

FINAL PRE-ASSESSMENT WORK PLAN: APPENDICES

REA Pre-Assessment Work Plan Appendices for:

Department of the Interior
Bureau of Land Management
Rapid Ecoregional Assessments

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The appendices for the final pre-assessment work plan are provided to BLM as a Phase I, Task 1 deliverable.

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A REA Project Schedule and Milestones

The main content for this appendix is provided as a separate pdf file; it is an export of the MS Project file showing the detailed project schedule and milestones. (MS Project does not permit ready export into a user-friendly format for MS Word.) Currently, only milestone events, tasks, or deadlines are shown; detailed contractor tasks are hidden for ease of reading.

Contract requirements such as 14-day review periods by BLM and provision of draft deliverables to BLM and the AMT and Technical Team 7 days in advance of AMT workshops are embedded within the task set-up within this project. Similarly, task dependencies and sequencing are also built into the project. For example, AMT workshops are dependent on the provision of the draft deliverables to be reviewed in the workshop. Similarly, Stakeholder Update Webinars are dependent on the completion and approval of final deliverables.

Color coding of task elements is as follows:

	Overall REA Tasks
	Contractor deadline for providing products
	BLM deadline for reviewing or approving products
	Event (AMT workshop, Development Forum, webinar, etc.)
	Ecology team tasks
	GIS / spatial analysis team tasks

Please note: This is a dynamic, working project file. The Start and Finish dates shown in the pdf are continuing to evolve as the contractor team estimates the duration/time needed to complete lengthier and more complex tasks within the overall phases and tasks of the REA, as well as when such tasks may be initiated. The **Deadlines** column for the overall BLM tasks are most relevant at this point. However, the sequencing of subtasks within overall tasks is correct.

B Team Charters

B-1 Purpose of the Teams

The Madrean Archipelago (MAR) Rapid Ecoregional Assessment (REA) is intended to identify, assemble, synthesize, and integrate existing information about native species, aquatic and terrestrial resources, and environmental change agents to provide information that will help BLM and other land managers in the ecoregion understand resource status and the potential for change of this status from a broad landscape viewpoint. This information will be used by the BLM to assist it with its land management responsibilities, including Resource Management Planning, developing best management practices, authorizing uses, and establishing conservation and restoration priorities. This information will be made available to partners and the public.

B-2 Organizational Structure

Consistent with other BLM REAs, two principal deliberative teams have been identified for the MAR REA: the Assessment Management Team (AMT) and the Technical Team.

B-2.1 Assessment Management Team: Purpose and Roles

- The AMT shall provide overall guidance for the development of the MAR, to ensure that procedures and products are consistent with the project objectives.
- The AMT shall ensure a collaborative, inter-agency approach through membership representing the interested state and federal agencies.
- The AMT will support and provide policy and workload guidance for the Technical Team regarding review, dissemination, and use of the best available data for the assessment.
- The AMT will receive technical input and product review from the Technical Team and from the Data Management Team, and will provide guidance on resolving remaining questions/areas of disagreement following these reviews.

B-2.2 Technical Team: Purpose and Roles

- The Technical Team shall provide technical and ecological guidance, direction, review, and recommendations for the development of the MAR.
- The Technical Team will provide interpretation and advice to the AMT. The Technical Team will be tasked by the AMT to provide specific information and technical knowledge about the ecoregion, its conservation elements, change agents, and ecological integrity, to assist with developing management questions, evaluating conceptual models, reviewing process models, interpreting results of the assessment, etc.
- The contractor will engage these BLM and partner subject matter experts to vet ideas, explain work products, and solicit advice on conceptual models. These discussions are anticipated to be through virtual workshops and during AMT workshops.
- The Technical Team shall ensure a collaborative, inter-disciplinary approach through membership representing the interested state, federal and tribal natural resource and land management agencies.

B-3 Authority and Responsibility

B-3.1 Assessment Management Team

- The AMT is responsible for overall guidance of the REA process and for providing the forum for reaching agreements and recommendations, and providing approvals, which are officially made by the AMT Leader to the CO and/or COR.
- AMT agreements and recommendations will only become official direction to the contractor when communicated to the contractor by the Contracting Officer (CO) or Contracting Officer's Representative (COR), who are solely responsible for managing the contractor's involvement in the MAR.
- No member of the AMT, including the AMT Lead, nor the AMT as a whole, nor any individual or group other than the CO or the COR (as delegated) have any authority, expressed or implied, to enter into or terminate the MAR REA contract, modify any term or condition, waive any requirement of this contract, accept deliverables, or grant extensions of time. Any agreement or recommendation by the AMT or its members or lead must be officially transmitted to the contractor by the CO or COR before it has any bearing on the performance of this contract in any way.
- The AMT is responsible for ensuring BLM and partner participation and timely responses during the MAR REA. The AMT must be particularly responsive and timely concerning review and comment of contractor products. The AMT is responsible for providing their own and/or appropriate staff time to ensure coordinated and consolidated review and comment as requested, and by appropriate established deadlines. The contractor is under no obligation to accept any review or comment after established and agreed upon deadlines have passed.

B-3.2 Technical Team

- The Technical Team will work closely with the contractor to develop models and methodology. The Technical Team will provide recommendations to the AMT, but the AMT will have final approval of all methods before their incorporation into the REA, subject to the limitations and authorities of the AMT, CO, and COR relationship.
- No member of the Technical Team nor any individual or group other than the CO or the COR (as delegated) have any authority, expressed or implied, to enter into or terminate this contract, modify any term or condition, waive any requirement of this contract, accept deliverables, or grant extensions of time. Any contractual recommendations of the Technical Team or its members must be made to the AMT for subsequent review and recommendations, which then must be officially transmitted to the contractor by the CO or COR before it has any bearing on the performance of this contract in any way.

