, etc., but the same data from a different source might not contain frequency or population attribute information. The attribute information can be used in the modeling phase of the process, and will often assist the analyst in determining which features should be included in each stage of the analysis.

Metadata offers additional information relating to the spatial reference, accuracy, creation, workflow, and dynamics of a GIS data layer. Federal Geographic Data Committee (FGDC) compliant data must contain metadata as part of the data source information. Metadata was either acquired as part of the GIS data layer, or as additional files paired with the data. The information contained within the metadata file is often relevant to the data quality itself. Therefore, each dataset that will be acquired throughout this process will be examined to determine the quality of the associated metadata. Figure 7-1 illustrates the DQE process that will be used for datasets throughout the REA process. Each data quality criteria was given a score from 0-4 (0 = unknown, 1 = low, 2 = moderate, 3 = high, 4 = very high) for a total possible score of 44. The totaling of the eleven data quality criteria allow for a quantitative comparison of all the criteria. One additional item SAIC is also tracking is the relative dataset coverage across the ecoregion. This information wasn't included in the dataset total score as some species distributions do not cover the entire ecoregion but is another criterion that can be used for comparing datasets where applicable. Table 7-1 listed below contains the evaluation criteria that is being used in the DQE process.

***Table 7-1. BLM Data Quality Evaluation Metrics***

| Data Quality Evaluation | Description | Software | Method |
|---|---|---|---|
| Validity | The degree to which data conforms to their definitions, domain values and business rules. | ArcCatalog | If there are domains, check to see if they are properly used (geodatabase only). Check attributes for strange entries (email column with a phone number). |
| Non-Duplication | The degree to which there are no redundant occurrences of the same real world object or event. | ArcCatalog | Export attributes to excel and use 'Remove Duplicates' to find if there are any identical records. |
| Completeness | The degree to which the required data are known. This includes having the required data elements (the facts about the object or event), having the required records, and having the required values. | ArcCatalog | Rate how complete the attributes are filled in. Note some spatial data standards have many fields that will never all be filled in. |
| Relationship Validity | The degree to which related data conform to the associate business rules. | ArcCatalog | Review the attributes to see if the values in each column are logically connected. Does one column give a sighting count of 2 with other columns tracking male, female, juveniles, etc. having totals that do not equal 2? |
| Consistency | The degree to which redundant facts are equivalent across two or more databases in which the facts are maintained. | ArcCatalog | If the dataset being evaluated is part of a series of datasets from the same source with redundant data, is the redundant the data the same. |
| Concurrency | The timing of updates to ensure that duplicate data stored in redundant files are equivalent. This is a measure of the data float (the time elapsed from the initial acquisition of the data in one file or table to the time they are propagated to another file or table. | ArcCatalog | Open the metadata viewer and review the date of data acquisition and process steps to see if the data was processed and made available in a timely fashion. This would minimize the chance of something changing and making the data irrelevant. |
| Data Quality Evaluation | Description | Software | Method |
| Timeliness | The degree to which data are available to support a given information consumer or process when required. | ArcCatalog | Open the metadata view and review the date of acquisition, update frequency, etc. Was it collected recently? Is it year two of a ten year project? How accurately does it represent the current condition? |
| Spatially Accurate | The degree to which data accurately reflect the real-world object or event being described. Includes spatial, temporal and thematic accuracy. | ArcCatalog ArcMap | Look for data collection methods (GPS, type accuracy, etc.) and when the data was collected.<br>In ArcMap, overlay the layer with ESRI Roads/Streetmap, detailed county layer, or aerial imagery (NAIP, Seamless, etc.). Do the positions make sense to reflect the scale that they data will be used? |
| Thematic Accuracy | The degree to which the attributes represented in the map are reflective of reality on the ground. | ArcCatalog | In ArcCatalog, review the metadata details for accuracy information used in the layer. Is there a threshold or confidence interval that the data needed to exceed to be classified a certain way? Does that same threshold or interval match the requirements for it to be used in the REA? |

***Table 7-1. BLM Data Quality Evaluation Metrics***

| Data Quality Evaluation | Description | Software | Method |
|---|---|---|---|
| Precision | The degree to which data are known to the right level of detail (e.g., the right number of decimal digits to the right of the decimal point). Includes spatial, temporal and thematic precisions. | ArcCatalog | In ArcCatalog, review the attributes to see if the proper fields are used for numbers to ensure enough accuracy in recording results. This will be most notable for latitude and longitude (should have at least six decimal points). If there are less the three decimal points the data may not be worthwhile using due to accuracy. Look at other columns storing numeric data. Is the precision acceptable for this data type (precipitation measurements, etc.)? |
| Derivation Integrity | The correctness with which derived data are calculated from their base data. | ArcCatalog ArcMap | In ArcCatalog, review the metadata to see what the original data is based on or level of accuracy it has. Was the trail digitized off an aerial image or topographic map? Did the roads layer use ESRI Streetmap or TIGER roads layer for its origins? In ArcMap, add the layer along with the original basemap layer. Do they still line up or did it get bumped along the way? |

# 8. Phase 2 Task 2 – Conduct Analysis and Generate Findings

## 8.1 Modeling Conservation Elements and Change Agents

Rolling Review Teams (RRTs) will be assembled for each conservation element as outlined in Section 5. Information for each conservation element (CE) will be assembled into a CE Package containing information about the CE, rationale for inclusion in the REA, management questions (MQs), conceptual model, data sources, Key Ecological Attributes (KEAs) and references. As MQs are answered, the resulting maps and analysis will be added to the CE package which will, when complete, be added to the final Rapid Ecological Assessment (REA) document in the appendix.

### 8.1.1 Modeling Fine Filter Conservation Elements

The fine filter CEs can be broken up into two groups, CEs that are modeled by merging or using existing data layers (polyline or polygon data) and CEs that use point or occurrence data and a modeling process to create a distribution layer (polygon or raster).

#### CEs with Existing Habitats or Ranges

The CEs that would fall into this category would be mule deer, bighorn sheep, pronghorn, greater sage-grouse, cold water fish assemblage, white sturgeon and bull trout. All of these CEs have habitat or ranges established by each state, Western Association of Fish and Wildlife Agencies (WAFWA), Streamnet, or USFWS range-wide assessments.

#### CEs Requiring a Model to Generate Habitats or Ranges

The CEs to be included in this group would be the golden eagle, bald eagle, pygmy rabbit, bats and spotted frog. These species will need to have a distribution created using an appropriate modeling technique. One example model that would be proposed would be Maxent. It has been used in other ecoregions for modeling golden eagle and may be appropriate for other CEs listed here depending on the quality and abundance of the observations.

### 8.1.2 Modeling Coarse Filter Conservation Elements

The coarse filter CEs can be divided into three groups, vegetation, aquatic and other (vulnerable soils, specially designated areas of ecological and/or cultural value, and wild horse and burro herd management areas).

#### Vegetation Coarse Filter CEs

The coarse filter CEs that would be included in this group would be sagebrush (low sagebrush, mountain big sagebrush and Wyoming/Basin big sagebrush), desert salt shrub, western and Utah juniper, aspen, other conifer, riparian areas and cottonwood galleries. The locations of these CEs will be determined by extracting the vegetative communities from the NWReGAP, SWReGAP, and LANDFIRE (California only) datasets within the ecoregion. Some of the vegetative communities such as riparian or cottonwood galleries may require different approaches to model their presence. Cottonwood galleries are narrow pockets that might not be well represented in the larger remote sensing driven vegetation mapping programs. Riparian areas in neighboring ecoregions have also been modeled by buffering streams to define riparian habitat.

### Aquatic Coarse Filter CEs

The aquatic coarse filters would include wetlands, open water, perennial streams, springs and seeps and groundwater. The main source of data for open water, springs and seeps and perennial streams would be the National Hydrographic Dataset (NHD). This dataset should contain the best source of data for an ecoregion-wide study. The National Wetlands Inventory (NWI) would be the basis for the wetlands coarse filter with some gaps in coverage filled in by state datasets. Groundwater is still to be fully determined as to a suitable dataset as currently the only datasets identified besides well log records (for a couple states) is the USGS Base Flow Index.

### Other Coarse Filter CEs

Vulnerable soils will be identified by trying to extract wind and water erodible soils from the STATSGO soils database from NRCS. The STATSGO soils database provides ecoregion-wide data layers and soil components or horizons containing the necessary attributes for determining erodible soils. Specially Designated Areas of Ecological and/or Cultural Value (SDAs) will be extracted from the Protected Areas Database (PADS) or other datasets showing theses protected areas. Wild horse and burro Herd Management Areas (HMAs) is a defined BLM dataset.

## 8.1.3 Modeling Change Agents

To conduct an analysis as required to answer the MQs, each of the change agents (CAs) will be modeled with the results being a raster surface that can be used as an overlay with the CEs. The exact composition of each of the CA layers will be determined by guidance from the RRTs on what data should be included, data availability, and buffering thresholds (if required) for data being used. Each CA will be modeled differently based on its own requirements and will be distributed and reviewed by RRTs so that all analysis is done with approved CA layers.

### Climate Change

Climate change data is already in a raster format and the only manipulation will be to subtract the future scenario from the present.

### Development

The development CA will probably be the most complex as it has many components such as roads, agricultural areas, oil and gas wells, transmission lines, etc. (see Table 3-2). Some of this data is linear or point data that will need to be buffered (wind turbines, oil and gas wells), some is already polygon data (census data), and other data may already be in a raster format such as agricultural data from the LANDFIRE or Crop Land Data layer. If a dataset is to be buffered, the CA RRT will be consulted to approve the distance thresholds used to ensure that each is suitable for that type of development feature. Since some MQs call out specific types of development such as renewable and non-renewable energy, separate development layers will need to be created for each.

### Invasives

The main data sources for invasive species data will be the NISIMS database, BLM state office datasets and state data such as Nevada whose invasive data is kept by their natural heritage program (see Table 3-2). Since modeling approaches for invasive species can be very data dependant on good observations, the RRT will be heavily relied upon to ensure that the approach used is suitable for the ecoregion and the

requirements of the REA. The RRT will also be consulted for advice on ways to determine not only presence and absence but also relative dominance.

### Wildlfire

In table 3-2 there is good ecoregion-wide datasets available for wildfire such as GeoMAC or Monitoring Trends in Burn Severity (MTBS) that go back to the 1980's and 1990's. One item that was brought up at AMT Workshop 4 was the integrity of these datasets to capture all the large fires. The modeling approach used for wildfire will contain ways to try to validate if any large fires were missed by a dataset. This may include verifying the modeled wildfire data with other datasets such as MODIS data. The RRT for wildfire will be consulted to ensure the modeled data accurately describes the ecoregion.

### Grazing

At AMT Workshop 4 it was determined that there was not suitable data to attempt to model grazing intensity at individual allotments across the ecoregion. Key factors such as slope, distance from water sources animals will travel, locations of piped-in or trucked-in water, etc. were not available across the ecoregion. The RRT for grazing will be consulted to devise an approach for grazing that can be used to answer the MQs.

