FINAL MEMORANDUM I-1-C
MIDDLE ROCKIES
RAPID ECOREGIONAL ASSESSMENT

Prepared for:

Department of Interior
Bureau of Land Management
Rapid Ecological Assessments

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LIST OF ACRONYMS, ABBREVIATIONS, AND DEFINITIONS

AMT	Assessment Management Team
BLM	Bureau of Land Management
CA	change agent
CAPS	Crucial Areas Planning System
CBM	coalbed methane
CE	conservation element
ESA	Endangered Species Act
FMAR	forest mortality assessment report
FPC	Fish Passage Center
GAP	Gap Analysis Program
GIS	geographic information system
HUC	Hydrologic Unit Code
km	kilometer
km^2	square kilometers
LCC	Landscape Conservation Cooperative
LCCS	Land Cover Classification System
mi^2	square miles
MQ	management question
NVCS	National Vegetation Classification System
OHV	off-highway vehicle
PAC	Primary Activity Center
REA	Rapid Ecoregional Assessment
SAIC	Science Applications International Corporation
SGCN	Species of Greatest Conservation Need
SOW	statement of work
SWAP	state wildlife action plan
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
WUI	Wildland Urban Interface

Assessment Management Team (AMT): The AMT consists of Bureau of Land Management (BLM) Branch Managers for renewable resources, and other natural resource scientists from all the BLM states involved.

Change Agent (CA): An environmental phenomenon or human activity that can alter/influence the future status of resource condition. Some CAs (e.g., roads) are the result of direct human actions or influence. Others (e.g., climate change, wildland fire, invasive species) may involve natural phenomena or be partially or indirectly related to human activities.

Coarse Filter: A focus of ecoregional analysis that is based upon conserving resource elements that occur at coarse scales, such as ecosystems, rather than upon finer scale elements, such as specific species. The concept behind a coarse-filter approach is that preserving coarse-scale conservation elements will preserve elements occurring at finer spatial scales.

Conservation Element (CE): A renewable resource object of high conservation interest often called a conservation target by others, made up of core (those that are used as surrogates to measure ecological integrity) and desired (those outside of core indicators

that are also of interest in the region). For purposes of this statement of work (SOW), CEs will likely be types or categories of areas and/or resources, including ecological communities or larger ecological assemblages.

Ecological Integrity: The ability of an ecological system to support and maintain a community of organisms that have the species composition, diversity, and functional organization comparable to those of natural habitats within the ecoregion.

Ecological Systems: Defined as "groups of plant community types that tend to co-occur within landscapes with similar ecological processes, substrates and/or environmental gradients" (Comer et al. 2003a). The ecological system concept emphasizes existing dominant vegetation types, but also incorporates physical components, such as landform position, substrates, hydrology, and climate (Lowry et al. 2005).

Fine Filter: A focus of ecoregional analyses that is based upon conserving resource elements that occur at fine scale, such as specific species. A fine-filter approach is often used in conjunction with a coarse-filter approach (i.e., a coarse-filter/fine-filter framework) because coarse filters do not always capture some concerns, such as when a threatened and endangered species is a CE.

Hazard: Any real or potential condition that can cause injury or damage to life, property, or other value that is assigned by people for a particular event.

Rapid Ecoregional Assessment (REA): REAs look across 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.

Regionally Significant: A native plant, wildlife, or fish resource or community that has a range of distribution and affects management concerns across two or more BLM field office boundaries and is more than locally important. Being more than locally important could include having qualities that give the resource special worth, meaning, or value.

Risk: The chance (probability) of an event starting (i.e. wildfire, bark beetle infestation, landslide, etc.) as determined by the presence and activity of causative agents.

EXECUTIVE SUMMARY

This final memorandum documents the work completed under Task 1 of Phase I of the Rapid Ecoregional Assessment (REA) for the Middle Rockies ecoregion. This final memorandum builds on the draft that was submitted prior to Assessment Management Team (AMT) workshop 1 in Billings, Montana, and includes feedback, comments, and recommendations received during and after the workshop. Through the REA process, the Bureau of Land Management (BLM) is taking a proactive, landscape-scale approach to the evaluation of natural resources that cross traditional administrative boundaries and transcend ownership. The Middle Rockies ecoregion is a large, diverse area that includes southwestern Montana, northeastern Wyoming, a contiguous portion of eastern Idaho, and several non-contiguous mountain ranges. The ultimate goal of this assessment is to produce documents, maps, and other materials that will provide BLM land managers with tools and information that will inform decisions for carrying out the BLM's mission "to sustain the health, diversity, and productivity of the public lands for the use and enjoyment of present and future generations."

The Science Applications International Corporation (SAIC) Team met with the AMT on November 8-10, 2010, in Billings, Montana, to discuss the draft memorandum. Feedback, comments, and recommendations received at this workshop were used to modify the draft memorandum for completion of this final memorandum.

We anticipate this REA process to be a cooperative effort between the AMT and the SAIC Team. This memorandum is the first step of the cooperative effort that will be carried through all phases of the process.

During this first phase, the SAIC Team used the management questions (MQs) contained in the statement of work (SOW) as a basis to develop the initial list of MQs. The draft memorandum contained a list of 102 MQs (Appendix 1). These questions were consolidated and aggregated under the various MQs contained in the SOW. The aggregated table of MQs is in Appendix 1. The revised list of MQs is contained in Section 3 (page 8, Table 3-1). The list of MQs may be further revised during the data identification tasks, dependent on the availability and quality of data.

The identification of conservation elements (CEs) and change agents (CAs) representative of this ecoregion started with an evaluation of the CEs and CAs identified in the SOW. For CEs, we propose using the coarse-filter/fine-filter approach. This approach started with an evaluation of habitats across the ecoregion. We used the Northwest and North Central Gap Analysis Program (GAP) to identify major ecological systems that would provide habitat for species-specific CEs. Section 4 describes the process used for the identification of CEs in this ecoregion. The coarse-filter CEs are located on page 19, Table 4-3. The fine-filter CEs are located on page 22, Table 4-4.

For landscape species CEs, the identification process started with the construction of a database that included species listed in the BLM SOW; species contained in the state wildlife action plans (SWAPs); species that are listed as federally endangered, threatened, or candidate by the U.S. Fish and Wildlife Service (USFWS); species listed as G1-G3 by NatureServe; and the BLM sensitive species lists for Wyoming, Montana, and South Dakota. This database was useful to screen faunal species and identify those that could serve as potential CEs. For this memo, we identified 41 faunal species, species assemblies, or categories proposed as potential CEs for discussion at AMT Workshop 1.

Development of the CAs started with the evaluation of those proposed by the BLM in the SOW and included a thorough evaluation of ecoregion-specific literature that has identified threats to the resources in this ecoregion. Five major categories of CAs include: fire; development; invasive species, insect/diseases; and climate change. Within each of these categories are subcategories that further specify the threat of the CA to resources within the ecoregion. CAs can be found on page 23, Table 5-1.

Once the MQs were developed and the initial lists of CEs and CAs were completed, the SAIC Team initiated development of conceptual models. This process started with the development of a graphical diagram that attempted to capture all of the processes, habitats, elements, and agents within the ecoregion. This diagram is included in Section 2. The conceptual model for this ecoregion is presented in Section 6.

1.0 INTRODUCTION

The Bureau of Land Management (BLM) is currently evaluating a wide variety of environmental challenges to western ecosystems. These challenges transcend land ownership and administrative jurisdictions, and necessitate a landscape-scale approach to evaluation of these ecosystems. Rapid Ecoregional Assessment (REA) is the BLM's first step toward a broader initiative to systematically develop and incorporate landscape-scale information into the evaluation, and eventual management, of public land resources.

REAs look across 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 change agents (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 I is the pre-assessment, and includes four tasks. Phase II is the assessment, and includes three tasks. Phase I includes finalization of the management questions (MQs) that the REA will attempt to answer. MQs identify (implicitly or explicitly) information needed to formulate management responses to regional or landscape-scale resource management issues or concerns. Conservation elements (CEs) and CAs specific to the Middle Rockies ecoregion will also be identified. A CE is an element of conservation interest or action. A CA is an environmental phenomenon or human activity that can influence the future progression and condition of CEs. Phase I also includes the development of conceptual models, the identification of datasets to be used and data gaps, and culminates in a work plan that will provide a roadmap for the completion of Phase II. Phase II includes analysis of the data relative to the identified CAs and CEs, documentation of the results, and culminates in the REA document, which will guide BLM and other land managers in developing and prioritizing planning and management strategies. In addition to the two phases mentioned above, a forest mortality assessment report (FMAR) will be prepared as part of this project for the Middle Rockies ecoregion. Although the FMAR will be completed during the same time as Phase I and II of the REA, separate deliverables associated with the FMAR will be provided at various times over the course of this project.

Table 1-1. REA Phases and Tasks

Phase	Task #	Product
I. Pre-assessment	1	Refine MQs
	2	Identify and recommend datasets for analysis
	3	Identify and recommend analytical models and tools
	4	Prepare REA work plan
II. Assessment	1	Synthesize datasets
	2	Conduct analyses and generate findings
	3	Prepare REA report, maps, and supporting documents

Management Questions (MQs)

The BLM specifically designed the REA approach to start with MQs. These questions identify current or anticipated problems or issues concerning resource management. MQs need to provide clear direction concerning the information needed to answer the question, and without this direction a REA can become merely an expensive data collection effort (Johnson et. al., 1999). The BLM Assessment Management Team (AMT) for this ecoregion developed 65 initial questions or applications of questions that were used as a basis in developing the list of questions in this memorandum.

Conservation Elements (CEs) and Change Agents (CAs)

Although the MQs are key drivers of this REA, the REA could not be completed without the identification of CEs and CAs. In order to be able to answer the most important MQ, which is “What do we have?” the CEs must be identified early in the process. In addition to the CEs, in order to answer another important MQ, which is “What is happening to what we have?” the CAs must also be identified early in the process. Identification of the CEs and CAs in each ecoregion also assists with the development of conceptual models for the ecoregion.

Conceptual Model

The conceptual model developed for this ecoregion will be used to provide a science-based context regarding how the CEs will be affected by the CAs identified for the Middle Rockies ecoregion. The ecoregion model will be used as a guide for the development of specific CE models that will depict particular CE status relative to CAs.

Memorandum

This memorandum documents the activities completed under Task 1 of Phase I. The objectives of this task were to identify the boundaries of the Middle Rockies ecoregion, refine and finalize the MQs, identify the CEs and CAs, develop the ecoregion-specific conceptual model, and complete this memorandum as an initial basis for the REA work plan that will be completed under Task 4 of this phase.

2.0 REA STUDY AREA AND LANDSCAPE REPORTING UNITS

2.1 STUDY AREA

The Middle Rockies ecoregion includes portions of western Montana and Wyoming, eastern Idaho, and several small, non-contiguous areas in central Montana, northeastern Wyoming, and western South Dakota (Figure 2-1). The spatial boundary for this REA will include this ecoregion (Middle Rockies Level III Ecoregion – 6.2.10), as defined by the Commission for Environmental Cooperation (2006), plus a buffer consisting of those 5th level Hydrologic Unit Code (HUC) watersheds that overlap the ecoregion boundary. The purpose of the buffer is to help ensure a seamless boundary between mapped layers generated for REAs in neighboring regions, and to avoid problems associated with "edge effects" during geographic information system (GIS) analyses. With the buffer area, the extent of the Middle Rockies REA will be approximately 105,000 square miles (mi^2) (271,949 square kilometers [km^2]).

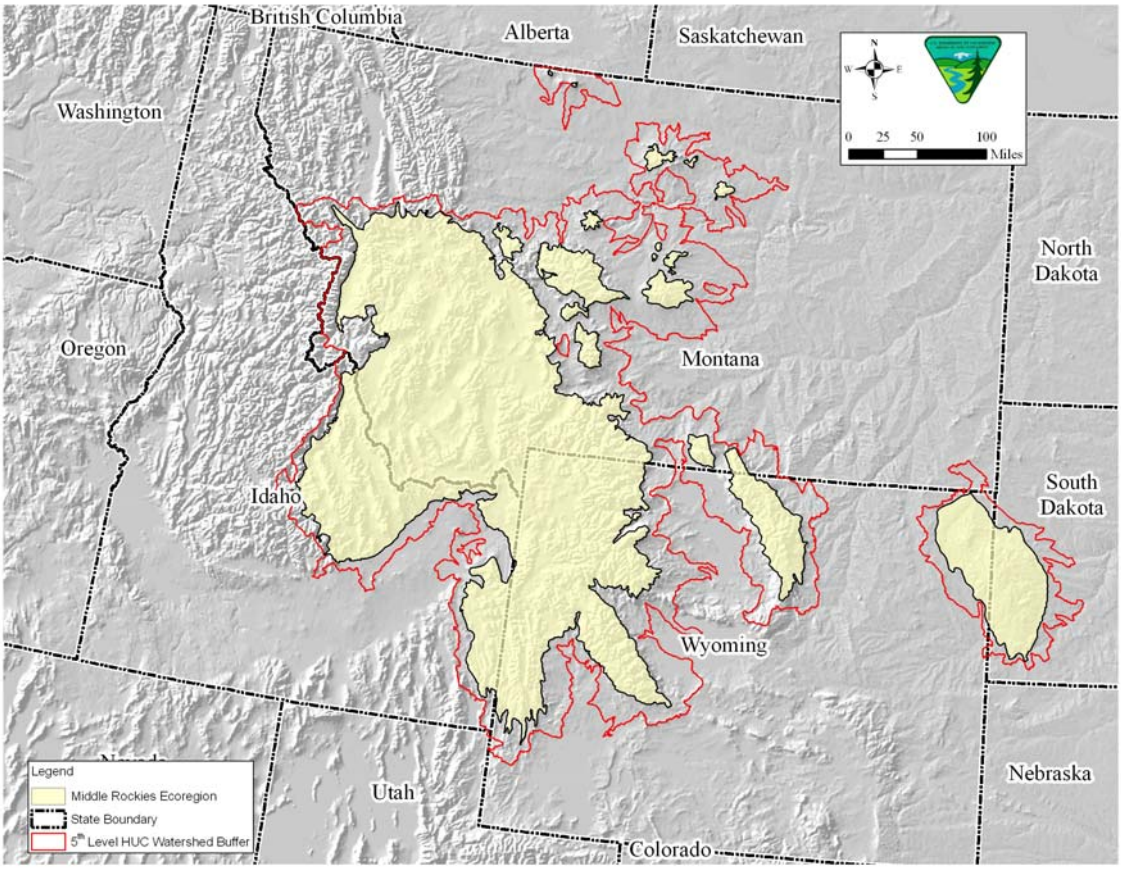

Figure 2-1. Extent of the Middle Rockies Ecoregion

The predominant feature common to areas within the Middle Rockies ecoregion is mountainous terrain that supports forested, alpine tundra, and shrub/grassland ecosystems. The ecoregion arose from a rich and complex geologic history overlying parent material interlaced with faults, and changed over time by numerous tectonic events as well as glacial and volcanic influences. In addition to its wide range of elevations, the ecoregion presents strong contrasts in precipitation and temperatures,

resulting in diverse mosaics of ecosystem types and associated plant and animal communities. Coniferous forests occur in mountainous areas throughout this ecoregion on all substrates and aspects, and are characterized by lodgepole pine, Douglas-fir, whitebark pine, limber pine, Ponderosa Pine, and spruce/fir stands. Above the forested zone, vegetation is characterized by alpine communities comprised of dwarfed woody plants, grasses, sedges, and forbs. These species are adapted to cold temperatures, windy conditions, intense sunlight, and heavy snows that occur in the tundra. Sites dominated by rock outcrops and talus slopes also occur at the upper elevations, where often only the hardiest cushion plants can survive. Deciduous forests are usually dependent on extra moisture from streams and other contributing factors, including high water tables and fire frequency. Those that occur at higher elevations support aspen and alders, and at lower elevations cottonwood are intermixed with grasslands. The foothills regions are covered with woodlands and shrublands intermixed with grasslands.