B-4 Membership

B-4.1 Assessment Management Team

- The Chairperson of the AMT is the BLM representative from the Arizona State Office. The Chairperson is responsible for consulting with other AMT members, and with BLM leadership, to provide overarching guidance about the scope of work and direction for the Project Manager and contractor in implementing recommendations. The Chairperson serves as the focal point for the AMT's membership; he/she works with the Project Manager to establish priorities, identify issues which must be addressed, and determine the level and types of staff and financial support required.

- The AMT shall consist of representatives of appropriate federal, tribal and state government organizations or any other entity selected by the AMT Chairperson in consultation with the AMT. The AMT Chairperson shall be responsible for inviting initial and additional members through the life of this project.
- All AMT members must have sufficient authority to represent their organization concerning this REA (i.e., direct workloads, attend meetings, provide data, and review products).
- Membership includes the responsibility to personally attend and participate actively in all AMT workshops, conference calls, web-based meetings, and/or video-conferences, as necessary.
- A member may specify an alternate to represent them. It is the responsibility of the member to ensure that their alternate is well informed and can participate effectively.

B-4.2 Technical Team

- Membership will typically include technical experts from the invited AMT member agencies including BLM and other federal, tribal, state and natural resource and land management agencies.
- Technical team members from non-AMT members entities will be approved by the AMT Chairperson in consultation with the AMT.
- It is expected that AMT members will provide technical representatives, as appropriate.
- Technical team members will also be assigned to subject-specific conservation element and change agent subteams based on areas of expertise and interest.

B-5 Meeting Procedures and Documentation

B-5.1 AMT Meeting Procedures

- Meetings will be called by the Chairperson in consultation with the COR and contractor. All in-person meetings will be tentatively scheduled during the pre-assessment phase of the REA.
- The contractor will prepare a draft agenda for all meetings for the Chairperson to review and approve. The contractor will distribute the agenda to members prior to each meeting. Items for the agenda may be submitted to the Chairperson by any member of the AMT. Items may also be suggested by the Technical Team leads, COR, and contractor.
- AMT workshops will be open to AMT and Technical Team members.
- Meetings will be organized, facilitated and documented by the contractor following procedures outlined in the Charter and Statement of Work. Meeting summaries will be reviewed for accuracy by the Chairperson and COR and distributed to members by the contractor following BLM approval.
- Preference will be for in-person meetings, but a virtual option will be offered as well.
- Meeting locations: All meetings will be held within the ecoregion.

B-5.2 Technical Team Meeting Procedures

- Meetings will be called by the COR or AZ/NM Technical Team Leads in consultation with the contractor.
- Technical team meetings will predominantly be virtual (conference or webinar), unless an in-person meeting is determined necessary and agreed to by the AMT.
- Meetings will be one of three types: 1) core technical team representatives (COR, AZ/NM Leads), 2) general technical team meetings (all members), or 3) subject-specific (members to be defined)

- Technical Team members will also be invited to participate in Development Forums.
- Relevant Technical Team members will participate in core, general, and subject-specific webinars organized by the contractor (expected to begin in February 2013).
- Meetings will be facilitated and documented by the contractor. Meeting summaries will be approved by the core technical team and made available to all AMT and Technical Team members

B-5.3 Documentation and Communications

In addition to meeting invitations, agenda creation, and other communication procedures outlined above, the following will apply:

- The AMT will receive preliminary documents at least seven days prior to workshops, and members are responsible for reviewing these in advance and actively and constructively providing feedback, comments, and recommendations during AMT meetings, in consultation with Technical Team members.
- AMT members are responsible for submitting written comments on the proposed documents after the AMT Workshop and on the draft and final documents within agreed-upon time periods using methods established by the COR.
- Technical Team members will receive proposed, draft, and final documents and are encouraged to submit their contributions within agreed-upon time periods through their AMT representative.
- Technical Team members will receive materials for core, general, and subject specific webinars prior to meetings. Although most comments and contributions will be through feedback provided at these webinars, they are encouraged to submit written contributions within agreed upon time periods.
- AMT Meeting agendas, summaries and all key documents will be shared with AMT members by email, and will be posted on BLM's MAREA Share Point site or portal as identified by the COR.
- Communications will be timely and clear.
- All documents, reports, or other materials prepared by, or for, the AMT constitute official government records and must be maintained according to BLM policies and procedures.

B-6 Decision Making

- Consensus shall be the preferred model for all team deliberations and is expected to be used to reach the majority of agreements and recommendations. For the purposes of the AMT and Technical Team, consensus is defined as the cooperative development of agreements and recommendations that draw on input and experience from all group members. Consensus has been reached when everyone agrees they can accept whatever is proposed after every effort has been made to meet the interests of all members.
- Decision making in the AMT should be clear, explicit, and efficient.
- In situations where the AMT cannot reach consensus, the COR will work with the AMT Chair to negotiate an appropriate outcome, incorporating input from AMT deliberations. Two examples may include:
 - When a proposed agreement or recommendation would result in a significant inconsistency with other BLM REAs
 - When the proposed agreement or recommendation is in conflict with BLM policy, directives, or rules and regulations

- The Technical Team will strive for general agreement on recommendations. Responses to these recommendations will be made by the AMT, contractor and/or COR, as appropriate.
- The Technical Team will provide technical input and product review to the Assessment Management Team. The AMT will provide guidance on resolving remaining questions/areas of disagreement following these reviews as per the procedures above.
- For contractual issues, the COR, CO, and contractor will negotiate agreement. Two examples may include:
 - When consensus cannot be reached within the project timeline and the lack of a final product would delay timely completion of the REA by the established deadline
 - When proposed agreements or recommendations would be in violation or require amendment of BLM's contract with its contractor(s)

B-7 Expenses and Reimbursement

All AMT and Technical Team member agencies are responsible for their own expenses. However, as necessary, support for expenses may be available from the BLM Arizona State Office, or through an agreement between the BLM and the Western Governors Association (WGA). BLM may also pay travel and per diem cost for invited, non-governmental guests at any time. The travel costs will be at a rate equivalent to that allowable for federal employees.