## 8.2 Ecological Integrity (Intactness)

The Western Governors Association (WGA) is currently finishing their west-wide mapping of ecological integrity (EI) for both terrestrial and aquatic function. Since this initiative is a collaboration amongst states within the ecoregion it only makes sense to use the results of their EI mapping. It is expected that the WGA will be able to provide this ecoregion terrestrial and aquatic EI results within a suitable timeframe for inclusion in the Phase 2, Task 3 Conduct Analysis and Generate Findings.

## 8.3 Management Questions

Iterate through each of the groups, or questions, and give a paragraph for each on what will be done to answer the question.

### 8.3.1 Fine Filter Conservation Element (MQs 1-8)

*MQ 1. What is the currently occupied habitat or modeled suitable habitat for each species CE?*

*MQ 2. Where are the areas of greatest and least collective impact of existing CAs on occupied habitat or modeled suitable habitats of species CEs?*

*MQ 3. Where are the connectivity corridors identified by the WGA landscape integrity dataset?*

*MQ 4. Where are the areas of greatest and least collective impact of existing CAs on connectivity corridors identified in MQ3?*

*MQ 5. Where are species CEs whose current locations or suitable habitats overlap with the potential future distribution of CAs (other than climate change)?*

*MQ 6. Given current and anticipated future locations of CAs, which habitat areas remain as opportunities for habitat enhancement/ restoration?*

*MQ 7. Where are potential areas to restore connectivity for landscape species and species assemblage CEs, based on current locations of CAs?*

*MQ 8. Where will landscape species and species assemblage CEs (not including white sturgeon and cave bat species, and limited to winter and/or summer range for mule deer, pronghorn winter range) experience climate outside their current climate envelope?*

The MQs will be added to each of the CE packages and the RRT will be tasked with ensuring each is answered or if not answered, then explain why. Section 8.1.1 briefly describes some of the modeling approaches for each CE (based on current data) but the way most of these MQs will be answered will vary greatly based on the CE. The RRT for each fine filter CE will be consulted for the best approach to use for answering MQs.

### 8.3.2 Coarse Filter Conservation Elements (MQs 9 -12)

*MQ 9. Where are coarse filter CE vegetative communities located?*

*MQ 10. Where are intact (i.e., minimally disturbed by human activities) coarse filter CE vegetative communities located?*

*MQ 11. Where will existing and potential future CAs (aside from climate change) affect current communities?*

*MQ 12. Where will current locations of these communities experience significant deviations from normal climate variation?*

These MQs (similar to the fine filter) will be answered based on modeling approaches outlined in Section 8.1.2 and guidance from the RRT.

### 8.3.3 Terrestrial Sites of High Biodiversity (Questions 13-15)

These questions were dropped from consideration in this REA. See section 8.4 for a description of why an MQ was dropped.

### 8.3.4 Aquatic Sites of High Biodiversity (Questions 16-19)

*MQ 16. Where do spring snails occur?*

This question will be answered by gathering spatial data for either spring snail survey locations or actual observations of the snails. The main contact identified by the AMT ( Desert Research Institute) has not returned our calls or emails due to field work, but a contact at the Smithsonian Institution provided geospatial data for some spring snail species in the NGB ecoregion. The results will be overlaid on a map of springs, seeps, and water courses to show where these species occur within the NGB ecoregion.

*MQ 17 – 19.* These questions on aquatic high biodiversity sites were recommended to be dropped as they fall under a similar rationale as the terrestrial high biodiversity questions. See section 8.4 for a description of why an MQ was dropped.

### 8.3.5 Specially Designated Areas of Ecological and/or Cultural Value (Question 20)

*MQ 20. Where are specially designated areas of ecological and/or cultural value?*

The list of SDAs can be viewed in the coarse filter table in Appendix C. These locations (wilderness areas, wild and scenic rivers, areas of critical environmental concern, etc.) will be extracted from the protected areas database (PADS) or from BLM state office data if newer data exists than what is in PADS. This data will be displayed on a map to show their locations within the NGB ecoregion.

### 8.3.6 Wild Horse and Burro Management Areas (Questions 21-23)

*MQ 21. Where are the current wild horse and burro Herd Management Areas (HMAs)?*

This question will be answered by overlaying BLM's wild horse and burro HMAs on top of the ecoregion map.

*MQ 22. Where uwill CAs (excluding climate change) overlap HMAs, under each time scenario?*

This question will be answered by several maps as placing development, invasive species and wildfire on one map will probably be too much. Since the development CAs contains so many sub items ranging from oil and gas to agricultural, some of these may be devoted to their own map. The Rolling Review Teams (RRTs) for each of the CAs will determine what a suitable future time frame is. After overlaying the CAs with the HMAs, some summary text will be written to describe how significant the CAs will be on the HMAs.

*MQ 23. Where will HMAs experience significant deviations from normal climate variation?*

Using the Hostetler/USGS climate data and the 2060 climate scenario, an analysis will be done by overlaying the projected temperature and precipitation changes from the present scenario on top of the HMAs. A discussion will be provided describing if based on the Hostetler/USGS 2060 scenario any of the HMAs will experience climate change outside its normal variation.

### 8.3.7 Grazing (Questions 24-26)

*MQ 24. Where are the current livestock grazing allotments?*

This question will be answered by overlaying the BLM and USFS grazing allotments on top of the ecoregion map.

*MQ 25. Where will CAs (excluding climate change) overlap grazing allotments under each time scenario?*

This question will be answered by several maps as placing development, invasive species and wildfire on one map will probably be too much. Since the development CAs contains so many sub items ranging from oil and gas to agricultural, some of these may be devoted to their own map. The Rolling Review Teams (RRTs) for each of the CAs will determine what a suitable future time frame is. After overlaying the CAs with the grazing allotments, some summary text will be written to describe how significant the CAs will be on the grazing allotment.

*MQ 26. Where will grazing allotments experience significant deviations from normal climate variation?*

Using the Hostetler/USGS climate data and the 2060 climate scenario, an analysis will be done by overlaying the projected temperature and precipitation changes from the present scenario on top of the grazing allotments. A discussion will be provided describing if based on the Hostetler/USGS 2060 scenario any of the grazing allotments will experience climate change outside its normal variation.

### 8.3.8 Vulnerable Soils (Questions 27-29)

*MQ 27. Where are vulnerable (e.g., wind or water erodible, slickspot) soil types within the ecoregion?*

This question will be answered by using STATSGO soil data from NRCS. This dataset is more generalized than SSURGO data but will provide better ecoregion coverage as SSURGO data is more focused on a county or section of county level. The two main types of soils to be focused on are wind and water erodible soils. STATSGO data from each state will be merged together to form one continuous soils layer. The wind erodible soils will be determined by using the Wind Erodibility Group value or the Wind Erodibility Index of the largest soil component. The water erodible soils will be determined by the K factor attribute of the top horizon of the largest component in the soil map unit. The AMT will be consulted to help determine appropriate thresholds for identifying water and wind erodible soils.

*MQ 28. Where will vulnerable soil types overlap with CAs (aside from climate change) under each time scenario?*

Using the information from MQ 27, each CA will be overlaid to produce maps showing the spatial relationship between vulnerable soils and CAs. The future time scenario will be determined by the RRT for each change agent.

*MQ 29. Where will current vulnerable soil types experience significant deviations from normal climate variation?*

Using the Hostetler/USGS climate data, changes in temperature and precipitation will be overlaid on to maps with results from MQ 27. Areas determined to be at higher risk due to deviations in climate will be discussed.

### 8.3.9 Surface and Subsurface Water Availability (Questions 30-33)

*MQ 30. Where are current natural and man-made surface water resources, and which are perennial, seasonal, ephemeral, spatially intermittent, etc.?*

The National Hydrographic Dataset (NHD) contains most of the available natural and man-made water resources. This data will be overlaid on the maps to show perennial and intermittent streams along with any man-made water resources.

*MQ 31. What is the natural variation of monthly discharge and monthly base flow for streams and rivers?*

The main source of data for this MQ will be USGS stream gage data. Based on data availability, a map of stream gage locations within the ecoregion will be created. Based on AMT guidance, certain streams or rivers will be selected and graphs will be created showing the natural variation of the stream flow and discharge.

### 8.3.10 Aquatic Ecological Function and Structure (Question 34)

*MQ 34. What is the condition (ecological integrity) of aquatic CEs?*

The AMT decided that the EI approach used in this REA would be one created by the WGA. The WGA is creating metrics for measuring EI for both terrestrial and aquatic. These metrics will be overlaid with aquatic CEs to determine the condition of their location/range.

### 8.3.11 Fire History (Question 35)

*MQ 35. What is the frequency, size, and distribution of wildfire on the landscape?*

The main data inputs for answering this MQ will be GeoMAC and Monitoring Trends in Burn Severity (MTBS). A determination will need to be made as to what is the temporal time frame for the analysis because most spatial data only exists back to 1980. Spatial data for fires do exist prior to 1980, but are not mapped as accurately as more recent data. Even post-1980 fires were often mapped by a field person simply as boundaries on a topo map. Newer fire maps are created from satellite or aerial photos, which enable more accurate determination of boundaries. The difference is significant if you are planning to compute fire statistics or quantify disturbance regimes because the earlier, coarser resolution maps will tend to overestimate fire extent relative to new methods. Miller *et al*. (2011) provides summaries of fire data since 1940 for the Northern Great Basin and Snake River Plain, including number of fires, average fire size, and total area burned. This question will be answered by creating a map showing extent of fires across the ecoregion. A separate analysis including histograms and graphs of fire size and frequency will be included to fully answer this question. It was mentioned at AMT Workshop 4 that some fires may not be included in GeoMAC. A way to get a picture of how many fires are not in GeoMAC would be to look at a different source of data such as MODIS that can provide point locations of fires. Comparing the two would give an estimate of the amount or percent of fires that may have been missed.

### 8.3.12 Fire Potential (Questions 36-37)

*MQ 36. What areas now have (high, medium, low) potential for fire based on fuels composition (e.g., invasive plants, uncharacteristically dense sagebrush)?*

Since invasive species, including cheatgrass, are the biggest source of high fuel composition, showing locations of invasives and other vectors such as roads will be one of the main inputs into determining fuel loads. LANDFIRE has some data layers that model fuel loads as well. Potential climate change effects on fuels composition will be considered as a factor in this analysis. The RRT will be consulted for recommendations on the best approach to answer this question with available data.

*MQ 37. Where are areas that in the future will have high potential for fire?*

This question will be answered by focusing on ignition sources within the ecoregion. A map will be created showing Department of Defense (DOD) and Department of Energy (DOE) locations, frequent lightning strike areas and other features that would be included as development change agent such as roads, recreation areas, oil and gas areas, etc. Fuel loads will also be included by using LANDFIRE's 13 Anderson fuel model and prevailing winds during the fire season will be displayed on the map.