Snowmelt, seeps, and springs provide water for perennial streams that support a wide diversity of aquatic species, although in limited areas. The non-contiguous portions of the ecoregion occur as isolated “islands” among adjacent ecoregions that share more ecological characteristics with Middle Rockies, such as coniferous forests, higher elevations, and their associated species. These can be areas of relictual (remnant) rare plant and animal species as well. Land use throughout this ecoregion is characterized by livestock grazing, recreation, logging, and mining. Natural vegetation communities in the lower elevations and intermontane valleys have largely been converted to agricultural or urban land uses. Figure 2-2 represents various habitats, processes, CEs, and CAs in the Middle Rockies ecoregion.

2.2 LANDSCAPE REPORTING UNITS

Throughout this REA process, a wide variety of data will be collected and evaluated, much of which will vary in size and scale, and in the region covered. Uniform landscape reporting units will provide common assessment reporting throughout the process. Landscape reporting units are predefined areas that are specific enough to provide useful information about species and communities, but general enough to provide appropriate context and avoid mapping at an inappropriately small scale. Although collected datasets will be maintained at their native resolution, the primary landscape unit for this REA will be at least the 6th level hydrological unit of the National Watershed Boundary Dataset (USGS 2009), with ecological integrity assessed at the 5th level unit. Thirty meter pixel raster data will be utilized in the geospatial analysis and modeling in support of answering the MQs. For raster data, 30 meter pixel resolution refers to the resolution of the raster data derived from satellite imagery. In addition to the landscape reporting units listed above, the downscaled regional climate model data that will be provided by BLM will be at the 15 kilometer (km) resolution level.

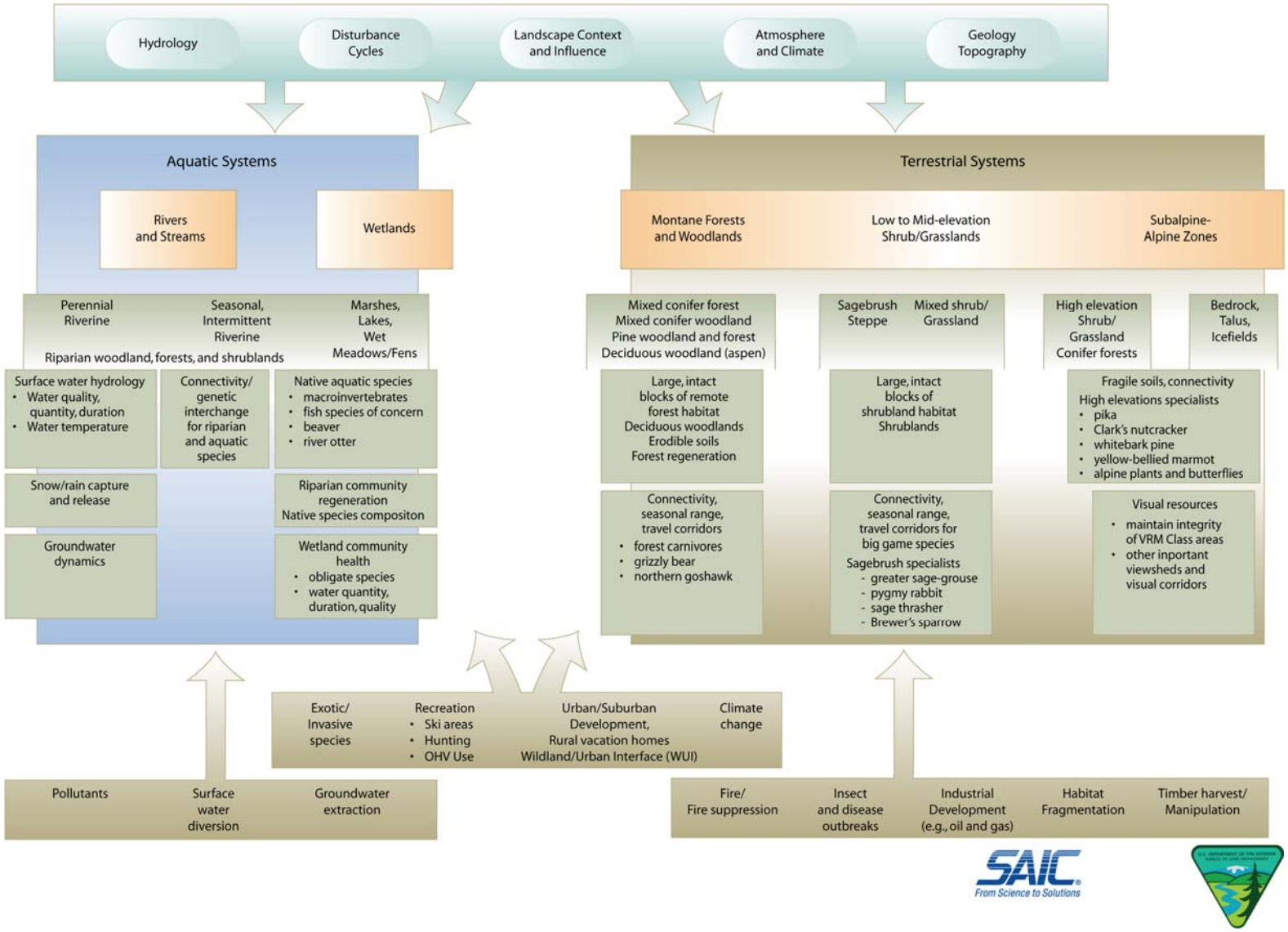

Figure 2-2. Examples of Habitats, Processes, Conservation Elements, and Change Agents in the Middle Rockies Ecoregion

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3.0 MANAGEMENT QUESTIONS

3.1 INTRODUCTION

REAs begin as MQs and culminate with determining how completely the questions were answered by the analysis. MQs need to provide clear direction concerning the information necessary to answer the question; without this direction a REA can become merely an expensive data collection effort (Johnson et. al., 1999). In their simplest form, MQs should be specifically framed toward landscape-scale issues and address resource values (species, populations, communities, or ecological values) and CAs, or phenomena that influence or affect the resource values.

3.2 MANAGEMENT QUESTION SCREENING CRITERIA

The AMT for this ecoregion developed 65 different MQs or applications of MQs grouped into nine categories in the statement of work (SOW). Because a diversity of interests are involved in every ecoregion, the BLM recommended that MQ screening criteria be developed to ensure that the MQs are not only focused, but can be answered by the analysis completed as part of this project. The six criteria are listed below:

1. Is the MQ clear, focused, and relevant to the ecoregion?
2. Can the MQ be answered if data are available?
3. Does the MQ address regional-scale issues?
4. Does the MQ help to answer the following; what do we have, what is its condition, and what is happening or likely to happen to what we have?
5. Do the conceptual models respond to the MQs?
6. Is the MQ amenable to geospatial analysis (This would apply to all questions except the overarching general questions at the top of the list)?

3.3 MANAGEMENT QUESTIONS

The Science Applications International Corporation (SAIC) Team presented the screened list of 102 MQs to the AMT in the draft memorandum. Although the SAIC Team used the initial BLM MQ list as a basis, it was determined that many of the 102 were redundant or otherwise did not meet the criteria listed above. Based on discussions that occurred at the workshop, it was determined that the MQs included in the SOW should be used as the MQs for this final memorandum. Also included in the SOW under each of the main MQs was a list of MQ applications, which are more appropriately defined as geospatial exercises that help answer the overarching main MQ. The MQ list contained in the draft memorandum was consolidated relative to the screening criteria listed above and the AMT input received at the workshop. Many of the original 102 MQs contained in the draft memorandum should have been labeled as MQ applications and were accordingly aggregated under the main overarching MQs contained in the SOW. The aggregated list of MQs and MQ applications is presented in Table 3-1. The MQ list contained in Appendix 1 is cross-referenced to criteria that excluded or combined the question. If the MQ was retained, the table in Appendix 1 shows where the MQ has been included in Table 3-1.

Table 3-1. Management Questions

Terrestrial Biotic Resources		
SOW Management Question	**Revised Management Question**	**Comment/Note(s)**
1. *What is the terrestrial ecological integrity (i.e. high, medium, low) for regionally significant features, functions, and services across the ecoregional landscape?*	*Where are the important regionally significant terrestrial features, functions, and services across the ecoregional landscape?*	Ecological Integrity was changed to regional significance. (see definition below)
Example of Application of this Management Question		
a) What is the current location/distribution of sites that have the greatest species richness?		
b) What are the regionally significant vegetation types? How are they distributed over the landscape (extent/pattern)? Where will current regionally significant vegetation types be at greatest risk from CAs?		
c) What regionally significant vegetation types are suitable for potential corridor connectors, and where are areas of potential restoration?		
d) Where are specially designated areas of high ecological value (designated by various agencies or in other work)? What levels of resource management and protection from future development exist in these areas, and where are adjacent areas with potential for restoring connectivity?		
e) What soils are present and what is their current condition?		
f) Which CAs are likely to affect soil fertility and erodibility?		
g) Where are areas of high soil erodibility due to wind or water erosion if existing vegetation cover is removed?		

Table 3-1. Management Questions (cont'd)

Aquatic/Riparian Biotic Resources		
SOW Management Question	**Revised Management Question**	**Comment/Note(s)**
2. *What is the aquatic ecological integrity (i.e. high, medium, low) for regionally significant features, functions, and services across 5th level HUC (or 6th) watersheds?*	*Where are the important regionally significant aquatic/riparian biotic features, functions, and services across the ecoregional landscape?*	*Ecological Integrity was changed to regional significance. (see definition below)*
Example applications of this management question		
a) Where are the current locations of regionally significant aquatic/riparian habitats, including rivers, streams, lakes, ponds, wetlands, springs, and reservoirs?		
b) Where are current riparian or aquatic areas currently at risk of fragmentation impoundment, diversion, and lowered water tables due to development, mineral extraction, and agricultural and residential development?		
c) What is the current flow regime (hydrograph) of regionally significant stream or river habitats or duration and extent of surface water in regionally significant pond and lake habitats?		
d) What is the condition of aquatic systems, as defined by the Fish Passage Center (FPC)?		
e) How have dominant species changed over time?		
f) Where are exotic species an existing and potential problem?		
g) Where are degraded aquatic systems (water quality) and what are the sources of the degradation (saline discharges, petrochemical discharges, leaching of toxic mineral salts, eutrophication due to concentrated nutrient runoff, other)?		
h) Where will regionally significant aquatic habitats potentially be affected by CAs (duration, magnitude and temperature of flow; duration and extent of surface water presence, if applicable)?		
i) Where will regionally significant aquatic habitats potentially experience the greatest effects of climate change (duration and magnitude of flow, duration and extent of surface water presence, if applicable)?		
j) Where are the most species losses likely to occur due to temperature increases or water reductions?		
k) What/where is the potential for future change in dominant species composition of regionally significant aquatic habitats?		
l) What areas have potential for regionally significant aquatic habitat restoration (based on available geospatial data)?		
m) Where are areas of watershed habitat connectivity?		
n) Where are aquatic habitat strongholds for sensitive species that are intact and provide the best opportunity for protection, restoration, and enhancement?		
o) Where are sensitive aquatic species at risk from stream connectivity or from interbreeding with closely related non-native or exotic species?		
p) Where are areas of watershed habitat connectivity?		

Table 3-1. Management Questions (cont'd)

Landscape Species/Species Richness		
SOW Management Question	**Revised Management Question**	**Comment/Note(s)**
3. *Where are the key habitat types (seasonal, refuges, corridors/connectivity, migration routes, concentrations of regionally significant species, etc.) for landscape species, keystone species, regionally significant species, and regionally significant suites of species?*		No change
Example applications of this management question:		
a) Where are areas that have potential for restoring regionally significant species habitat or habitat connectivity for regionally significant species,		
b) Where are the key habitat types (seasonal refuges, corridors/connectivity, migration routes, concentrations of regionally significant species)?		
c) Where are current regionally significant landscape/keystone species and their habitats, including seasonal habitat and movement corridors, at greatest risk from CAs, including climate change (connectivity, small population size)?		
Change Agents		
Wildland Fire		
SOW Management Question	**Revised Management Question**	**Comment/Note(s)**
4. *Where will regionally significant values identified above be at risk from altered wildland fire regimes (frequency, severity, and seasonality change from historic to present to future)?*	*Where could core regionally significant values be negatively and positively affected from altered wildland fire regimes (frequency, severity, and seasonality change from historic to present to future)?*	*Changed to address Core CEs identified in memo by the AMT.*
• **Example applications of this management question:**		
a) Where are areas that have been historically changed by fire suppression?		
b) Where are current areas with high fire frequency such that they burn on a regular basis?		
c) Where are Wildland Urban Interface (WUI) areas that have high potential for frequent fire?		
d) Where will CEs be at risk from altered fire regimes?		
e) Where are areas with potential to show future increases or decreases in wildfire frequency or intensity?		
f) Where do these areas intersect with human development, high conservation and restoration potential?		
g) Where are watersheds with high erosion potential vulnerable to high severity fire?		

Table 3-1. Management Questions (cont'd)

Invasive or Undesired Non-native Species, Insect and Disease		
SOW Management Question	**Revised Management Question**	**Comment/Note(s)**
5. *Where will regionally significant values be affected through changes in the spatial distribution and abundance of invasive and (undesired) non-native species?*	*Where will regionally significant values be affected through changes in the spatial distribution and abundance of invasive, (undesired) non-native species, and insect/disease outbreaks?*	Added insect/disease outbreaks to maintain consistency with CAs in memo.
Example applications of this management question:		
a) What habitats have been, or have the potential to be, most severely affected by exotic invasions, and where are they?		
b) What areas have the greatest occurrence of invasive species (high, moderate, low effect)?		
c) Where are areas with invasive species that have restoration potential to reverse the infestation (high, moderate, low)?		
d) Which exotics have potential for control and which do not?		
e) Where are areas of potential future introduction and encroachment from invasive species currently known from the region?		
f) Which areas are experiencing the most rapid spread of invasives (may not be supported by existing data) and why?		
g) How might other CAs influence the introduction or spread of non-native species?		
h) Which insects and diseases might pose a significant future problem?		
i) Where will state and federal high-valued resource areas be affected through changes in intensity and range of insects and disease?		
j) What has the change been in frequency and severity of outbreaks (in the last 50 years) and where have they occurred?		
k) How and where are frequency and severity of outbreaks expected to change in response to climate change and to other CAs such as change in fire frequency and intensity?		
l) What is the extent of recent (previous 5 years) forest mortality and what areas are susceptible to mortality over the next 5 years?		
m) Where are the whitebark pine and other pine stands that have been substantially impacted by the mountain pine beetle?		
n) Based on climate change models, what areas could be susceptible to beetle infestation or disease in the future?		
o) Where are the forests that have been substantially impacted by disease?		
p) Where are the stands of ponderosa, lodgepole, and whitebark pine that have not been impacted by the insects or disease?		

Table 3-1. Management Questions (cont'd)

Urban, Agricultural, Industrial, & Water Development		
Management Question	**Revised Management Question**	**Comment/Note(s)**
6. *Where will regionally significant values be affected through development?*	*Where will core regionally significant values be affected through development?*	Changed to address Core CEs identified in memo by the AMT.
Example applications of this management question:		
a) Where are areas of existing, planned, and potential future development, including roads (based on existing WUI literature, including Theobald and others)?		
b) Where will the WUI increase as a result of urban/suburban/exurban and second/vacation home development relative to state and federal areas of high conservation and restoration potential?		
c) Which core CEs are threatened by sod-busting, energy development, gravel mining, fragmentation, loss of connectivity, and other development pressures?		
d) Where are areas of existing, planned, and future renewable and non-renewable energy development (based on existing geospatial databases), including locations of existing leases, relative to areas of high conservation and restoration potential?		
e) Where are existing, planned, and potential corridors, including roads, transmission lines, and pipelines, and how do they relate geographically to state and federal high value areas?		
f) Where are likely sources and sinks of discharge from such developments that may diminish quality of receiving waters and habitats (e.g., saline discharges)?		
g) Location of methane extraction ponds located that could serve as breeding sites for mosquitoes carrying west Nile virus and threaten Sage Grouse?		
h) Where are aquifers and their recharge basins? What is the current and projected land use in these areas?		
i) Where are areas in which groundwater extraction has the potential to change surface flow?		
j) Where are areas with high densities of surface water impoundment?		
k) Where do surface water diversions or ground water withdrawals have the potential to create discontinuity between spawning and other habitats (i.e., by creating seasonally dry or impassible stream reaches)?		
l) Where are opportunities to restore continuity in habitats?		
m) Where are existing, planned, and potential areas for development or expansion of recreation areas [e.g., off-highway vehicle (OHV) and snowmobile routes, ski areas, reservoirs) in proximity to areas of high conservation and restoration potential?		
n) Where are existing, planned, and potential visitor serving facilities (food, lodging, etc.) and corridors, including roads and utilities, and how do they relate geographically to high conservation value areas?		
o) On public lands, where are high conservation value resource areas vulnerable to unauthorized use?		