B-8 Data Sharing and Use

- REAs will involve the use and sharing of confidential data. Therefore, a confidential data-sharing agreement between the contractor and the BLM will be completed. Likewise, any partner agency or other entity that would like access to confidential data, either to view a map containing confidential information, or to download data, must also complete a Confidential Data-Sharing Agreement according to BLM Records Management Policy contained in Manual 1278.
- All contractors have signed a Non-Disclosure Agreement (NDA) that serves as the basis for proper use and sharing of sensitive datasets. Any dataset flagged as sensitive and provided by the BLM shall not be used for any other purpose than the REAs.
- Therefore, data-sharing agreements will be developed between the BLM, contractor, and appropriate AMT members as necessary. These agreements will set up the responsibilities and limitations for partners on supplying data for the assessment, reviewing data and products during the assessments, and dissemination of data following the assessment.

C Conceptual Model Template: Terrestrial and Aquatic Coarse-Filter CEs

C-1 Overview

Conceptual models for Conservation Elements combine descriptive text, concept diagrams, and tabular summaries in order to clearly state assumptions about the ecological composition, structure, dynamic processes, and interactions with major CAs within the ecoregion. The conceptual models form the foundation for identifying measurable indicators of ecological status, and then developing spatial models to assess those indicators. The proposed content for the CE conceptual models is described below.

The narrative material builds upon the descriptions for ecological systems that NatureServe has been maintaining since 2003 when the ecological systems classification was first developed (see <http://www.natureserve.org/explorer/index.htm>) to search and download existing descriptions). For this REA, additional material for each coarse-filter CE will be added, especially focusing on content describing natural and altered vegetation or aquatic habitat dynamics, as well as threats and stressors to the system. The initial information to be developed is intended to cover the full range of distribution of the CEs, which can extend beyond the MAR ecoregion. Additional information pertinent to characteristics or dynamics as they occur within this ecoregion will be developed.

The descriptions will include many names of plant species that are characteristic of the coarse-filter ecological system type. In the text sections these names are provided as scientific names. Vascular plant species nomenclature follows the nationally standardized list of Kartesz (1999), with very few exceptions. Nomenclature for nonvascular plants follows Anderson (1990) and Anderson et al. (1990) for mosses, Egan (1987, 1989, 1990, 1991) and Esslinger and Egan (1995) for lichens, and Stotler and Crandall-Stotler (1977) for liverworts/hornworts. For the aquatic/wetland/riparian CEs, names of many animal species associated with the aquatic habitats will be included, e.g., for fish, amphibians, mollusks, or other invertebrates; standard references for taxonomic nomenclature will be followed and provided as citations for these groups of species.

For some coarse-filter types, animal or plant species of conservation or management concern that are known to be strongly associated with the CE will be listed. Assessment of these species is presumed to be well-addressed through assessment of these coarse-filter CEs. These species are listed by informal taxonomic groups, with common names followed by scientific names.

Each model begins with a characterization of the CE and how it fits within the broader conceptual model for the ecoregion. Each CE will be placed within one of the (estimated) four major model components (Level 1, see table below for the list), and within one of the Model Groups (Level 2) within those; the ecoregional conceptual model for the MAR has yet to be developed.

Example Structure of Ecoregional Conceptual Model Components

Level 1	Level 2
Montane Dry Land System	Madrean Oak Woodlands
	Mixed Conifer Woodlands

Level 1	Level 2
Basin Dry Land System	Unfragmented Desert Grassland
	Desert Grassland and Scrub
Montane Wet System	Montane Stream and Riparian
Basin Wet System	Basin River and Riparian

The next component of the conceptual model clarifies relevant taxonomic relationships, and will provide crosswalks to other classification systems, as appropriate (e.g., to the Cowardin et al. (1979) classification for aquatic CEs, or to the Brown, Lowe and Pase classification (Brown 1983, Brown et al. 1980) for terrestrial and riparian/wetland).

C-2 Template for Coarse-Filter CE Conceptual Models

C-2.1 Conservation Element Characterization

This section of the conceptual model contains a narrative summary of the CE distribution, biophysical setting, and floristic or faunal composition. Relevant ecosystem dynamics, both natural and altered, are described in narrative text, with supporting literature cited. This information is developed for each coarse-filter conservation element across its range-wide distribution. The characterization includes three sub-sections: (1) Summary; (2) Species of Conservation or Management Concern; and (3) Natural Dynamics.

C-2.1.1 Summary

This sub-section of the conceptual model for each coarse-filter CE contains a narrative overview of the structure, composition, environmental setting and ecological processes that characterize the ecological system type. The overview addresses topics including geographic distribution, elevation range, and key environmental and ecological variables such as climate regime; topography; landform; soil depth, texture, salinity/alkalinity and moisture; geology/geomorphology; hydrologic regime; and adjacent systems. The overview also includes information on vegetation structure and characteristic species (dominant and differential) that distinguish the ecological system from similar types. The discussion of distinguishing vegetation for aquatic coarse-filter CEs includes information on associated riparian or wetland vegetation. The discussion of aquatic coarse-filter CEs differs from the discussion of terrestrial coarse-filter CEs by including separate information on both the aquatic and wetland/riparian habitat components of the CE, and their ecology and dynamics.

C-2.1.2 Species of Conservation or Management Concern Assessed via Coarse-Filter

This sub-section of the conceptual model for each coarse-filter CE provides a list of the species of conservation or management concern that are very strongly associated with the subject ecosystem type. Because of this strong association, the ecosystem type provides a practical “coarse filter” that is expected to “capture” or adequately represent these individual species and provide a reliable indication of the ecological status for each of these species. Because the ecological system type serves as a coarse-filter focal resource for purposes of resource assessment, the individual species of conservation or management concern listed in this sub-section will not be assessed individually.