### 8.3.13 Invasive Species (Questions 38-41)

*MQ 38. What is the current distribution of invasive species included as CAs?*

This question will be answered by displaying the location of invasive species selected as important within the ecoregion. This will either be based on existing data only or modeled approach approved by the RRT. Published models showing probability of occurrence of certain invasive species such as cheatgrass will be used. The resulting data will be placed on a map of the ecoregion.

*MQ 39. What is the relative abundance or intensity of effect of invasive species included as CAs (dominant/non-dominant, presence/absence, or not detected)?*

This question will be answered in consultation with the RRT on the best way to determine dominance vs. presence or absence. The focus will not only be on the data but also what areas have been surveyed and not surveyed.

*MQ 40. Focusing on the distributions of terrestrial and aquatic CEs that are significantly affected by invasive species, which areas have restoration potential?*

This MQ resulted from the CBR AMT's interest in cheatgrass, and is related to MQ 6: *Given current and anticipated future locations of CAs, which habitats remain as opportunities for habitat enhancement/restoration?* AMT members will discuss whether to pursue MQ 40 as an issue separate from MQ 6.

*MQ 41. Given current patterns of occurrence and expansion of the invasive species included as CAs, what is the potential future distribution of these invasive species?*

The AMT recognized that this MQ is related to MQ 6: Given current and anticipated future locations of CAs, which habitats remain as opportunities for habitat enhancement/restoration? However, it was decided to retain MQ 41 as a separate analysis. This MQ will be answered using published range-wide models for certain invasive species and in consultation with the RRT and AMT on the best way to depict the potential for future distribution of these invasive species. Development (Questions 42-45)

*MQ 42. Where are current locations of development CAs?*

This question will be answered by the creation of several maps showing the combined development CA footprint along with individual maps broken up into categories (Human, Agriculture, Oil and Gas, etc.). This will provide a spatial display of both the overall development footprint along with maps of the individual components. Since some of the development data will be linear or point features, data may be buffered to create a polygon such as roads or oil and gas wells. The size of the buffers will be determined by the RRT or AMT.

*MQ 43. Where are areas of planned or potential development CAs?*

This question will be answered by assessing what data is available at the ecoregion-scale that could be used to locate areas where new development is planned or there is the potential for new development. The response to this question will be focused so that it does not duplicate other MQs, such as those for renewable or non-renewable energy unless the RRT feels the need to include them as well. The planned or potential development layer will be placed on a map of the ecoregion.

*MQ 44. Where do development CAs cause significant loss of ecological integrity?*

This question will be answered by using the development layer created to answer MQ 42 and overlaying it with the ecological integrity layer created by the WGA on a map of the ecoregion. Areas identified with a loss of EI will be focused upon detailing what development CAs may be contributing to the low EI. Depending on the results, if there are only a few key areas, a detailed synthesis will be done describing the areas of low EI. If there are a high number of areas, the RRT will be consulted as to whether to focus on a selected few ecoregion significant sites of low EI or to only describe generally the ecoregion.

*MQ 45. Where do current locations of CEs overlap with development CAs?*

This question will be answered by using the development layer created in MQ 42 and overlaying it with the existing habitat or modeled suitable habitat for each CE. Maps for each of the CEs will be created showing the level of impact of the development CA with each CE.

### 8.3.14 Recreation (Questions 46-48)

*MQ 46. Where are areas with significant recreation use?*

This question will be answered by determining the significant recreation uses in the ecoregion and gathering spatial data for these recreation uses. Some of the main recreation sources would be ski hills, off-high vehicle (OHV) use, camping, hiking, fishing and hunting. The RRT will be consulted to ensure that all significant recreation sources are included. The locations of these recreation sites will be overlaid on a map of the ecoregion.

*MQ 47. Where have designated recreation areas, such as for off-highway vehicle (OHV) use, affected CEs and invasive species?*

This question will be answered by taking only the designated OHV areas (and any other areas recommended by the RRT) and overlaying their locations with both the locations of each CE as well as for the CA invasive species. A determination will be made, in consultation with the RRT, to identify CEs within the designated recreation areas that may be affected by the recreation use. In a similar fashion, a determination will be made to locate designated recreation areas that may have affected invasive species. These locations will be placed on a map of the ecoregion.

*MQ 48. Where are other areas of likely high OHV use (as determined by modeling) that may affect CEs and invasive species?*

This question will be answered by developing a model to locate areas of possible OHV use outside of a designated recreation area. The RRT will be consulted to ensure the model accurately identifies these areas outside of designated areas. These modeled locations will be placed on a map of the ecoregion and a GIS process model will be included to show the steps taken to identify these areas.

### 8.3.15 Oil, Gas, and Mining Development (Questions 49-52)

*MQ 49. Where are the current locations of oil, gas, and mineral extraction?*

This question will be answered by using oil and gas well location data provided by BLM. Mining locations will be determined by the USGS's data in MRDS. These datasets will be combined and overlaid onto a map.

*MQ 50. Where will locations of oil, gas, and mineral extraction potentially exist by 2025?*

This question will be answered by looking sources at data for future oil and gas. One of the main sources is the Energy and Policy Act (EPCA) data products produced by BLM. There are two basins studied in EPCA Phase 3, those being Eastern Oregon –Washington and Eastern Great Basin. There currently is not a data source for future mineral extraction potential. The AMT will be consulted to help locate future mineral extraction data along with additional data for oil and gas future potential. The locations of oil, gas and mineral extraction will be overlaid onto a map of the ecoregion.

*MQ 51. Where are the areas of potential future locations of oil, gas, and mining (including gypsum) development (locatable, salable, and fluid and solid leasable minerals)?*

This question is very similar to MQ 50 and may not yield different results.

*MQ 52. Where do locations of current CEs overlap with areas of potential future locations of non-renewable energy development?*

This question will be answered by intersecting the CEs with the results of MQ 51 and/or MQ 50. The CEs that share an intersection will be placed on maps to display the spatial location and amount of overlap between future oil, gas, and mineral locations. A synthesis describing the overlap for each CE and its possible effects will be included.

### 8.3.16 Renewable Energy Development (Questions 53-57)

*MQ 53. Where are the current locations of renewable energy development (solar, wind, geothermal, transmission)?*

This question will be answered by using BLM's permitted boundaries for solar, wind, and geothermal. These boundaries were provided by BLM and will be displayed on a map to show the locations of existing solar, geothermal, and wind energy in the ecoregion. The locations will be restricted to existing developed sites, permitted areas will be included in MQ 57.

*MQ 54. Where are the areas identified by the National Renewable Energy Laboratory (NREL) as potential locations for renewable energy development?*

This question will be answered by downloading the solar, wind, and geothermal potential from the NREL website and show the locations of these areas on a map of the ecoregion. Biomass will not be included unless the AMT deems it significant since NREL only displays a few counties in the ecoregion with significant biomass resources.

*MQ 55. Where are the areas of low renewable and non-renewable energy development that could potentially mitigate impacts to CEs from potential energy development?*

This question will be answered by merging areas identified in MQ 49, 50, 51, 53, and 54 and erasing them from the ecoregion leaving the low renewable or non-renewable areas only. Using the remaining part of the ecoregion, areas would be identified that are semi-degraded and outside the existing habitat of the CEs.

*MQ 56. Where do current locations of CEs overlap with areas of potential future locations of renewable energy development (MQ 54)?*

This question will be answered by taking the locations identified in MQ 54 and intersecting them with CEs. The CEs that share an intersection will be placed on maps to display the spatial location and amount of overlap between potential renewable energy. A synthesis describing the overlap for each CE and its possible effects will be included as a table.

*MQ 57. Where will locations of renewable energy development potentially exist by 2025?*

This question will be answered by taking the permitted and pending to be built sites from the data provided in MQ 53 and display these locations on a map of the ecoregion.

### 8.3.17 Groundwater Extraction and Transportation (Questions 58-60)

*MQ 58a. Where are areas with current groundwater extraction?*

This question will be answered by locating data sets that show areas of groundwater extraction and transport of extracted water. This data may be hard to find ecoregion-wide so the RRT and AMT will be consulted to help locate suitable datasets. These locations of groundwater extraction will be placed on a map of the ecoregion.

*MQ 58b. Where are the areas of potential future change in groundwater extraction?*

Using the results from MQ 58a, this question will be answered by determining areas that may change in the future. The RRT will be consulted to help isolate these areas of change. These areas will be placed on a map of ecoregion.

*MQ 59. This question was dropped from consideration in this REA. See Section 8.4 for more details*.

*MQ 60. Where are the aquatic CEs showing degraded ecological integrity from existing groundwater extraction?*

This question will be answered by using the aquatic CEs and comparing them to locations of groundwater extraction (MQ 58a), as well as the WGA EI for aquatics. In AMT Workshop 4, the situation of groundwater extraction lowering the water table and drying up springs was identified. The RRT will advise us on which aquatic CEs to focus on, if needed. The locations of each aquatic CE with degraded aquatic EI will be displayed on a map of the ecoregion.

### 8.3.18 Surface Water Consumption and Diversion (Questions 61-63)

*MQ 61. Where are current surface water diversions?*

This question will be answered by locating data sets that show areas of surface water consumption and diversion. The main sources of this data will the National Hydrographic Dataset as it includes man made features and the USACE dam's dataset. The RRT and AMT will be consulted to help locate additional suitable datasets. These locations of surface water consumption and diversion will be placed on a map of the ecoregion.

*MQ 62. Where are the areas of potential future change in surface water diversion?*

The RRT will be consulted to determine the best source of data in the ecoregion that would provide information on proposed new construction or demolition of existing diversions.

*MQ 63. Where are the CEs showing degraded ecological integrity from existing surface water diversion?*

This question will be answered by using the CEs and comparing them to locations of surface water consumption (MQ 61) as well as the WGA EI. The RRT will advise us on which CEs to focus on, if needed. The locations of each CE with degraded EI will be displayed on a map of the ecoregion.

### 8.3.19 Climate Change: Terrestrial Resource Issues (Questions 64-67)

*MQ 64. Where will changes in climate be greatest relative to normal climate variability?*

*MQ 65. Given anticipated climate shifts and the direction shifts in climate envelopes for CEs, where are potential areas of significant change in extent such as ecotones?*

*MQ 66. Where are vegetation CEs that will experience significant deviations from normal climate variation?*

*MQ 67. Where are wildlife CE habitats that will experience significant deviations from normal climate variation?*

The climate change questions will be answered using either the Hostetler/USGS climate scenarios or using the CIG (Climate Impacts Group) dataset. Normal climate will be defined by the Rolling Review Team for Climate Change once the dataset being used is decided upon.

### 8.3.20 Climate Change: Aquatic Resource Issues (Question 68)

*MQ 68. Where will aquatic CEs experience significant deviations from historic climate variation that potentially could affect the hydrologic and temperature regimes of these aquatic CEs?*

The analysis will be the same as listed in the previous section describing terrestrial climate change.