Table 3-1. Management Questions (cont'd)

Climate Change		
SOW Management Question	**Revised Management Question**	**Comment/Note(s)**
7. *Where are climatic zones located today and what are the potential realistic scenarios for climate (precipitation, temperature, evapotranspiration, storm intensity, flood frequency, etc.) and the impacts to regionally significant ecological values?*	*Where will regionally significant values be affected by climate change?*	Changed to address AMT comment.
• **Example applications of this management question:**		
a) Where are climatic zones located today and what are the potential realistic scenarios for climate (precipitation, temperature, evapotranspiration, storm intensity, flood frequency, etc.) and the impacts to regionally significant ecological values?		
b) Where are species habitats most vulnerable to climate change?		
c) Where are areas of state and federal high conservation value and restoration potential most vulnerable to climate change?		
d) Where are watersheds with the greatest potential for alterations in thermal regime and hydrologic regime? What will these changes be?		
e) Where are surface water and groundwater availability likely to change?		
f) What are predicted changes in the distribution of vegetation types given climate change (including changes to extramural climate)?		
g) Where are CE species' habitats most vulnerable to changing climatic conditions?		
h) What and where are the vegetation types and seral stages that are carbon sinks and carbon sources? What actions in those vegetation types alter the sink/source balance?		
i) Where are the highly vulnerable stands of major tree species susceptible to impacts from climate change over the next 50 years and what is the potential for decreased carbon sequestration on public lands?		
j) Where are potential carbon sequestration areas?		

Regionally Significant – See definition in List of Acronyms, Abbreviations, and Definitions.

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4.0 CONSERVATION ELEMENT SELECTION

4.1 INTRODUCTION

The Middle Rockies REA is intended to characterize the current status (baseline conditions) and forecast the future condition of ecological resources in this ecoregion. Conducting the REA requires specific resource values throughout the ecoregion to be identified. These will be referred to as CEs and will be the objects of assessment for 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).

In this section we propose a limited suite of CEs that will be used to represent the entirety of renewable resources and values within the ecoregion. Through the REA analyses of the condition of these CEs within the Middle Rockies ecoregion in Phase II of the project, we will ultimately evaluate ecological integrity at the watershed level across the ecoregion.

Our approach to selecting core CEs is based on identifying an effective set of ecosystems, species assemblages, and individual species that will adequately represent the ecoregion's resources and be suitable gauges of the effects of CA impacts. The selected CEs must assist us in clearly articulating our understanding of the roles of key ecological drivers of the region's natural systems. Information in existing databases on selected CEs must be adequate to permit us to characterize the current condition of these resources. For example, thousands of species are present in the region, but for most of them existing documentation would not permit us to account for all aspects of their geographic range, life histories, and responses to CAs. The CEs must also be useful in depicting the effects of CAs on these resources (i.e., it must be possible to clearly state what the potential change in status of these resources would be in terms of trends, magnitude, or scope of change, and likelihood of change over the required time horizons).

To ensure that our suite of core CEs adequately represents the ecoregion's resources of conservation concern, we will use the "coarse-filter/fine-filter" approach recommended in the SOW. This approach focuses on ecosystem representation,

complemented by a limited subset of focal species assemblages and individual species. The objective of this dual approach is to include the ecosystems and ecological functions (coarse-filter) that are required for biotic integrity, while also providing for biodiversity and species of concern (fine-filter).

4.2 CONSERVATION ELEMENTS

4.2.1 Coarse-Filter Ecological Systems

4.2.1.1 Introduction

Coarse-filter CEs will include all of the major ecosystem types that occur within the assessment area, 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. For this analysis, we used the Northwest and North Central Gap Analysis Program (GAP) definitions of vegetation types in the Middle Rockies ecoregion, as this classification approach provides several levels of detail that can be used to characterize and map vegetation cover (USGS 2010). The Middle Rockies ecoregion included a mosaic of GAP data sources, including two of the National GAP landcover regions, the Northwest and North Central. The source data for the Northwest region was the Northwest ReGAP dataset that improved upon the original Northwest GAP analysis.

The Level 1 (Land Cover) Classification is the most generalized level of vegetation type aggregation in the database. It is useful for displaying broad categories of vegetation structure such as forest land, grassland, shrubland, etc. (Figure 4-1). GAP Level 3 (Ecological Systems[1]) subdivides Level 1 categories into the major ecosystems and broad categories of human land use and disturbance in the region. This classification level will provide the necessary detail to characterize habitat occupancy for the landscape-species CEs that will be used as fine-filters in this REA. A complete listing of Level 3 ecological systems that occur in the Middle Rockies ecoregion, organized by Level 1 ecosystems, is provided in Appendix 2.

Although the GAP data will serve as the primary source for vegetation data, it is recognized that the GAP data may not be completely accurate for various ecological systems. For example, it is widely known that the GAP system does not provide accurate classifications for xeric uplands. In addition, GAP does not provide a classification for whitebark or limber pine. These inaccuracies will be addressed through all phases of the REA.

4.2.1.2 Selection Approach

SAIC's approach to coarse-filter CE selection at the first AMT workshop started with the GAP Level 3 ecological systems (N = 107) as candidates for the coarse-filter ecosystem-level CEs. We recommended not including human land use systems, recently disturbed or modified systems, or areas for which there are "No GAP data" as coarse-filter CEs. Collectively, these disturbed systems, along with the "no data" (N = 19), account for approximately 17.6 percent of the ecoregion (Table 4-1).

[1] Ecological Systems – See definition in List of Acronyms, Abbreviations, and Definitions.

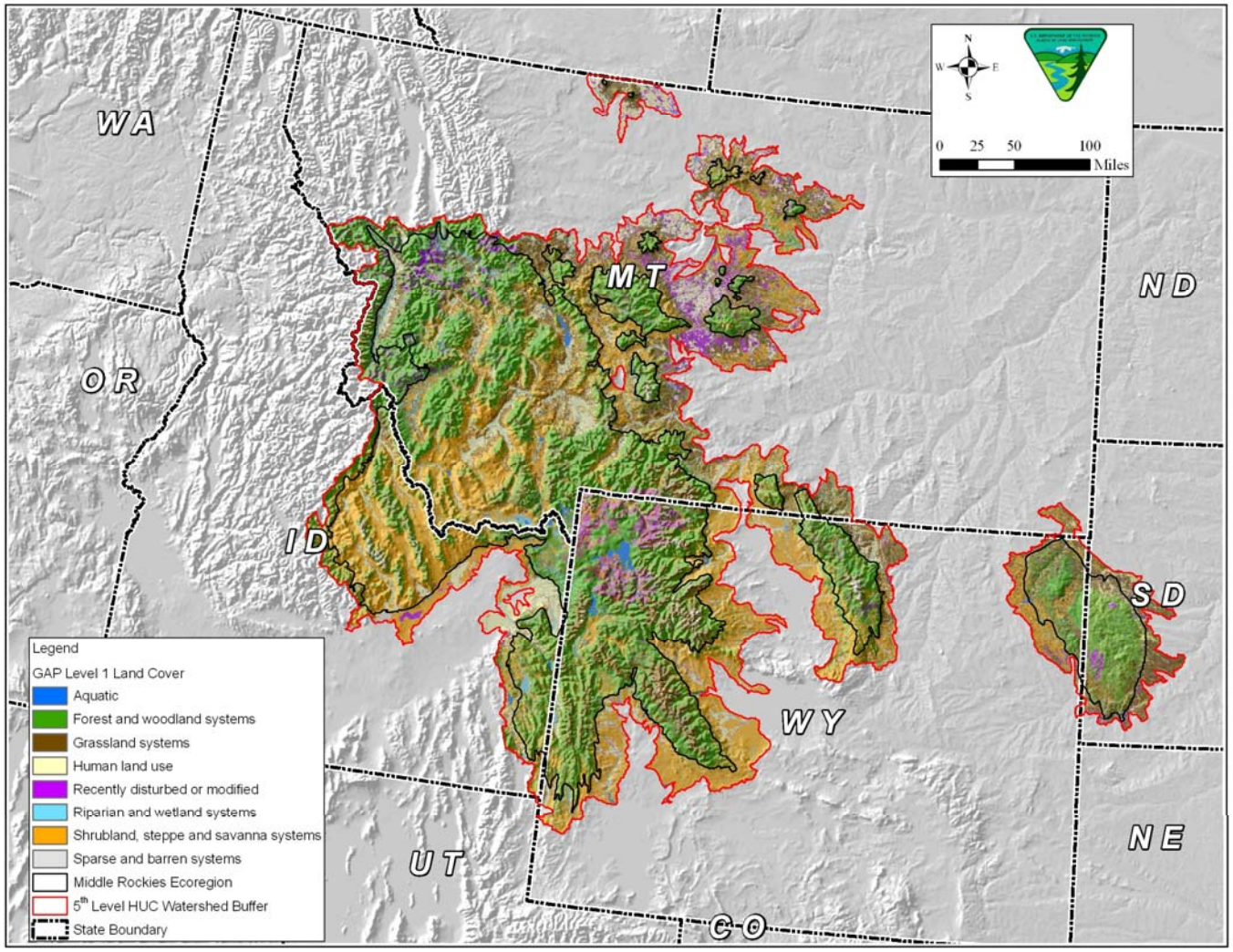


Figure 4-1. Major Land Cover Types (GAP Level I) of the Middle Rockies Ecoregion

Conditions in these areas consist of human-created land cover, such as developed areas and cropland, or reflect predominantly human-related disturbance, such as logging. Cropland and other disturbed areas provide habitat value for some species of conservation concern (e.g., pronghorn). It should be noted that geospatial data for disturbed systems would nonetheless be utilized in the REA, in particular with regard to the role those systems play relative to CAs such as urbanization and agricultural conversion. Thus, the data for all mapped ecological systems and cover types in the ecoregion will be retained and available for use in the event that it is required by conceptual models for fine-filter CEs.

Although it is important to identify human land use systems (Table 4-1), the BLM has no influence over these areas and thus they will not be carried forward as CEs; however, they can be important indicators in measuring habitat quality. Recently disturbed systems (Table 4-2), such as burned or logged systems, will be retained with their respective pre-disturbance ecological systems. Relatively minor amounts of these cover types classified as recently disturbed are present in the Middle Rockies ecoregion. These areas are important to link to CEs due to the temporary nature or reversibility of some of these conditions (e.g., recently burned or harvested) and the fact that these areas may provide habitat value for CE species now or in the foreseeable future. Therefore, these categories will be available for analysis but will not be evaluated as coarse-filter CEs. Placement of these disturbed systems is described below.

Table 4-1. Human Land Use GAP Level 3 and Other Land Cover Types Not Included as Coarse Filters for the Middle Rockies Ecoregion

Human Land Use	Percent of Ecoregion
Developed, High Intensity	0.01
Developed, Medium Intensity	0.11
Developed, Low Intensity	0.28
Developed, Open Space	0.69
Quarries, Mines, Gravel Pits and Oil Wells	0.02
Pasture/Hay	2.71
Cultivated Cropland	4.28
No Data	5.52
TOTAL	**13.62**

Table 4-2. Disturbed GAP Level 3 Systems and Other Land Cover Types That Were Aggregated with Natural Ecological Systems and Included in the Coarse Filters for the Middle Rockies Ecoregion

Recently Disturbed	Percent of Ecoregion
Introduced Upland Vegetation - Shrub	0.02
Recently burned grassland	0.06
Harvested Forest - Grass/Forb Regeneration	0.29
Harvested Forest - Northwestern Conifer Regeneration	0.42
Introduced Riparian and Wetland Vegetation	0.12
Harvested forest-Shrub Regeneration	0.25
Disturbed, Non-specific	0.0
Recently burned forest	1.09
Introduced Upland Vegetation - Annual Grassland	0.25
Introduced Upland Vegetation - Perennial Grassland and Forbland	1.47
TOTAL	**3.96**

All natural ecological systems will be retained as coarse filters with the exception of human land uses and no data categories (Table 4-1), and to aggregate Level 3 systems into a higher-level classification that would be cross-referenced (crosswalked) to the National Vegetation Classification System (NVCS). GAP mapping units (Level 3 ecological systems) have recently been crosswalked by BLM staff to the Idaho Land Cover Classification System (LCCS) (Foster 2010, personal communication) at the Division level, which has been crosswalked to a comparable category in the NVCS. Appendix 3 contains a listing of Level 3 Ecosystems organized by Division, Formation, and Class in an adaptation of the BLM Idaho LCCS.

The Idaho LCCS includes 14 natural vegetation divisions, 3 sparse vegetation/barren area divisions, 2 agricultural divisions, 2 urban and other developed land divisions, and 1 open water division. The Idaho LCCS natural vegetation divisions include GAP Level 3 recently disturbed systems (Table 4-2), such as harvested or burned systems, that have not been converted to human land uses. For example, Harvested Forest-Northwestern Conifer Regeneration and Recently Burned Forest are grouped with the Evergreen Woodland division, and Recently Burned Grassland is grouped with the Perennial Grassland division (see Appendix 3). Most of the GAP Level 3 systems that occur in the Middle Rockies ecoregion (listed in Appendix 2) are included in the Idaho LCCS divisions, effectively linking the GAP Level 3 systems to NVCS. Additional NVCS crosswalk efforts in other states, such as the Montana Crucial Areas Planning System (CAPS) (Vance 2010, personal communication) and (Comer et al. 2003b), and professional judgment were used to associate remaining Level 3 systems to Idaho LCCS Divisions (Appendix 3).

The aggregation and crosswalk process allows evaluation of a reduced number of coarse-filter CEs, for example, at the division level, while retaining the capability to evaluate nested geospatial data on every Level 3 mapping unit within or across divisions. Table 4-3 lists the 10 division-level coarse filters that we propose to carry forward to the next phase of the REA. Ecological models for these coarse-filter elements (or combinations of Level 3 Ecosystems subsumed within these division level categories, as needed) will form a major focus for this REA.

Table 4-3. Ecological Systems Proposed as Coarse Filters for the Middle Rockies Ecoregion

Division Name (Idaho LCCS Crosswalk with ReGAP)	Percent of Ecoregion	SOW regionally significant Vegetation types
Terrestrial Systems	***82.5***	*Regionally significant terrestrial communities*[1]***,*** *functions, and services*
Deciduous Forest and Woodland[2]	4.9	Mixed deciduous woodlands (aspen)
Evergreen Forest and Woodland	28.9	Mixed conifer forests, Mixed conifer woodlands (Ponderosa, lodgepole, Douglas-fir, juniper), Pine woodlands (5-needled pines)
Mixed Evergreen/Deciduous Forest	0.2	Mixed deciduous woodlands (aspen)
Mesic Shrubland and Grassland (Deciduous and Evergreen)	16.0	Mixed shrub/grass associations

Table 4-3. Ecological Systems Proposed as Coarse Filters for the Middle Rockies Ecoregion (cont'd)

Division Name (Idaho LCCS Crosswalk with ReGAP)	Percent of Ecoregion	SOW regionally significant Vegetation types
Semi-Desert Shrubland and Grassland	28.2	Mixed shrub/grass associations, Sagebrush/grassland complexes
High Montane Vegetation	3.0	Alpine (high montane shrub and grasslands)
Sparse Vegetation & Natural Barren Areas	1.3	
Aquatic/Riparian/Floodplain and Wetland Systems	***6.4***	*Regionally significant aquatic/riparian features, functions, services.*
Deciduous Forest and Woodland[3]	2.9	Riparian communities (evaluate at the division/subdivision/system level as appropriate): (deciduous woodlands, shrublands), Snow vs. rain driven systems—includes floodplains
Emergent Wetland	2.9	Herbaceous wetlands, Springs, spring-brooks
Open Water	0.6	Watercourses Perennial vs. intermittent systems
Total	88.9	

[1] Evaluate at the division/subdivision/system level, as appropriate.
[2] Includes upland deciduous systems.
[3] Includes floodplain systems, riparian systems, ravine systems, and conifer swamp.