C-2.1.3 Natural Dynamics

This sub-section of the conceptual model for each coarse-filter CE provides a narrative description of the natural dynamics relevant to the ecological system, including climate, fire regime, hydrology, and other drivers, processes, and responses of selected species to natural disturbances.

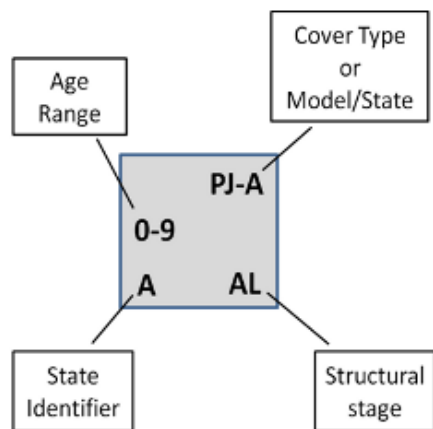
Model Description for Terrestrial Coarse-filter CEs

This sub-section contains an illustrative model of the CE's natural dynamics. For each terrestrial coarse-filter CE, a state-and-transition model illustrating the vegetation dynamics as shaped by key ecological process (e.g., fire, insects) will be developed. The LANDFIRE effort developed state-transition models for terrestrial ecological systems which characterize the system's natural range of variability (NRV), especially as it pertains to fire regimes. LANDFIRE's modeling data will provide the material for this sub-section of the conceptual model.

For many terrestrial coarse-filter CEs, a state-and-transition model for the natural range of variability (NRV) was developed by LANDFIRE using the Vegetation Dynamics Development Tool (VDDT) and simulations run in the Path Landscape Model (ESSA Technologies). The Path Landscape Model is a state-and-transition modeling platform that simulates vegetation dynamics based on user-defined states and transitions. The historic (NRV) model contains state classes that characterize natural vegetation conditions and transitions that describe vegetation dynamics.

States (boxes) represent a vegetation community defined by a cover type and structural stage (Figure C-1). Transitions link states through processes such as succession, disturbance, and management, and can be either deterministic or probabilistic. Deterministic transitions usually simulate successional changes by defining the number of years until a transition occurs from one successional stage to the next, in the absence of disturbance. Probabilistic transitions specify an annual transition probability of moving from one state to another. Probabilistic transitions represent disturbances (e.g. fire and drought), ecological processes (e.g. tree encroachment and natural recovery), and land management activities (e.g. seeding and prescribed fire).

Figure C-1. Example showing state classes in VDDT-described plant community type by defining the cover type, age range, structural stage, and identifier of each of its vegetative state classes.



Model Description for Aquatic Coarse-filter CEs

The models developed for the aquatic components of aquatic/riparian coarse-filter CE natural dynamics will differ from those developed for terrestrial coarse-filter CEs and the terrestrial components of aquatic/riparian coarse-filter CEs. No comprehensive body of tools exists for building state-transition

models for aquatic ecosystems, and in fact the concept of “states” and “transitions” is used only in a narrow range of contexts in studies of aquatic ecosystems. Specifically, the concept of states and transitions in aquatic ecology refers only to changes in the structure of the food web as a consequence of anthropogenic changes in nutrient cycling (trophic states) or in the abundance of different feeding guilds due to the arrival or depletion of pivotal species. Otherwise, studies of aquatic ecological systems – specifically studies of anthropogenic impacts on such systems – focus on gradients of ecological response either to individual stressors or to the cumulative effects of all stressors (e.g., USEPA 2005; Davies and Jackson 2006; Hawkins et al. 2010). The models developed for the aquatic components of aquatic/riparian coarse-filter CE natural dynamics will focus on this idea of response gradients rather than on “states” and “transitions.”

C-2.2 Change Agent Effects on the CE

This section of the conceptual model presents a narrative description of the primary change agents and current knowledge of their effects on the CE. It contains two sub-sections: (1) A list of primary change agents identified for the CE; and (2) a discussion of altered dynamics caused by these agents.

C-2.2.1 List of Primary Change Agents

This sub-section simply lists the primary change agents identified for the CE, including climate change, altered fire regime, invasive species, development, and grazing as appropriate, with notes as necessary on why these agents are included and others were excluded.

C-2.2.2 Altered Dynamics

This sub-section provides a narrative overview of the impacts of primary CAs on the ecological system. The overview will be developed through a review of the scientific literature, consultation with thematic experts, and a review of other assessment results. The models developed by the Integrated Landscape Assessment Program (ILAP) will be utilized here when available to characterize altered states of the terrestrial ecosystems, for example, to incorporate “uncharacteristic” states, such as complete conversion to invasive annual grasses, or native tree or shrub cover with invasives in the herb layer. The ILAP models also can be used to predict trends in departure from NRV over the next half-century.

Conceptual models of aquatic ecosystem biological response gradients will be used similarly when available.

C-2.3 Ecological Status: Key Ecological Attributes and Indicators

NatureServe’s ecological integrity assessment framework sets up practical criteria and indicators for assessing the ecological status of each CE within an ecoregion (Faber-Langendoen et al. 2006, Unnasch et al. 2008). Application of this framework results in a “scorecard” for reporting on the ecological status of a given CE within a given location.

This section of the conceptual model contains two sub-sections, which address: (1) Key Ecological Attributes; and (2) Indicators of Ecological Status.