### 8.3.21 Military Constrained Areas (Question 69)

*MQ 69. Where are areas of Department of Defense and Department of Energy use?*

This question will be answered by extracting locations of DOD and DOE land use within the ecoregion. Since some agencies use land that is owned by BLM, the RRT will be consulted to ensure all DOD and DOE used land will be identified. The resulting data will placed on a map of the ecoregion.

### 8.3.22 Atmospheric Deposition (Question (70)

*MQ 70. Where are areas affected by atmospheric deposition of pollutants, as represented specifically by nitrogen deposition, acid deposition, and mercury deposition?*

This question will be answered by locating monitoring stations within the ecoregion from programs such as the National Atmospheric Deposition Network (NADN), EPA, and data collection by people such as Edith

Allen at UC Riverside. The direction of prevailing winds will also be overlaid on a map of the ecoregion. Any data on deposition sources such as gold mines or Asian dust will be also included and discussed.

### 8.3.23 Livestock Grazing (Questions 71-78)

*MQ 71. Where is structure of vegetation CEs affected by livestock grazing?*

This question will not be answered in a spatial manner. At AMT Workshop 4, the AMT determined that this question was too fine-scale for an REA, as the details that really drive this question relate to the loss of understory. This question will be answered by narrative discussing this issue.

*MQ 72. Where can livestock grazing be used to reduce wildfire risk in areas with herbaceous fuel loads and proximity to high-probability ignition locations (roads, train tracks, lightning etc.)?*

This question will be answered by locating areas of high risk to wildfire taking into account the fire, frequency, size, and intensity. Since using domestic sheep can result in disease transmission to wild bighorn sheep, the locations of bighorn sheep will also be placed on the map of the ecoregion.

*MQ 73. Where will livestock grazing have the potential to increase fire frequency as a result of increased cover of annual grasses (high, medium, low)?*

This question will be answered by trying to locate areas of the conversion of native annual grasses or changes due to fire frequency. These locations will be placed on a map of the ecoregion.

*MQ 74. Where are areas in the landscape with various (low, medium, high) levels of resilience to livestock grazing (based upon ecological site and existing vegetation)?*

The RRT will be consulted to determine the best use of state and transition models or ecological site descriptions to determine the resiliency.

*MQ 75. Where has the landscape been modified for purposes of livestock grazing or management (sagebrush elimination, fences, plantings, water sources, etc.)?*

This question will be answered by locating various land treatments for grazing or range management and placing these locations on a map of the ecoregion. Some identified datasets would include digital lands treatment database, fence locations from SAGEMAP, etc. The RRT will be consulted to provide insight into other datasets and also ways to represent non-spatial treatment data on a map.

## 8.4 Management Questions to be Dropped from Consideration

*MQ 13. Where are sites identified as having high biodiversity characteristics? Which designated sites are protected?*

*MQ 14. Where will CAs (aside from climate change) potentially affect sites of high biodiversity?*

*MQ 15. Where will locations of these high biodiversity sites experience significant deviations from normal climate variation?*

*MQ 17. Where are areas representing unique aquatic lineages or assemblages or other areas of high aquatic biodiversity (considering both local [alpha] and regional [beta or gamma] diversity?*

*MQ 18. Where will these aquatic high biodiversity sites (as defined in MQ 17) be potentially affected by CAs (aside from climate change)?*

*MQ 19. Where will current locations of these aquatic high biodiversity sites (as defined in MQ 17) experience significant deviations from normal climate variation?*

The AMT discussed the challenges involved in answering these MQs, which were carried forward from the Central Basin and Range (CBR) set of MQs. The intention was to utilize "priority conservation species" datasets similar to those created by NatureServe for the six original ecoregions in the REA effort, (including those assigned to SAIC [Middle Rockies (MIR) and Northwestern Plains (NWP)]). However, SAIC experienced problems with using these data sets in these ecoregions and advised the MIR/NWP AMT that the evaluation of MQs related to sites of high biodiversity should not proceed as planned. To summarize the issues, we found that there were large differences in the number of state-ranked species of concern included in the data sets. For example, some states had a much more comprehensive list of priority conservation species than adjacent states, likely because of different criteria for considering a species for inclusion, but we believe this is not necessarily an indicator of greater diversity in that state. Also, within a particular state, the number of species reported in a watershed, in part, reflects the intensity of survey effort in that watershed; given that some watersheds may be well surveyed while others may not, a comparison of watersheds would require that we weight the results based on survey effort. However, we cannot readily calculate survey effort from the data set, nor would we expect that this could be done across an entire ecoregion. For these reasons the AMT agreed to drop MQ 13-15 related to terrestrial sites of high biodiversity in the NGB. Answering MQs 17-19 related to aquatic sites of high biodiversity would pose challenges similar to those described for terrestrial biodiversity MQs. The AMT did not know, with respect to MQ 18, that it was too difficult in CBR to get water level drawdown data, and so this CA could not be adequately evaluated. Recognizing that existing information on aquatic resources and CA effects on them is very limited and that we cannot directly address these gaps, the AMT's USGS advisor on aquatic resources recommended that the REA focus on the larger question of describing the uncertainty over aquatic species. He provided a draft process for categorizing the types of uncertainty about species distribution and status, and change agent effects, and suggested a scoring system for each type of uncertainty. The AMT directed SAIC to pursue this approach with USGS guidance. MQs 17-19 related to sites of high aquatic biodiversity will be dropped in favor of addressing uncertainty about species in the NGB.

*MQ 32. Where are the likely recharge areas within a HUC?*

The AMT decided that it was beyond the scope of the REA to try to delineate recharge areas by devising an approach to model these regions. Only existing data on recharge areas would be considered, if this data wasn't available this question would be identified as a data gap.

*MQ 33. Where will the recharge areas (relating to aquatic CEs) identified in MQ 32 potentially be affected by CAs?*

Based on information gathered in MQ 32, CAs will be overlaid to produce maps showing where recharge areas and CAs overlap. If MQ 32 is dropped, this MQ will be dropped as well.

*MQ 59. What is the present distribution of municipal and agricultural water use of groundwater resources in relation to the distribution of aquatic CEs?*

The AMT decided to drop this MQ because it will be covered by MQ 58: *Where will CAs potentially impact groundwater-dependent aquatic CEs?*

MQ 61. *Where are artificial water bodies including evaporation ponds, etc.?* The AMT decided to drop this MQ because artificial water sources are covered by MQ 30: *Where are current natural and man-made surface water resources, and which are perennial, ephemeral, etc.?* Also it was noted that a MQ for existing surface water diversions was missing, so MQ 6 will be replaced by*: Where are current surface water diversions?*

*MQ 76. What areas of the landscape are low density vs. high density livestock grazed (streams, water developments, corrals, steep slopes, etc.)?*

*MQ 77. Where are areas best suited to potential livestock cattle and sheep grazing based on environmental factors (such as slope, aspect, water availability, wild ungulate grazing)?*

*MQ 78. Where do grazing areas have the highest potential to increase invasive and/or noxious species occurrences?*

Livestock grazing CA questions were not addressed at AMT Workshop 4 due to lack of time, although SAIC's proposed approach to modeling suitable grazing areas using physiographic and infrastructure inputs was discussed in the context of the livestock grazing CE. AMT members thought that grazing pressure in reality was far more complex than this type of modeling could predict and therefore the modeling would not be worth the effort. In particular, AMT members felt that there are too many other variables to consider, such as <u>how</u> the land is grazed that are potentially more important. For this reason, SAIC recommended and AMT concurred that these MQs (76, 77, and 78) be dropped.

# 9. Phase 2 Task 3 - Prepare Rapid Ecological Assessment Document

The outline of the final Rapid Ecological Assessment (REA) document was provided by BLM to ensure that the final REA documents had a similar organization, look, and feel. The final REA document is broken up into sections to highlight these key areas:

- An introduction to the REA process,
- Discussion of the what is included (Management Questions [MQs], Conservation Elements [CEs] and Change Agents [CAs]) in the REA and the modeling approaches used,
- Current Condition of the Ecoregion,
- Potential Future Condition of the Ecoregion,
- Summary and Conclusions, and
- Management Recommendations to Address REA Findings.

Since there is page limit for the main document, the majority of the document will be organized within the Appendices. The CE and CA packages will each be self-contained documents containing the REA life history of the CE or CA from why it is included in the REA to resulting maps showing its current and potential future scenarios. The main body and the appendices will be linked where appropriate to allow the reader to jump to the appendix for more detailed info about CEs or CAs from the main body.

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# Appendix A

Management Question Changes from Memo 3 to Memo 4

## *Appendix A. Management Questions for the NGB*

| MQ # | MQ Group | Original Management Question[1] | Revised Management Question[2] | MQ Tier[3] | AMT Conclusion/Guidance[4] |
|---|---|---|---|---|---|
| **Questions Related to Conservation Elements (CEs)** | | | | | |
| 1 | Species | What is the current distribution of potential habitat for each species CE? | What is the currently occupied habitat or modeled suitable habitat for each species CE? | 1 | Combine occupied and potential habitat (as determined by modeling) into one MQ and produce one distribution map per species that distinguishes between occupied and modeled habitat. Show seasonal ranges and movement corridors if these are provided with distribution data sets. |
| 2 | Species | Where are current locations of species CEs that are potentially affected by existing change agents (CAs) (and thus potentially at risk)? | Where are the areas of greatest and least collective impact of existing CAs on occupied habitat or modeled suitable habitats of species CEs? | 2? | Limit CAs to the most important ones for a particular species CE, or the intersection of the most important CAs that affect a particular species CE. An example of high CA impact would be the intersection of major CAs leading to a land cover type conversion. Overlay the CEs on these areas to answer this MQ. SAIC prioritize CAs for this analysis and then seek Rolling Review Team (RRT) confirmation. |
| 3 | Species | What is the current distribution of suitable habitat, including seasonal habitat and movement corridors, for each landscape species and species assemblage CE? | Where are the connectivity corridors identified by the Western Governors Association (WGA) landscape integrity dataset? | 1 | Reword this MQ to address connectivity corridors in general and move species-specific seasonal habitat and movement corridors to MQ 1. If states provide movement corridors for species, depict this in occupied habitat map (MQ 1) but don't attempt to model any movement corridors. The WGA landscape integrity data set should be used to identify general connectivity corridors. |
| 4 | Species | Where are existing CAs potentially affecting this current habitat and/or movement corridors, for landscape species and species assemblage CEs? | Where are the areas of greatest and least collective impact of existing CAs on connectivity corridors identified in MQ3? | 2? | Use WGA data set. Similar to MQ 2, use RRT expert opinion to help prioritize CAs for this analysis. |

[1] Original Management Questions from Workshop 1.
[2] Revised Management Questions from Workshop 4.
[3] Tier 1 questions involve basic data describing where CEs or CAs are located. Tier 2 questions identify where CAs and CEs overlap; i.e., where conflicts may occur. Tier 3 questions ask about the significance of CA/CA relationships in terms of magnitude of effect or management opportunities.
[4] Assessment Management Team (AMT) guidance from Workshop 4.
[5] Yellow highlighted MQs require AMT action or concurrence with SAIC recommendation.