It is important to note that all of the Level 3 system data are retained through the aggregation to division process, and we have the ability to re-aggregate any number of Level 3 systems as needed for the REA analysis.

The selected suite of ecological systems encompasses the habitat requirements of most characteristic native species, ecological functions, and services in the region. Careful selection of fine-filter species as CEs will ensure that resources of particular interest to the AMT and local agency managers are included in the REA.

4.2.2 Landscape-Species Conservation Elements

4.2.2.1 Introduction

Landscape species CEs are fine-filter elements in this REA. The fine filter focuses on species and species assemblages that include rare species and landscape/keystone species. Species assemblages are groups of species whose habitats and distribution are sufficiently similar that they may be treated as a single unit of analysis. Landscape species are defined by their use of large, ecologically diverse areas and their impacts on the structure and function of natural ecosystems (Sanderson et al. 2002). Keystone species play a lead role in their ecosystems, helping to determine the types and numbers of various other species that co-occur in the system. Selecting these species involves considering whether they have habitat requirements that are adequately

represented by the coarse-filter elements, or whether they are likely to be overlooked in the assessment, for example, because of distinctive habitat requirements or particular vulnerability to certain CAs. For example, species that are strongly associated with a major coarse-filter ecological system may be adequately represented by assessment of the ecological system. Other species, however, should be addressed as individual elements because they have habitat requirements that are different from other species of concern, or range over wide areas. This category would include landscape species.

4.2.2.2 Selection Approach

Our goal in the selection process was to produce an initial list of 25-35 candidate species for consideration as fine-filter CEs. This list was presented for AMT review with the ultimate goal of focusing on 7 to 12 species to be carried through the REA process as core CEs. To build the initial list, we started with the list of species identified in the SOW, recognizing that the AMT and agency partners had given considerable thought to the species-specific CEs in this ecoregion. This initial list was supplemented with some landscape species that have been identified in the literature and species that are representative of habitat that may be inadequately represented by the coarse-filter ecological system data in Table 4-3.

A comprehensive review of federal, state, and agency lists of species of conservation concern was also conducted as part of the initial selection process. For ease of review this information was compiled into a database. Due to size limitations, the database was not included as an appendix. However, representative screenshots are included in Appendix 4. The database includes species from the following sources:

1. All species listed as Federally Endangered, Threatened, or Candidate status.
2. G1-G3 ranked species.
3. Species listed by applicable SWAPs with habitat in this ecoregion.
4. BLM Special Status species.

Any species that was included in three or more SWAPs and appeared to be of landscape-scale was automatically included in the initial candidate list of CEs.

4.2.2.3 Final Landscape-species Conservation Element Selections

At AMT Workshop 1, the AMT recommended that the selection criteria for landscape species CEs be modified to reduce the number of candidate species and species assemblages. The primary criterion for selecting CE species is that they should be 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 necessarily surrogates for other species of concern; they should be of concern themselves. The following criteria reflect workshop guidance and were used to reduce the list of candidate fine-filter CEs (Appendix 5):

- Strong association with one or more coarse-filter CEs (such as a specific GAP level 3 ecological system).
- Association with a keystone or umbrella species identified as a CE (examples include species typically associated with black-tailed prairie dog colonies).

- Association with a species group or assemblage being carried forward as a CE (e.g., cold water fish species, grassland breeding bird species, forest carnivores, big river fish species).
- Lack of consensus among the AMT to carry the species forward as a fine-filter CE. Discussion points for not carrying a species forward included:
    - o insufficient ecological knowledge or lack of data
    - o not of regional significance or strong agency concern throughout the ecoregion

These criteria were used to reduce the candidate list of fine-filter CEs. If any of the candidate fine-filter CEs met any of the criteria listed above, the candidate CE was either combined with an assemblage or not carried forward as a core CE. The rationale for each of the candidate CEs is contained in the table in Appendix 5. Table 4-4 lists the core CEs that will be evaluated in the REA.

Table 4-4. Fine-Filter Conservation Elements for the Middle Rockies Ecoregion

Species Common Name or Species Assemblage	Rationale
Grizzly bear	Regional Significance
Forest Carnivore Assemblage (C. Lynx, Wolverine, Marten)	Regional Significance
Greater sage-grouse	Regional Significance
Big game Crucial Winter Range & Parturition Areas (Mule Deer, Elk, Rocky Mountain bighorn sheep)	Regional Significance
Pronghorn (migration corridors)	Regional Significance
Native Cold Water Aquatic assemblage (Cutthroat Trout, summer steelhead, bull trout, sockeye, Chinook, fluvial Arctic grayling)	Regional Significance
Five Needle Pine Assemblage (Whitebark Pine, Limber Pine	Added by AMT
Golden eagle	Added by AMT

5.0 CHANGE AGENTS

5.1 INTRODUCTION

Successful completion of this REA will in part be based on a sound understanding of the landscape-scale CAs and their potential impact on ecological values throughout this ecoregion. CAs are natural or anthropogenic disturbances that influence the current and future status of CEs. 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 SWAPs, existing literature on threats, and regional experts to develop the CAs described below (Table 5-1). As we refine our data evaluation, CAs important to the ecoregion will be addressed in more detailed analysis and conceptual models.

Table 5-1. Change Agents Selected for the Middle Rockies

Change Agents	Status
Fire	Accepted
Development	Accepted
Urban and Exurban	Accepted
Agricultural	Accepted
Hydrological	Accepted
Invasive Species	Accepted
Terrestrial	Accepted
Aquatic	Accepted
Climate Change	Accepted
Insect Outbreaks and Diseases	Accepted

Historically, a variety of CAs in the Middle Rockies ecoregion included natural fire cycles, mining, hydrologic alteration, timber harvest, and grazing and other agricultural uses. More recently, the suppression of fire, urban development and other encroachment on natural areas, non-native species invasions, and the changes in climate patterns have played larger roles.

5.2 Change Agent Categories

For the purpose of this analysis, CAs were divided into five categories (fire; invasive species; insect/diseases; climate; and development) (Table 5-1). Several of these categories were subsequently divided into subcategories, as shown below. As the SAIC Team refines the data evaluation, CAs important to the ecoregion will be addressed in more detailed analysis and conceptual models. For example, specific invasive species will be selected that impact the CEs selected for this REA.

5.2.1 Fire

Because the ecosystems in the Middle Rockies region evolved under natural fire cycles, fire was historically most often a beneficial CA for the system in general. Fires recycled nutrients into the soil, cleared dense woody vegetation for herbaceous and young tree and shrub renewal, and allowed meadows and grasslands to persist in areas where

forests would expand. Human-influenced changes in forest and grassland management have affected fire frequency, severity, and seasonality. Additional effects are expected in the future from climate change influences as well as a new awareness of allowing fires to burn, controlled burns, and new sources of ignition (e.g., more people moving into the Wildland Urban Interface [WUI]) expanding development into forest edges. All of these affect the ecoregion's biota. Areas with the greatest present and potential departure from historical fire regimes will be important to identify throughout this ecoregion. Certain sagebrush communities, such as Wyoming big sagebrush, have poor adaptations to recover from high frequency fire, whereas most grassland and prairie communities are maintained or improved by periodic fire. In addition, connectivity of fire-prone areas with aquatic features will also be evaluated. In many areas of the Middle Rockies ecoregion, fire frequency has declined due to fire suppression and road networks acting as firebreaks.

5.2.2 Development

Urban, Exurban, and Rural (Industrial) Development – "Exurban development" includes the expansion of neighborhoods outside of urban areas to form commuter communities and the addition of new communities, often second and vacation homes, into open areas that are bordered by natural ecosystems. Energy exploration and development, both fossil fuel and renewable, remain a large and important economic factor for this ecoregion and usually occur in roadless areas. Because of the potential for habitat fragmentation from not only development, but also new access roads and utility lines, particular attention will be focused on planned, permitted, and leased development. This development includes resource extraction (mining, coal, oil, and gas) and related processing, generation, and transmission facilities as well as those proposed or projected under reasonably foreseeable development scenarios for areas of intact habitat that are isolated from existing urban and industrial infrastructure.

The disposal of saline waters into existing surface or groundwater resources, which may accompany oil, gas, and coalbed methane (CBM) processing, is also an ecosystem stressor if not properly discharged. Particular attention is required for energy extraction developments due to the potential for landscape-scale indirect impacts such as habitat fragmentation, corridors for invasive species and human intervention, ignition sources for fire, groundwater extraction, erosion potential, dust generation, and impacts on various species, including removal of habitat, noise, and impairing access to habitat by blocking movement corridors. Reports and maps generated by the Western Governors Wildlife Corridors, Crucial Habitats Initiative, and other state decision support systems will be reviewed and considered where appropriate in reviewing CAs.

<u>Agricultural</u>

The Middle Rockies incorporate a wide variety of agricultural occupations contributing to the economy. Crops produced in the region include dryland grains, hay, and other grain and oil crops such as barley, safflower, and canola where irrigation water is available. Biofuels are also becoming an abundant agricultural crop.

<u>Hydrological – (dams, diversions, water table drawdown, industrial uses)</u>

Surface water impoundments and diversions affect the timing and amounts of downstream flows, reducing connectivity and gene flow by affecting passage and survival of fish and other aquatic vertebrates, and curtailing flood events necessary to

regenerate cottonwood and willow riparian communities. In addition to physical habitat disturbance, groundwater extraction has the potential to impact groundwater tables and, in some cases, surface waters such as seeps, springs, or live stream segments. Lowering groundwater tables can affect sensitive aquatic invertebrate and vertebrate species, as well as plant species and entire habitats dependent on surface water or elevated groundwater tables (e.g., most riparian and wetland species). The health of these aquatic and riparian communities is essential in the semi-arid regions for the survival of a great variety of resident and migratory wildlife species. Many listed and sensitive species in the ecoregion utilize riparian habitats for essential life stages such as breeding, and their decline can be tied to the general degradation of water-dependent habitats in the West. Effects on these habitats can also lead to soil destabilization and erosion.

5.2.3 Invasive Species

Expansion of invasive species is associated with human activity, such as development of roads, clearing ground for well pads, addition of pipelines and transmission lines, and other disturbances in native habitat. Several species, such as cheatgrass, knapweeds, Canada thistle, whitetop, and leafy spurge, have the potential to cause serious ecological effects in terrestrial environments. In addition, woody, invasive non-native species such as Russian-olive and tamarisk have spread through riparian areas and continue to threaten areas throughout the Middle Rockies ecoregion. Other species listed in the BLM SOW include skeleton weed, dalmation toadflax, and European starling.

Invasive species with the potential to impact aquatic resources include New Zealand mudsnails, whirling disease, didymo, quagga/zebra mussels, Eurasian milfoil, Asian clam, and chytid fungus. Other species listed in the BLM SOW include non-native fishes that pose undesired threats to native fish species or important sport fisheries, such as brook trout, rainbow trout, brown trout, northern pike, and walleye.

5.2.4 Insect Outbreaks and Diseases

Diseases such as sylvatic plague, canine distemper, chronic wasting disease, and West Nile virus have had, and continue to have, the potential to exert severe effects on populations of species such as prairie dogs, black-footed ferrets, important game ungulates, swift fox, and a wide variety of birds, including greater sage-grouse. Exotic pests, such as mountain pine beetle and emerald ash borer, and exotic diseases, such as White Pine Blister Rust, have the potential to spread through portions of the ecoregion, causing severe ecological damage to woodland and forest ecosystems. A key issue is to conceptually model the relationships between habitats vulnerable to climate change effects and the spread of invasive species; invasions of native and non-native insect pests and diseases; and susceptibility of host plant and animal populations.

5.2.5 Climate Change

Global climate change has the potential to directly and indirectly affect organisms and communities by changing the locations where species and communities can exist. Climate change may include changes in precipitation amounts, distribution, and seasonality; frequency and duration of drought episodes; and temperature regimes. Climate change is also likely to affect species and communities by affecting the

frequency and distribution of fire and threats from invasive species, disease, and insect outbreaks. Although there is a view that climate change toward warmer-drier conditions, for example, would cause communities to move northward (or, in some localized instances, to higher elevations), species are likely to respond individually, as they have in past geologic epochs. Additionally human-caused barriers to movement may affect the ability of species or communities to move in response to changing conditions or become genetically isolated. Additionally, potential climate change effects on carbon sequestration and water supply or quality may need to be considered.

6.0 BASIC ECOREGION CONCEPTUAL MODEL

6.1 INTRODUCTION

As part of this initial task, a base conceptual model for the Middle Rockies ecoregion has been developed. This conceptual model will be used to provide a science-based context that illustrates how CEs are affected by CAs. This model will be used to guide the development of specific conceptual models developed in Task 3 of Phase I. The conceptual model developed in this task is simple and general due to the diversity of systems that occur throughout this ecoregion.

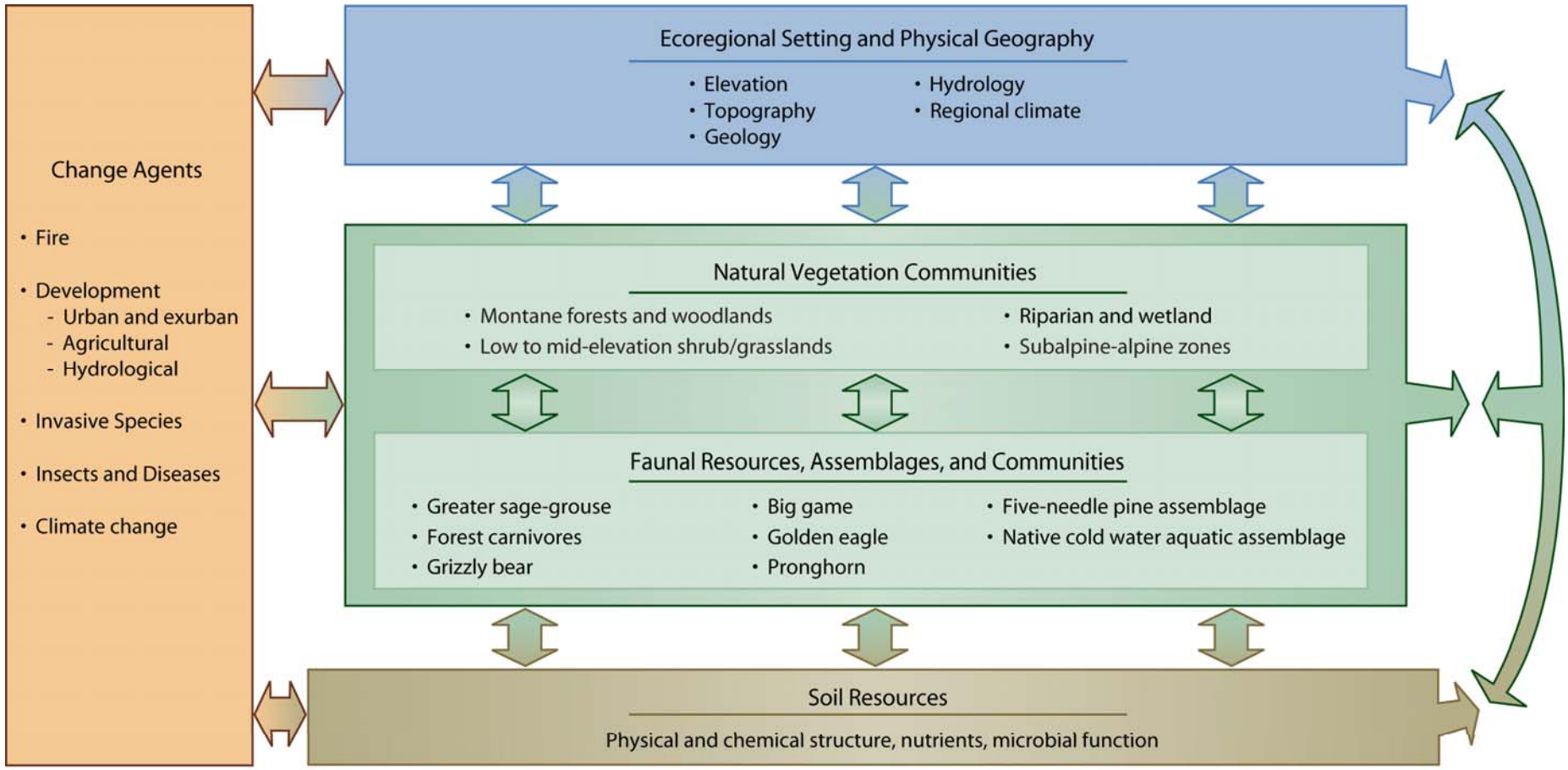
6.2 DESCRIPTION OF THE BASIC ECOREGION CONCEPTUAL MODEL FOR THE MIDDLE ROCKIES ECOREGION

In this conceptual model for the Middle Rockies ecoregion, the ecoregional setting and physical geography box at the top of the model includes natural features that form the basis for the setting of this ecoregion (Figure 6-1). These include geology, topography, regional climate, and hydrology. Listed below the setting and geography box are the natural vegetation communities that dominate this specific ecoregion and provide the habitat that is necessary for the sustainment of faunal resources. The natural vegetation box contains the Level 1 GAP classifications for the natural vegetation systems in this ecoregion. Below the natural vegetation systems are the faunal and wildlife community resources that were determined to be carried forward as CEs (Figure 6-1). The bottom box represents soil resources upon which the ecoregional resources described above are based and sustained. The CAs are listed in the left-hand box to depict their relationship/effect on all the resources of the ecoregion.