C-2.3.1 Key Ecological Attributes

A **key ecological attribute** of a focal ecological resource is a characteristic of the resource’s biology, ecology, or physical environment that is critical to the resource’s persistence in the face of both natural and human-caused disturbance. Alteration of such a characteristic beyond some critical range of variation will lead to the degradation or loss of the resource within decades or less. Key ecological attributes of a resource include critical or dominant characteristics of the resource, such as specific characteristics of (a) demographic or taxonomic composition; (b) functional composition; (c) spatial structure; (d) range or extent. They also include critical biological and ecological processes and

characteristics of the environment that (a) limit the regional or local spatial distribution of the resource; (b) exert pivotal causal influence on other characteristics; (c) drive temporal variation in the resource's structure, composition, and distribution; (d) contribute significantly to the ability of the resource to resist change in the face of environmental disturbances or to recover following a disturbance; or (e) determine the sensitivity of the resource to human impacts.

Conservation of key ecological attributes contributes to current ecological integrity and to the resilience of ecological systems in the face of large-scale or long-term stressors. The ecological integrity assessment framework identifies four classes of key ecological attributes, concerning resource size or extent; biotic condition; abiotic condition; and landscape context. These four may overlap, and provide a guide for considering and identifying key ecological attributes. They also provide a basis for integrating information on key ecological attributes. "Size" refers to the numerical size and/or geographic extent of a focal resource. "Biotic condition" refers to biological composition, reproduction and health, and succession; and critical ecological processes affecting biological structure, functional organization (e.g., food-web guild structure), and interactions. "Abiotic condition" refers to physical environmental features and dynamics within the geographic scope of the focal resource that significantly shape biotic conditions, such as fire, weather, and hydrologic regimes; and soil and geological conditions and dynamics. "Landscape context" refers both to the spatial structure (spatial patterning and connectivity) of the landscape within which the focal resource occurs; and to critical processes and environmental features that affect the focal ecological resource from beyond its immediate geographic scope.

The ecological integrity assessment framework calls for identifying a **limited** suite of key ecological attributes for each focal resource. The framework contains specific criteria for limiting the selected attributes to only those most pivotal to the condition and resilience of the subject ecological system.

C-2.3.2 Indicators of Ecological Status

Assessing the status of key ecological attributes requires explicit identification of indicators – specific means for measuring their status. Indicators may be a specific, measurable characteristic of the key ecological attribute; or a collection of such characteristics combined into a "multi-metric" index. Indicators may also be measurable characteristics of stressors that are known to affect the natural function and integrity of a key ecological attribute; or a collection of such characteristics again combined into a multi-metric stressor index. Indicators of stressors are often used as surrogates for direct indicators of a key ecological attribute, because data on stressor condition is often far more readily available than data on direct indicators. Examples of stressor-based indicators include measures of overall landscape development such as the Landscape Condition Model methodology (Comer and Hak 2012); measurements of invasive annual grass distributions that affect fire regimes; or measurements of fragmentation of the riparian corridor due to development.

Spatial models that reflect these indicators serve as the link between the conceptual models and the spatial representation of ecological status. These spatial models will be developed as appropriate during Phase 2 of the REA. For each CE, definitions and justifications for each of the indicators to be assessed will be provided, organized in an Ecological Status Scorecard table. Each indicator that can be spatially assessed will be structured so that it can be scored on a scale that ranges between 0 and 1, with 1 indicating highest ecological status and 0 indicating lowest status (and presumably transitional to a wholly different ecological state).

C-2.3.3 Ecological Status Scorecard

This sub-section of the conceptual model for each coarse-filter CE contains the Ecological Status Scorecard for the CE. The Ecological Status Scorecard links conceptual models that describe the relationships between change agents and the ecological requirements of each CE to spatial models that

provide practical indicators of ecological status. The indicators are organized by key ecological attributes (KEAs), as illustrated in Table C-1. KEAs are assessed using indicators that can be evaluated and reported at spatial scales and units that are supportable with existing information.

Table C-1. Example of key ecological attributes and indicators used for ecological status assessment of terrestrial and aquatic/wetland/riparian coarse-filter CEs.

Indicator	Definition	KEA & Indicator Justification
Key Ecological Attribute Class: Landscape Context		
Key Ecological Attribute: Landscape Condition <i>(all CE types)</i>		
Landscape Condition Index	This indicator is measured by intersecting the mapped area or habitat distribution map of the CE with the LCM layer and reporting the average LC index value for the CE or habitat within each 5th level watershed, or 4x4 km ² units for species. Landscape Condition Index is a 90x90 m ² unit resolution map surface that incorporates a land use intensity rating and a distance decay function, reflecting decreasing ecological impact with distance from the source.	Ecological conditions and landscape dynamics that support ecological systems or species habitat are affected by fragmenting effects of land use (Franklin 1993, Farig 2003). Land use impacts vary in their intensity where they occur, as well as their ecological effects with distance.
Key Ecological Attribute: Surrounding Watershed Land Use Context <i>(Aquatic resources only):</i>		
Perennial Flow Network Fragmentation by Dams	Number of intersections with NHD perennial streams. The total number of intersections per watershed defines the index score.	The degree of fragmentation of continuous aquatic habitat directly affects processes and populations for aquatic species (Allan 2004, Ward and Stanford 1989).
Key Ecological Attribute Class: Relative Extent		
Key Ecological Attribute: Extent / Size <i>(riparian/riverine aquatic resources and cave-roosting bats)</i>		
Riparian Corridor Continuity	Indicates the degree to which the riparian areas (buffered by 200 m) exhibit an uninterrupted corridor. A measure of the linear, continuous unfragmented riparian corridor based on Landscape Condition Index (LCI), to measure how many fragments are created by the interruption of the natural riparian corridor by non-natural land use.	Unfragmented riparian corridors support individual animal movement, gene flow and natural flooding and sediment deposition and scour processes upon which aquatic and wetland species depend (Belsky et al. 1999, Allan 2004, Hansen et al. 2005).