## *Appendix A. Management Questions for the NGB*

| MQ # | MQ Group | Original Management Question[1] | Revised Management Question[2] | MQ Tier[3] | AMT Conclusion/Guidance[4] |
|---|---|---|---|---|---|
| **Questions Related to Conservation Elements (CEs)** | | | | | |
| 5 | Species | Where are species CEs whose current locations or suitable habitats overlap with the potential future distribution of CAs (other than climate change)? | | 2 | |
| 6 | Species | Given current and anticipated future locations of CAs, which habitat areas remain as opportunities for habitat enhancement/ restoration? | | 3 | Focus on plant community restoration, starting with areas already impacted by CAs, and then overlay future CAs. Develop a gradient of impact intensity, identify thresholds for areas with relatively low CA weight, which may require selection of threshold values that would be opportunities for restoration. |
| 7 | Species | Where are potential areas to restore connectivity for landscape species and species assemblage CEs, based on current locations of CAs? | | 3 | For terrestrial CEs, focus on mule deer and greater sage-grouse, but also evaluate potential restoration of connectivity using the WGA layer and other CA layers like juniper expansion and invasives. With respect to aquatic CEs, pursue this MQ if data are available. AMT recognizes (and WGA currently working on) problems related to dry reaches, predator presence, etc. |
| 8 | Species | Where will landscape species and species assemblage CEs experience climate outside their current climate envelope? | Where will landscape species and species assemblage CEs (not including white sturgeon and cave bat species, and limited to winter and/or summer range for mule deer, pronghorn winter range) experience climate outside their current climate envelope? | 2 | Only include species that will be evaluated by Healy Hamilton. Not much change was found at 2025 in her climate envelope modeling of CBR. Tim Bottomley will confirm time frame(s) for NGB analysis. |
| 9 | Native Plant Communities | Where are intact (i.e., minimally disturbed by human activities) CE vegetative communities located? | Where are coarse filter CE vegetative communities located? | 1 | |
| 10 | Native Plant Communities | Where are the likeliest current locations for high-integrity examples of each major terrestrial ecological system? | Where are intact (i.e., minimally disturbed by human activities) coarse filter CE vegetative communities located? | 2 | Use WGA integrity layer |
| 11 | Native Plant Communities | Where are existing and potential future CAs (aside from climate change) likeliest to affect current communities? | Where will existing and potential future CAs (aside from climate change) affect current communities? | | Analyze the gradient of effect on current communities. |

| MQ # | MQ Group | Original Management Question[1] | Revised Management Question[2] | MQ Tier[3] | AMT Conclusion/Guidance[4] |
|---|---|---|---|---|---|
| **Questions Related to Conservation Elements (CEs)** | | | | | |
| 12 | Native Plant Communities | Where will current locations of these communities experience significant deviations from normal climate variation? | | 2 | Significant deviations defined per Healy Hamilton work: +/- 1 or 2 standard deviations. |
| 13 | Terrestrial Sites of High Biodiversity | Where are sites identified as having high biodiversity characteristics? Which designated sites are protected? | | | Drop this MQ because of lack of data, inconsistent survey effort, and variation in the species that were included in the biodiversity data base by each state. |
| 14 | Terrestrial Sites of High Biodiversity | Where will CAs (aside from climate change) potentially affect sites of high biodiversity? | | | Drop this MQ because of lack of data, inconsistent survey effort, and variation in the species that were included in the biodiversity data base by each state. |
| 15 | Terrestrial Sites of High Biodiversity | Where will locations of these high biodiversity sites experience significant deviations from normal climate variation? | | | Drop this MQ because of lack of data, inconsistent survey effort, and variation in the species that were included in the biodiversity data base by each state. |
| 16 | Aquatic Sites of High Biodiversity | What has been the general level of survey effort (ecoregion-wide, not site-specific) for spring snails and other species of concern? | Where do spring snails occur? | 1 | Map known occurrences of spring snails, using Nevada NHP data and Sada's data. Do not add these species as a CE or do CA effects analysis. |
| 17 | Aquatic Sites of High Biodiversity | Where are areas representing unique aquatic lineages or assemblages or other areas of high aquatic biodiversity (considering both local [alpha] and regional [beta or gamma] diversity)? | | 2 | Drop this MQ because of lack of data and inconsistent survey effort..Work with USGS to list and categorize the types of uncertainty over aquatic species and CA effects |
| 18 | Aquatic Sites of High Biodiversity | Where will these aquatic high biodiversity sites (as defined in MQ 17) be potentially affected by CAs (aside from climate change)? | | 2 | AMT: It was too difficult in CBR to get aquatic drawdown CA data. Pursuing this MQ depends on output of MQ17. Drop this MQ. |
| 19 | Aquatic Sites of High Biodiversity | Where will current locations of these aquatic high biodiversity sites (as defined in MQ 17) experience significant deviations from normal climate variation? | | 2 | Pursuing this MQ depends on output of MQ17. Drop this MQ |
| 20 | Specially Designated Areas of Ecological and/or Cultural Value (SDAs) | Where are specially designated areas of ecological and/or cultural value? | | 1 | |

| MQ # | MQ Group | Original Management Question[1] | Revised Management Question[2] | MQ Tier[3] | AMT Conclusion/Guidance[4] |
|---|---|---|---|---|---|
| **Questions Related to Conservation Elements (CEs)** | | | | | |
| 21 | Wild Horse and Burro Management Areas | Where are the current wild horse and burro Herd Management Areas (HMAs)? | | 1 | |
| 22 | Wild Horse and Burro Management Areas | Where will CAs (excluding climate change) overlap HMAs, under each time scenario? | | 2 | AMT would like a gradient or ranking of CA effects. |
| 23 | Wild Horse and Burro Management Areas | Which HMAs will experience climate outside their current climate envelope? | Where will HMAs experience significant deviations from normal climate variation? | 2 | Climate envelope modeling was dropped from the Healy Hamilton scope of work because the AMT didn't want to try to predict a range shift. AMT notes that HMA boundaries are artificially constrained and BLM provides water to animals in these areas. |
| 24 | Grazing | Where are the current livestock grazing allotments? | | 1 | Acquire USFS, BLM, Indian reservation, and state data, including sheep allotments. |
| 25 | Grazing | Where will CAs (excluding climate change) overlap grazing allotments under each time scenario? | | 2 | |
| 26 | Grazing | Which grazing allotments will experience climate change outside their current climate envelope? | Where will grazing allotments experience significant deviations from normal climate variation? | 2 | |
| 27 | Vulnerable Soils | Where are vulnerable (e.g., erodible, slickspot) soil types within the ecoregion? | | 1 | Soils vulnerable to wind erosion include flat, gentle slopes, valley bottom, fine texture, low elevation; post-fire (no vegetative cover). Focus on texture to distinguish erodible from non-erodible soils. |
| 28 | Vulnerable Soils | Where will vulnerable soil types overlap with CAs (aside from climate change) under each time scenario? | | 2 | |
| 29 | Vulnerable Soils | Where will current vulnerable soil types experience significant deviations from normal climate variation? | | 2 | |
| 30 | Surface and Subsurface Water Availability | Where are current natural and man-made surface water resources, and which are perennial ephemeral, etc.? | Where are current natural and man-made surface water resources, and which are perennial, seasonal, spatially intermittent, etc.? | 1 | Ephemeral water courses are probably not mapped. |
| 31 | Surface and Subsurface Water Availability | What is the natural variation of monthly discharge and monthly base flow for streams and rivers? | | 1 | Focus on less- or unregulated rivers and streams. Mapping may not be possible to answer this MQ, but try to provide data charts or graphs for selected streams showing natural variation in stream flow. |

| MQ # | MQ Group | Original Management Question[1] | Revised Management Question[2] | MQ Tier[3] | AMT Conclusion/Guidance[4] |
|---|---|---|---|---|---|
| **Questions Related to Conservation Elements (CEs)** | | | | | |
| 32 | Surface and Subsurface Water Availability | Where are the likely recharge areas within a HUC? | | | If data are available then use it, otherwise don't attempt to model recharge because of complexity of analysis. Per Bryce Bohn, recharge areas are not generally known but some recharge is assumed for perennial streams. USGS measures discharge in reaches where they suspect recharge happens. |
| 33 | Surface and Subsurface Water Availability | Where will the recharge areas (relating to aquatic CEs) identified in MQ 32 potentially be affected by CAs? | | | Depends on answering MQ 32. |
| 34 | Aquatic Ecological Function and Structure | What is the condition (ecological integrity) of aquatic CEs? | | 2 | AMT discussed the potential for reporting ecological integrity (vs. intactness) for aquatic CEs. WGA is working with integrity, and Bryce Bohn suggested that aquatic systems data may be suited to modeling integrity. Gregg Servheen will check on the status of the WGA aquatic systems effort. Also look at the Western Trout Habitat Initiative. Tim Bottomley will check on what CBR is doing. |
| **Questions Related to Change Agents (CAs)** | | | | | |
| 35 | Fire History | What is the frequency, size, and distribution of wildfire on the landscape? | | 1 | GeoMAC fire data layer may be incomplete. Compare to other data sets to see the proportion of fires that may not be in GeoMAC. |
| 36 | Fire Potential | What areas now have (high, medium, low) potential for fire based on fuels composition (e.g., invasive plants)? | | 2 | |
| 37 | Fire Potential | Where are areas that in the future will have high potential for fire? | | 2 | |
| 38 | Invasive Species | What is the current distribution of invasive species included as CAs? | | 1 | Do not include weed data for agricultural lands. Analysis should not include cropland, but recognize there is drift from ag lands to wildlands. NSIMS data gap: mapping of weed distribution on private land. |

| MQ # | MQ Group | Original Management Question[1] | Revised Management Question[2] | MQ Tier[3] | AMT Conclusion/Guidance[4] |
|---|---|---|---|---|---|
| **Questions Related to Change Agents (CAs)** | | | | | |
| 39 | Invasive Species | What areas are significantly affected by invasive species? | What is the relative abundance or intensity of effect of invasive species included as CAs (dominant/non-dominant, presence/absence, or not detected)? | 2 | CBR looked at dominance of cheatgrass; per Matt Germino, datasets are available that map dominance of cheatgrass. Build on the NGB Pilot project model for cheatgrass risk (low, moderate, high). Other invasive species are of management interest even with trace occurrence, i.e., mapping as present vs. absent. The AMT made a series of suggestions: 1) Develop a table showing criteria for invasive species mapping, including criteria related to presence and/or dominance. 2) Consider developing maps that show concentrations of forb and grassy invasives (which may pool occurrences of species); woody invasives may be mappable as individual species. 3) While not recommending weighting the relative importance of different species, which is a field-level judgment, the AMT suggested developing a gradient of invasive CA effect intensity. |
| 40 | Invasive Species | Focusing on the distributions of terrestrial and aquatic CEs that are significantly affected by invasive species, which areas have restoration potential? | | 3 | This MQ resulted from the CBR AMT's interest in cheatgrass, and will be dropped because it is covered under MQ 6 (which asks about all CAs). |
| 41 | Invasive Species | Given current patterns of occurrence and expansion of the invasive species included as CAs, what is the potential future distribution of these invasive species? | | 3 | Drop this MQ because it is covered under MQ 6. Recognize that there is higher risk of invasives adjacent to private land, especially cropland. |
| 42 | Development | Where are current locations of development CAs? | | 1 | |
| 43 | Development | Where are areas of planned or potential development CAs? | | 1 | |
| 44 | Development | Where do development CAs cause significant loss of ecological integrity? | | 2 | |
| 45 | Development | Where do current locations of CEs overlap with development CAs? | | 2 | |