This model depicts relationships among functional components of the system (e.g. vegetation resources, wildlife) and the major environmental influences, such as climate and development, that control them. The model's simplifications suggests events or processes that impact ecosystem attributes, focusing on the major forces of change with large-scale influence, and include CAs that are influenced by both natural and human forces.

To simplify the model, all the possible specific effects of the CAs are not depicted but could include those resulting from chemical or physical changes, including drought, salination, changes in fire and hydrologic regimes including timing of snowmelt, nutrient and pollutant deposition, and erosion. Biological effects of the CAs could include botanical and migration phenology alterations resulting from climate change, and invasive species, disease, and insect infestations. Human-influenced CAs can also alter landscape extent and pattern, resulting in increased flooding, habitat conversion through agricultural practices, and fragmentation due to development.

Some natural processes that are also CAs, such as historic fire regimes, have been modified or exacerbated by human activities, (i.e. fire ignition, fire suppression, weed spread, and creation of features that act as firebreaks). Other CAs are wholly associated with human influence on the landscape, for example, pollutants, surface water diversion, groundwater extraction, industrial/energy development, and urbanization. Finally, CAs interact with one another to further influence CEs. For example, climate change has an influence on insect outbreaks and frequency of fire. The primary CAs listed are depicted as affecting all of the resources within the ecosystem.



Adapted from: Rocky Mountain Network Vital Signs Monitoring Plan 2007

Figure 6-1. Conceptual Model for the Middle Rockies Ecoregion

The conceptual model shown in Figure 6-1 is intended to be descriptive of landscape-scale functions while remaining simple and generic. In Task 3, more detailed models will be developed for the analysis of specific CEs relative to CAs. This ecoregional conceptual model does not include uncertainty or indicate spatial scale, relative magnitude or intensity of effects, or the time-frame of processes. Again, the detailed analytical models developed in Task 3 will provide the indices or categorization needed to complete the REA.

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7.0 SUMMARY

This memorandum documents the work completed under Phase I Task 1. The development of this memorandum was an iterative process that began with development of the MQs and identification of the initial lists of CEs and CAs, all of which served as a basis for the development of the ecoregion diagram and the conceptual model. This memorandum describes the geographic and ecological setting of the Middle Rockies ecoregion, identifies a buffer around the ecoregion boundary defined by the 5th level HUC watersheds, and describes the reporting units for the REA. We developed a comprehensive set of MQs, using those initially provided by the BLM and screening them through various criteria to identify a subset that could be answered through the geospatial analysis to meet the goals of the REA.

We proposed candidate lists of coarse and fine-filter resources for consideration as CEs that were discussed with the AMT at the first workshop. These resources included ecosystems, dominant plant species in the principal ecosystems of the region, landscape-level species taken from the BLM SOW, ESA listings, and SWAP species rankings. Species richness information for this ecoregion is currently under development by NatureServe and will be incorporated into the analysis when available.

After direction from the AMT to aggregate the Level 3 systems to the NVCS, we propose to carry forward 10 division level coarse-filter elements. Ecological models for these coarse-filter elements (or combinations of Level 3 ecosystems subsumed within these division level categories, as needed) will form a major focus for this REA. We also reduced the number of the fine-filter CEs by focusing on species of regional significance.

We also discuss CAs in broad categories including fire, invasive or non-native species, climate change, and development, and consider the stressor processes that they impose on ecoregion resources. Development is discussed in terms of sub-categories, including urban, exurban, and rural (industrial) development, agricultural development, surface water diversion, and groundwater extraction. We discuss interactions of these CAs; for example, effects of climate change on wildfire frequency, severity, and seasonality, and the effects of climate change on disease and insect outbreaks.

The conceptual model in this final memorandum illustrates events or processes that impact ecosystem attributes, focusing on the major forces of change with large-scale influence, and includes CAs that are influenced by both natural and human forces.

The number and variety of MQs included in this document also indicates that the REA process for this ecoregion will be comprehensive and broad in scope. It will be imperative that the SAIC Team and the AMT maintain focus on landscape-scale applications that are relevant to resources across the ecoregion. Because a wide variety of local, state, and federal agencies, stakeholders, and non-governmental organizations have substantial interests in the resources of this ecoregion, a clear landscape-scale vision must be maintained throughout the process.

Various sensitive issues that are of significant importance to certain localized areas of the ecoregion, or to resources and agencies, or interest groups, have the potential to distract the analysis and change the outputs throughout the process. In order to maintain this landscape-scale vision, it will be further imperative to initiate and develop strong and trusting relationships with groups such as the Landscape Conservation

Cooperatives (LCCs) and others so that wise use of resources can be maintained and agencies are clearly aligned along a similar path to landscape conservation.

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APPENDIX 1

BLM MANAGEMENT QUESTIONS

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At AMT workshop 1, the SAIC Team and the AMT evaluated the MQs to determine if data would be readily available to address each MQ. In addition, discussion resulted in reduction of the MQ list to remove redundant MQs and combine others where applicable. The table contained in this appendix displays the crosswalk, as well as whether the MQ was carried forward to the final memorandum or if removed, the reason why.

Status of MQ:

1. MQ carried forward to Final Memo
    a. MQ carried forward but made subset or combined with other MQ
2. Determined insufficient data exists to completely answer MQ
3. Redundant with other MQ
4. Directed by AMT to remove MQ

Appendix 1. BLM Management Questions

General Landscape Questions		Status	Current MQs Number
	~~1. Where are current intact regionally significant landscapes?~~	2	
	~~2. What is required to maintain long-term (20-50 year) productivity of the ecosystems being evaluated?~~	2	
	~~3. What is required to maintain current biodiversity in the ecoregion?~~	2	
	~~4. What management actions will restore and maintain ecosystem resilience (i.e. the capacity of a system to absorb disturbance and still retain its basic function and structure).~~	2,4	
	~~5. What is the acceptable range of future conditions and what is the historic range of conditions?~~	2	
	~~6. What is required to maintain CEs over time?~~	2	
Landscape Species/Species Richness		**Status**	**Current MQs Number**
CE Species (Fish, Wildlife, and Plants)	7. What is the terrestrial ecological integrity (high, medium, low) for regionally significant features, functions, and services across the landscape?	1a	1
	8. Where are current CE landscape/keystone species and their habitats, including seasonal habitat and movement corridors, at greatest risk from CAs including climate change (connectivity, small population size)?	1a	3c
	~~9. Where are areas of high species richness for surrogate groups of species?~~	3	
	~~10. What is the current location/distribution of G1-G3 & BLM special status species?~~	3	
	11. What areas have potential for restoring CE species habitat or habitat connectivity for CE species, currently and in the future?	1a	3a
	12. Where are the key habitat types (season refuges, corridors/connectivity, migration routes, concentrations of regionally significant species)?	1	3d
	13. Where are the crucial winter and or parturition areas for big game species at risk from long-term habitat conversion or fragmentation?	1	3e
	14. Where are the regionally significant keystone species complexes such as black-tailed prairie dogs at risk from disturbance or development?	1	
Terrestrial Resource Values		**Status**	**Current MQs Number**
Sites of High Biodiversity (Both Terrestrial and Aquatic)	15. What is the current location/distribution of sites that have the greatest species richness?	1	1a
	16. Which species groups should be used as surrogates?	1	1b
	~~17. Which high biodiversity sites will potentially be affected by CAs and where are they?~~	2	

Appendix 1. BLM Management Questions (cont'd)

Terrestrial Resource Values (cont'd)		**Status**	**Current MQs Number**
Vegetation Types	18. What are the CE vegetation types? How are they distributed over the landscape (extent/pattern) and how have they changed over time?	1a	1c
	19. Where will current CE vegetation types be at greatest risk from CAs?	1	1d
	~~20. What CE vegetation types are currently at risk due to; development, hydrologic alterations, overgrazing and fragmentation (connectivity, size, etc.)?~~	2	
	21. What CE vegetation types are suitable for potential corridor connectors?	1a	1c
	~~22. Where will there be changes in CE vegetation types?~~	2	
	~~23. What areas have potential for CE vegetation type restoration (based on existing available data)?~~	3	
Specially Designated Areas (Both Terrestrial and Aquatic)	24. Where are specially designated areas of high ecological value (designated by various agencies or in other work)?	1	1e
	25. What levels of resource management and protection from future development exist in these areas, and where are adjacent areas with potential for restoring connectivity?	1	1e
Soils	26. What soils are present and what is their current condition?	1	1f
	27. Which CAs are likely to affect soil fertility and erodibility?	1	1g
	28. Where are areas of high soil erodibility due to wind or water erosion if existing vegetation cover is removed?	1	1h
	~~29. What/where is the potential for future change in soil conditions due to CAs?~~	2	
Aquatic Resource Values		**Status**	**Current MQs Number**
	30. What is the aquatic ecological integrity (i.e. high, medium, low) for regionally significant features, functions, and services across the HUC watersheds?	1	2
	31. Where are the current locations of CE aquatic/riparian habitats, including rivers, streams, lakes, ponds, wetlands, springs and reservoirs?	1	2a
	32. Where are current riparian or aquatic areas currently at risk of fragmentation impoundment, diversion and lowered water tables due to development, mineral extraction, and agricultural and residential development?	1	2b
	33. What is the current flow regime (hydrograph) of CE stream or river habitats or duration and extent of surface water in CE pond and lake habitats?	1	2c
	34. What is the condition of aquatic systems as defined by the Fish Passage Center (FPC)?	1	2d
	35. How have dominant species changed over time?	1	2e

Appendix 1. BLM Management Questions (cont'd)

Aquatic Resource Values (cont'd)		Status	Current MQs Number
	36. Where are exotic species an existing and potential problem?	1	2f
	37. Where are degraded aquatic systems (water quality) and what are the sources of the degradation (saline discharges, petrochemical discharges, leaching of toxic mineral salts, eutrophication due to concentrated nutrient runoff, other)?	1	2g
	38. Where will CE aquatic habitats potentially be affected by CAs (duration, magnitude and temperature of flow; duration and extent of surface water presence, if applicable)?	1	2h
	39. Where will CE aquatic habitats potentially experience the greatest effects of climate change (duration and magnitude of flow, duration and extent of precipitation and surface water presence, if applicable)?	1	2i
	40. Where are the most species losses likely to occur due to temperature increases or water reductions?	1	2j
	41. What/where is the potential for future change in dominant species composition of CE aquatic habitats?	1	2k
	42. What areas have potential for CE aquatic habitat restoration (based on available geospatial data)?	1	2l
	43. Where are areas of watershed habitat connectivity?	1	2m
	44. Where are aquatic habitat strongholds for sensitive species that are intact and provide the best opportunity for protection, restoration and enhancement?	1	2n
	~~45. Where are the fisheries and associated aquatic macroinvertibrate food sources of regional concern?~~	2	
	46. Where are sensitive aquatic species at risk from stream connectivity or risk from interbreeding with closely related non-native or exotic species?	1	2o
Change Agents		**Status**	**Current MQs Number**
Fire	47. Where are areas that have moved outside their presettlement range of variation from fire regimes?	1	4a
	~~48. Where are areas of sagebrush/forest ecotone?~~	4	
	49. Where are current areas with high fire frequency such that they burn on a regular basis?	1	4b
	50. Where are Wildland-Urban Interface (WUI) areas that have high potential for frequent fire?	1	4c
	51. Where will CEs be at risk from altered fire regimes?	1	4d
	52. Where are areas with potential to show future increases or decreases in wildfire frequency or intensity?	1	4e
	53. Where do these areas intersect with human development, high conservation and restoration potential?	1	4f
	54. Where are old growth forest areas that might be vulnerable to stand-replacing fires due to fire suppression?	1	4g
	55. Where are watersheds with high erosion potential vulnerable to high severity fire?	1	4h

Appendix 1. BLM Management Questions (cont'd)

Change Agents (cont'd)		Status	Current MQs Number
Invasive Species, Insect Outbreaks, and Diseases	~~56. What portions of the landscapes have the most potential for the restoration of native species?~~	3	
	57. What habitats have been or have the potential to be most severely affected by exotic invasions and where are they?	1	5a
	58. What areas have the greatest occurrence of invasive species (high, moderate, low effect)?	1	5b
	59. Where are areas with invasive species that have restoration potential to reverse the infestation (high, moderate, low)?	1	5c
	60. Which exotics have potential for control and which do not?	1	5d
	61. Where are areas of potential future introduction and encroachment from invasive species currently known from the region?	1	5e
	62. Which areas are experiencing the most rapid spread of invasives (may not be supported by an existing database) and why?	1	5f
	63. How might other CAs influence the introduction or spread of non-native species?	1	5g
	64. Which insects and diseases might pose a significant future problem?	1	5h
	65. Where will state and federal high valued resource areas be affected through changes in intensity and range of insects and disease?	1	5i
	66. What has the change been in frequency and severity of outbreaks (in the last 50 years) and where have they occurred?	1	5j
	67. How and where are frequency and severity of outbreaks expected to change in response to climate change and to other CAs such as change in fire frequency and intensity?	1	5k
	68. Where are the major tree stands that have been substantially impacted by insects?	1	5l
	69. Based on climate change models what areas could be susceptible to insect infestation or disease in the future?	1	5m
	70. Where are the forests that have been substantially impacted by disease?	1	5n
	71. Where are the stands of major tree species that have not been impacted by the insects or disease?	1	5o
Development – Urban and Exurban	72. Where are areas of existing, planned, and potential future development, including roads (based on existing WUI literature including Theeobald and others)?	1	6a
	73. Where will the WUI increase as a result of urban/suburban/exurban and second/ vacation home development relative to state and federal areas of high conservation and restoration potential?	1	6b
	74. Which core CEs are threatened by sod-busting, energy development, gravel mining, fragmentation, loss of connectivity, and other development pressures?	1	6c

Appendix 1. BLM Management Questions (cont'd)

Change Agents (cont'd)		Status	Current MQs Number
Development – Urban and Exurban Energy Development/ Mining	75. Where are areas of existing, planned, and future renewable and non-renewable energy development (based on existing geospatial data bases), including locations of existing leases, relative to areas of high conservation and restoration potential?	1	6d
	76. Where are existing, planned, and potential corridors including roads, transmission lines, and pipelines and how do they relate geographically to state and federal high value conservation areas?	1	6e
	77. Where are likely sources and sinks of discharge from such developments that may diminish quality of receiving waters and habitats (e.g., saline discharges)?	1	6f
	78. Where are methane extraction ponds located that could serve as breeding sites for mosquitoes that could carry West Nile Virus and threaten Greater Sage-Grouse?	1	6g
Development – Hydrological (Dams, Diversions Water Table Drawdown, Industrial Uses/Saline Discharges)	79. Where are aquifers and their recharge basins? What is the current and projected land use in these areas?	1	6h
	80. Where are areas in which groundwater extraction has the potential to change surface flow?	1	6i
	81. Where are areas with high densities of surface water impoundment?	1	6j
	82. Where do surface water diversions or ground water withdrawals have the potential to create discontinuity between spawning and other habitats (i.e., by creating seasonally dry or impassible stream reaches)?	1	6k
	~~83. Where are opportunities to restore continuity in habitats?~~	3	
Development – Urban and Exurban Recreation	84. Where are existing, planned, and potential areas for development or expansion of recreation areas (e.g., off-highway vehicle [OHV] and snowmobile routes, ski areas, reservoirs) in proximity to areas of high conservation and restoration potential?	1	6l
	85. Where are existing, planned, and potential visitor serving facilities (food, lodging, etc) and corridors including roads, utilities and how do they relate geographically to high conservation value areas?	1	6m
	86. On public lands, where are high conservation value resource areas vulnerable to unauthorized use?	1	6n
Climate Change	87. Which habitats and species are most likely to be negatively impacted by climate change?	1a	7b
	88. Where are areas of state and federal high conservation value and restoration potential most vulnerable to a changing climate?	1	7c
	89. Where are watersheds with the greatest potential for alterations in thermal regime and hydrologic regime? What will these changes be?	1	7d
	90. Where are surface water and groundwater availability likely to change?	1	7e
	~~91. How is the timing of streamflow likely to change?~~	2	