Indicator	Definition	KEA & Indicator Justification
Key Ecological Attribute Class: Condition		
Key Ecological Attribute: Fire Regime (<i>vegetated terrestrial coarse-filter CEs only</i>)		
Fire Regime Departure Index	This indicator is assessed by calculating and summarizing the updated LANDFIRE Succession classes (SClass) layer which characterizes current vegetation succession classes for the distribution of each CE within each 5th-level watershed. The resulting proportional calculation for current conditions is compared to the expected proportions, as derived from the VDDT or Path-Tools model characterizing the expected natural range of variation (NRV). This comparison defines the degree of departure (%).	A mix of successional classes among patches of a given vegetation type results from fire and other natural disturbances. Through field observation and modeling, one can establish a working hypothesis for the expected proportional mix of successional classes where human alterations are limited. Departure from the mixture predicted under NRV indicates uncharacteristic disturbance regime and declining integrity (Agee 1998, Brooks et al. 2004).
Key Ecological Attribute: Stressors on Biotic Condition		
Invasive Annual Grass Index (<i>selected terrestrial CEs only</i>)	This indicator is measured using the mapped area or habitat distribution of the CE with an abundance map of introduced invasive annual grass species. The output is predicted percent cover of invasive annual grass species within each 5th level watershed.	Invasive annual grass species displace natural composition and provide fine fuels that significantly increase spread of catastrophic fire (Brooks et al. 2004).
Presence of Invasive Aquatic Species (<i>Aquatic CEs only</i>)	The number of invasive taxa (known status).	Invasive species displace natural composition and affect natural food webs (Vitousek et al. 1996, Harju 2007, Shigesada and Kawasaki 1997).
Key Ecological Attribute: Stressors on Hydrologic Condition (<i>Aquatic CEs only</i>)		
Flow Modification by Dams	"F" Index (Theobald et al. 2010a) – Dams and their storage capacity relative to annual stream discharge.	Higher storage capacity is an indicator of greater impact to natural flow regimes of the downstream river or stream segments (Graf 1999, Theobald et al. 2010a).
Groundwater Use	The ratio of total flow per watershed (calculated from NHD) to the groundwater use as reported by USGS SWPA study (this is not a quantitative groundwater budget).	This indicates the degree to which surface water is being consumed for human use relative to availability within each watershed. The greater the use, the less water is available to support aquatic species; specifically, higher ground water use is likely to draw down water tables and therefore springs (Manning 1999, Patten et al. 2007).

Indicator	Definition	KEA & Indicator Justification
Perennial Flow Modification by Diversion Structures	Number of aquaducts intersecting or branching from NHD perennial streams. Total per watershed.	This indicates the amount of flow modification and change in hydrologic regime (Poff et al. 2010).
Surface Water Use	Ratio of total watershed flow (calculated from NHD) to surface water use as reported by USGS SWPA study.	The greater the use relative to supply, the less water is available to support aquatic species (Richter et al. 1997).
Key Ecological Attribute: Stressors on Water Quality (Aquatic CEs only)		
Atmospheric Deposition-Nitrate Loading (NO ₃)	Rate of deposition of NO ₃ per unit area within watershed.	This indicator is used a representative indicator of nutrient loading pollutant. Increased nitrogen in aquatic systems can increase algal growth and decrease oxygen content (Fenn et al. 2003a, 2003b).
Atmospheric Deposition-Toxic Mercury Loading (Hg)	Rate of deposition of mercury (Hg) per unit area within watershed.	This indicator is used to represent the amount of toxic pollutants. Toxic pollutants affect reproduction, growth and neurologic functioning of aquatic animals. Mercury in particular accumulates up the food chain and can affect human health as well (Peterson et al. 2009, Ward et al. 2010).
Sediment Loading Index	Index values of total suspended sediment (developed by NSPECT) which are based on percent of land uses (NLCD) that contribute excess sedimentation and suspended solids via surface water runoff and overland flow into a wetland, as measured within the 200 m buffer area.	Different surrounding land uses contributes to the sediment loading in adjacent waters. Increased sediment clogs fish gills, reduce successful spawning, decrease visibility and increase pollutant loadings, especially heavy metals (Salomons et al. 1987, Apitz et al. 2005).

C-2.4 References for the CE

This section lists literature that is relevant to the classification, distribution, floristic composition, ecological processes, threats, stressors, or management of the CE, in some cases for portions of the CE's range outside of the ecoregion. These are not exhaustive literature surveys, rather are an accumulation of known references. Some documents may be listed that are not cited in the narrative text.

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D Conceptual Model Template: Landscape Species CEs

D-1 Overview of Species Conceptual Models

Species conceptual models combine text, concept diagrams, and tabular summaries in order to clearly state assumptions about the conservation elements (CEs) and their interactions with major change agents (CAs) within the ecoregion. These conceptual models provide the foundation for developing spatial models designed to assess the relative ecological status for the habitat of each CE within the analysis units identified for this ecoregion (e.g., 5th level HUCs).

In the section that follows, the content included for each species CE is described. Characterization data developed for these species is intended to represent the taxon across the entire range of its distribution (i.e., global-level data). However, due to the nature of the Madrean Archipelago ecoregion, many species are at the edges of their range and species may display region-specific characteristics that are important to their conservation. Because of this, content will describe the species across the entire range of its distribution but will focus on region-specific information whenever possible. Species CE data will be obtained from a biodiversity database developed centrally at NatureServe over the past thirty-five years. This database is dynamic, maintained and refined through updates made to reflect current changes to taxonomy, and by the periodic import of new records that are developed according to standard methodology by natural heritage member program scientists and other collaborators, including government agencies, universities, natural history museums and botanical gardens, and additional conservation organizations. This ongoing process of information being added and existing records revised helps to maintain currentness and enhance completeness of the data. Additionally, any available regional data will be obtained from regional experts and known in-region sources such as Mexican and American universities and research institutions and Mexican and American natural resource management agencies.