| MQ # | MQ Group | Original Management Question[1] | Revised Management Question[2] | MQ Tier[3] | AMT Conclusion/Guidance[4] |
|---|---|---|---|---|---|
| **Questions Related to Change Agents (CAs)** | | | | | |
| 46 | Recreation | Where are areas with significant recreational use? | | 1 | |
| 47 | Recreation | Where have designated recreation areas, such as for off-highway vehicle (OHV) use, affected CEs and invasive species? | | 2 | |
| 48 | Recreation | Where are other areas of likely high OHV use [as determined by modeling] that may affect CEs and invasive species? | | 2 | |
| 49 | Oil, Gas, and Mining Development | Where are the current locations of oil, gas, and mineral extraction? | | 1 | |
| 50 | Oil, Gas, and Mining Development | Where will locations of oil, gas, and mineral extraction potentially exist by 2025? | | 1 | |
| 51 | Oil, Gas, and Mining Development | Where are the areas of potential future locations of Oil, Gas, and Mining (including gypsum) development (locatable, salable, and fluid and solid leasable minerals)? | | 2 | |
| 52 | Oil, Gas, and Mining Development | Where do locations of current CEs overlap with areas of potential future locations of non-renewable energy development? | | 3 | |
| 53 | Renewable Energy Development | Where are the current locations of renewable energy development (solar, wind, geothermal, transmission)? | | 1 | |
| 54 | Renewable Energy Development | Where are the areas identified by the National Renewable Energy Laboratory (NREL) as potential locations for renewable energy development? | | 3 | |
| 55 | Renewable Energy Development | Where are the areas of low renewable and non-renewable energy development that could potentially mitigate impacts to CEs from potential energy development? | | 3 | |

| MQ # | MQ Group | Original Management Question[1] | Revised Management Question[2] | MQ Tier[3] | AMT Conclusion/Guidance[4] |
|---|---|---|---|---|---|
| **Questions Related to Change Agents (CAs)** | | | | | |
| 56 | Renewable Energy Development | Where do current locations of CEs overlap with areas of potential future locations of renewable energy development (MQ 65)? | | 2 | |
| 57 | Renewable Energy Development | Where will locations of renewable energy [development] potentially exist by 2025? | | 1 | |
| 58a | Groundwater Extraction and Transportation | | Where are areas with current groundwater extraction? | 1 | New question similar to MQ61, asking what is the current condition? |
| 58b | Groundwater Extraction and Transportation | Where will CAs potentially impact groundwater-dependent aquatic CEs? | Where are the areas of potential future change in groundwater extraction? | 2 | Remove reference to municipal and ag water use to make it more general, similar to MQ 62 |
| 59 | Groundwater Extraction and Transportation | What is the present distribution of municipal and agricultural water use of groundwater resources in relation to the distribution of aquatic CEs? | | | Omit this MQ because it is covered by MQ 58a & b. |
| 60 | Groundwater Extraction and Transportation | Where are the aquatic CEs showing degraded ecological integrity from existing groundwater extraction? | | 3 | |
| 61 | Surface Water Consumption and Diversion | Where are artificial water bodies including evaporation ponds, etc.? | Where are current surface water diversions? | 1 | Drop this MQ because artificial water sources are covered by MQ 30. A MQ related to current surface water diversion is missing, however, so need to add new MQ 58a. |
| 62 | Surface Water Consumption and Diversion | Where are the areas of potential future change in surface water consumption and diversion? | Where are the areas of potential future change in surface water diversion? | 2 | |
| 63 | Surface Water Consumption and Diversion | Where are the CEs showing degraded ecological integrity from existing surface water diversion? | | 3 | |
| 64 | Climate Change: Terrestrial Resource Issues | Where will changes in climate be greatest relative to normal climate variability? | | | |
| 65 | Climate Change: Terrestrial Resource Issues | Given anticipated climate shifts and the direction shifts in climate envelopes for CEs, where are potential areas of significant change in extent such as ecotones? | | | |

| MQ # | MQ Group | Original Management Question[1] | Revised Management Question[2] | MQ Tier[3] | AMT Conclusion/Guidance[4] |
|---|---|---|---|---|---|
| **Questions Related to Change Agents (CAs)** | | | | | |
| 66 | Climate Change: Terrestrial Resource Issues | Where are vegetation CEs that will experience significant deviations from normal climate variation? | | | |
| 67 | Climate Change: Terrestrial Resource Issues | Where are wildlife CE habitats that will experience significant deviations from normal climate variation? | | | |
| 68 | Climate Change: Aquatic Resource Issues | Where will aquatic CEs experience significant deviations from historic climate variation that potentially could affect the hydrologic and temperature regimes of these aquatic CEs? | | | |
| 69 | Military Constrained Areas | Where are areas of planned expansion for military use? | Where are areas of Department of Defense and Department of Energy use? | 1 | Data on future use will be limited to projects in public review (NEPA) process. Show BLM lands and other agency (USFS, DOE, etc.) land used by DOD. |
| 70 | Atmospheric Deposition | Where are areas affected by atmospheric deposition of pollutants, as represented specifically by nitrogen deposition, acid deposition, and mercury deposition? | | 1 | Use dust as a surrogate for nitrogen. Sulfur deposition is indicator of acid. Map prevailing winds. |
| 71 | Livestock Grazing | Where is structure of vegetation CEs affected by livestock grazing? | | 2 | This MQ is aimed at understory vegetation in shrublands, but this is not available in shrublands and grasslands data layers. Identify the data gap and state what information is needed to answer the MQ. The AMT also discussed applicability of this MQ to riparian zones to see where the veg structure has departed from historic conditions. |
| 72 | Livestock Grazing | Where can livestock grazing be used to reduce wildfire risk in areas with herbaceous fuel loads and proximity to high-probability ignition locations (roads, train tracks, lightning etc.)? | | 3 | Fire management MQ 36 covers high fuel load areas. Add the bighorn sheep occupied habitat layer to this map and bound it out from areas under consideration for livestock grazing. |
| 73 | Livestock Grazing | Where will livestock grazing have the potential to increase fire from vegetation cover type conversion (high, medium, low)? | Where will livestock grazing have the potential to increase fire frequency as a result of increased cover of annual grasses (high, medium, low)? | 2 | Evaluate the edges of areas currently dominated by cheatgrass. |

| MQ # | MQ Group | Original Management Question[1] | Revised Management Question[2] | MQ Tier[3] | AMT Conclusion/Guidance[4] |
|---|---|---|---|---|---|
| **Questions Related to Change Agents (CAs)** | | | | | |
| 74 | Livestock Grazing | Where are areas in the landscape with various (low, medium, high) levels of resilience to livestock grazing (based upon ecological site and existing vegetation)? | | 2 | State and transition models are intended by this MQ –Use county-level SURGO data. |
| 75 | Livestock Grazing | Where has the landscape been modified for purposes of livestock grazing and management (sagebrush elimination, fences, plantings, water sources, etc.)? | | 3 | This MQ could cover 1) rangeland vegetation improvements and 2) infrastructure. Map various vegetation treatments: crested wheatgrass plantings, juniper removal, shrub removal, cheatgrass removal, tree removal. Add a pasture layer, fence layer if available. |
| 76 | Livestock Grazing | What areas of the landscape are low density vs. high density livestock grazed (streams, water developments, corrals, steep slopes, etc.)? | | | AMT considered SAIC's suggested approach to modeling this MQ but decided that the reality of grazing pressure is more complicated. Drop this MQ. |
| 77 | Livestock Grazing | Where are areas best suited to potential livestock cattle and sheep grazing based on environmental factors (such as slope, aspect, water availability, wild ungulate grazing)? | | | AMT considered SAIC's suggested approach to modeling this MQ but decided that the reality of grazing pressure is more complicated. Drop this MQ. |
| 78 | Livestock Grazing | Where do grazing areas have the highest potential to increase invasive and/or noxious species occurrences? | | | Similar to AMT concerns over MQ 76, drop this MQ. |
| *Note*: Yellow highlighting indicates that the MQ is under review to be removed from consideration. | | | | | |

# Appendix B

Change Agents

## *Table B. Refinement of Change Agents for the NGB*

| Change Agent | Rationale | AMT Conclusion |
|---|---|---|
| **Wildfire** | Covered in pilot REA | **Cover in this REA.**<br>Example:<br>• Consider evaluating prescribed fire in the context of Range Developments/Land Treatments CA, (subject to data availability). |
| **Climate Change** | | **Cover in this REA.** |
| **Development:** | | |
| *Note*: Some of the CAs in this category, e.g., solar energy, may not be significant developments (current or future) but will be carried through subsequent REA tasks in order to evaluate datasets. | | |
| Oil & Gas | | **Cover in this REA.** |
| Wind Energy | | **Cover in this REA.** |
| Geothermal Energy | | **Cover in this REA.** |
| Solar Energy | Although the National Renewable Energy Laboratory (NREL) maps indicate moderate potential is present in the ecoregion, large-footprint solar development may be limited due to distance from load centers and transmission costs. | **Cover in this REA** |
| Pumped Storage | | **Cover in REA.** |
| Non-transportation Linear Features | Transmission CAs would cover overhead transmission, subsurface transmission, and associated infrastructure. | **Cover in this REA.**<br>Examples:<br>• Service roads (for pipelines, transmission lines,)<br>• Pipelines (gas, oil)<br>• Communication lines<br>• Power transmission lines<br>• Cell towers |
| Urban | Separate treatment will distinguish habitat loss related to large development footprint vs. habitat degradation due to indirect proximity effects around small dispersed development. Exurban development is noted as having small footprint but big impact due to corridors, fragmentation, etc. Ski resort areas, golf-centric developments cause induced growth of second homes. | **Cover in this REA.**<br>Examples:<br>• Dense Urban/Industrial<br>• Exurban (Dispersed) |
| Mining | Abandoned mines and mining waste can be a source of pollutants many years after mines have been abandoned.<br>Infrastructure for mines? | **Cover in this REA**<br>Examples:<br>• active mines<br>• abandoned mines<br>• mining waste management<br>• gravel pits |
| Transportation | Include road categories based on traffic volume or other designation, and railroads. | **Cover in this REA** |