Appendix 1. BLM Management Questions (cont'd)

Change Agents (cont'd)		Status	Current MQs Number
Climate Change (cont'd)	92. What are predicted changes in the distribution of vegetation types given climate change (including changes to extramural climate)?	1	7f
	93. Where are CE species' habitats most vulnerable to changing climatic conditions?	1	7g
	~~94. Where are areas projected to lose dominant native plant species and what species are projected to replace them?~~	2	
	95. What and where are the vegetation types and seral stages that are carbon sinks and carbon sources? What actions in those vegetation types alter the sink/source balance?	1	7h
	96. Where are potential carbon sequestration areas?	1	7j
Development – Agricultural	~~97. Where are historical and existing agriculture and the potential for future land conversion to agriculture (CRP and other conversions through tillage)?~~	3	
	~~98. What is the water availability considering the existing development rights (ongoing and potential)?~~	3	
	~~99. What areas are not impacted by grazing?~~	3,4	

Status of MQ:
1. MQ carried forward to Final Memo
   a. MQ carried forward but made subset or combined with other MQ
2. Determined insufficient data exists to completely answer MQ
3. Redundant with other MQ
4. Directed by AMT to remove MQ

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APPENDIX 2

MIDDLE ROCKIES GAP LEVEL 3 ECOLOGICAL SYSTEMS

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GAP Level 3 Ecological Systems in the Middle Rockies Ecoregion[1]

GAP Level 1 FOREST & WOODLAND CLASSES (29.68%)	
Percent of Ecoregion	**GAP Level 3 Ecological System**
7.46%	Rocky Mountain Lodgepole Pine Forest
5.15%	Middle Rocky Mountain Montane Douglas-fir Forest and Woodland
4.68%	Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland
3.03%	Northwestern Great Plains - Black Hills Ponderosa Pine Woodland and Savanna
2.73%	Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland
1.58%	Rocky Mountain Aspen Forest and Woodland
1.40%	Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest
0.81%	Rocky Mountain Foothill Limber Pine-Juniper Woodland
0.73%	Northern Rocky Mountain Ponderosa Pine Woodland and Savanna
0.56%	Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland
0.31%	Northern Rocky Mountain Mesic Montane Mixed Conifer Forest
0.26%	Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland
0.21%	Rocky Mountain Subalpine-Montane Limber-Bristlecone Pine Woodland
0.17%	Northern Rocky Mountain Subalpine Woodland and Parkland
0.15%	Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland
0.15%	Western Great Plains Dry Bur Oak Forest and Woodland
0.13%	Rocky Mountain Poor-Site Lodgepole Pine Forest
0.11%	Western Great Plains Wooded Draw and Ravine
0.04%	Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland
0.01%	Southern Rocky Mountain Ponderosa Pine Woodland
0.01%	Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland
0.00%	Rocky Mountain Bigtooth Maple Ravine Woodland
0.00%	Columbia Plateau Western Juniper Woodland and Savanna
GAP Level 1 SHRUBLAND, STEPPE, AND SAVANNA SYSTEMS (28.52%)	
Percent of Ecoregion	**GAP Level 3 Ecological System**
13.05%	Inter-Mountain Basins Montane Sagebrush Steppe
11.33%	Inter-Mountain Basins Big Sagebrush Steppe
1.06%	Inter-Mountain Basins Big Sagebrush Shrubland
0.74%	Wyoming Basins Dwarf Sagebrush Shrubland and Steppe
0.42%	Inter-Mountain Basins Mat Saltbush Shrubland
0.39%	Northern Rocky Mountain Montane-Foothill Deciduous Shrubland
0.38%	Northwestern Great Plains Shrubland
0.36%	Northern Rocky Mountain Foothill Conifer Wooded Steppe
0.36%	Rocky Mountain Alpine Dwarf-Shrubland
0.24%	Northern Rocky Mountain Subalpine Deciduous Shrubland
0.12%	Inter-Mountain Basins Mixed Salt Desert Scrub
0.04%	Inter-Mountain Basins Semi-Desert Shrub Steppe

GAP Level 3 Ecological Systems in the Middle Rockies Ecoregion[1] (cont'd)

GAP Level 1 SHRUBLAND, STEPPE, AND SAVANNA SYSTEMS (28.52%) (Continued)	
Percent of Ecoregion	**GAP Level 3 Ecological System**
0.01%	Inter-Mountain Basins Juniper Savanna
0.01%	Rocky Mountain Lower Montane-Foothill Shrubland
0.01%	Western Great Plains Sandhill Steppe
0.00%	Columbia Plateau Low Sagebrush Steppe
0.00%	Columbia Plateau Steppe and Grassland
0.00%	Great Basin Xeric Mixed Sagebrush Shrubland
GAP Level 1 GRASSLANDS (18.09%)	
Percent of Ecoregion	**GAP Level 3 Ecological System**
6.91%	Northwestern Great Plains Mixedgrass Prairie
5.14%	Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland
2.01%	Rocky Mountain Dry Tundra
1.97%	Rocky Mountain Subalpine-Montane Mesic Meadow
0.95%	Northern Rocky Mountain Subalpine-Upper Montane Grassland
0.57%	Rocky Mountain Alpine Fell-Field
0.28%	Western Great Plains Sand Prairie
0.18%	Southern Rocky Mountain Montane-Subalpine Grassland
0.08%	Western Great Plains Shortgrass Prairie
0.00%	Inter-Mountain Basins Semi-Desert Grassland
0.00%	Columbia Basin Foothill and Canyon Dry Grassland
0.00%	Western Great Plains Tallgrass Prairie
GAP Level 1 RIPARIAN & WETLAND CLASSES (4.15%)	
Percent of Ecoregion	**GAP Level 3 Ecological System**
0.80%	Rocky Mountain Lower Montane Riparian Woodland and Shrubland
0.75%	Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland
0.75%	Northwestern Great Plains Riparian
0.52%	Rocky Mountain Alpine-Montane Wet Meadow
0.31%	Inter-Mountain Basins Greasewood Flat
0.20%	Western Great Plains Saline Depression Wetland
0.18%	Western Great Plains Riparian Woodland and Shrubland
0.12%	Rocky Mountain Subalpine-Montane Riparian Woodland
0.09%	North American Arid West Emergent Marsh
0.09%	Rocky Mountain Subalpine-Montane Riparian Shrubland
0.07%	Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland
0.06%	Western Great Plains Open Freshwater Depression Wetland
0.05%	Western Great Plains Floodplain
0.05%	Northwestern Great Plains Floodplain
0.04%	Western Great Plains Closed Depression Wetland

GAP Level 3 Ecological Systems in the Middle Rockies Ecoregion[1] (cont'd)

GAP Level 1 RIPARIAN & WETLAND CLASSES (4.15%) (Continued)	
Percent of Ecoregion	**GAP Level 3 Ecological System**
0.03%	Rocky Mountain Subalpine-Montane Fen
0.03%	Western Great Plains Floodplain Systems
0.01%	Columbia Plateau Vernal Pool
0.00%	Western Great Plains Depressional Wetland Systems
0.00%	Great Plains Prairie Pothole
0.00%	Northern Rocky Mountain Conifer Swamp
0.00%	Inter-Mountain Basins Alkaline Closed Depression
0.00%	Northern Rocky Mountain Wooded Vernal Pool
0.00%	Eastern Great Plains Wet Meadow, Prairie, and Marsh
GAP Level 1 HUMAN LAND USE (8.1%)	
Percent of Ecoregion	**GAP Level 3 Ecological System**
0.01%	Developed, High Intensity
0.02%	Quarries, Mines, Gravel Pits and Oil Wells
0.11%	Developed, Medium Intensity
0.28%	Developed, Low Intensity
0.69%	Developed, Open Space
2.71%	Pasture/Hay
4.28%	Cultivated Cropland
GAP Level 1 RECENTLY DISTRURBED OR MODIFIED (4.09%)	
Percent of Ecoregion	**GAP Level 3 Ecological System**
0.00%	Disturbed, Non-specific
0.02%	Introduced Upland Vegetation - Shrub
0.06%	Recently burned grassland
0.12%	Introduced Riparian and Wetland Vegetation
0.25%	Harvested forest-Shrub Regeneration
0.25%	Introduced Upland Vegetation - Annual Grassland
0.29%	Harvested Forest - Grass/Forb Regeneration
0.42%	Harvested Forest - Northwestern Conifer Regeneration
1.09%	Recently burned forest
1.47%	Introduced Upland Vegetation - Perennial Grassland and Forbland
GAP Level 1 NO DATA (5.52%)	
Percent of Ecoregion	**GAP Level 3 Ecological System**
5.52%	No Data

GAP Level 3 Ecological Systems in the Middle Rockies Ecoregion[1] (cont'd)

GAP Level 1 SPARSELY VEGETATED / BARREN CLASSES (2.15%)	
Percent of Ecoregion	**GAP Level 3 Ecological System**
0.00%	Columbia Plateau Ash and Tuff Badland
0.00%	Southwestern Great Plains Canyon
0.01%	Geysers and Hot Springs
0.01%	Western Great Plains Cliff and Outcrop
0.01%	North American Alpine Ice Field
0.03%	Inter-Mountain Basins Active and Stabilized Dune
0.05%	Rocky Mountain Cliff, Canyon and Massive Bedrock
0.07%	Inter-Mountain Basins Volcanic Rock and Cinder Land
0.13%	Inter-Mountain Basins Cliff and Canyon
0.24%	Inter-Mountain Basins Shale Badland
0.25%	Western Great Plains Badland
0.54%	Rocky Mountain Alpine Bedrock and Scree
GAP Level 1 OPEN WATER (0.60%)	
Percent of Ecoregion	**GAP Level 3 Ecological System**
0.60	Open Water

[1] Ecoregion inclusions are included.

Classes adapted from:

US Geological Survey, National Biological Information Infrastructure, Gap Analysis Program (GAP). February 2010. National Land Cover, Version 1, Available at http://www.gap.uidaho.edu/landcoverviewer.html (Accessed: October 2010)

APPENDIX 3

MIDDLE ROCKIES ECOREGION CROSSWALK WITH IDAHO LAND COVER CLASSIFICATION SYSTEM

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Appendix 3. Idaho Land Cover Classification System Cross-walk With Middle Rockies Level 3 Ecological Systems

Information: Where the Northwest ReGap mapping unit (ecological system) included more than one formation (Forest, Woodland, Mesic Shrubland, etc.) we assigned it to the structurally taller or denser formation. For example, forested ecological systems that include "forest and woodland" descriptors (e.g. Rocky Mountain Aspen Forest and Woodland) were assigned to the appropriate forest division (e.g. Deciduous Forest) rather than woodland division for mapping. Where an ecological system had "woodland and savanna" or "woodland and partkland" in its title it was assigned to the woodland division rather than a grassland division for mapping. In addition, some ecological systems listed here are not listed on the NatureServe website as being in Idaho. These are identified with an * after the ecological system name and are likely mis-classified if mapped in Idaho.

Class	Formation	LCCS Division	Middle Rockies REA Coarse Filter Name	Middle Rockies Level 3 Ecological Systems*	Percent of Area
1. Forest & Woodland	Forest	Deciduous Forest	Deciduous Forest and Woodland	Rocky Mountain Aspen Forest and Woodland	1.6
		Evergreen Forest	Evergreen Forest and Woodland	Northern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest	1.4
				Southern Rocky Mountain Dry-Mesic Montane Mixed Conifer Forest and Woodland	0.3
				Northern Rocky Mountain Mesic Montane Mixed Conifer Forest	0.3
				Southern Rocky Mountain Mesic Montane Mixed Conifer Forest and Woodland	0.0
				Middle Rocky Mountain Montane Douglas-fir Forest and Woodland	5.1
				Rocky Mountain Lodgepole Pine Forest	7.5
				Rocky Mountain Poor-Site Lodgepole Pine Forest	0.1
				Rocky Mountain Subalpine Mesic Spruce-Fir Forest and Woodland	2.7
				Rocky Mountain Subalpine Dry-Mesic Spruce-Fir Forest and Woodland	4.7
		Mixed Evergreen Deciduous Forest	Mixed Evergreen Deciduous Forest	Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland	0.2
	Woodland	Deciduous Woodland	Deciduous Forest and Woodland	Western Great Plains Floodplain	0.1
				Western Great Plains Floodplain Systems	0.0
				Northwestern Great Plains Floodplain	0.0
				Rocky Mountain Lower Montane Riparian Woodland and Shrubland	0.8
				Great Basin Foothill and Lower Montane Riparian Woodland and Shrubland	0.1
				Northern Rocky Mountain Lower Montane Riparian Woodland and Shrubland	0.7
				Northwestern Great Plains Riparian	0.7
				Western Great Plains Riparian Woodland and Shrubland	0.2
				Rocky Mountain Subalpine-Montane Riparian Woodland	0.1
				Rocky Mountain Bigtooth Maple Ravine Woodland	0.0
				Western Great Plains Wooded Draw and Ravine	0.1
				Northern Rocky Mountain Conifer Swamp	0.0
				Western Great Plains Dry Bur Oak Forest and Woodland	0.0
				Inter-Mountain Basins Curl-leaf Mountain Mahogany Woodland and Shrubland	0.6
			Evergreen Forest and Woodland	Northwestern Great Plains - Black Hills Ponderosa Pine Woodland and Savanna	3.0
				Northern Rocky Mountain Ponderosa Pine Woodland and Savanna	0.7
				Southern Rocky Mountain Ponderosa Pine Woodland	0.0
				Northern Rocky Mountain Foothill Conifer Wooded Steppe	0.4
				Rocky Mountain Foothill Limber Pine-Juniper Woodland	0.8

Appendix 3. Idaho Land Cover Classification System Cross-walk With Middle Rockies Level 3 Ecological Systems (cont'd)					
Class	**Formation**	**LCCS Division**	**Middle Rockies REA Coarse Filter Name**	**Middle Rockies Level 3 Ecological Systems***	**Percent of Area**
1. Forest & Woodland (cont'd)	Woodland (cont'd)	Deciduous Woodland (cont'd)	Evergreen Forest and Woodland (cont'd)	Northern Rocky Mountain Subalpine Woodland and Parkland	0.2
				Columbia Plateau Western Juniper Woodland and Savanna	0.0
				Inter-Mountain Basins Juniper Savanna	0.0
				Rocky Mountain Subalpine-Montane Limber-Bristlecone Pine Woodland	0.2
				Harvested Forest - Northwestern Conifer Regeneration	0.4
				Recently burned forest	1.1
2. Mesic Shrubland & Grassland	Mesic Shrubland (Deciduous & Evergreen)	Mesic Shrubland (Deciduous & Evergreen)	Mesic Shrubland and Grassland (Deciduous and Evergreen)	Rocky Mountain Lower Montane-Foothill Shrubland	0.0
				Introduced Riparian and Wetland Vegetation	0.1
				Northern Rocky Mountain Montane-Foothill Deciduous Shrubland	0.4
				Western Great Plains Sandhill Steppe	0.0
				Introduced Upland Vegetation - Shrub	0.0
				Rocky Mountain Subalpine-Montane Riparian Shrubland	0.1
				Harvested forest-Shrub Regeneration	0.2
	Mesic Grassland	Perennial Grassland		Northwestern Great Plains Mixedgrass Prairie	6.9
				Recently burned grassland	0.1
				Western Great Plains Tallgrass Prairie	0.0
				Western Great Plains Shortgrass Prairie	0.1
				Introduced Upland Vegetation - Perennial Grassland and Forbland	1.5
				Harvested Forest - Grass/Forb Regeneration	0.3
				Northern Rocky Mountain Lower Montane, Foothill and Valley Grassland	5.1
				Northern Rocky Mountain Subalpine-Upper Montane Grassland	1.0
				Columbia Basin Foothill and Canyon Dry Grassland	0.0
				Columbia Plateau Steppe and Grassland	0.0
				Inter-Mountain Basins Semi-Desert Grassland	0.0
				Southern Rocky Mountain Montane-Subalpine Grassland	0.2
		Emergent Wetland	Emergent Wetland	Western Great Plains Closed Depression Wetland	0.0
				Western Great Plains Open Freshwater Depression Wetland	0.1
				Great Plains Prairie Pothole	0.0
				Western Great Plains Saline Depression Wetland	0.2
				Northern Rocky Mountain Wooded Vernal Pool	0.0
				North American Arid West Emergent Marsh	0.1
				Inter-Mountain Basins Alkaline Closed Depression	0.0
				Western Great Plains Depressional Wetland Systems	0.0
				Eastern Great Plains Wet Meadow, Prairie, and Marsh	0.0
				Rocky Mountain Subalpine-Montane Mesic Meadow	2.0
				Rocky Mountain Alpine-Montane Wet Meadow	0.5
				Rocky Mountain Subalpine-Montane Fen	0.0
				Columbia Plateau Vernal Pool	0.0