NatureServe's database contains an array of information about elements of biodiversity, with particular emphasis on those that are more threatened across their range. Tracked data includes taxonomy, conservation status, ecological and life history, habitat requirements, and distribution, with primary sources of this information consisting of scientific literature, museum specimen records, reliably documented observation records, species lists, range maps, external databases, and experts, including scientists from natural heritage member programs. While centrally NatureServe maintains range maps and/or data representing all native full species of vertebrates and vascular plants, at the local member program level, resources generally limit tracking specific locations where elements occur within their jurisdictions to those having the highest conservation concern.

NatureServe scientists use a set of references generally accepted by researchers working on a given taxonomic group, supplemented by recent scientific literature and expert opinion, to establish a standard "global" scientific name and taxon circumscription for every element of biodiversity contained in the central database. The major taxonomic references will be provided as relevant for the CEs.

The primary purpose of the species CE characterization is to provide sufficient information on classification, range, ecology and life history, and habitat requirements to permit assumptions about effects on the species that would likely result from change agents such as development, invasive plant species, or changes in fire regime (components of the assessment process). Thus, the CE characterization provides narrative detailing individual attributes of the element, and information on Change Agents (CAs) that may threaten its survival.

D-2 Species Conceptual Model Template

Below, the individual components included in each species CE conceptual model are described. For all of the species characterization components, characteristics will be described for the entire range of the species and for the range of the species within the Madrean Ecoregion whenever they differ from the entire range. Note that for some species, particular components of information may be lacking. Focus will be on conditions, drivers, and threats in the Madrean Ecoregion, which may be different from the range-wide characteristics.

The narrative provided includes information on classification, range, ecology and life history, and habitat requirements, as well as major threats. Each field of information is described below with a brief description of the field's contents.

D-2.1 Species Summary Description

D-2.1.1 Biology and Distribution Status

Narrative of the species distribution within the ecoregion, with breeding/nonbreeding or seasonal ranges specified, if different, population size including information on how the estimate was derived, variations, and data for specific portions of the range; and discussion of the seasonality, direction, distances, major routes, sociality/dispersion, daily timing, and variability (e.g., between populations) in movement/migration patterns of the species. Occurrence data is developed and maintained by natural heritage member programs, which document and delimit the presence and extent of individual species on the landscape. Species occurrences commonly reflect populations or subpopulations; where available an estimate of total number of precise locations where the species is known to occur across its range will be provided.

Description of the reproduction of the species in the ecoregion, including information on clutch/litter size and frequency, gestation/incubation period, seasonal timing of reproductive activities, nature and period of any parental care, age of sexual maturity, and size and general nature of breeding aggregations.

Summary of the seasonal variations of the species, including differences in seasons of activity and periods of daily activity.

D-2.1.2 Habitat and Ecology

Description of major habitat requirements including physical habitats commonly used by the species and daily, seasonal and geographic variation in habitat use, description of areas needed to support breeding/populations and description of environmental tolerances if known and how these change by life stage. Information on habitat will include food resources, food location (e.g., microhabitat), foraging methods/strategy, seasonal and geographic variation in diet, and major differences in diet among age classes (e.g., young vs. adults).

Summary of the ecology of the species including key interactions with other species, information on population density, dispersal distances, home range size, annual and seasonal fluctuations in population size, non-breeding coloniality/sociality, major predators, competitors, parasites, age-specific survival rates, and other significant ecological factors could be included.

D-2.2 Change Agent (CA) Characterization

D-2.2.1 Altered Dynamics

This component contains a description of the primary change agents, including information on the scope, severity, and immediacy (timing) of threats, and current knowledge of their effects on the species

across its range. Comments will include whether the scope and severity of the threats to species are observed, inferred, or suspected, or result from qualitative observation of its impact on the CE. The extent, including geographic variation, and effects of current or projected extrinsic influences on the species should be described, along with any additional threats or interactions among different threats, including high-magnitude threats considered insignificant in the immediate term.

D-2.3 Conceptual Model Diagram

A diagram is provided for each CE conceptualizing the relationships between Change Agents, the stresses they induce in the CE, the response of the CE to those stressors, and how to measure either the stress or the CE response with indicators. It is intended to be illustrative of the effect of each Change Agent on the CE's ecological condition. Change Agents are a source of different types of stressors. Different types of stressors invoke different responses, and Indicators are metrics by which we can directly measure the amount of stress or response within each CE.

D-2.4 Ecological Status: Key Ecological Attributes and Indicators

NatureServe's ecological integrity assessment framework sets up practical criteria and indicators for assessing the ecological status of each CE within an ecoregion (Faber-Langendoen et al. 2006, Unnasch et al. 2008). Application of this framework results in a "scorecard" for reporting on the ecological status of a given CE within a given location.

This section of the conceptual model contains two sub-sections, which address: (1) Key Ecological Attributes; and (2) Indicators of Ecological Status.

D-2.4.1 Key Ecological Attributes

A **key ecological attribute** of a focal ecological resource is a characteristic of the resource's biology, ecology, or physical environment that is critical to the resource's persistence in the face of both natural and human-caused disturbance. Alteration of such a characteristic beyond some critical range of variation will lead to the degradation or loss of the resource within decades or less. Key ecological attributes of a resource include critical or dominant characteristics of the resource, such as specific characteristics of (a) demographic or taxonomic composition; (b) functional composition; (c) spatial structure; (d) range or extent. They also include critical biological and ecological processes and characteristics of the environment that (a) limit the regional or local spatial distribution of the resource; (b) exert pivotal causal influence on other characteristics; (c) drive temporal variation in the resource's structure, composition, and distribution; (d) contribute significantly to the ability of the resource to resist change in the face of environmental disturbances or to recover following a disturbance; or (e) determine the sensitivity of the resource to human impacts.