## *Table B. Refinement of Change Agents for the NGB*

| Change Agent | Rationale | AMT Conclusion |
|---|---|---|
| Recreation | Proposed divisions recognize recreational uses with a discernible footprint vs. recreation uses that involve motorized or non-motorized transportation, off-road uses, and fishing/boating. | **Cover in this REA**<br>Examples:<br>• Developed Areas (Ski resorts)<br>• Motorized dispersed (OHV)<br>• Non-motorized dispersed<br>• Aquatic recreation |
| Agriculture | Cropland would include irrigated and dryland cropland, and water quality effects.<br><br>Also of concern are the use of concentrated animal feeding operations (CAFOs). | **Cover in this REA with caveats.**<br>Examples:<br>• Cropland (including contaminants such as run-off pesticides, herbicides, and fertilizers)<br>• Pastureland and CAFO issues (including animal treatment, run-off, and odors) |
| Hydro Diversions | Proposed diversions address surface and subsurface withdrawal and associated infrastructure (pipelines, ditches, canals, other conveyances). | **Cover in this REA**<br>Examples:<br>• Groundwater withdrawal<br>• Surface water withdrawal<br>• Water transmission (ditches, canals, etc.) |
| Hydro Impoundments | Effects of linear infrastructure likely to be different from impoundment effects. Pumped storage for wind energy mentioned. | **Cover in this REA**<br>Examples:<br>• Hydropower impoundments<br>• Irrigation impoundments<br>• Supporting infrastructure (roads and pipelines) |
| Military and other Federal Land Managers | Evaluate whether military and Department of Energy (DOE) uses of these ecoregions are significant agents of change. DOE facility (Idaho National Energy Lab) is a significant feature in the upper Snake River Plain. Department of Defense (DOD) land ownership and future expansion of existing facilities (Mountain Home Air Force Base [AFB] and Sierra Army Depot), may not be significant acreage. Evaluate existing and future military use of public land, if data available. | **Cover in this REA.**<br>Example:<br>• Military Plans and Operation Use Areas (Western Regional Partnership)<br>• DOE facility and land use effects |
| Rangeland Treatments | Intended to cover programs for range management and improvement practices. More information is needed on programs on public and private land. | **Cover in this REA**<br>Examples:<br>• traditional livestock management tools and land treatments including seeding, fences, and livestock water sources<br>• fuel treatment<br>• mechanical treatment of vegetation<br>• prescribed fire |

## *Table B. Refinement of Change Agents for the NGB*

| Change Agent | Rationale | AMT Conclusion |
|---|---|---|
| **Invasives:** | | |
| Cheatgrass | Covered in pilot REA; data and model(s) assumed to be available. | **Cover in this REA** |
| Medusahead | | **Cover in this REA** (subject to data availability**)** |
| Other Exotic Grasses | | **Cover in this REA** AMT guidance: Group cheatgrass, medusahead, other invasive grasses (subject to data availability) |
| Exotic Forbs | | **Cover in this REA** (subject to data availability) |
| Russian olive, tamarisk and other Invasive Woody Plants | Potential habitat and predicted range expansion with climate change predict that tamarisk may be an upcoming issue. | **Recommended by U.S. Geological Survey (USGS) reviewer. Cover in this REA.** |
| Aquatic Invasives | | **Cover in this REA** (subject to data availability) |
| **Grazing:** Livestock | Address narrowly focused management questions, e.g., evaluate sensitivity of areas that are subject to certain constraints such as low precipitation to grazing pressure in concert with climate change predictions | **Cover in this REA** |
| Wild Horses & Burros | Treatment as a CA refers to grazing impacts. Data availability? Link to Wild Horse and Burro Management Areas. | **Cover in this REA** Will be considered as part of larger grazing evaluation. |

# Appendix C

Coarse Filter Conservation Elements

## *Table C. Coarse-filter Conservation Elements Chosen for the NGB Ecoregion*

| CE | Rationale | Action |
|---|---|---|
| ***Regionally Important Terrestrial Ecological Features, Functions, and Services*** (e.g., large areas of native vegetation providing important cover, fiber, and forage; habitat strongholds and corridors; upland areas important for water quality or water supply; areas capable of significant carbon sequestration (CS); etc.) | | |
| Sagebrush | • Covered in pilot REA.<br>• Ecoregional significance.<br>• Need to caveat results, given inaccuracies of available Gap Analysis Program (GAP), Rapid Ecoregional Gap Analysis Program (ReGAP), and Landfire vegetation coverages for these ecosystems.<br>• Carbon sequestration | **Cover in this REA.** |
| Salt desert shrub | • Covered in pilot REA.<br>• Ecoregional significance.<br>• Need to caveat results, given inaccuracies of available GAP, ReGAP, and Landfire vegetation coverages for these ecosystems.<br>• Carbon sequestration | Cover in this REA. |
| Utah Juniper | • Covered in pilot REA.<br>• Ecoregional significance.<br>• Need to caveat results, given inaccuracies of available GAP, ReGAP, and Landfire vegetation coverages for these ecosystems.<br>• Include expansion into shrub-steppe communities<br>• Carbon sequestration | Cover in this REA.<br><br>Distinguish between areas dominated by Utah juniper and western juniper. |
| Western Juniper | • Covered in pilot REA.<br>• Ecoregional significance.<br>• Need to caveat results, given inaccuracies of available GAP, ReGAP, and Landfire vegetation coverages for these ecosystems.<br>• Include expansion into shrub-steppe communities<br>• Carbon sequestration | Cover in this REA.<br><br>Distinguish between areas dominated by Utah juniper and western juniper. |
| Aspen | • Need to caveat results, given inaccuracies of available GAP, ReGAP, and Landfire vegetation coverages for these ecosystems.<br>• Much of Aspen-dominated acreage would be in ecoregion buffers upslope from BLM-managed lands.<br>• Carbon sequestration | **Cover in this REA.** |
| Pinyon | • Indirectly covered in pilot REA (as P-J).<br>• Need to caveat results, given inaccuracies of available GAP, ReGAP, and Landfire vegetation coverages for these ecosystems. | **Not covered in REA.**<br>**AMT guidance: Pinyon communities are rare in this ecoregion.** |

## *Table C. Coarse-filter Conservation Elements Chosen for the NGB Ecoregion*

| CE | Rationale | Action |
|---|---|---|
| ***Regionally Important Terrestrial Ecological Features, Functions, and Services (continued)*** | | |
| Other conifer | • Ecoregion-wide significance.<br>• Douglas-fir and subalpine forests are present in the mountains under U.S. Forest Service (USFS) management. With notable exceptions, these tend to be mostly in ecoregion buffers upslope and upstream from BLM lands.<br>• Fire is most likely potential factor potentially originating on BLM lands that could affect these forests, which would generally be at higher elevations and upstream from BLM lands. Healthy cover in these upslope communities is important to maintaining water quality and streamflow to BLM lands below the forest and may be important in conveying fire. Climate change has the potential to cause substantial elevational shifts in boundaries between montane communities.<br>• Carbon sequestration | **Cover in this REA.** |
| Vulnerable soils | • Sparsely vegetated shrublands where cryptogamic crusts stabilize soils are vulnerable to trampling, vehicular traffic, and subsequent erosion.<br>• Plowed soils and shrubland/grassland soils after wildfire are vulnerable to wind and water erosion.<br>• Ecoregional importance of edaphic endemism, such as slickspot soils<br>• Need direction from AMT. | **Cover in this REA**<br>Use consistent approach with Central Basin and Range |
| Caves | • Ecoregional significance? Possibly important as hibernacula for bats (along with abandoned mines), for endemic cave organisms, and for recreation.<br>• Little interaction with most CAs. Is there a clear management handle for BLM?<br>• Lack of data availability may make this impractical to address at an ecoregional scale. | **Not Covered in REA**<br>AMT Guidance: Consider as step-down issue (e.g., avoid during transmission line siting to protect bats) |
| Carbon sequestration (CS) potential | • CS potential is related to CAs including climate change and wildfire but data problems may preclude analysis or make analysis impractical.<br>• Sequestration potential is related to the type of vegetation and the age of the stand (CS depends on biomass accretion rates, longevity of plants, and frequency of wildfire). Consult recent national map prepared by Woods Hole Research Center (WHRC).<br>• Sequestration potential is also a property of the chemical and organic composition of soils. | **Not covered in this REA.**<br>AMT guidance: Embed carbon sequestration as a function of coarse filter plant community CEs |
| Areas of high biodiversity | • Uneven data sets related to non-biological issues such as differences in accessibility of lands for species surveys, state-to-state differences in number of species considered sensitive, and need to normalize data for size of reporting unit create problems in objectively assessing this important characteristic.<br>• Available data appear to be inadequate to carry forward on an ecoregional basis despite the importance of high biodiversity. Analysis at the state level is of interest to AMT members.<br>• Protected areas (below) may provide a partial surrogate. | **Cover in this REA.**<br>BLM to provide data. |
| Livestock grazing allotments | • Not in task order<br>• Economically important in the ecoregion.<br>• Provides open lands for other biological resources including wildlife CEs, wild horses and burros. | **Cover in this REA.** |

## *Table C. Coarse-filter Conservation Elements Chosen for the NGB Ecoregion*

| CE | Rationale | Action |
|---|---|---|
| ***Regionally Important Aquatic Ecological Features, Functions, and Services*** (e.g., habitat strongholds and corridors; wetland, riparian, and other aquatic areas important for water quality, water supply, stream bank stability, flood control, and similar purposes) | | |
| Perennial streams/rivers | • Data challenges due to small dimensions of these key features. | **Cover in this REA.** |
| Springs/seeps | • Data challenges due to small dimensions of these key features will cause underreporting of these systems, whose high ecological significance is disproportionate to their small size.<br>• Need to caveat the results. | **Cover in this REA.** |
| Wetlands | • Data challenges due to small dimensions of these key features will cause underreporting of these systems whose high ecological significance disproportionate to their small size.<br>• Need to caveat the results.<br>• Consider including open water habitat, < 5 acres with the wetland CE.<br>• This would enable extensive shallow lakes that are important to wildlife to be accounted for and would help address the underrepresentation of wetland habitats due to their small size.<br>• Closely linked to climate/water use changes | **Cover in this REA.**<br>Use National Wetland Inventory (NWI) data as one source. |
| Open water habitat | • Analyze > 5-acre habitats in this CE. Not included in request for proposal (RFP). | **Cover in this REA.** |
| Cottonwood galleries | • Data challenges due to small dimensions of these key features whose high ecological significance is disproportionate to their small areal extent (many are less than a pixel in width).<br>• Need to caveat the results. | **Cover in this REA.** |
| Riparian habitat | • Data challenges due to small dimensions of these key features (ditto above). | **Cover in this REA** |
| Groundwater | • Linkage to surface waters (springs, seeps) or specific vegetation features constitutes the importance of this in an REA.<br>• Likely to have difficulty with data uniformity and availability making it impractical to address on an ecoregional scale. | **Cover in this REA.**<br>Use Phase V MQs from CBR |
| ***Specially Designated Areas of Ecological and/or Cultural Value*** | | |
| Specially Designated Areas of Ecological and/or Cultural Value (all categories) | • Use uniform analysis approach for CAs in each type of SDA, but identify areas where direct impacts from development CAs or other CAs are influenced by management rules and policies. Consider treating SDAs as a special overlay on other coarse filter CEs where level of protection may preclude certain CE effects.<br>• Include other protected area types (NWRs, National Natural Landmarks, RNAs, state-protected lands such as WMAs, LTER sites, State Land Trust or Conservancy Lands, other protected lands) from PAD database. | **Cover the individual types of areas listed below as CEs in this REA** |