Appendix 3. Idaho Land Cover Classification System Cross-walk With Middle Rockies Level 3 Ecological Systems (cont'd)					
Class	**Formation**	**LCCS Division**	**Middle Rockies REA Coarse Filter Name**	**Middle Rockies Level 3 Ecological Systems***	**Percent of Area**
3. Semi-desert Shrubland & Grassland	Semi-desert Shrubland	Deciduous Shrubland	Semi-desert Shrubland and Grassland	Inter-Mountain Basins Greasewood Flat	0.3
				Inter-Mountain Basins Mat Saltbush Shrubland	0.4
				Inter-Mountain Basins Mixed Salt Desert Scrub	0.1
				Northern Rocky Mountain Subalpine Deciduous Shrubland	0.2
				Northwestern Great Plains Shrubland	0.4
		Evergreen Shrubland		Inter-Mountain Basins Montane Sagebrush Steppe	13.0
				Inter-Mountain Basins Big Sagebrush Steppe	11.3
				Inter-Mountain Basins Big Sagebrush Shrubland	1.1
				Wyoming Basins Dwarf Sagebrush Shrubland and Steppe	0.7
				Columbia Plateau Low Sagebrush Steppe	0.0
				Great Basin Xeric Mixed Sagebrush Shrubland	0.0
				Inter-Mountain Basins Semi-Desert Shrub Steppe	0.0
	Semi-desert Grassland	Perennial Grassland		Western Great Plains Sand Prairie	0.3
		Annual Grassland		Introduced Upland Vegetation - Annual Grassland	0.3
4. High Montane Vegetation	High Montane Shrubland	High Montane Shrubland	High Montane Vegetation	Rocky Mountain Alpine Dwarf-Shrubland	0.4
	High Montane Grassland	High Montane Grassland		Rocky Mountain Dry Tundra	2.0
				Rocky Mountain Alpine Fell-Field	0.6
5. Sparse Vegetation & Natural Barren Areas		Unconsolidated Materials	Sparse Vegetation & Natural Barren Areas	Western Great Plains Badland	0.3
				Inter-Mountain Basins Shale Badland	0.2
				Inter-Mountain Basins Active and Stabilized Dune	0.0
				Columbia Plateau Ash and Tuff Badland	0.0
		Volcanic Rock		Inter-Mountain Basins Volcanic Rock and Cinder Land	0.1
		Bedrock, Scree, Cliffs & Canyons		Rocky Mountain Alpine Bedrock and Scree	0.5
				Western Great Plains Cliff and Outcrop	0.0
				Inter-Mountain Basins Cliff and Canyon	0.1
				Rocky Mountain Cliff, Canyon and Massive Bedrock	0.0
				Southwestern Great Plains Canyon	0.0
6. Agriculture		Crops	Agriculture	Cultivated Cropland	4.3
		Pasture, hayland, etc.		Pasture/Hay	2.7
7. Urban & Other Developed Lands	Urban / Industrial / Excavation Areas	Urban	Urban & Other Developed Lands	Developed, Open Space	0.7
				Developed, Low Intensity	0.3
				Developed, Medium Intensity	0.1
				Disturbed, Non-Specific	0.0
				Developed, High Intensity	0.0
		Industrial, Excavation & Other Areas		Quarries, Mines, Gravel Pits and Oil Wells	0.0
8. Open Water		Open Water	Open water	Open Water	0.6
				Geysers and Hot Springs	0.0
			No Data	No Data	5.5
				Total	**99.8**

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APPENDIX 4

SPECIES SPECIFIC CONSERVATION ELEMENT DATABASE (Screenshot)

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Sci_Name	Com_Name	Status	ESA	Naturese	MT-SWAP	WY-SGCN	SD-SGCN	SD-Status	SD-Ranking	ID-SGCN	ID-Ranking	BLM-SOW	BLM-MT, ND, SD	BLM-WY
Acipenser transmontanus	White sturgeon		LE	☐	Tier I	☐	☐			☑	S1	☐	☐	☐
Astragalus anserinus	Goose Creek Milkvetch	G2	C	☑		☐	☐			☐		☐	☐	☐
Bos bison	American bison		PS	☐	Tier I	☐	☐			☐		☐	☐	☐
Brachylagus idahoensis	Pygmy rabbit		LE	☐	Tier I	☑	☐			☑	S2	☑	☑	☑
Bufo baxteri	Wyoming Toad	G1	LE	☑		☑	☐			☐		☐	☐	☐
Canis lupus	Gray wolf		PS: LE, L	☐	Tier I	☐	☐			☑	S3	☐	☑	☐
Castilleja christii	Christ's Indian-paintbrush	G1	C	☑		☐	☐			☐		☐	☐	☐
Charadrius melodus	Piping Plover	G3	LE, LT	☑	Tier I	☐	☑	ST	S2B,SZN	☐		☐	☐	☐
Charadrius montanus	Mountain Plover	G3	PT	☑	Tier I	☑	☐			☐		☐	☑	☐
Felis lynx	Canada lynx		PS:LT	☐	Tier I	☐	☐			☐		☐	☐	☐
Gaura neomexicana	New Mexico Gaura	G3	PS	☑		☐	☐			☐		☐	☐	☐
Gaura neomexicana var. coloradensis	Colorado Butterfly plant		LT	☐		☐	☐			☐		☐	☐	☐
Gila cypha	Humpback Chub	G1	LE	☑		☐	☐			☐		☐	☐	☐
Gila elegans	Bonytail	G1	LE	☑		☐	☐			☐		☐	☐	☐
Gila robusta	Roundtail Chub	G3	PS	☑		☑	☐			☐		☐	☐	☑
Grus americana	Whooping Crane	G1	LE, XN	☑	Tier I	☐	☑	SE	SZN	☐		☐	☐	☐
Howellia aquatilis	Water Howellia	G3	LT	☑		☐	☐			☐		☐	☐	☐
Lampsilis higginsii	Higgins Eye Pearlymussel		LE	☐		☐	☑		S1	☐		☐	☐	☐
Lanx sp.	Banbury Springs Limpet		LE	☐		☐	☐			☑	S1	☐	☐	☐
Lepidium papilliferum	Slick-spot Pepper-grass	G2	LT	☑		☐	☐			☐		☐	☐	☐
Leptodea leptodon	Scaleshell Mussel		LE	☐		☐	☑		S1	☐		☐	☐	☐
Lynx canadensis	Canada Lynx		LT	☐		☑	☐			☑	S1	☐	☐	☐
Mirabilis macfarlanei	Macfarlane's Four-o'clock	G2	LT	☑		☐	☐			☐		☐	☐	☐
Mustela nigripes	Black-footed Ferret	G1	LE, XN	☑	Tier I	☑	☑	SE	S1	☐		☑	☐	☐
Nicrophorus americanus	American Burying Beetle		LE	☐		☐	☑		S1	☐		☐	☐	☐
Notropis topeka	Topeka Shiner		LE	☐		☐	☑		S3	☐		☐	☐	☐
Numenius borealis	Eskimo Curlew		LE	☐		☐	☐			☐		☐	☐	☐
Oncorhynchus mykiss	"summer steelhead"		LT	☐		☐	☐			☑	S3	☑	☐	☐
Oncorhynchus nerka	Sockeye		LE	☐		☐	☐			☑	S1	☑	☐	☐
Oncorhynchus tshawytscha	Chinook salmon		LT	☐		☐	☐			☑	S1	☑	☐	☐
Oreohelix peripherica	Deseret Mountainsnail	G2	PS	☑		☐	☐			☐		☐	☐	☐
Penstemon haydenii	Blowout Penstemon	G1	LE	☑		☐	☐			☐		☐	☐	☐
Physa natricina	Snake River Snail		LE	☐		☐	☐			☑	S1	☐	☐	☐
Platanthera praeclara	Western Prairie Fringed Orchid		LT	☐		☐	☐			☐		☐	☐	☐
Ptychocheilus lucius	Colorado Pikeminnow	G1	LE, XN	☑		☐	☐			☐		☐	☐	☐
Pyrgulopsis bruneauensis	Bruneau Hot Springsnail	G1	LE	☑		☐	☐			☑	S1	☐	☐	☐
Rangifer tarandus caribou	Woodland Selkirk Mountain Caribo		LE	☐		☐	☐			☑	S1	☐	☐	☐
Rhinichthys osculus thermalis	Kendall Warm Springs Dace		LE	☐		☑	☐			☐		☐	☐	☐
Salvelinus confluentus	Bull Trout	G3	PS LT	☑	Tier I	☐	☐			☑	S3	☑	☐	☐
Scaphirhynchus albus	Pallid Sturgeon	G2	LE	☑	Tier I	☐	☑	SE	S1	☐		☐	☐	☐
Silene spaldingii	Spalding's Campion	G2	LT	☑		☐	☐			☐		☐	☐	☐
Spermophilus brunneus	Idaho Ground Squirrel	G2	LT,C	☑		☐	☐			☑	S1	☐	☐	☐
Spiranthes diluvialis	Ute Ladies'-tresses	G2G3	LT	☑		☐	☐			☐		☐	☐	☐
Sterna antillarum athalassos	Interior Least tern		LE	☐	Tier I	☐	☑	SE	S2B,SZN	☐		☐	☐	☐
Taylorconcha serpenticola	Bliss Rapids Snail	G1	LT	☑		☐	☐			☑	S1	☐	☐	☐
Ursus arctos horribilis	Grizzly bear		PS: LT,	☐	Tier I	☑	☐			☑	S1	☑	☑	☐
Valvata utahensis	Desert Valvata	G1	LE	☑		☐	☐			☑	S1	☐	☐	☐
Vulpes velox	Swift Fox	G3	PS:LE	☑		☑	☑	ST	S1	☐		☐	☑	☑
Xyrauchen texanus	Razorback Sucker	G1	LE	☑		☐	☐			☐		☐	☐	☐

Sci_Name	Com_Name	Status	ESA	Natures	MT-SWAP	WY-SGCN	SD-SGCN	SD-Status	SD-Ranking	ID-SGCN	ID-Ranking	BLM-SOW	BLM-MT, ND, SD	BLM-WY
Abronia ammophila	Tweedy's Sand-verbena	G1		☑		☐	☐			☐		☐	☐	☐
Acalypta cooleyi	Cooley's Tingid	G2		☑		☐	☐			☐		☐	☐	☐
Accipiter gentiles	Northern goshawk			☐		☑	☑		S3B,S2N	☐		☐	☑	☑
Accipiter sp.	goshawk			☐		☐	☐			☐		☑	☐	☐
Achnatherum contractum	Contracted Ricegrass	G3G4		☑		☐	☐			☐		☐	☐	☐
Acipenser transmontanus	White sturgeon		LE	☐	Tier I	☐	☐			☑	S1	☐	☐	☐
Acris crepitans	Northern Cricket Frog			☐		☐	☑		S1	☐		☐	☐	☐
Acrolophitus pulchellus	Idaho Point-headed Grasshopper	G1G3		☑		☐	☐			☑	S1	☐	☐	☐
Adelolecia pilati		G2G4		☑		☐	☐			☐		☐	☐	☐
Adrityla cucullata	A Millipede	G1G3		☑		☐	☐			☐		☐	☐	☐
Aechmophorus clarkii	Clark's Grebe			☐		☑	☐			☑	S2B	☐	☐	☐
Aechmophorus occidentalis	Western Grebe			☐		☑	☐			☑	S2B	☐	☐	☐
Aegolius funereus	Boreal Owl			☐		☑	☐			☑	S2	☐	☐	☐
Agapetus montanus	An Agapetus Caddisfly	G3		☑		☐	☐			☑	S1	☐	☐	☐
Agastache cusickii	Cusick's Giant-hyssop	G3G4		☑		☐	☐			☐		☐	☑	☐
Ageratina occidentalis = Eupatorium occidentale	Western boneset			☐		☐	☐			☐		☐	☑	☐
Agrestia hispida	A Lichen	G3		☑		☐	☐			☐		☐	☐	☐
Agrostis rossiae	Ross' Bentgrass	G1		☑		☐	☐			☐		☐	☐	☐
Alasmidonta marginata	elktoe			☐		☐	☑		S1	☐		☐	☐	☐
Alces alces	Moose			☐		☑	☐			☐		☐	☐	☐
Aletes humilis	Larimer Aletes	G2G3		☑		☐	☐			☐		☐	☐	☐
Allium aaseae	Aase Onion	G3		☑		☐	☐			☐		☐	☐	☐
Allium acuminatum	Tapertip onion			☐		☐	☐			☐		☐	☑	☐
Allium columbianum	Columbia Onion	G3		☑		☐	☐			☐		☐	☐	☐
Allium madidum	Swamp Onion	G3		☑		☐	☐			☐		☐	☐	☐
Allogona lombardii	Selway Forestsnail	G1		☑		☐	☐			☑	S1	☐	☐	☐
Allogona ptychophora solida	Dry Land Forestsnail			☐		☐	☐			☑	S1	☐	☐	☐
Allomyia bifosa	A Caddisfly	G3G4		☑		☐	☐			☐		☐	☐	☐
Allomyia chama	A Caddisfly	G2G4		☑		☐	☐			☐		☐	☐	☐
Allomyia hector	A Caddisfly	G1G2		☑		☐	☐			☐		☐	☐	☐
Allomyia picoides	A Caddisfly	G1G3		☑		☐	☐			☐		☐	☐	☐
Alloperla pilosa	Hairy Sallfly	G3		☑		☐	☐			☐		☐	☐	☐
Amblycheila cylindriformis	Great Plains tiger beetle			☐		☐	☑		S1	☐		☐	☐	☐
Ambystoma tigrinum	Tiger Salamander			☐		☑	☐			☐		☐	☐	☐
Ameiurus melas	Black Bullhead			☐		☑	☐			☐		☐	☐	☐
Ameletus bellulus	A Mayfly	G3		☑		☐	☐			☐		☐	☐	☐
Ameletus majusculus	A Mayfly	G3G4		☑		☐	☐			☐		☐	☐	☐
Ameletus pritchardi	A Mayfly	G3G4		☑		☐	☐			☐		☐	☐	☐
Ameletus shepherdi	A Mayfly	G3G4		☑		☐	☐			☐		☐	☐	☐
Ameletus sparsatus	A Mayfly			☐		☐	☐			☑	S2	☐	☐	☐
Ameletus suffusus	A Mayfly			☐		☐	☐			☑	S1	☐	☐	☐
Ameletus tolae	A Mayfly	G1G2		☑		☐	☐			☑	S1	☐	☐	☐
Ameletus vernalis	A Mayfly	G3G4		☑		☐	☐			☐		☐	☐	☐
Ametropus ammophilus	A Mayfly			☐		☐	☐			☑	S1	☐	☐	☐
Ammodramus bairdii	Baird's sparrow			☐		☐	☑		S2B,SZN	☐		☐	☑	☑
Ammodramus leconteii	LeConte's sparrow			☐		☐	☑		S1S2B,SZN	☐		☐	☑	☐
Ammodramus nelsoni	Nelson's sharp-tailed sparrow			☐	Tier I	☐	☐			☐		☐	☑	☐
Ammodramus savannarum	Grasshopper Sparrow			☐		☑	☐			☑	S2B	☐	☐	☐
Amnicola limosus	Mud Amnicola			☐		☑	☐			☐		☐	☐	☐