Conservation of key ecological attributes contributes to current ecological integrity and to the resilience of biological organisms in the face of large-scale or long-term stressors. The ecological integrity assessment framework identifies four classes of key ecological attributes, concerning resource size or extent; biotic condition; abiotic condition; and landscape context. These four may overlap, and provide a guide for considering and identifying key ecological attributes. They also provide a basis for integrating information on key ecological attributes. "Size" refers to the numerical size and/or geographic extent of a focal resource. "Biotic condition" refers to biological composition, reproduction and health, and succession; and critical ecological processes affecting biological structure, functional organization (e.g., food-web guild structure), and interactions. "Abiotic condition" refers to physical environmental features and dynamics within the geographic scope of the focal resource that significantly shape biotic conditions, such as fire, weather, and hydrologic regimes; and soil and geological conditions and dynamics. "Landscape context" refers both to the spatial structure (spatial patterning and connectivity)

of the landscape within which the focal resource occurs; and to critical processes and environmental features that affect the focal ecological resource from beyond its immediate geographic scope.

The ecological integrity assessment framework calls for identifying a **limited** suite of key ecological attributes for each focal resource. The framework contains specific criteria for limiting the selected attributes to only those most pivotal to the condition and resilience of the subject species.

D-2.4.2 Indicators of Ecological Status

Assessing the status of key ecological attributes requires explicit identification of indicators – specific means for measuring their status. Indicators may be a specific, measurable characteristic of the key ecological attribute; or a collection of such characteristics combined into a “multi-metric” index. Indicators may also be measurable characteristics of stressors that are known to affect the natural function and integrity of a key ecological attribute; or a collection of such characteristics again combined into a multi-metric stressor index. Indicators of stressors are often used as surrogates or for direct indicators of a key ecological attribute, because data on stressor condition is often far more readily available than data on direct indicators. Examples of stressor-based indicators include measures of overall landscape development such as the Landscape Condition Model methodology (Comer and Hak 2012); measurements of invasive annual grass distributions that affect fire regimes of ecosystems supporting the species; or fragmentation of the riparian corridor due to development.

Spatial models that reflect these indicators serve as the link between the conceptual models and the spatial representation of ecological status. These spatial models will be developed as appropriate during Phase 2. For each CE, definitions and justifications for each of the indicators to be assessed will be provided, organized in an Ecological Status Scorecard table. Each indicator that can be spatially assessed will be structured so that it can be scored on a scale that ranges between 0 and 1, with 1 indicating highest ecological status and 0 indicating lowest status (and presumably transitional to a wholly different ecological state).

It can be anticipated that for most of the landscape species conservation elements, spatial representation of the species distribution will be predicted habitat; only a few species are likely to have current occupied habitat mapped. Hence for the ecological status assessment, the unit of assessment for most species is likely to be its predicted habitat, rather than current occupied habitat.

D-2.4.3 Ecological Status Scorecard

This sub-section of the conceptual model for each coarse-filter CE contains the Ecological Status Scorecard for the CE. The Ecological Status Scorecard links conceptual models that describe the relationships between change agents and the ecological requirements of each CE to spatial models that provide practical indicators of ecological status. The indicators are organized by key ecological attributes (KEAs), which reflect primary ecological drivers of integrity. KEAs are assessed using indicators that can be evaluated and reported at spatial scales and units that are supportable with existing information.

D-2.5 References for the CE

Literature is listed that is relevant to the classification, distribution, ecology and life history, threats, and habitat requirements of the individual CE, in some cases from portions of its range outside of the ecoregion. These are not exhaustive literature surveys, but rather an accumulation of known references. Some documents may be listed that are not cited in the narrative text.

References cited in this template

Comer, P., and J. Hak. 2012. Landscape condition model of the western United States. NatureServe, Boulder, CO. In preparation.

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E Pre-Assessment Report Outline

The following outline is proposed for the Pre-Assessment Report, refined from the outline specified in the BLM SOW for this REA.

- 1) Executive Summary
- 2) Madrean Archipelago Ecoregion: Current Environment
 - a) Ecoregional Conceptual Model [propose to place this at the beginning, to give picture of ecoregion, rather than under “Conceptual Model: Ecological Integrity” as proposed by SOW]
 - b) Current Issues in Ecoregion [this will be broad overview of the 4 change agents, plus other known issues, and brief summary of economic context, land management/ownership, etc. of ecoregion]
 - c) Findings of Large Scale Assessments and Other Relevant Research
- 3) Overview of Methodology
 - a) General workflow description [describe the alternating sequence of content development by contractor team followed by Development Forums, webinars, and AMT workshops to get feedback and final approval for CEs, CAs, MQs, conceptual models, ecological integrity]
 - b) Literature review and annotated bibliography process
- 4) Management Questions
- 5) Conservation Elements [this section will list and provide general overview and characterization of final CEs]
- 6) Change Agents [this section will list and provide general overview and characterization of final CAs]
- 7) Conceptual Models: Conservation Elements
- 8) Conceptual Model: Ecological Integrity
 - a) Ecological integrity conceptual model
- 9) Annotated Bibliography
 - a) Madrean Archipelago Ecoregion: Current Environment
 - b) Methodology
 - c) Relevant Landscape Assessments [in Field Guide format, see Attachment 7.1 from RFP]
 - d) Conservation Elements
 - e) Change Agents
- 10) Literature Cited
- 11) Appendix A: Detailed Methodology and Rationale
 - a) Ecoregional conceptual model development
 - b) CE identification and selection
 - c) CA identification and selection

- d) MQ identification and selection
- e) CE conceptual model development
- f) Ecological integrity model development

12) Appendix B: Preliminary Data Findings

- a) Data sources
- b) Data gaps