## *Table C. Coarse-filter Conservation Elements Chosen for the NGB Ecoregion*

| CE | Rationale | Action |
|---|---|---|
| ***Specially Designated Areas of Ecological and/or Cultural Value (continued)*** | | |
| Areas of Critical Environmental Concern | • Management emphasis for resource protection.<br>• Linkages to CAs including wildfire, climate change are important because these CAs may affect the ability of the ACEC to support the resources for which the ACECs were originally established. | **Cover in this REA.** |
| Historic Districts | • Carry forward in REA if certain protected historic districts support substantial habitat or other attributes relevant to REA | **Cover in this REA**<br>(to the extent that the historic districts have high natural resource values). |
| National Monuments | • Management for resource protection.<br>• Linkages to CAs including wildfire, climate change are important because these CAs may affect the ability of the protected area to support the resources they currently protect. | **Cover in this REA**<br>**(**unless they lack high natural resource values) |
| National Conservation Areas (NCA) | • Management emphasis for resource protection (e.g., Snake River Birds of Prey NCA).<br>• Linkages to CAs including wildfire, climate change are important as described above. | **Cover in this REA.** |
| State Parks | • Management for resource protection.<br>• Linkages to CAs including wildfire, climate change are important as described above. | **Cover in this REA**<br>(to the extent that they have high natural resource values). |
| Wild and Scenic Rivers | • Wild and Scenic River designation provides resource protection (e.g., Owyhee River).<br>• Linkages to CAs including wildfire, climate change are important as described above. | **Cover in this REA.** |
| Study Rivers (candidates for Wild and Scenic status) | • Study Rivers are candidates for Wild and Scenic status and need to be managed for resource protection consistent with Wild and Scenic status until a decision is reached. | **Cover in this REA** |
| Wilderness Areas | • Management emphasis provides resource protection.<br>• Linkages to CAs including wildfire, climate change are important as described above. | **Cover in this REA.** |
| Wilderness Study Areas | • Management emphasis provides temporary resource protection until a decision is reached.<br>• Linkages to CAs including wildfire, climate change are important as described above. | **Cover in this REA.** |
| Other specially designated areas of ecological and/or cultural value | • NWRs, National Natural Landmarks, RNAs, state-protected lands such as WMAs, LTER sites, State Land Trust or Conservancy Lands, other protected lands from PAD database | **Cover in this REA**<br>(to the extent data are available and areas have substantial resource values). |
| Wild Horse and Burro Herd Management Areas | • Pursuant to the Wild and Free Roaming Horses and Burros Act of 1971, BLM is required to protect, manage and control Wild Horses and Burros in designated Herd Management Areas.<br>• Linkages to CAs including vegetation change, wildfire, and climate change are important as described above. | **Cover in this REA.**<br>(Develop very focused MQs). |

# Appendix D

Fine Filter Conservation Elements

## *Table D. Fine-Filter Conservation Elements Chosen for the NGB Ecoregion*

| CE | Rationale | Action |
|---|---|---|
| Mule Deer | • Game species of ecoregional importance. Covered in pilot REA[1]. Focus on winter range.<br>• Include year-round crucial habitat (i.e., fawning and summer range) in addition to winter range. | **Cover in this REA** |
| Greater Sage-grouse | • Ecoregional importance. Covered in pilot REA. Ongoing parallel efforts by others. | **Cover in this REA**<br>Attempt to assimilate WGA crucial habitat data with BLM priority habitat and general habitat, (as defined by Instructional Memo), and states' habitat mapping. |
| Golden Eagle | • Knowing occurrence and nesting areas is important to management.<br>• Include migratory corridors, which are of interest due to wind energy development. | **Cover in this REA** |
| Bald Eagle | • Large wintering populations; scattered nesting.<br>• Numbers in the ecoregion peak in January-February with influx of birds that breed in the north.<br>• Focus analysis on wintering areas. | **Cover in this REA** |
| Pygmy Rabbit | • Associated with sagebrush-steppe habitat.<br>• Potential to use soils types and topography to identify habitat<br>• Pygmy rabbit distribution is centered on the NGB ecoregion. Isolated DPS in Washington listed under ESA. | **Cover in this REA.**<br>There is mapping of suitable habitat, but occurrence data are probably sparse. |
| Sagebrush Obligates | • Is mapped data for sagebrush reliable enough to serve as a coarse filter? Mapped sagebrush, even if recognition of the dominant species is reliable, may not distinguish between different understories and associated species sufficiently to be valuable as a predictor of presence/absence of sagebrush obligate species.<br>• Consider viewing this as a species assemblage including sage-grouse, pygmy rabbit, others.<br>• No species assemblage identified; some wildlife and plant species are tied to different sagebrush types. | **Not covered in this REA as fine-filter species CE.**<br>Sagebrush communities will be used as coarse filter for sagebrush obligate species other than pygmy rabbit and greater sage-grouse, which are treated as individual fine filter CEs. Tim Bottomley and Don Major will consider how to achieve consistency with CBR for this CE. Key issue is concern about disappearing sagebrush as a result of many factors including fire/cheatgrass invasion. |
| Bighorn Sheep | • Native subspecies has very patchy distribution in ecoregion.<br>• California bighorn sheep subspecies has been introduced to portions of Idaho (not native to this area). | **Cover in this REA.**<br>Include all subspecies, as they hybridize. |
| Pronghorn | SAIC recommended that American pronghorn be considered for addition to the REA:<br>• Characteristic species of ecoregional significance<br>• Game species | **Cover in this REA** |
| Bull Trout (*Salvelinus confluentus*) | • See below | **Cover in this REA**<br>Include critical habitat, but evaluate separately from other coldwater fishes. |

## *Table D. Fine-Filter Conservation Elements Chosen for the NGB Ecoregion*

| CE | Rationale | Action |
|---|---|---|
| Northern Leatherside Chub (*Snyderichthys copei*) | Characteristic of quality habitats in the Snake River drainage. Location of "pure populations" versus introduced occurrences is unclear.<br>Former candidate species -- listing recently determined as not warranted (October, 2011). | **Not Covered in this REA**<br>Not likely to be listed and its range is very limited. AMT guidance: Omit from this REA. |
| Warm Water Fish Assemblage | • Baseline data and management monitoring/plans/actions available are unlikely to be sufficient for native warm water species so that status and population trends within the ecoregion can be assessed.<br>• If carried forward, assemblage could include Klamath smallscale sucker (*Catostomus rimiculus*), speckled dace (*Rhinichthys osculus*), peamouth chub (*Mylocheilus caurinus*), Utah sucker (*Catostomus ardens*), species for with some data are available for some parts of range.<br>• Aquatic habitat types treated below may serve as a coarse filter. | **Not Covered in this REA**<br>Some of proposed species widely distributed, with generalized habitats, but less sensitive to CAs, and adequate distribution mapping is probably not available. AMT guidance: Omit from this REA. |
| Yellowstone Cutthroat Trout (*Oncorhynchus clarkii bouvieri*) | • See below | **Cover in this REA**<br>AMT guidance: Treat Yellowstone cutthroat trout, Lahontan cutthroat trout, redband trout, mountain whitefish (*Prosopium williamsoni*) as a coldwater fish assemblage. |
| Lahontan Cutthroat Trout | Added by AMT:<br>• Unique high temperature (>27°C) tolerance (http://www.fws.gov/oregonfwo/Species/Data/LahontanCutthroatTrout/)<br>• ESA-listed as threatened<br>• Sensitive to habitat degradation.<br>• Completed 1995 recovery plan available: http://ecos.fws.gov/speciesProfile/profile/speciesProfile.action?spcode=E00Y | **Cover in this REA**<br>AMT guidance: Treat Yellowstone cutthroat trout, Lahontan cutthroat trout, redband trout, and mountain whitefish as a coldwater fish assemblage. |
| Cold Water Fish Assemblage | • Eliminate anadromous species (Chinook [*Oncorhynchus tshawytscha*], sockeye [*Oncorhynchus nerka*], summer steelhead) as they do not occur upstream of Hells Canyon Dam. Drop Pacific lamprey (*Lampetra tridentata*) along with other anadromous spp. Combined the species identified in the column to the right are expected to have sufficient baseline data and management monitoring/plans/actions that status, population trends, and likely response to CAs within the ecoregion can be assessed. | **Cover in this REA**<br>AMT guidance: Treat Yellowstone cutthroat trout, Lahontan cutthroat trout, redband trout, and mountain whitefish as a coldwater fish assemblage. |
| White Sturgeon | • White sturgeon are present within the ecoregion--landlocked in the upper Columbia River drainage including the Snake River.<br>• Although not present in Nevada, sturgeon are widespread in the Snake River and of landscape-level concern despite small population sizes.<br>• The population in the Kootenai drainage (north of the ecoregion) is listed as endangered and has very low resilience, with a minimum population doubling time more than 14 years. As a result, their vulnerability is considered very high. | **Cover in this REA** |

## *Table D. Fine-Filter Conservation Elements Chosen for the NGB Ecoregion*

| CE | Rationale | Action |
|---|---|---|
| Bats | • Data deficiencies make it impractical to address bats on an ecoregional scale. | **Cover in this REA**<br>Subject to Bat Grid, mine closure, and other data availability. |
| Slickspot Pepperweed (*Lepidium papilliferum*) | • Critical Habitat proposed in Idaho (four counties). Found only in Snake River Plain (Boise Foothills and Owyhee Plateau). Inhabits microsites within sagebrush ecosystem.<br>• Consider feasibility of carrying this forward with sagebrush obligate species assemblage. | **Not Covered in REA**<br>Not a landscape species but slickspot soils may be captured in vulnerable soils data. AMT guidance: Omit as a CE, consider in step-down analyses |
| Spotted Frog | • Widespread species sensitive to factors related to disease, climate change, water use, introduced species, and isolated habitats.<br>• Isolated populations are present in the Northern Great Basin<br>• Locality records may be good indicator of perennial aquatic habitats with associated wetlands.<br>• May respond to restoration of certain habitats.<br>• Threatened by loss/degradation of wetland habitats and predation by non-native bullfrogs. | **Cover in this REA.** |

*Note:*
1. Unless noted, species/resources on this list are not covered in the Pilot REA.