APPENDIX 5

RATIONALE FOR SELECTION OF FINE-FILTER CONSERVATION ELEMENTS FOR THE MIDDLE ROCKIES ECOREGION

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Appendix 5. Rationale for Selection of Fine-Filter Conservation Elements for the Middle Rockies Ecoregion

Species Common Name or Species Assemblage	Species Scientific Name(s)	Rationale for Proposing the Species or Assemblage	AMT Decision[1]
Forest carnivores			
grizzly bear	*Ursus arctos horribilis*	ESA, MT SWAP, WY-Species of Greatest Conservation Need (SGCN), ID-SGCN, ID S1, BLM special status species	Carried forward as CE
Canada lynx	*Felis lynx*	ESA, MT SWAP	Carried forward as CE
wolverine	*Gulo gulo*	MT SWAP, WY-SGCN, ED-SGCN, ID S2, BLM special status species	Carried forward as CE
pine marten	*Martes americana*	WY SGCN	Carried forward as CE
		Clear-cut logging, habitat fragmentation, and the encroachment of development into forests has reduced the suitable, large, forested ranges required by these species. The recent reduction in whitebark pine stands threatens the recently achieved fragile recovery of grizzly bears. Lower trophic level species become severely over-balanced with the decline in forest carnivores leading to reduced woody plant regeneration, less breeding habitat for birds, and less prey availability for other species.	
Sagebrush obligates			
greater sage-grouse	*Centrocercus urophasianus*	MT SWAP, WY SGCM, ID SGCN, ID S2, BLM special status species	Carried forward as CE
pygmy rabbit	*Brachylagus idahoensis*	ESA, MT SWAP, WY SGCN, ID SGCM, ID S2, BLM special status species	For future resolution
sage sparrow	*Amphispiza belli*	This guild of birds and mammals is completely dependent upon the health of large blocks of dense, multi-age sagebrush steppe ecosystems. These species also serve as indicators of sagebrush shrubland health, long in decline in the western U.S. due to vegetation manipulation to favor introduced grazing animals (livestock) and other development, such as for energy extraction. The non-migratory greater sage-grouse also requires suitable winter, lekking, and brood-rearing habitats, making its existence more specialized and precarious. This grouse was recently included as a federal candidate species for listing under ESA and is considered sensitive by the BLM.	Lack of consensus to carry forward
sage thrasher	*Oreoscoptes montanus*		Lack of consensus to carry forward
Brewer's sparrow	*Spizella breweri*		Lack of consensus to carry forward

Appendix 5. Rationale for Selection of Fine-Filter Conservation Elements for the Middle Rockies Ecoregion (cont'd)

Species Common Name or Species Assemblage	Species Scientific Name(s)	Rationale for Proposing the Species or Assemblage	AMT Decision[1]
Big game species			
mule deer	*Odocoileus hemionus*	BLM SOW	Carried forward as CE - winter range & parturition areas
elk	*Cervus Canadensis*	BLM SOW	Carried forward as CE - winter range & parturition areas
pronghorn	Antilocapra *americana*	BLM SOW	Carried forward as CE – migration corridors
Rocky Mountain bighorn sheep	Ovis *canadensis canadensis*	WY SGCN, ID SGCN, ID S1	Carried forward as CE – Seasonal habitat; issues with domestic sheep
		Game species, in addition to their economic and recreational value, primarily make up the secondary production trophic level in the ecoregion, consuming the available vegetation in a variety of habitats (sagebrush, grasslands, shrublands, alpine, and wetlands). They are the prey species for the predators of several systems (gray wolf and mountain lion, in addition to forest carnivores) as well as for scavengers (turkey vulture, coyote, occasionally black bear). A limiting factor may be availability of winter and severe winter range; access to which has potential to be affected by climate change and energy development.	
Fish (Native Cold Water Aquatic Assemblage)			
cutthroat trout (west slope, yellowstone)	*Oncorhynchus clarki lewisi, Oncorhynchus clarki bouvieri*	MT SWAP, WY SGCN, ID SGCN, ID S3/S2, BLM special status species	Carried forward as CE
summer steelhead	*Oncorhynchus mykiss*	ESA, ID SGCN, ID S3	Carried forward as CE
bull trout	*Salvelinus confluentus*	ESA, MT SWAP, ID SGCN, ID S3	Carried forward as CE
sockeye	Oncorhynchus *nerka*	ESA, ID SGCN, ID S1	Carried forward as CE

Appendix 5. Rationale for Selection of Fine-Filter Conservation Elements for the Middle Rockies Ecoregion (cont'd)

Species Common Name or Species Assemblage	Species Scientific Name(s)	Rationale for Proposing the Species or Assemblage	AMT Decision[1]
Fish (Native Cold Water Aquatic Assemblage) (cont'd)			
spring/summer Chinook	Oncorhynchus *tshawytscha*	ESA, ID SGCN, ID S1	Carried forward as CE
fluvial Arctic grayling	Thymallus *arcticus*	MT SWAP, WY SGCN, BLM special status species	Carried forward as CE
burbot	*Lota lota*	MT SWAP, WY SGCN, ID SGCN	Not discussed, not carried forward
		Many fish species in western aquatic systems are declining. The declining anadromous fish (steelhead and salmon) require access from the ocean to clean, cold, clear running streams with microhabitat and substrate that are adversely affected by water diversions and changing flows during essential seasons, sedimentation, and removal of shade and woody debris. Other vertebrates that live in arid and semi-arid systems also are dependent upon the availability of healthy aquatic systems, for which these fish are indicators.	
Raptors			
bald eagle	*Haliaeetus leucocephalus*	ID, MT, WY. MT SWAP Tier I, WY-SGCN, Tier I, ID-SGCN, S3B, S4N; BLM-SOW, MT, SD	Lack of consensus to carry forward as CE
peregrine falcon	*Falco peregrinus*	WY SGCN, ID SGCN, ID S2B, BLM special status species	Lack of consensus to carry forward as CE
northern goshawk	*Accipiter gentiles*	WY SGCN, BLM special status species	For future resolution
flammulated owl	*Otus flammeolus*	MT SWAP, ID SGCN, ID S3B, BLM special status species	For future resolution
		Certain raptors are indicators of the health of old growth deciduous and coniferous forest ecosystems (northern goshawk, flammulated owl). The BLM and U.S. Forest Service (USFS) include several raptors on sensitive lists, and these are species that are relatively easy to monitor because of the fact that nest sites and/or Primary Activity Centers (PACs) are usually reused year after year. Good protocol survey methods have been established and proven to be reliable population census methods. This is a factor in how we know raptors are declining, but we often do not know the underlying reasons beyond habitat manipulation. Prey availability also plays a role that is difficult to measure.	

Appendix 5. Rationale for Selection of Fine-Filter Conservation Elements for the Middle Rockies Ecoregion (cont'd)

Species Common Name or Species Assemblage	Species Scientific Name(s)	Rationale for Proposing the Species or Assemblage	AMT Decision[1]
Beaver/wetland complexes			
American Beaver	*Castor canadensis*	BLM SOW secondary landscape scale species. Beaver is the keystone species for aquatic communities that require the calm, warmer, deeper waters created by damming mountain streams into ponds. Higher elevation amphibians often require these conditions for breeding areas, as do some fish.	Close association with wetlands – Not carried forward
Alpine species			
Pika	Ochotona *princeps*	Recent studies are focusing on the potential for climate change to affect alpine wildlife species. Pika and yellow-bellied marmot are landscape species that are alpine habitat specialists. Yellow-bellied marmots have gone extinct in some Great Basin mountain ranges (Floyd 2004) and pikas have also shown declines there (Beever et al. 2003). Whereas other species could shift ranges as the climate warms, these species have nowhere to shift to as the alpine tundra shrinks.	Lack of consensus to carry forward as CE
Yellow-bellied marmot	Marmota *flaviventris*		Lack of consensus to carry forward as CE
Other Species			
Clark's nutcracker	Nucifraga *columbiana*	Clark's nutcracker is a landscape species found at mid to high elevations. It is dependent on pine seed and is a major seed disperser for whitebark pine.	Lack of consensus to carry forward as CE
Harlequin duck	*Histrionicus histrionicus*	ID, MT, WY. MT-SWAP Tier I; WY-SGCN; ID-SGCN, S1B; BLM-MT,SD This duck occurs in fragmented populations in western Montana and Wyoming. It prefers remote, cold, shallow mountain streams lined with dense shrubs or forests, having braided channels, swift currents, abundant aquatic insects, and excellent water quality. Increasing recreational activity during the breeding season may be a threat as well as stream degradation as a result of sedimentation, channelization, logging, and livestock grazing.	Lack of consensus to carry forward as CE

Appendix 5. Rationale for Selection of Fine-Filter Conservation Elements for the Middle Rockies Ecoregion (cont'd)

Species Common Name or Species Assemblage	Species Scientific Name(s)	Rationale for Proposing the Species or Assemblage	AMT Decision[1]
Other Species (cont'd)			
Western pearlshell	*Margaritifera falcata*	ID, MT, WY. MT-SWAP Tier I, SSC; WY-SGCN; ID-SGCN, S3 Some populations of this freshwater mollusk occur in the Missouri drainage of Montana into Wyoming, range unknown (no WY range map provided in SWAP). Natural hosts for the pearlshell include salmon (chinook, coho, and sockeye), cutthroat trout, speckled dace, Lahontan redside, and Tahoe sucker; non-native trout are also hosts. Most abundant in large, cold, clear rivers, but also inhabits small headwater streams with sand, gravel, and cobble substrates. Habitat loss and degradation occurs from stream alterations, diversions, and manipulated flows by reservoir management.	Lack of consensus to carry forward as CE
Trumpeter swan	*Cygnus buccinator*	ID, MT, SD, WY. MT-SWAP Tier I; WY-SGCN; ID-SGCN, SIB, S2N; WY–SWAP Tier II, SGCN; SD-SGCN, S3; BLM-MT,SD,WY These swans breed all along the Rocky Mountains using small pothole lakes with shallow, unpolluted water that maintains emergent vegetation through the breeding season but that have been susceptible to recent droughts. These birds remain all year; however, trumpeter swans that breed in Canada migrate to join these residents for the winter.	Lack of consensus to carry forward as CE
Common loon	*Gavia immer*	ID, MT, WY. MT-SWAP Tier I; WY-SGCN, WY-SWAP Tier I; ID-SGCN, SIB, S2N; BLM-MT,SD Considered an uncommon summer resident where small, isolated populations and restricted distribution make extirpation possible in Montana into Wyoming, as its southern-most nesting population. Species is highly sensitive to human disturbance during nesting and may be affected by climate change. Loons have very specific choices for breeding lakes that are at high elevation and are large, clear, and remote.	Lack of consensus to carry forward as CE

Appendix 5. Rationale for Selection of Fine-Filter Conservation Elements for the Middle Rockies Ecoregion (cont'd)

Species Common Name or Species Assemblage	Species Scientific Name(s)	Rationale for Proposing the Species or Assemblage	AMT Decision[1]
Other Species (cont'd)			
Long-billed curlew	*Numenius americanus*	ID, MT, SD, WY. MT-SWAP Tier I; WY-SGCN; SD-SGCN, S3B, SZN; ID-SGCN, S2B; BLM-MT,SD,WY Uncommon shorebird during breeding season in this area, nesting in dry grasslands. These birds forage individually and fly/roost in loose flocks. Threats include habitat loss/degradation/alteration, changes to historical disturbance regimes, nest site disturbance by early season grazing, mowing, pesticide use, and other human activities.	Lack of consensus to carry forward as CE
Black tern	*Chlidonias niger*	ID, MT, SD, WY. WY–SWAP Tier II, SGCN; MT-SWAP Tier I; WY-SGCN; SD-SGCN, S3B, SZN; ID-SGCN, S1B; BLM-MT,SD Uncommon and local, this tern nests on marshy ponds and roosts with other terns on sandbars. Threats include habitat loss/degradation by conversion/drainage of wetlands, changes to historical disturbance regimes, vulnerability to weather conditions that destroy nests through wind and waves, or changing water levels, other water level manipulations that flood nests or make them vulnerable to predation, and pesticides/herbicides.	Lack of consensus to carry forward as CE
Townsend's big eared bat	*Corynorhinus townsendii*	ID, MT, SD, WY. MT-SWAP Tier I; WY-SGCN; SD-SGCN, S2S3; BLM-MT, ND, SD, WY Inhabits a variety of grasslands, shrublands, and forests using rock shelters, caves and/or abandoned mines for roosts. Habitat loss/degradation occurs when caves and mines are closed or if roost sites and hibernacula are disturbed or vandalized.	Lack of consensus to carry forward as CE
Lewis's woodpecker	*Melanerpes lewis*	ID, SD, WY. WY-SGCN; SD-SGCN, S3B, S3N; ID-SGCN, S3B This woodpecker is scattered throughout Wyoming, although very localized in suitable habitat and considered an uncommon summer resident. Inhabits open forests with scattered trees, usually below 2,700 m (9,000 ft) and burned stands of Douglas-fir, mixed conifer, and juniper forests, as well as riparian habitats and oak woodlands. Habitat loss and change are its greatest threats.	Lack of consensus to carry forward as CE

Appendix 5. Rationale for Selection of Fine-Filter Conservation Elements for the Middle Rockies Ecoregion (cont'd)

Species Common Name or Species Assemblage	Species Scientific Name(s)	Rationale for Proposing the Species or Assemblage	AMT Decision[1]
Other Species (cont'd)			
American three-toed woodpecker	*Picoides dorsalis*	ID, SD, WY. WY-SGCN; SD-SGCN, S2 Uncommon to rare in spruce forests, particularly those with many dead trees; therefore, dependent on disturbance. Flakes off bark to retrieve insects. Threats to this woodpecker include snag removal, forest fragmentation, logging of recently burned stands, and change in historical fire regime.	Lack of consensus to carry forward as CE
American white pelican	*Pelecanus erythrorhynchos*	ID, SD, WY. WY-SGCN; SD-SGCN, S3B, SZN; ID-SGCN, S1B Uncommon to common locally roosting on sandbars and small low islands. Requires shallow, sheltered waters of lakes, marshes, and lagoons for foraging on fish in groups of up to 10 birds. Habitat loss/degradation occurs through dams/impoundments on rivers and lakes that reduce the amount of shallow water, corresponding island habitat, and barrier to predation; increasing water levels can flood nest sites; also other nest site disturbance by recreational use of lakes/reservoirs.	Lack of consensus to carry forward as CE
Whitebark Pine	*Pinus albicaulis*	ID, MT, WY Whitebark pine is a slow-growing, climax species of high-elevation forests that occupies harsh, wind-swept exposures characterized by rocky, poorly developed soils. Considered a keystone species of the subalpine forests because of the dependence of many animal species on the rich pine seeds as a food source. Corvids, such as Clark's nutcracker, are critical components in regeneration, geographic range, spacing, successional status, and genetics of the species. In July 2010, due to recent alarming population declines, USFWS began a year-long study to see if protection under ESA for the species is warranted.	Added by AMT workshop. 5-needled pine association – Carried forward as CE.
Golden Eagle	*Aquila chrysaetos*	The Golden Eagle is an increasingly important management issue, in particular with respect to transmission line development in the region.	Added by AMT workshop – Carried forward as CE

[1] Selection Criteria Used to Drop Species from Consideration as CEs:

- Strong association with one or more coarse-filter CEs (such as a specific GAP Level 3 ecological system).
- Association with a keystone or umbrella species identified as a CE.
- Association with a species group or assemblage being carried forward as a CE.
- Lack of consensus among the AMT to carry the species forward as a fine-filter CE, including a) insufficient ecological knowledge or lack of data, and b) not of regional conservation significance or strong agency concern throughout the ecoregion.

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